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RISK AND PROTECTIVE FACTORS ASSOCIATED WITH EARLY CHILDHOOD DEVELOPMENT AMONG 3- TO 4-YEAR OLD CHILDREN IN NIGERIA

A dissertation

by

NGOZI VICTORIA ENELAMAH

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Dissertation Chair: Dr. Margaret Lombe

Abstract

For children that overcome Nigeria's high child mortality rate, there is the additional and less-obvious hurdle of not reaching their full potential in life due to developmental delays. When children are on track developmentally, they stand a better chance of being ready for school, excelling academically, economically, and socially throughout the lifespan. Fewer studies in the Nigerian context have examined how known risk and protective factors interact to affect early childhood development (ECD).

This three-paper dissertation used data from the nationally representative 2016/17 Multiple Indicator Cluster Surveys (MICS), and was guided by the social determinants of health framework, the socioecological model of child development, and the family stress and investment models.

The study highlighted the factors, including disparities across the multiethnic and diverse socioeconomic groups of Nigeria that are associated with child outcomes.

i. Paper 1 assessed the performance and psychometric properties of the 10-item ECDI used in the MICS to track developmental outcomes among Nigerian children.
ii. Paper 2 characterized the risk and protective factors for ECD across the 36 states and FCT of Nigeria using a multilevel modeling approach and,
iii. Paper 3 used a structural regression to model the association between maternal subjective wellbeing (SWB), and developmental outcomes among the 3- to 4-year-old children.

Findings highlighted discrepancies in the construct validity of the ECDI. Across the studies, resources and family socioeconomic status particularly maternal level of education were significant predictors of outcomes for the child. Further, the study revealed that a child's developmental context matters, where 29% of the variation in child outcomes was attributed to clustering by states. The studies extend prior research on ECD in Nigeria by its use of more accurate milestones to characterize ECD, its multilevel modeling approach, and its investigation of maternal SWB as a proxy for mental health. In all, findings from the dissertation call attention to the need to revise the ECDI, and for culturally adapted and validated ECD instruments. The study also highlighted the need to invest more resources in child development, and family strengthening especially through maternal education and wealth creation.

DEDICATION

To the love of my life, Johnny

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Chapter I. Introduction

Risk and Protective Factors Associated with Early Childhood Development among 3- to 4-year-old Children in Nigeria

Not much has changed since studies predicting that over 200 million children under five in low and lower middle income countries (LMICs), of which Nigeria is one, are at risk for less than optimal future outcomes (Engle et al., 2007; Grantham-Mcgregor et al., 2007). Currently, more than 36.8% of 3- to 4 -year-old children in sub-Saharan Africa (SSA) fall short of basic cognitive and socioemotional skills (Black & Hurley, 2016; Jimoh, Anyiam, & Yakubu, 2018). Children from SSA account for the largest number (29.4 million) of children under five who are not on track in their developmental trajectories (McCoy, Waldman, CREDI, & Fink, 2018).

Nigeria's young population of over 200 million people includes over 31.8 million children under the age of five. Recent studies indicate that approximately 6 million children in Nigeria are at risk of not reaching their full developmental potential, third only to India (17.7 million) and China (6.6 million) worldwide (McCoy et al., 2017). In addition, while the under-5 mortality rate in Nigeria decreased from 201 deaths per 1,000 live births to 128 deaths per 1,000 live births between 2003 and 2013; recent surveys indicate an increased child mortality rate of 132 deaths per 1000 live births (UNICEF, 2017b), calling attention to the developmental milieu of the Nigerian child. (National Malaria Elimination Programme (NMEP), National Population Commission (NPopC), National Bureau of Statistics (NBS), & ICF International, 2016). Developmental delays, which may be indicators of other neurodevelopmental disorders, are those deviations from the normal growth milestones expected for children either in their motor, cognitive, social, emotional, or in language functions (Ertem, 2012). There are fewer studies in Nigeria paying attention to children's progress as reflected in how their interactions, early life

experiences, and how their brains and bodies are responding to toxic stress influence their development. Most early childhood studies in Nigeria have rightly focused on the nutritional, and infectious diseases' impact on child survival, immunization programs, HIV/AIDS or on early education programs (Adekanmbi, Kayode, & Uthman, 2013; Akombi, Agho, Hall, Astell-burt, & Renzaho, 2017; USAID, 2018). Prior studies and interventions have led to improvements in infant and child mortality, and school enrolment over the decades. Yet, few studies, to our knowledge, have delved into other tenets of early childhood development (ECD) that is primarily unseen (Center on the Developing Child, 2007), that influences a child's ability to function fully as a productive member of society. This dissertation set out to bridge this gap, to highlight and examine the developmental status, risk and protective factors associated with early ECD in the Nigerian context.

Early childhood development research in Nigeria is plagued by challenges such as the dearth of nationally representative, current or longitudinal research on the development of children that is specific to the multicultural and heterogeneous context. Many studies in the SSA region rely on instruments that were designed, and validated for use in countries of the global north. Few are conscientiously adapted or structured to reflect the diverse, low income, and multicultural settings of low- and middle-income countries (LMICs) such as Nigeria. In addition, beyond routine immunization monitoring, the practice of assessing developmental progress among children in Nigeria is not common, leaving local practitioners and policy makers at the mercy of global estimates and population measures to plan for interventions.

Previous studies establish that the environmental context in which children grow can facilitate their progress in life or predispose them to cumulative disadvantage (Avan & Kirkwood, 2010). Nigeria is ranked fifth in the world for having the highest number of deaths

from armed conflict (Bakken & Rustad, 2018; Howell, Waidmann, Holla, Birdsall, & Jiang, 2018; Maxted, 2003; Odozi & Oyelere, 2019). As a result of the conflict, over 15 million people in Nigeria, including 1.3 million children living in the conflict-affected areas (Gebremichael et al., 2018; UNICEF, 2017). Households have been displaced, are unsafe, and food insecure with risks to their children's developmental progress in Nigeria's conflict settings (Kah, 2017). Previous studies attest to the psychiatric, emotional and behavioral disorders (Betancourt, 2015a; Betancourt, Thomson, & Vanderweele, 2019), and undernutrition (Kraamwinkel, Hans, Davia, & Daoud, 2019), and deaths (Howell et al., 2018) extending to children living in conflict settings. Indicators show that the ongoing and sporadic conflicts in Northern Nigeria leaves children with greater odds of wasting (5% in urban settings), that is higher for children in rural settings (Dunn, 2018; Howell et al., 2018).

Nigerian children as with their peers in other contexts primarily grow and develop among their families, and under the primary influence of mothers and caregivers. Mothers play and influential role in ECD. Challenges that affect the mental health and wellbeing of mothers unlike other stressors a child may be exposed to are reoccurring and often chronic (Goodman & Gotlib, 1999) making a child's exposure to risks longer. Moreover, the mother or caregiver facilitates interventions such as support for child learning or protective factors such as responsive nurturing. A number of social and behavioral theories will guide the three component studies of this dissertation. Theories and frameworks such as the social determinants of health framework (Solar & Irwin, 2010), the ecological model of child development (Bronfenbrenner, 1997), the family stress and investment models (Conger & Donnellan, 2007) and an initial item response theory will be used to emphasize the interplay between social position, a child's context, and macros factors in their association with child developmental outcomes.

Significance of the Study

The public health crisis proportion of ignoring the early childhood development process. Nigeria is projected to become the third most populated country in the world by 2050 (Gerver, 2015), presenting a risk for unchecked negative outcomes especially for mothers and children (Izugbara, Wekesah, & Adedini, 2017a; Rahman, Surkan, Cayetano, Rwagatare, & Dickson, 2013b; United Nations, 2017). Nigeria's increasing population, recently estimated at over 200 million includes 32 million children, many of whom are at risk. The sheer numbers of children, the poverty level, on-going armed conflict, and stressors of daily living necessitate the need for public health, population-level, empirically supported, and contextualized intervention research and attention to issues affecting the development of children in Nigeria (Babatunde, 2011; Gebremichael et al., 2018; Howell et al., 2018; Kah, 2017; UNICEF, 2017b). If population growth is not paralleled by maternal and child development research and appropriate care, more adverse outcomes will accrue to the children.

Low level of awareness and services for ECD in relation to maternal wellbeing and mental health. While most studies in Nigeria focus on maternal education, early childhood illnesses, and their impact on child outcomes, there is a low level of awareness on challenges that affect maternal mental health in relation to the child (Baumgartner, Kaaya, & Siril, 2015; Iheanacho et al., 2015). Studies note a dearth of specialized services (World Health Organization, 2008), and intense stigma (Baumgartner et al., 2015; Betancourt, 2015; Iheanacho et al., 2015) on maternal and child mental wellbeing. Despite the impact of maternal wellbeing on child outcomes, and the increasing global burden of mental health problems (Baumgartner et al., 2015; Patel et al., 2016; Vigo, Thornicroft, & Atun, 2016), few studies (Fisher et al., 2012;

Williams et al., 2004) in sub-Saharan Africa have used culturally relevant and contextual mental health measures (Betancourt, 2015).

In addition, only 8% of LMICs (Fisher et al., 2012) such as Nigeria had data on the prevalence of developmental challenges among children and their mothers (World Health Organization, 2008), and 9 out of 13 countries had only began including ECD or mental health variables in their studies (Fisher et al., 2012), a situation that has not changed much today. To address some of these gaps in research and knowledge of ECD in Nigeria, this study will use the MICS data to examine the risk and protective factors associated with the ECD process in Nigeria. This study will also adopt a multilevel approach that incorporates factors in the different levels of influence in a child's ecology. This study sought to address some of the observed gaps, extending current knowledge on how maternal (subjective) wellbeing is associated with child development.

Background to the Study.

Early childhood is associated with the rapid development of physical, motor, cognitive, language, and social skills (Black, Walker, Fernald, Andersen, & DiGirolamo, et al., 2017; Loizillon, Petrowski, Britto, & Cappa, 2017) with implications for mental and cognitive outcomes for the child (Loizillon et al., 2017). Across a child's brain architecture, neural connections form and evolve to sensory pathways that have responsibility for basic human functions, see figure 1 (Center on the Developing Child, 2007).

When children are on track developmentally, they stand a better chance of being ready for school, excelling academically, economically, and socially (Braveman & Barclay, 2009; Kang, Aguayo, Campbell, & West, 2018). When a child is not progressing, they achieve less educationally, and often do not complete primary school (Grantham-Mcgregor et al., 2007).

Children who develop poorly are predisposed to more (mental) health problems, with increases in public health costs as much as 10 fold and over the next 14 years, and have 4.6 times more psychopathology than other healthy children (Elgar, McGrath, Waschbusch, Stewart, & Curtis, 2004). There are also implications for conflict with others, suicidal behavior, and other delinquent behaviors when children do not achieve their developmental potential.

Brain architecture development before birth and in the first 1000 days of life influence early childhood (Monk, Georgieff, & Osterholm, 2013; Shonkoff, 2003). Ongoing interactions between genes, family life and environmental experiences, and skills acquisition shape the brain and set the child off toward strong or weak cognitive, emotional and social structures that have lifelong effects in the life course (Society for Neuroscience, 2016; Applegate & Shapiro, 2005). During the first three years, brain neural connections occur (fire) at speeds of over 1,000 per second, indicating how every second in ECD counts (Applegate & Shapiro, 2005; Society for Neuroscience, 2018). The firing, neuronal generation or synaptogenesis in the brain are responsible for a child being able to develop learning, social, motor and other life skills (Center on the Developing Child, 2007).

By age five, the level of socio-emotional, cognitive, and physical development a child attains is already a significant determinant of poverty, academic performance, skills to be used across life, and other generational challenges in later adulthood (Black & Hurley, 2016; Child Mind Institute, 2016; Kessler et al., 2007; Semerei & Erdogan, 2014; Surkan, Kennedy, Hurley, & Black, 2011 see figure 1). A child's developmental progress depends on multiple factors including their genetics (Zandi, Wilcox, Dong, Chon, & Maher, 2012), social contexts (Black, Walker, Fernald, Andersen, Digirolamo, et al., 2017), and conditions of the proximal

environment (Betancourt et al., 2017; Bronfenbrenner, 1997; Lombe, Saltzman, Chu, Sinha, & Nebbitt, 2017; Wakhweya, Dirks, & Yeboah, 2008).

The success or failure of ECD has repercussions that extend throughout the lifespan (Goodman & Gotlib, 1999; Walker et al., 2007). Exposure to poverty, poor health and nutrition, violence, and inadequate care are sufficient to predispose a child to negative outcomes (Reeves & Krause, 2019; Richter et al., 2016). Factors such as responsive caregiving from parents (Scherer et al., 2019) that strengthens attachment (Carney & Buttell, 2008), maternal depression that is associated with negative parenting behaviors (Gelaye, Rondon, Araya, Williams, & Author, 2016), and a mother's education that facilitates learning and engagement (Jackson, Kiernan, & Mclanahan, 2017) are associated with child development.

Fewer studies in the Nigerian context have examined the factors associated with poor early childhood indices, especially in relation to maternal and societal factors. The data in place for Nigerian children indicate that there is a high prevalence of developmental delay (Bakare, Bello-Mojeed, Munir, Ogun, & Eaton, 2016; Jimoh et al., 2018; Kazeem & Musalia, 2018). For instance, a study found that only 19% of Nigerian children were on track in learning, literacy numeracy, 96% were on track in the physical, while 60% were on track in socioemotional development (60%) (Efevbera, Bhabha, Farmer, & Fink, 2017). Based on their measure, across the developmental domains, Efevbera et al. (2017) found minimal differences among Nigerian children and those from other countries with an overall 62% of Nigerian children in the sample being on track developmentally.

A study by Jimoh, Anyiam & Yakubu (2017) investigated ECD among a sample of Nigerian children using the Schedule of Growing Skills II that assessed postural, locomotor, manipulative, language, social and cognitive skills among others. They found a high prevalence

(35.4%) of developmental delay in northern Nigeria. The data in place also suggest that under- or malnutrition (Jimoh et al., 2018); availability of early childhood education (Hackman & Farah, 2009; Kazeem & Musalia, 2018); and stimulating support have been shown to influence the most progress needed for a child to be developmentally on track in Nigeria. Closely related, another study of children 3- 31 months in Lagos, Nigeria showed that of 0.9% of children in the sample that screened positive for neurodevelopmental delays, 33.3% were diagnosed with cerebral palsy, 14.8% were in the autism spectrum. Approximately 18% were nutritionally deficient, while 7.4% and 25.9% of developmental delays were attributed to Down syndrome and non-specific disorders respectively (Bakare et al., 2016). However, few if any, nationally representative data have been used to examine the variations in risk and protective factors associated with early childhood in the context.

Dissertation Purpose and Aims

To add to science on ECD in Nigeria, this dissertation used a nationally representative sample to examine the association between a child's risk, protective and intervention factors, including the influence of disparities across the multistate, multiethnic, and diverse socioeconomic groups in the Nigerian ecology on child development. The forthcoming chapters addressed the following specific aims:

I. Assess the psychometric properties of the Multiple Indicator Cluster Survey (MICS) Early Childhood Development Index (ECDI) used among 3- to 4-year-old children in Nigeria. This aim is addressed in chapter 2 where we explore the performance of the 10-item ECDI screener used in the MICS survey among Nigerian children.

II. Characterize the intergenerational risk and protective factors for ECD in the Nigerian context. This aim addressed in chapter 3 investigated the association between the ECDI and protective, intervention and risk factors across the 36 states and FCT of Nigeria.

III. Model the association between maternal subjective wellbeing, cognitive, and socioemotional outcomes among 3-to 4-year-old children in Nigeria. This aim is detailed in chapter 4, where a structural equation modeling is utilized to test the mediating effect of maternal subjective wellbeing as a proxy for maternal mental wellbeing on child development scores, as measured with the ECDI screener.

Methods and Data Source

Data Source. This dissertation used data from the nationally representative 2016/17 UNICEF-Nigeria Multiple Indicator Cluster Surveys (MICS) (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). The MICS, facilitated by UNICEF for over two decades in 116 countries are household surveys that provide internationally comparable estimates of adult and child socioeconomic and health indicators (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). The sampling frame is the updated Nigeria 2015 population-housing census, with primary sampling units (PSUs) in both rural and urban areas. The PSUs are census enumeration areas (EAs) within each of Nigeria's 36 states, and located within its six geopolitical zones.

The research design involved a two-stage sampling where the first stage was the selection of 2340 EAs (60 from each state) within the strata and during the second stage, an enlistment of all households within each sample EA, from which 16 households were systematically drawn from each sample. The sample was designed so that weights can be applied for reporting results as the sample was stratified by state (National Bureau of Statistics (NBS) & United Nations

Children's Fund (UNICEF), 2017). The final sample was drawn from 2239 EAs, as 101 EAs most affected by conflict (in Borno and Adamawa states) could not be accessed.

The MICS study administered four sets of questionnaires in sampled households. These include the household questionnaire for basic characteristic and demographic information on all household members, the individual women questionnaire for all women 15- 49 years, the individual men questionnaire for one man in every two households 15 - 49 years, and the under-5 children questionnaire administered to mothers/caretakers of all under-5 years children. (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). The questionnaires were customized and pretested, data collectors trained, and survey piloted in purposively selected areas. The data collection team used the Computer Assisted Personal Interviewing (CAPI) instrument to gather data electronically, which they transmitted to a central server using CSPro CAPI application, version 5.0.

The results for the MICS came in from 33,901 out of 37,440 households sampled (response rate 98.9%). Of 36,176 women aged 15- 49 years identified, 34,376 were interviewed, including 28,578 children under five. Using this large nationally representative sample size strengthen the power and validity of this study. For the first research aim, calibrated sample sizes were used for item response theory, exploratory and confirmatory factor analysis. The second research aim focused on mothers at late adolescence (15-19 years) and early adulthood (20-24 years) who responded to the subjective wellbeing module, and their focal children under five (n=1,523). The third study consisted of the full sample of children under-five (approximately n=11,207, less than 3% missing data) and their mothers or caregivers nested within 37 states of the country.

Ethical Considerations. The dissertation was deemed exempt from ethics review by the Boston College Institutional Review Board, as no human participants were contacted. The data is de-identified and was used with permission from the MICS-UNICEF group.

Outline of the Full Dissertation

Following this introductory chapter, consecutive chapters of the dissertation addressed the research aims with chapter two focused on an exploration of the psychometric properties of the ECDI used among 3- to 4-year-old Children in Nigeria. Based on findings on the performance of the 10-item ECDI screener, chapter three examined the variations in risk, protective factors for cognitive, and socioemotional development outcomes among 3- to 4- year-olds in Nigeria using a multilevel modeling approach. In chapter 4, the dissertation used the subjective wellbeing construct (comprising overall happiness, life satisfaction and perception of a better future, optimism) as a proxy for maternal wellbeing, to examine its association with child factors. In the concluding chapter (5), we integrated findings from the three studies to present an overall implication of the study for social work and ECD research and practice in Nigeria.

Chapter II. Assessment of the Psychometric Properties of the MICS Early Childhood Development Index used among 3-to 4-year-old Children in Nigeria.

Instruments for tracking ECD may be for research, screening or diagnostic purposes. While some measures have been used on a small scale, others have been employed at the national and international levels in large-scale studies (Ertem et al., 2019; Halle & Darling-Churchill, 2016; Ringwalt, 2008). There is a dearth of culturally and contextually appropriate instruments that capture ECD in low-resource settings (Betancourt, 2015b). Most items on ECD instruments are likely not relevant across cultures as there may be behavioral features not easily

attainable given the cultural milieu. In addition, there may be differences in understanding based on the area of residence, where the culture, educational level, definitions, and norms of ECD vary significantly. Reliability tests and cultural adaptation using both qualitative and quantitative methods, and emic approaches to adapt gold standard instruments are often rare and cost intensive. There are also issues of feasibility where the time and human resources required to administer a measure may present a huge barrier (Hanlon et al., 2016). However, ideal instruments should be easy to use and facilitate health systems assessment of development outside of major surveys (Hanlon et al., 2016).

More so, measuring child development has been described as a Child and Human Rights issue (Loizillon et al., 2017; Uchitel et al., 2019), emphasizing a child's right to be included and accounted for. The inclusion of ECD as a target in the Sustainable Development Goals (SDGs) under goal IV show that the international community has recognized ECD as a central component of global and national development (Britto et al., 2017). Goal IV of the SDGs aims to "ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education" by 2030. The objective, 4.2.1 will measure the "proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial well-being, by sex."

Several instruments that have been used to measure ECD are multidimensional or single domain oriented. These include the Battelle Developmental Inventory Screener (BDI-2), Bayley Scales of Infant and Toddler Development (Bayley-III), Ages and Stages Questionnaires (ASQ-3), the Caregiver Reported Early Development Index (CREDI), Denver Developmental Screening Test (Denver-II). Shorter form tests that measure fewer domains include the MacArthur-Bates Short-Forms (SFI 7 SFII and the WHO Motor Milestones (WHO-Motor)

(Rubio-Codina, Araujo, Attanasio, Muñoz, & Grantham-McGregor, 2016). Generally, most instruments are usually more problematic for toddlers under the age of three.

To our knowledge, the ECDI 10-item screener used to track child development in the MICS has not been validated in the Nigerian context. While the ECDI 10-item screener has been validated in Kenya, there is little or no information about the cross-cultural equivalence and performance of the screener in Nigeria. The multiethnic, language and cross-cultural diversity of the Nigerian context necessitates an examination of the validity and reliability of the instrument. In addition, different literacy levels, educational attainment of mothers, recall, and bias (such as social desirability) may skew mothers' reported measures of child development, thus necessitating the use of complex statistical methods to analyze the properties of the instrument.

The first paper of the dissertation examined the psychometric properties of the 10-item ECDI screener used in the MICS survey, based on responses from the mothers of the focal 3-4 year old children. The overall aim of the study was to help strengthen the effective and context-appropriate tracking of ECD in heterogeneous and LMICs settings with valid and reliable instruments. The study also assisted with the preparation of the ECDI screener as an outcome measure for use in the subsequent chapters. The 10-item ECDI screener, a population-based measure of children's developmental progress is a module in the UNICEF-supported MICS. The ECDI is one of over 147 tools in the ECD measurement inventory, and has been used in more than 80 countries to highlight developmental progress of children, aged 3- to 4 years (Fernald, Kariger, Engle, & Raikes, 2009; Loizillon et al., 2017). However, no study, to our knowledge has conducted an analysis of the psychometric properties and performance of the MICS ECDI in Nigeria.

The assessment of the ECDI 10-item screener was based on the classical test theory (CTT), and used the item response theory (IRT) modeling that includes an exploratory and confirmatory factor analysis to examine the degree to which the variables measure the desired construct specifically or if other underling constructs, are at play. The main questions that were answered by this study are: Does the 10-item ECDI screener used among Nigerian children accurately capture the underlying domains of ECD as claimed? What is the underlying factorial structure of the items? Does the MICS 10item ECDI screener exhibit good discriminatory power in distinguishing between children who are developmentally on track and those who are not? Methods. The outcome measure for the first study was the 10-item MICS ECDI screener. The MICS ECDI comprised ten binary response (yes/no) questions covering four domains namely the literacy/numeracy, the physical, the learning approaches/cognitive and the socioemotional. The literacy/numeracy domain (3 items) asked caregivers if child can name or identify at least 10 items of the alphabet; if child can name and read at least four simple, popular words; and if child knows the name and recognizes the symbol of all numbers from 1-10. The physical domain (2 items) asked if child is able to pick small objects with two fingers, and if child is sometimes too sick to play (See table 2). Questions on the cognitive or approaches to learning domain (2 items) asked if child follows simple directions on how to do something correctly and if child is able to do something independently when given a task to do. The socio-emotional domain (3 items) asked if child gets along well with other children; if child kicks, bites or hits other children or adults; and if child gets easily distracted.

***Analytical approach*.** An exploratory and confirmatory factor analysis to determine the underlying factor structure of the instrument was conducted to ascertain the dimensionality of the ECDI domains, and how they load on a one-factor, and a 4-factor model based on the literature

(Loizillon et al., 2017). For model fit, recommended tests such as the Root Mean Square Error of Approximation (RSMEA), Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and Standardized Root Mean Square were also carried out. 1PL and 2PL IRT models were estimated to further highlight the construct validity or degree to which the measure reflects the underlying ECD domains (Michalopoulos et al., 2019).

Examining the performance of the MICS ECDI measure that has been used in two rounds and in the ongoing survey (2020) in Nigeria will highlight and clarify speculations about gaps, if any, in this crucial instrument and promote the engagement of designers for modifications, if need be. Exploring the properties and performance of the 10-item ECDI screener will add to science, as it will first establish the reliability of this instrument for an extended use in the subsequent studies. Further, the dissertation will extend knowledge on the association between the ECDI and maternal and household factors across regions of the Nigerian context. In addition, this focus on the 10-item ECDI screener and the dissemination of findings will increase the overall awareness on ECD, the level of discourse among communities, including caregiver orientation to expectations for ECD. With increased focus on child development, a child-centered development approach will evolve and foster overall prosperity in the communities (Avan, 2008).

Chapter III. Variations in Risk and Protective Factors for Cognitive and Socioemotional Development among 3- to 4-Year-Old Children in Nigeria: A Multilevel Modeling. Few studies, if any, in the Nigerian setting have examined how known risk and protective factors for cognitive and socioemotional development are associated with factors in the child's ecology, and especially across the 36 states and FCT. In this chapter, we delved into the socio-demographic context of the overall dissertation, and provided an overview of Nigeria's

multiethnic, multi-language, and pervasive north-south religious divide that reflects on the socioeconomic and political milieu of the 36 states and Federal Capital Territory (FCT), Abuja (National Population Commission [Nigeria] & ICF, 2019). Further, this chapter investigated how child individual factors interact with maternal and household factors, and the macro level to influence child status as measured by items on the ECDI, and across state-level factors.

This study extends prior research on ECD in Nigeria by its use of a nationally representative sample, and definition of early childhood outcomes based on substantive domains of the ECDI, namely the literacy, cognitive and socioemotional domains. Based on the first study, these selected domains provide a more accurate assessment of child development rather than the full 10-item MICS ECDI scale (Loizillon et al., 2017). Further, this study was guided by the socio-ecological model of child development (Bronfenbrenner, 1997) embedded within the social determinants of health framework (Solar & Irwin, 2010). The social ecological model of child development emphasizes the role of processes and conditions interacting in the nested layers of a child's environment to influence outcomes (Bronfenbrenner, 1997; Wethington, 2005), thus providing utility to policy and practice recommendations.

A multilevel modeling approach was used for statistical analysis to account for any potential ecological fallacies (Raudenbush, Bryk, Congdon, & Toit, 2019). In all, two-level regression models were fitted for 11,207 mother-child dyads at level- 1, nested within 37 states/ FCT at level -2. By highlighting the risk and protective factors for ECD, including the influence of the macro context, this study not only contributed to new knowledge on ECD in Nigeria but also provided cues for discussions and interventions aimed at promoting child wellbeing and mental health in Nigeria. Findings from the study allude to state-level variations in early childhood indicators, which though minimal when compared to child and individual-level

factors, call for stronger social protection programs that strengthen families' capacities to facilitate ECD.

Chapter IV. Maternal subjective wellbeing, and child cognitive, and socioemotional outcomes among 3- to 4-year-old children in Nigeria.

In the fourth chapter and third study of the dissertation, we modelled the relationship between maternal subjective wellbeing (SWB) and early childhood outcomes based on selected items of the ECDI screener. Few studies, if at all have examined the SWB particularly of women and much less its association child literacy, cognitive, and socioemotional outcomes in Nigeria. It is important to examine SWB among Nigerian women given the closeness of the construct to mental health outcomes. Few, if any nationally representative studies examine the mental health of mothers of young children, especially given its implications for child development. Subjective wellbeing comprises the eudemonic (positive functioning), and the hedonic (happiness and life satisfaction) aspects of wellbeing, and is defined as an individual's evaluation of their self-realization, meaning and psychological wellbeing (Diener, 1984; Keyes, 2006). Subjective wellbeing is also defined as a combination of subjective emotional wellbeing (hedonic) and subjective psychological wellbeing (eudemonia) (Keyes, 2006).

Children grow and develop in the context of their family processes with mothers and caregivers being the curators of the child's proximal environment. When mothers face adversity including MH problems, substance abuse, or domestic violence, their contribution to child development is compromised. Several studies note that when a mother is living a subpar life, the adverse effect of her apathy on the child's developing brain and subsequently ECD is inevitable (Grantham-Mcgregor et al., 2007; Hackman & Farah, 2009; Kazeem & Musalia, 2018; Shonkoff, 2003). Maternal pregnancy circumstances may also predispose the child to negatively reinforcing

cognitive, socioemotional, and behavioral problems (Elgar et al., 2004). Adversity or family events such as such as divorce or separation death, abuse, mental illness or drug use disorders in a parent has also been shown to impact ECD in more ways than one (Gundersen & Ziliak, 2014).

Very few nationally representative studies in Nigeria have measures of maternal mental health that can be used to examine its influence on ECDI. In other settings, previous studies (Fergusson et al., 2015; Heady, Kelley, & Wearing, 1993; Prasoon & Chaturvedi, 2016) find a positive association between life satisfaction and mental health problems including measures of depression, anxiety and alcohol dependence. Life satisfaction has been conceptualized as a cognitive constituent of the SWB construct (Botha, Wouters, & Booysen, 2018; Diener, Emmons, Randy, & Griffin, 1985; Fergusson et al., 2015; Mobarak Hossain, Kayesh, & Ferdous, 2018; Prasoon & Chaturvedi, 2016) and measure of mental health (Fergusson et al., 2015; Heady et al., 1993; Prasoon & Chaturvedi, 2016).

The inclusion of mental health targets in the Sustainable Development Goals (SDGs) is an indication of the recognition of the dearth of mental health research in SSA (Lund et al., 2010), and will help to highlight and muster action toward positive mental health outcomes. Nigeria's young population is projected to become the third largest in the world by 2050 with implications for mental health and overall wellbeing (National Bureau of Statistics & UNICEF, 2017; UNICEF, 2017; United Nations, 2017). Young adolescent women in Nigeria have a fertility rate of 107 births per 1000, with 30.8% of women aged 20-24 years having at least one live birth before the age of 18 (National Bureau of Statistics & UNICEF, 2017).

Given these projections, there is a need to examine the SWB of women, 15-24 years who are at the peak of reproduction and whose actions will have substantial implications for the wellbeing of their offspring and families (Izugbara et al., 2017; Rahman et al., 2013). Using the

SWB construct as a proxy for maternal mental health and wellbeing can present a strengths-based perspective of mental wellbeing that allows for stigma-free discussion of mental health in Nigeria's nuanced multicultural and multi-language setting. The SWB construct was included for the first time in the MICS in Nigeria in 2016/2017. Of the 34,376 women in the MICS study, only women aged 15 -24 years were administered the SWB questions.

To ground the study, we adapted the family stress theory and the family investment model. We took a narrow focus to posit that maternal socioeconomic status (measured by the household wealth index, mother's education, and context -rural or urban) will affect the mother's emotional state (examined through her SWB, and consisting of her level of life satisfaction, overall happiness and optimism). This study hypothesized that mothers with higher levels of education, living in urban areas, and having higher family wealth index (socioeconomic status) will have higher levels of SWB. We also hypothesized that mothers with higher levels of SWB (life satisfaction, overall happiness and, optimism for a better future) will be more involved and invest more resources toward their child's development and thus have higher child development coefficients. Over all, we hypothesized that higher levels of education, family wealth index, and living in urban areas, (higher socioeconomic status) will be associated with more resources for child development and better outcomes.

***Methods*.** As with the previous studies, this study used data from the fifth round of the MICS survey. The outcome variable was an endogenous latent measure comprising scales from seven items in three domains of the 10-item ECDI screener (Loizillon et al., 2017), namely the literacy/numeracy, the cognitive and the socioemotional domains. The primary mediator variable was an endogenous latent construct, subjective wellbeing comprising measures of life satisfaction, optimism and overall happiness. A socioeconomic latent exogenous variable

comprised maternal sociodemographic measures such as her level of education, wealth index quintile, and place of residence, whether rural or urban. Covariates in the form of a latent endogenous variable that measured investments or resources into child development and comprised of observed variables the number of children's books, mother's engagement in stimulating activities with the child and, the child's enrollment in early education were included in the analysis.

The analytical approach for this study involved separate confirmatory factor analysis of each of the latent variables – socioeconomic status, investment and learning resources, SWB and child outcomes - to ascertain model fit. A structural equation model (SEM) analysis that combines correlations, linear regression, and factor analysis was used to test the hypotheses about the relationship between the mother's SWB and child's literacy, learning, and socioemotional outcomes. The goodness of fit statistics were also generated to test the adequacy of the model while examining the theoretical basis of the study.

Paper 3 set out to ascertain whether the proposed model of maternal SWB and literacy, learning, and socioemotional constructs produce a population covariance matrix that is consistent with the sample covariance matrix. Both direct and indirect effects were examined. The sub-focus on young mothers, 15 to 24 years, barely leaving adolescence, and hitherto understudied in LMIC population studies highlighted their unique impact on ECD for policy and planning.

Summary of Findings

In summary, the dissertation surmised that there is a need to review the construct validity of the MICS ECDI screener, and ensure that the index is actually capturing ECD as it is designed to. Further, there is a need for a gold standard ECD instrument in the MICS to ascertain and strengthen the convergent validity of the ECDI. In addition, based on the findings from the study

on maternal SWB, and the increasing global burden of mental health the study finds a need for a simple mental health measure to be included in the MICS. The studies further highlighted the role of early childhood education and stimulation. There was also an emphasis on the role and longstanding disparities arising from ethnicity, maternal education, and poverty on child outcomes.

Limitations of the Dissertation

In-depth description of the limitations and strengths of the studies in the dissertation are discussed under each chapter. Some overall limitations of the study include the cross-sectional nature of the study design, and the absence of assessment at more than one time point, thus limiting any causal inferences. In addition, the 10-item ECDI is a population based measure and screener, and may not be specific in capturing developmental delays in children. Further, there was no gold-standard instrument in the survey to support further validation and for comparison with the ECDI. Responses to the 10-item ECDI screener are also problematic, being limited to the mother-only report or account of their child's developmental status, and may suffer from recall or social desirability bias.

In addition, measures of SWB may be problematic in the Nigerian setting given the internalized or gendered position that the women may have been normed to, and/or accept as their lot in life. In addition, there are no other measures for mental health outcomes in the survey to compare with maternal SWB as a proxy for mental health. There is also the possibility that using the SWB construct to examine maternal wellbeing in relation to child outcomes in this population may overlook the impact of SSA's collectivist culture, natural settlements and social support that may mediate self-reported life satisfaction.

Further, conducting a multi-level model analysis of the variations in risk and protective factors for ECD across Nigerian states that have immense disparity and heterogeneity within them, would have benefitted from a closer macro level in the child's ecology rather than the states may have yielded estimates that obscure the true picture of child development in the sates. For instance, the use of a state's education-specific budget and investment in early education rather than the overall state budget may have provided more realistic estimates on the macro effect of state policies.

Conclusions

Taken together, these three studies sought to contribute to the understanding of the profile of 3- to 4-year-olds in Nigeria, and the interplay of risk and protective factors affecting their developmental status. This study highlighted the significant risk and protective factors, including disparities across the multiethnic and diverse socioeconomic groups of the country. Results from this study will be useful, given its theory-driven nature, prospect for generalizability, and strengths-based approaches. These results have potential to contribute to the science on child wellbeing in a representative LMIC context, such as Nigeria by strengthening the discourse on the use of culturally sensitive and validated measures for ECD.

By highlighting the interplay of risk and protective factors through this study, researchers and practitioners can adopt objective levers for integrating social work and mental health services into existing structures to improve maternal and child health. By focusing on previously understudied aspects of child development in Nigeria, this dissertation also advanced knowledge that is useful for designing research in the ECD sector. Further, by providing a comprehensive analysis of the ECDI instrument, this study advanced an implementation science approach to the use, revision, and development of research instruments in African contexts.

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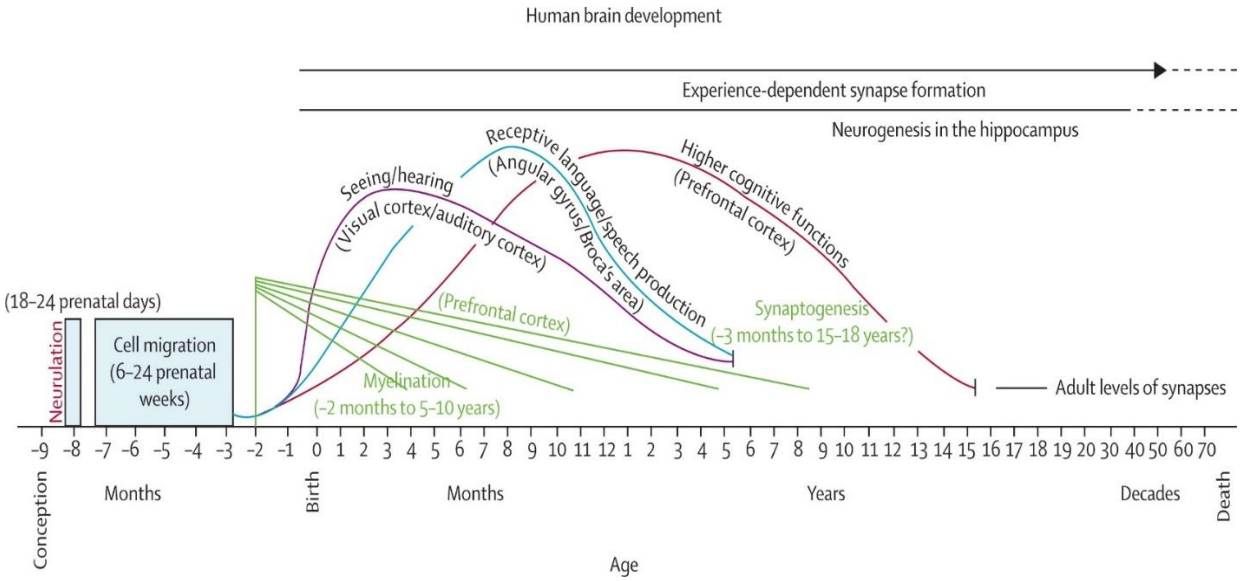
Figure 1.1 Beyond what the eyes can see: Concept of early childhood development



Source: (Grantham-Mcgregor et al., 2007)

Chapter II. Assessment of the Psychometric Properties of the Early Childhood Development Index used among 3- to 4-year-old Children in Nigeria

Introduction

This study aimed to assess the performance of the Early Childhood Development Index (ECDI) used in the Multiple Indicator Cluster Survey (MICS) among 3 to 4-year-old children in Nigeria. While the ECDI had been validated for use in one sub-Saharan African (SSA) country, Kenya (Loizillon, Petrowski, Britto, & Cappa, 2017), to our knowledge, there are no studies reporting its performance in the Nigerian context. The objectives of the study were to ascertain the reliability of the instrument, including its construct validity. The study also assisted with the preparation of the ECDI as an outcome measure for use in the subsequent chapters of this dissertation. The overall goal of examining the properties of the ECDI is that through the findings, an awareness of its performance, need for effective and context-appropriate tracking of early childhood development (ECD) in heterogeneous and low- and lower middle-income countries (LMICs) settings such as Nigeria, with valid and reliable instruments can be strengthened.

Over the years, advances in child development have helped to reduce child mortality to less than 200 per 1,000 in Nigeria (National Population Commission [Nigeria] & ICF, 2019; UNICEF, 2017a). However, landmark studies highlight the risk of over 200 million children in LMICs not achieving their developmental potential primarily due to social determinants of health (Engle et al., 2007; Grantham-Mcgregor et al., 2007). Nigeria accounts for over 31 million children under five of which over 6 million are estimated to be at risk for not reaching their full potential in life (McCoy et al., 2017; National Population Commission [Nigeria] & ICF, 2019).

Factors associated with mental, social, and behavioral problems, examined through their association with ECD often predispose children to developmental delays. Developmental delays decrease children's chances of success in life –socially, academically and financially, including their ability to function as productive members of their communities thus necessitating the consistent tracking of childhood development (Bornstein et al., 2012).

When the developmental status of children are regularly monitored as is the case in high income countries, children who may be experiencing developmental delays are identified on time and interventions are planned for (Boggs et al., 2019; Fernald, Kariger, Engle, & Raikes, 2009). Practitioners use results from child development assessments to plan for, and design interventions, and assist with strategies to facilitate the optimal development of children. While some measures have been used on a small scale, others have been employed at the national and international levels in large-scale studies (Ertem et al., 2019; Halle & Darling-Churchill, 2016; Ringwalt, 2008). However, many LMICs do not have a practice of assessing ECD (UNICEF, 2013) either for research, screening or diagnostic uses, and are often limited to using proxy measures for child development (Fernald & Pitchik, 2019).

A systematic review of maternal and child intervention studies in Nigeria over a 24 year period revealed that only a meagre number of studies (18) had been published on the development of children under the age of five (Kana, Doctor, Peleteiro, Lunet, & Barros, 2015). Added to this, there is a dearth of ECD assessment instruments that are culturally and context-specific to the multicultural LMIC and often-low resource settings (Betancourt, 2015). Differences in outcomes for children from different regions necessitate culture-specific models of development and assessments (Ertem, 2012). For instance, a country as diverse in language and cultural nuances such as Nigeria may present a challenge for direct application of

instruments used in western cultures. Without a validation process, there may be concerns that assessment tools such as the ECDI may be interpreted differently by mothers of different socioeconomic classes, or educational levels.

This study examined the psychometric properties and performance of the ECDI used in the MICS among children in Nigeria's multi-cultural, multi-language and heterogeneous context. The study examined how the ECDI functioned and how, if at all, it can be modified for optimal use. To achieve this goal, this study assessed the internal consistency, reliability and structure of the ECDI items using statistical methods based on the Classical Test Theory (CTT) (DeVellis, 2006) and the Item Response Theory (IRT) (Steinberg & Thissen, 2013). The analytical approach included exploratory and confirmatory factor analysis to ascertain the underlying structure of the variables, as presented by the designers of the ECDI (Loizillon et al., 2017). Item Response Theory (IRT) modeling was used to examine the differential functioning of each item and the degree to which the items measure the desired ECD construct specifically or if other underling constructs, are at play.

Significance of Study

The report indicating that over 43% of children less than five years old in LMICs are at risk of not reaching their full developmental potential as a result of stunting, extreme poverty and other challenges of early childhood was a global wake-up call for policy-level intervention (Grantham-Mcgregor et al., 2007; Machel, 2017). However, there is a dearth of appropriate age, and context-specific measures of child development in LMICs. More so, inadequate measures result in poor estimates, poor planning, and allocation of resources for the development of children. When countries fail to invest in the wellbeing of children, they compromise their future progress, and rather foster a continued cycle of lower human development indices. This study is

significant, as it will contribute to insights on the current population measure used to examine ECD in a LMIC setting, Nigeria.

Most national level interventions in Nigeria focus on increasing enrollment in early education and literacy (The World Bank, 2013), which are important requirements for participation in an increasingly globalized world (Ferguson, Cassells, MacAllister, & Evans, 2013; Murray et al., 1999). However, there is limited attention on other aspects of ECD which are precursors to success in education and life (Engle, Britto, & Super, 2013). Examining and highlighting the performance of the population-level, MICS ECDI 10-item screener, which includes literacy-numeracy, cognitive, motor, socioemotional and cognitive measures can serve to strengthen research, political will, and commitment towards integrated, multi-sectoral, and evidence-based interventions needed for children in Nigeria. This study will contribute to science by highlighting the performance of all the domains of ECD within the measure that can allow for a holistic discussion of ECD.

This study is will also add to the knowledge base on the ECDI instrument, as it will use the IRT modeling to examine the difficulty and discrimination parameters of the items, and assess how well they perform given different contexts. This study has the potential to call attention to areas that can be strengthened in ECD measurement in Nigeria and, perhaps, other LMICs where the MICS is in use.

Review of the Literature

Child development encompasses the process of evolution of a child to a teenager "in all areas of human functioning - social and emotional, cognitive, communication and movement" (Fernald et al., 2009; Irwin, Siddiqi, & Hertzman, 2007). Different schools of thought describe ECD as a period ranging from zero to 8 years while others use an upper age limit of 5 years

(Avan, 2008; Fernald et al., 2009). Within the life course perspective, childhood comprises the prenatal period (conception through birth), infancy (the first two years), early childhood (3-5 years) and middle childhood (6-11 years), and is a sensitive period, whose experiences lay the foundation for success or failure throughout life (Braveman & Barclay, 2009).

From conception to about 36 months (approximately 1000 days), a child's brain experiences rapid growth (Monk, Georgieff, & Osterholm, 2013). From birth to four years, the brain continues to develop and in supported settings within or outside the home such as the pre-school environment, opportunities for further stimulation toward cognitive and social skills development are afforded to the child. The brain development that occurs through neural connections are affected by nutrition, disease conditions, stimulations, and positive or negative stressors in the child's external and internal environment (Monk et al., 2013).

The most common and interdependent domains of holistic child development examined in ECD studies are the physical/motor, language, mental, emotional, and social development (Avan, 2008; Fernald et al., 2009). Physical development includes changes in the internal and external organs, motor and cognitive abilities, and is at its peak between two months to one year of life (Avan et al., 2008). Children grow in size and shape with weights and heights tripling during the first year. Movement, communication and increased perception of the environment are important features that come with physical development. In addition, by age two, a child's brain attains 75% of the weight of the adult brain.

The mental domain of child development encompasses the development of the five senses, and coordination between the body and mind is facilitated by increased neural connections in the brain. In addition, development in the emotional domain encompasses "the development of attachment, trust, security, love, and affection, and a variety of emotions and

feelings" (Avan et al., 200s8). In early childhood, foundations for experiencing, interpreting and expressing emotions are laid, and when positively developed in terms of secure attachments, and go on to facilitate stability.

The socioemotional aspect of child development takes into account the interdependent nature of human lives on family, neighborhood and societal context, and the child's ability to relate with other children and adults within established norms (Halle & Darling-Churchill, 2016). Factors such as adult consistency in meeting the child's needs enables children to pay more attention to their environment, regulate their emotions, and have more secure relationships. From Halle and Darling-Churchill (2016) review of measures of socioemotional development, they identified four sub-domains namely social competence (which examines how a child interacts socially with other children, make and sustain connections and cooperate with others), emotional competence, conflict-related behavioral problems, and self-regulation. The children in this study, 3- to 4-years-old, are at the stage where external interactions through pre-school necessitate new friendships and emotional connections with peers and teachers.

There is lack of agreement on the milestones that delineates each stage of childhood especially to support the detection of delays or planning for interventions (Tennyson, Kemp, & Rao, 2016). There are also still many unknowns about whether all healthy children in different countries attain developmental milestones in a similar manner. The Guide For Monitoring Child Development (GMCD) note that many milestones are similar across countries and cultures and posit a commonality in the age at which children in diverse countries achieve gross motor milestones (Ertem et al., 2019; Fernald et al., 2009). However, there have been notable challenges with measuring ECD in LMICs (UNICEF, 2013).

Challenges with measuring ECD. Practitioners, researchers and institutions assess, screen for, and use markers of child development to monitor, diagnose, strengthen school programs or plan for early interventions for children. In therapeutic settings, screenings of child development are conducted to identify delays and manage developmental progress. Families, caregivers or professionals are often tasked with completing screening and assessment instruments that are either multi-domain or focused on one domain of ECD (American Academy of Pediatrics, 2010; Ringwalt, 2008). Some measures are diagnostic in nature (and mostly used by specialists) while others are programmatic or population-based assessment tools and only provide an overall estimate or snap shots of whether a child is on track or not. Several studies have examined the validity and psychometric properties of various instruments used to assess ECD (Betancourt et al., 2009; Boggs et al., 2019; Forrest et al., 2019; Hanlon et al., 2016; McCoy, Waldman, CREDI, & Fink, 2018). A few studies of Nigerian children have validated and used some instruments to highlight the prevalence of developmental delays in their study population. Yet no study to our knowledge has examined the reliability of the ECDI, and especially its performance in the Nigerian population.

Status and domains of early childhood development in Nigeria.

Currently, more than 44% of 3- to 4-year-old children in sub-Saharan Africa (SSA) fall short of basic cognitive and socioemotional skills, accounting for the largest number (29.5 million) of children 3- and 4- year-old experiencing developmental delay globally (Black et al., 2017; McCoy et al., 2017). Also, based on the ECDI measure, Nigerian children (6 million) are experiencing developmental delays, high figures comparable only to India (17.2 million) and China (6.7 million) (McCoy et al., 2017)(McCoy et al., 2017) (McCoy et al., 2016, 2017). Another study estimated that 45.7% of Nigerian children in a sample of 9,382 had low cognitive

and or socioemotional ECDI score implying a high prevalence of developmental delay (McCoy et al., 2016)(McCoy et al., 2016). Other studies indicate that only about 62% are on track developmentally in all domains based on their ECDI overall score (Efevbera, Bhabha, Farmer, & Fink, 2017; National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017; UNICEF, 2017b).

The ECDI as a population measure. According to its designers, the ECDI is not diagnostic in nature but a population measure that aims to inform policy within countries and enable cross-country comparisons, especially to track the Sustainable Development Goals (Loizillion et al., 2017). Population measures track outcomes and the distribution of the outcomes at group or population level, showing general applicability, a wide range of responses across items, and an indication of breadth for outliers (Hendrikx, Spreeuwenberg, Drewes, Ruwaard, & Baan, 2018).

Population measures are brief enough for ease of use and generate small amounts of missing data. Population measures aim to be comparable across different subgroups at the same or different points in time representing the state of a particular population as a single number, and expressed in values that are easily interpretable by policy makers and the public. Population measures are also appropriate for population health change and not individual life cycle change, showing health or developmental gaps in the population (Molla, Madans, Wagener, & Crimmins, 2003). Other common population measures akin to the ECDI include life expectancy (mortality), DALYs, and the IADL. Measures such as the ECDI aid comparison of child development across countries, at different points in time, highlight overall inequalities within populations, and support policy, service delivery and health planning (Horton, 2017).

Evolution of the UNICEF ECDI. From 2006 to 2009, UNICEF and expert partners attempted to bridge a gap in the lack of a comprehensive measure of child development by creating the ECDI as a globally accepted, measure for tracking child development. The ECDI was an improvement from an earlier and country-specific Early Learning Development Standards (ELDS) (Loizillon et al., 2017). Designed to support the tracking of the Millennium Development Goals (MDGs) and subsequently the SDGs, the ECDI module was developed through consensus building on the domains of ECD with expert debates on global indicators of ECD. The goal was to develop a measure that can be used across the board, and that could accommodate the constraints of time, costs and ease of use as a module within the MICS. The ECDI has evolved from an initial 48-item version developed through qualitative, quantitative and clinical/observational methods, and piloted in Jordan and the Philippines to an 18-item version. This study will use the current 10-item version, tested in Kenya and used in over 300 surveys over six rounds globally (Loizillion et al., 2017).

While initial resolutions were to include direct child and parent responses for children 3- to 5-years of age, the final product is a caregiver/mother-reported screener. The ECDI was examined for convergent validity using the Strengths and Difficulties Questionnaire (SDQ) and the Early Development Instrument (EDI) (Loizillion et al., 2017). The ECDI was also assessed for content, construct and concurrent validity in the different cultural settings where it was pilot-tested. The ECDI went through psychometric Rasch modelling (IRT) and confirmatory factor analysis in three countries including Kenya in SSA (Loizillion et al., 2017). The 48-item ECDI assessed six developmental domains (physical/gross motor, language development, cognitive development, social development, approaches to learning and emotional development) and lasted about 9.8 minutes while the 18-item ECDI had similar domains but with fewer items. The

current 10-item ECDI (see table 2) was reorganized and collapsed to four domains targeting children aged 3 and 4 years (36-48 months).

For analytical purposes, a child is considered to be on track overall if three out of the four domains are on track. In addition, the aggregated results for each of the domains calculated separately and the total ECD1 represent children who are developmentally on track in at least three of the four domains ranging from 0-1. Other than reports by the designers of the ECDI about the process of its development (Loizillon et al., 2017), studies using the ECDI only report their observation of the discrepancies in the milestones examined for by the ECDI domains. Few studies, if any, have examined the psychometric properties and reliability of the ECDI in Nigeria. This is the first study to our knowledge that attempts to understand the performance of ECDI items using both classical and IRT quantitative methods to assess reliability within a Nigerian sample.

Rationale: Reliability of the ECDI. Applying analytical principles from the classical test theory (CTT) and the item response theory (IRT), this study examined the psychometric properties of the ECDI, and ascertained its reliability as an index for defining the developmental status of children in Nigeria. Reliability is the quality or character of the measurement instrument to reproduce a measure consistently, on different occasions, and across cultures or settings (Goldstein & Simpson, 2002). An instrument can be reliable without being a valid measure of the intended construct. Content validity is the quality of an instrument that addresses the procedures of constructing the measurement items; the adequacy of the items; the process of sampling; and testing the items (Goldstein & Simpson, 2002).

Content validity (more objective than statistical) examines how the "collection" of items in a measure represents the construct and how the test is constructed (Goldstein & Simpson,

2002), and reflects the level of the user (expert or amateur, caregiver or specialist) who would consider and determine the outcomes. Expert opinion and consensus is used to ensure accuracy and content validity, which often changes with new developments in science and evidence-based research. The MICS study did not include a gold standard to help ascertain the ECDI's convergent validity, or how it performs relative to a similar instrument.

Classical Test Theory (CTT) and Item Response Theory (IRT)

The Classical Test Theory (CTT) on measurement posits that a true score on any test is unobserved and theoretical, and does not have any direct relationship with the construct in question (Goldstein & Simpson, 2002) but represents an individual's expected value that may be influenced by their knowledge, state of health, distractions, and mistakes in addition to guessing (Willse, 2010). Based on the CTT, a child has an observed score on the ECDI that equals the true score plus random measurement error *(x = Tx + e)* (Goldstein & Simpson, 2002), and focuses on test score consistency (reliability) of the overall scale. Classical Test Theory focuses on three types of reliability –test-retest or stability, alternate form and internal consistency. Basic reliability analysis include true scores, correlation, testing, validity, type 1 errors, construct validity and theory testing (Willse, 2010).

Examining the ECDI based only on the face value of CTT relies on assumptions that caregivers responding on behalf of the children attribute their developmental level to reflect their true ability on that domain (Willoughby, Wirth, & Blair, 2011). In addition, the CTT assumes that all the scores provided are equally reliable implying that the ECDI is precise for all children irrespective of their ability, and the interchangeability of different domains of development. Relying solely on CTT to determine how successful the ECDI is in estimating child development has disadvantages such as difficulty in differentiating items with common themes, and

dependency on the sample of individuals involved (DeVellis, 2006). This study will extend the assessment of the ECDI items by examining the items using the 1-parameter and 2-parameter logistic model analysis of the Item Response Theory (IRT), in addition to the CTT.

Item Response Theory and the Early Childhood Development Index (ECDI). Item response theory (IRT) as a model scores proficiency in a trait by highlighting the relationship between the trait and the response provided to it. Item response theory examines the probability that a person "succeeds" on a given item or individual test question (Baker, 2001; Steinberg & Thissen, 2013). The IRT is not necessarily a theory but a technical measurement and probability model that estimates the likelihood of different responses to an item. Compared to the CTT that assumes that everyone is responding to the same items in the same way, the IRT takes into account the difficulty in answering the question the item seeks to measure, and the discrimination or the reliability, precision or reproducibility of a score. The more discriminating, the more reliable the instrument, if it consistently gives the same estimate. The IRT tests the degree of endorsement of each response or the endorsement pattern and the strength of each response compared to the underlying construct (Steinberg & Thissen, 2013; Yang, Chen, Liu, & Xin, 2019).

Item Response Theory is also different from CTT in that conducting an IRT puts the scores from each ECDI measure into the same metric so that each child's measure is customized, thus providing an index of the precision of the ECDI tool – a form of standard error measurement for each child (Betancourt, Yang, Bolton, & Normand, 2014; Steinberg & Thissen, 2013). Using the IRT, this study characterized the child's developmental level in the different domains based on item difficulty level and discrimination, and estimated the likelihood of different responses for children with different levels of the ECD. The IRT is based on several

assumptions such as monotonicity, uni-dimensionality, item variance, and local independence (Forrest et al., 2019; Steinberg & Thissen, 2013). Monotonicity assumes that the trait or in this case developmental level is increasing or the likelihood that a positive response increases as the ability increases. Monotonicity is best described on the item characteristic curve (ICC) graph, IRT being a visualization model. IRT also assumes uni-dimensionality meaning that there is only one dominant latent trait being measured and that this trait is the driving force for the response observed. Uni-dimensionality is confirmed using the confirmatory factor analysis fit statistics of the construct (Forrest et al., 2019).

The invariance assumption of IRT means that the behavior, ability or trait in this case the ECD developmental stage is independent of the characteristics of the sample across subpopulations (Betancourt et al., 2014; Steinberg & Thissen, 2013), such as age, gender or ethnicity and examined using the Differential Item Functioning (DIF). The local independence assumption of IRT supposes that responses provided by participants (in this case, mothers on behalf of their child) are not statistically related to each other prior to or after the measure although this may be violated in negatively worded items (Steinberg & Thissen, 2013). If the response to one item influences the pattern of response to another, then the local independence assumption will be violated. Thus, the correlation of the residuals should be zero.

The IRT's goal is to discriminate among different levels of item response in the construct (Stone, Matheson, Leventhal, & Boutelle, 2020). The IRT’s item characteristic curve or function (ICC or ICF) is a sigmoid line that describe the probability that a person says yes or succeeds on a given item (item difficulty). For instance, for the ECDI, the research question will be “how likely are mothers to provide a “yes” to questions about the level of their child’s developmental progress”. Based on the IRT, this study posits that mothers are likely to have a positive response

to an item depending on how much of the trait they believe their child has and on how difficult or intense the item is (Steinberg & Thissen, 2013). Applying the IRT as a probability model to this study will ensure that the underlying developmental domain resident in each child though latent is captured independent of the items used to measure its level. Thus each child's performance in a developmental domain (not their true scores as assigned by the mother) will be a joint function of their overall ability (termed *theta*) and the features of the ECDI test items.

Item difficulty. For the ECDI, the item response is dichotomous with two categories yes or no. The IRT equation for the question, 'what is the probability P of responding "yes" for the trait "theta θ" to an item *i (*that is (Pi = yes/ θ), (where θ= the level of ECDI domain or trait of a person *n* responding to item *i*, error, e= 2.7 a fixed value, and β = beta is difficulty of the item).

$$P_i = \text{yes}/\ \theta = \frac{e^{(\theta_n - \beta_1)}}{1 + e^{(\theta_n - \beta_1)}}$$

As shown above, this probability of a yes depends on how difficult the item is and on the value of theta (amount of trait). On the Ogive or sigmoid curve (ICC) generated by an IRT analysis, the prediction line predicts the probability for every level of the trait measured. Also, on the continuum of the prediction line, 0.5 probability of a yes is the point of median probability – where there is a 50:50 chance of saying yes, which has different logits for each item. At lower logits, the item is easier to estimate. The slope of the prediction line is the item difficulty. Item difficulty, denoted by β is the likelihood that each mother will respond correctly on the ECDI question (not in terms of the perceived difficulty or amount of effort required). In highlighting item difficulty, the IRT shows how sensitive the ECDI to capture both the strongest and the weakest developmental levels.

***Item discrimination*.** For different items on a scale, the slope can be equal in difficulty but different in discriminatory power at the point of median probability where the trait meets the slope. Discrimination, denoted by α is the instrument's ability to differentiate between the children with low and high levels of a developmental trait. A high discrimination suggests that the item or instrument has a high ability to differentiate between the levels of development of the children.

To compute the discriminatory level of a measure or slope, the probability P

$$P_i = \text{yes}/\theta = \frac{e^{\alpha(\theta n - \beta 1)}}{1 + e^{\alpha(\theta n - \beta 1)}}$$

Where the slope α = discrimination

Study Purpose and Aims

This current study and research questions. This study examined the performance and psychometric properties of the 10 items on the ECDI and sought to answer the following questions**:**

i. Does the 10-item ECDI used among Nigerian children accurately capture the underlying domains of ECD as claimed?

ii. What is the underlying factorial structure of the variables?

iii. Does the MICS ECDI exhibit good discriminatory power in distinguishing between children who are developmentally on track and those who are not?

Methods

Study Design and Data Set.

The study used data from the fifth round of the MICS conducted in 2016-2017 in Nigeria. The sampling frame of the MICS is the updated Nigeria 2015 population-housing census, with primary sampling units (PSUs) in both rural and urban areas. As noted in chapter 1, the PSUs are

census enumeration areas (EAs) within each of Nigeria's 36 states, and located within its six geopolitical zones where households in 60 enumeration areas (EAs) per state were sampled. Using the child questionnaires, caregivers (mostly mothers of the sample child) responded to questions about their children. In the child development module, 10 questions were asked of the child's developmental status. Responses were collected through face-to-face interviews with caregivers (mostly mothers of the sample child) who responded to the questionnaire for the under-5 children (n=11,073). Random calibration samples were extracted to conduct the EFA, CFA and IRT respectively.

Measures. The variables used for the study are measures in the MICS ECDI that asked questions relating to child's ability to perform or manifest certain developmental traits expected for their age. The MICS ECDI comprised ten binary response (yes/no) questions covering four domains. The literacy/numeracy domain (3 items) asked caregivers if child can name or identify at least 10 items of the alphabet; if child can name and read at least four simple, popular words; and if child knows the name and recognizes the symbol of all numbers from 1-10. The physical domain (2 items) asked if child is able to pick small objects with two fingers, and if child is sometimes too sick to play (See table 2).

Questions on the cognitive development/approaches to learning domain (2 items) asked if child follows simple directions on how to do something correctly and if child is able to do something independently when given a task to do. The socio-emotional domain (3 items) asked if child gets along well with other children; if child kicks, bites or hits other children or adults; and if child gets easily distracted. The child demographic variables such as age (in years), gender (male or female), place of dwelling (rural or urban), maternal (level of education) and household characteristics (wealth index, religion) were examined as covariates.

Analytical approach. Using the Stata 16 E statistical package, the data were cleaned and examined for outliers. The three negative items in the physical and socio-emotional domain were reverse-coded. Most of the items were normally distributed. Correlations among the variables and chi-squared difference in means were also determined for the ECDI items and child demographic variables. The sample was randomly split to provide calibration samples of appropriate sizes to ensure accuracy of item parameter estimates (Şahin & Anıl, 2017). Cronbach's alpha was used to determine the internal consistency reliability of the variables based on CTT. As a result of concerns about the factorial structure of the ECDI (McCoy et al., 2016), four exploratory factor analysis (EFA) methods were used to examine the construct validity and uni-dimensionality. Specifically, the principal axis factoring (paf), the iterated principal axes (ipf), principal component factors (paf), and the maximum likelihood (ml) methods of EFA were used to examine the factor structure of the ECDI. The *oblimin oblique r*otation method was used to elicit further information from the measures.

A CFA of the dimensionality of the ECDI domains, and how they load on a one-factor, and a 4-factor model based on the literature (Loizillon et al., 2017) was conducted. For model fit, recommended tests such as the Root Mean Square Error of Approximation (RSMEA), Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and Standardized Root Mean Square Residual (SRMR) were used for comparison (Schreiber, Nora, Stage, Barlow, & King, 2006). The Kuder Richardson coefficient of reliability (KR20) was also used to compute the item difficulty (proportion of 'right' answers), the average value of item difficulty for dichotomous items, estimating how reliable the ECDI is across different random sets of items. Both 1PL and 2PL IRT models were estimated to further highlight the construct validity or degree to which the measure reflects the underlying ECD (Michalopoulos et al., 2019). All assumptions such as

independent sampling, normality, and linearity were largely met. Missing items were less than .03%.

Results

Sample description and rates of ECD domains. As shown in table 3, the overall sample consisted of 11, 207 children (3- year olds, 51% and 4-year-olds, 49%). Forty-nine percent were female. Seventy-four percent of the children were from rural areas. Most of the mothers responding to the child-questionnaire were between 30-39 years (44%), and had at least some non-formal and primary education (37%). For most of the questions on the level of development, more than 50% of the children were on track developmentally (see table 4). Calibration samples were used for the exploratory, confirmatory and IRT model analysis.

Frequencies of children being on track on the ECDI items. Sixty-six percent (66%) of the children could not identify at least 10 letters of the alphabet, 76% could not read at least four simple popular words and 64% could not recognize number symbols. Over 80% of the children could perform the Pincer grasp. Fifty-two percent were often too sick to play. For the learning and cognition domain, the two variables had over 60% of the children being on track. For the socioemotional domain, 89% of the children were reported as being able to get along well with other children, 60% of the children did not kick bite or hit other children or adults, and 57% were not easily distracted.

An examination of the differences in children's developmental progress by demographics provided non-statistically significant chi-squared values across domains except for the difference between male children (58%) who kick, bite or hit other children and girls (61%) (Chi-squared = 12.31, $p<.001$) (See table 4). In terms of age, older children (4 years) performed better on all the variables than the 3-year olds and the association was statistically significant for all items. The

difference in level of trait between 3- to 4-year olds may corroborate that with the principle of increasing level of skill and development with age, barring any delays. Across the urban and rural divide, children in the urban areas were almost all more likely to perform better on the developmental tasks compared to children in the rural areas. All differences in ECDI domains between the groups were statistically significant except for the socioemotional development variable, kicking or biting other children.

When the ECDI items were combined to create a scale (higher values indicated children who were more on track developmentally), the developmental level in the population was normally distributed across the sample. When the items are combined according to the ECDI sub-domains, the results showed that 57% of the children were not on track in the literacy numeracy domain while 8% of the sample were not on track for the physical development tasks. In addition, 20% were not on track in terms of cognitive development or approaches to learning while approximately 1% were not on track socioemotionally.

Correlation of ECDI items. An examination of the correlation between the items showed a range of strong to weak correlations across board. The items that examined literacy/numeracy domain were most correlated with each other (0.62, 0.76, 0.60) and with the cognitive domain items indicating an increased ability to perform literacy and numeracy tasks with increase in cognitive development. The items that measured socioemotional learning were least correlated with all other items (see table 5). A negative correlation was seen between socioemotional development and learning and physical development (-.23) –whose measures primarily examined child's frequency of being ill, suggesting perhaps that illness may be a factor in a child not being able to carry out cognitive tasks. There was no correlation or linear relationship between the two socioemotional items (aggressive behavior and attention) and

practically any of the other items. At the domain level (scale), correlations were similarly average although statistically significant ($p<.001$). For instance, literacy/numeracy was correlated with physical development (.22), cognitive development (.24) and socioemotional (.10). The strongest correlation was between physical development and cognitive or approaches to learning (.31). The overall weak correlations among the ECDI items, where as one item or trait increases or decreases, the likelihood of the other variable changing is low - implying a low level of relationship among the variables in the construct.

Internal reliability/consistency. At the domain level, the three literacy/numeracy variables had an internal reliability (Cronbach alpha α) of .85, the physical development domain items (α =.10), the cognitive domain items (α = .71), and for the socioemotional development domain items, α = .36. The overall alpha of the 10 ECDI items was .65 before and after reverse coding. Removing the physical domain variable for sickness increases alpha to .67 and when the socioemotional variable measuring attention is removed, the alpha increases to .75. The internal consistency of the 10-items across child demographic characteristics such as age was 0.68 children are three years, and increases to 0.71 for 4-year-olds. For children in the urban areas, α = 0.67 and for the rural areas α = 0.69. By gender, α = 0.70 for males and 0.71 for females (See table 4). Using the Raykov's reliability coefficient to further test the composite reliability of the variables when they are congeneric and unidimensional yielded a value of 0.415 for the ECDI latent construct and 0.520 (when the physical development variables are removed). A value greater or equal to 0.7 is usually preferred (Padilla & Divers, 2016). Based on the CTT, measures with more items may have a higher reliability thus necessitating a need for more exploration of the ECDI via other parameters.

The Kuder-Richardson coefficient of reliability (KR-20). Given criticisms over the use of Cronbach's alpha for reliability or internal consistency and the need for complementary estimates of reliability, the KR-20 estimate for dichotomous responses was used to highlight the reliability of the variables and indicated how consistent the results are or how well the test is actually measuring the intended construct (Willse, 2010). The KR-20 value for the ECDI items was 0.672. The KR-20 value (.67) indicates that the ECDI items are just acceptable or reasonable (where 0 is no reliability and 1 is perfect reliability). A higher value above .7 is usually preferred (Lombe, Wang, Chu, Nebbitt, & Nebbitt, 2018). The KR-20 value for the variables when the gender is male was .670, when female (.675), urban (.670), and for children in the rural areas (.644).

Exploratory factor analysis (EFA). All EFA and parallel analysis methods used in the study provided support for a four-factor model (as proposed by the ECDI designers (Loizillon et al., 2017)) except the principal component factors (pcf) which consistently supported a three-factor model (see table 5). The proportion of variance accounted for by the first factor was 75%. A final principal axis factoring (paf) was preferred, computing the squared multiple correlations as estimates of communality and retained four factors, highlighting the uniqueness and communalities of the factors. For most of the variables, their uniqueness showed that less than .29 of the variance of the item was unique to it. Items measuring the physical (frequently sick) and socio-emotional domain items had high uniqueness values of variance not shared with others, making them questionable in the model factor. These findings suggest that the construct validity of the ECDI items do not agree with outlined factorial and domain structure proposed by the designers.

Communalities (index of the expression of common variance) from the squared multiple correlations indicated that the numeracy/literacy factor or domain variables had the highest communalities (.71, .49 and .70) meaning that this default model does the best job of explaining variation in these variables/factor model. The physical development variable (being sick) had the lowest communality where only 16% of its variation is explained by this model. This is the same for the socioemotional variables at approximately 18% communality. The oblimin oblique rotation where factors are correlated clearly partitioned the proposed literacy/numeracy factor variables and cognitive variables, two of the socioemotional variables, leaving an ambiguous placement of the physical domain and one socioemotional domain variable (see loading plot and table 6). However, the uniqueness values did not change after rotation, indicating that rotation did not affect the proportion of variance explained by each indicator.

Measure of sampling adequacy (MSA). The Kaiser-Meyer-Olin (KMO) test of an identity matrix, KMO value, was 0.74, indicating the sufficiency of the items for each factor, and two eigenvalues above one. In addition, a squared multiple correlation value (SMC) of each variable with all other variables ranged from .62 for the literacy-numeracy measures to .08 for the weak socioemotional development variables. A parallel analysis with predicted values of the items yielded an estimate of the same factor model as the original using randomly selected data, confirming retained factors.

Uni-dimensionality and Confirmatory factor analysis (CFA). Results of the CFA to test the specificity of the model (based on literature from the ECDI designers), and how the variables relate to the latent construct from a one-factor, and a 4-factor models is presented on table 6. Goodness of fit statistics from all the models suggest that the model may not fit the data well (chi-squared, $p < .001$) with the 4-factor solution proving a better fit (Loizillon et al., 2017).

The modified final model of the 4-factor solution, proposed by the ECDI developers yielded adequate fit with chi-squared with minor modifications and Chi-squared 503.25 and more degrees of freedom, 29, ($p<.001$). The 90% confidence interval for the RMSEA was .067 (within the ideal range of 0.05 -0.08). The comparative fit index (CFI) which compares the model with a baseline CFI was .94 (within the recommended 0.90 - .095).

The SRMR value .05 means that on average, the 4-factor ECDI model comes within 0.05 range of reproducing the correlations among the variables within the ideal value of less than 0.08. Also shown on Table 7 and figures 1 and 2 are the factor loadings from each model. The coefficient of determination, akin to the R-squared for the 4-factor model is higher (.99) than the one-factor model at predicting the variation. Other model fit indices such as the Akaike information (AIC) and Bayesian Information Criterion (BIC) were lower for the 4-factor model than the one-factor model. When the CFA for the final model is repeated by gender, age and place of dwelling, the fit and factor loadings showed similar stability. The poor fit of the one-factor model as opposed to the 4-factor model violates that IRT assumption of uni-dimensionality, that there is only one dominant latent trait being measured and that this trait is the driving force for the response observed

Binary IRT model of the ECDI items. The difficulty parameters (b) highlighted the underlying structure of the ECD through item location. A good instrument has item difficulties spread across the full range of the trait (thus differentiating the level of ECDI across all levels). The item characteristic curves (ICC) show the difficulty spectrum of all items, where the probabilities represent the expected scores for each ECDI variable along the developmental continuum (see figure 3a). The ICC was different for each ECDI item and as the difficulty level of the item increases, the curve shifts along the ability scale (x axis), meeting the monotonicity

assumption of IRT, that the developmental level is increasing or the likelihood that a positive response increase as the ability increases. The item difficulty spectrum, determined at the point of medium (.5) probability, ranged from the least difficult - the socioemotional variable (child gets along with others) -2.54 to literacy-numeracy (reading at least four letter words) at 1.18, being the highest or most difficult. The range is usually from -3 and +3. These values mean that the probability of success on the socioemotional variable is higher than the probability of success in the other traits, at any ability level, and that the literacy-numeracy item being more difficult to endorse is shifted to the right of the scale, and indicates a higher ability of those who endorse it correctly.

Overall, the one parameter logistic (1PL) model yielded an item discrimination parameter (constrained for all items) of 0.96, suggesting that the items are not particularly discriminating, such that any two children with distinct stages of development would have similar predicted probability of responding correctly to the question. The discrimination (slope α), highlights how fast the probability of a yes response changes with possession of the ECDI trait when the item is difficult. Table 7 shows the difficulty and discrimination parameters for the ECDI items using a 1PL IRT model. As shown in figure 12, for example, an estimation using the score lines (2 and 7) to plot, and according to the estimated Test Characteristic Curve (TCC), correspond to latent trait locations –1.91 and 1.03 respectively.

As shown on figure 5 (the overall Item Information Function, IIF for all items) and figure 6 (1 to 10 individual Item Information Function curves), the curves illustrate how well and precisely the items measure ECDI at every level of development (reliability) on a comparable standard scale. All curves were constrained to be of similar height (albeit low) discrimination, being short, wide, low precision and broad in range as illustrated in figure 7, the overall Test

Information Function (TIF) graph. The invariance property of IRT will hold true for the ECDI items only if the model fits the data. A test of the item fit for the 1PL model was conducted by superimposing empirical proportions of a sample item on the ICC (where if there is a close alignment of the predicted ICC with the empirical trace line as implied by the proportions, then the model fits or the items are assumed to have a satisfactory fit). Using a sample literacy-numeracy variable collapsed or superimposed on the predicted value, as shown in figure 8, there is a poor fit, and this is true for all items on the model. This poor fit suggest the use of a two-parameter logistic (2PL) IRT model.

Based on the 2PL model (table 7), the discrimination parameters or factor loadings of the ECDI items was used to demonstrate each item's local independence relative to other items (Michalopoulos et al., 2019). In this model as with the 1PL model, the social competence variable (getting along well) in the socioemotional domain was the easiest (difficulty level). The very high discrimination values for the literacy-numeracy and cognitive domain variables suggest that within any given difficulty estimate, any two mothers responding on the extent to which their children are developmentally on track and who have distinct levels of ability/development or trait for these questions will not have similar predicted probabilities of responding correctly to the item.

When an item has a large discrimination parameter, it means that they can distinguish better between when a child is on track or not of the latent ECDI trait. Both discrimination and difficulty parameters were statistically significant ($p<.001$) for all items except for the socioemotional variable (kicking or biting others) and physical variable (frequent sickness). A comparison of the 1PL model, nested in the 2PL using a likelihood ratio test yielded a chi-squared value of 482.42 with eight degrees of freedom. This estimate was statistically significant

($p<.001$) suggesting that the 2PL model that allows for a separate discrimination parameter for each item is preferred (Steinberg & Thissen, 2013). Additionally, a plot of the 2PL model's Item Information Function, IIF (figure 10) highlighted the amount of information each item provides for estimating overall ECDI.

The IIFs of the variables were unimodal and symmetric showing how each item provides the maximum amount of information at its estimated difficulty parameter with the height at the difficulty level, being proportional to its discrimination parameter. As shown in figure 10, the literacy and numeracy variables were the most discriminatory, having the steepest IIFs. A summed and overall IIF yielded a Test Information Function (TIF), figure 11 that illustrates how well the ECDI can estimate each child's location. Based on the TIF, the ECDI provides the maximum information for the children approximated located at ability level or theta (θ) =0.5. From this ability level to either direction (increasing or lowered), the standard error of the TIF graph increases, indicating that the information the instrument provides about a child's ECDI is decreasing, not being robust. We also examined the Differential Item Functioning (DIF) of the variables for wealth, rural and urban dwelling across groups. Results show that there were differential functioning for the total score of the ECDI construct within these groups, thus violating the invariance assumption of IRT.

Discussion

The 10 item-ECDI had a low to average internal consistency (Cronbach's alpha = .65) in the MICS Nigeria sample, suggesting that some of the items in the ECDI are not representative of the underlying construct. At the domain level, only the literacy- numeracy and the cognitive domains had acceptable alpha (.85 and .71 respectively). The physical and socioemotional domain variables had very poor Cronbach alphas (.10 and .36 respectively). These low internal

consistency values corroborate with past studies suggesting that these items may not be reliable constituents of the measure of ECD. These studies (Emerson, Savage, & Llewellyn, 2018; Kang, Aguayo, Campbell, & West, 2018; McCoy et al., 2016) point to discrepancies with the MICS ECDI such as the level of trait required per domain being too high and having low sensitivity of some domains. For instance, McCoy et al (2016) argue that the measures of physical development (pincer grasp) were too elementary for a well 3-to 4-year- old child. McCoy et al. (2016) further note that the question asking if the child is frequently sick is not a measure of development but an index of health, and indeed illness affects development among children in Nigeria (Yaya et al., 2017).

Additionally, given the role of disease, heritability, or access to health services, frequent sickness is not an ideal measure of a child's developmental stage. From our analysis, the low internal consistency of the ECDI as a scale support these arguments. When the physical domain variable (for frequent illness) was removed, the alpha increased to .67 and an elimination of the socioemotional variables (for distraction/attention) saw an increase of the alpha to .75, which should be a minimum for use in any setting.

Further, in agreement with past studies, we note that the second physical domain item (picking with two fingers) is a developmental milestone typically expected when a child is between 9 -12 months of age (Fernald et al., 2009; McCoy et al., 2016),. While the pincer grasp is a fine motor milestone in ECD, more appropriate physical development measures could have asked if the child is able to copy a circle, a cross or put on their shoes (3-year olds) or if they can copy a square or use a scissors for 4-year olds (WHO, 2014). Although contexts and socioeconomic factors may pose limitations to these expectations (Ertem et al., 2019; Fernald et al., 2009) in various settings. This item was found to perform poorly within the construct. The

observed misfit of the physical health variable could account for its poor performance in all the analysis.

As noted in previous studies (Ezeonwu, Chima, Oguonu, Ikefuna, & Nwafor, 2014), most Nigerian children under-five years primarily present with illnesses such as malaria (30.3%) diarrhea-related diseases (20.4%), respiratory tract infections (19%), including other infections. While these preventable diseases are major contributors to frequent sickness, child mortality, stunting, poor academic performance complicated by inadequate health services (Yaya et al., 2017), there are limited studies linking sickness to developmental delays or potential in Nigeria. Overall, the low Cronbach's alpha of the physical domain items – sickness and pincer grasp (.10), their low correlations with other items (except with cognitive development, which is understandable when a child is ill) may confirm concerns about the measures used for the domain. Moreover, the low factors loadings of the physical domain items compared to others, go on to confirm these concerns about their inclusion as part of the ECDI.

MccCoy et al (2016) also note that the variables used to measure literacy and numeracy may be too advanced for children 3-4 years of age in LMICs settings. Indeed, the literacy level in certain parts and contexts of the country for both mother and child may be low and preclude an accurate answer for the literacy and numeracy questions subjecting the caregiver's response to social desirability bias. In addition, given lower levels of maternal education and high level of poverty in many Nigerian communities (Burroway & Hargrove, 2018), it would be very rare for households to have reading materials and being able to teach children reading and letters at this age, a practice that is more typical in higher resource settings. However, the response from the caregivers showed consistent low percentages of children who have attained the literacy-numeracy milestone (with being older in age -4 years, being an important factor). The mothers'

acknowledgment of their child's inability to perform the domain-related tasks also gives credibility to the data in the sense that there a low sense of social desirability or an urge to present higher level of trait than is resident in the child. The literacy-numeracy measures is valid and had high internal reliability and consistency overall. The literacy-numeracy items also consistently loaded to one factor, showing uni-dimensionality.

The MICS ECDI included three questions for the socioemotional development domain that asked if the child gets along well with others (social competence) and if the child kicks, bites or hits other children and adults (behavior problems). The third question, "if the child gets easily distracted' speaks to attention problems. Halle and Churchill (2016) note that children between the age of 3 to 4 begin to pay attention for longer periods, delay gratification and solve social problems independently –which could have as appropriate basis for developing a measure to ascertain socioemotional development. The socioemotional attention item was the least correlated with any other ECDI items, and overall the socioemotional domain items were least correlated with all other items, and had low internal consistency (.36). Their removal resulted in an improvement in the overall Cronbach's alpha for the scale to .70, inferring that the ECDI could be optimized overall by dropping these items.

In terms of face validity, the distraction question may pose a challenge in the Nigerian multicultural, multi-lingual (over 300 languages) milieu. The socioemotional development item exhibited a poor fit, low correlations and the lowest communality of 18% in the exploratory factor analysis. The question "Is the child easily distracted" may be understood or interpreted differently by the sample women, and this may be a reason for its poor performance in the scale. There is also a possibility that other factors such as hunger or poor diet, lack of sleep, conflict in the home, separation anxiety, stress or obsessive-compulsive disorders unrelated to child

development may lead to distraction. Consistent with the literature review, these debated items in the ECDI presented problematic results in the statistical analysis. In addition, the exploratory factor analysis showed that Cronbach's alpha varied across sub-groups of women. Across educational levels, the items had an alpha of .60 for women with higher education, .63 (secondary and secondary technical education0, .63 (primary education), and .69 for women with non formal education. Across ethnicities, for women that identified as Hausa, the alpha for the items was .67, Yoruba .67. Igbo .68 and all other ethnicities combined, .65.

The IRT modeling helped to unpack the ECDI items, and individual item precision at different levels of difficulty. The overall Test Characteristic Curve (TCC) showed that the ECDI construct fulfilled the IRT requirement of monotonicity, where the probability of a positive response increased with ability holds true. As depicted in the IPL IRT model estimates, the physical and socioemotional domain items within the construct had the lowest difficulty parameters while the literacy-numeracy items had the highest difficulty estimates. Based on the 1PL model, the Test Information Function (TIF) curves were the same height for each ECDI item, and clustered at the mid-range confirming that the ECDI covers a wide range of different levels of child development and, at moderate to low levels of traits. The individual Test Information Function (TIF) curves of the items also had several overlaps, calling for a review of the items. The convergence of the 2PL model was challenging leaving the discrimination for one item constrained. Scholars suggest that lack of convergence may be an indication of poor model fit arising from 'too many poorly fitting observations' (Linacre, 1987), thus supporting previous findings that the scale may be problematic.

What do these findings mean for Children in Nigeria? First, despite the huge investment that the MICS are, the poor performance of the measure in a larger Nigerian sample may mean

that the instrument is not adequately capturing ECD information of value to support an understanding the development of children in the sample. The physical domain items a requisite milestone for the age group addressed issues of frequent sickness and the pincer grasp, features that are in particular not ideal for this age group, and may not at all be capturing child development in this domain,. However, the physical domain captures other yet important information, frequent sickness that may be a factor in a child not achieving other developmental milestones. Frequent sickness may also suggest the lack of access to health care and illness which is common in the country in children under age 5 where child mortality rates remain at 132 deaths per 1000 live-births (National Population Commission [Nigeria] & ICF, 2019). In addition, these items do not seem to capture any clear dimension or construct, not loading to one latent factor thus reducing the ECDI's validity and uni-dimensionality in measurement.

To the children and their families' credit, most (over 90%) were on track on the socioemotional development domain, perhaps speaking to the role of social connectedness, the collectivist cultural milieu or a predisposition to more positive mental health outcomes. In agreement with the current body of literature, the literacy-numeracy items were higher in their difficulty level and discriminatory power. Only 42% of the children were on track developmentally in this domain, corroborating findings from other studies (Efevbera et al., 2017; McCoy et al., 2016), and the need for more attention to be placed on early childhood education. Overall, the ECDI items appeared to perform very similarly across ethnicity but varied by household wealth index and place of dwelling (rural/urban) which may be attributed to their association with family socioeconomic risk factors (Sania et al., 2019; Walker et al., 2011)

Limitations

The study set out to examine the performance and psychometric properties of the ECDI items in the MICS survey and acknowledges several limitations. Parental reports of ECD may face drawbacks such as low literacy, recall bias, social desirability bias, and personality type that may affect maternal response (Bornstein & Lansford, 2013). More so, there is the challenge of cultural applicability of the instrument and the lack of evidence of text translation of the measures to address language differences across regions of the country as direct translation of items may connote different meaning given cultural and language nuances. The MICS study design, being cross-sectional also limits further analysis on other aspects of validity of the instrument. In addition, the lack of a gold standard measure to compare the ECDI measures with precluded the confirmation of the post-dictive or convergent validity of the construct. Because of challenges with fitting the data to logistic models, more robust extensions of the IRT could not be examined.

Given the observed limitations of the ECDI discovered in this Nigerian sample, this study has merit by providing detail on the properties of each ECDI item, highlighting the difficulty and discrimination parameters, and how well they performed in the Nigerian context. More so, given that the MICS ECDI has been used in two rounds and is currently in use in the ongoing 2020 survey, findings from this study will help inform designers and users to the gaps and promote attention to needed modifications.

Conclusions and Implications for Practice

This study examined the psychometric properties of the ECDI used in the MICS. The developers of the ECDI note that the instrument represents skills and behaviors expected of children 3- to 4-years-old at a global and monitoring level, and acknowledge that it is not a diagnostic tool. However, the construct validity of the instrument is in question as the analysis,

including information from the literature review suggest that the ECDI has gaps and may not be accurate in its determination of whether a child is developmentally on track or not. Importantly, the items in the physical domain need to be removed or revised. Further, a validation process needs to be undertaken to ensure that the socioemotional domain items are actually being used as intended.

Based on the findings, the ECDI did not meet the assumptions of uni-dimensionality as determined by the EFA. The ECDI physical domain items were problematic in their factor loading, as hinted in a different in a study (Frongillo, Kulkarni, Basnet, & Castro, 2017). The physical domain items consistently loaded on different factors while one of the socioemotional items did not load on the same factor as the rest. This result supports earlier concerns about the content and construct validity of the ECDI and the rationale for inclusion of items measuring health rather than development. The analysis confirmed that the four-factor model of the ECDI originally proposed by the instrument designers has a good fit, although we argue that the content of the construct is not as valid as can be, given the incongruence of the measures to existing definitions of child developmental stage.

In addition, the IRT analysis also confirmed the misfit of the physical and some socioemotional used in the ECDI construct. As noted in the measures section, the internal consistency of the ECDI was affected by physical domain indicators such as the pincer grasp, child being sick and child being distracted. In addition, based on the weak correlations and the low discriminatory power of some of the items in IRT modeling, the criterion validity of the instrument is also at stake.

On a positive note, based on its successful administration in over 110 countries, the MICS ECDI measure does not suffer from intense transcultural epidemiology - defined by Prince

(1997) in (Ommeren, 2003) as "research in which the views, concepts or measures of the investigator extend beyond the scope of one cultural unit to another". Most questions in the instrument are easily understandable (Loizillon et al., 2017), and varying contexts of studies have not affected its use. All the questions asked in the MICs ECDI are useful for child studies and may provide utility to different aspects of child wellbeing and behavioral health issues. For instance, the physical domain measure that asked about frequency of sickness in the child, and while not a developmental milestone, can be used to assess overall health status of children in the Nigerian sector, (especially with the high incidence of malaria and other preventable diseases) and how this may be an important correlate of other child outcomes. In addition, attention needs to be given to improve the literacy and numeracy skills of the children, appropriate to their age, as these items are associated with child cognitive development.

Another important idea emanating from this study is the need for flexibility of research systems to adopt an implementation science approach to large-scale studies such as the MICS. Over the past two decades, and with the implementation of increasing rounds of the MICS, several studies have pointed to the inconsistencies to the ECDI measure (McCoy et al., 2016, 2018). To our knowledge, this is the first study to conduct a detailed analysis highlighting the extent and dimensions of challenges with the instrument within a Nigerian sample. At the time of this writing, the ECDI screener is widely used in LMIC settings, but the data here indicate that the ECDI runs the risk of falling prey to the leaky funnel paradigm which notes that very little research makes its way into timely programmatic and policy use (Colditz & Emmons, 2018).

An important construct from implementation science (Aboud & Prado, 2018; Colditz & Emmons, 2018) can be applied here related to the possibility of de-implementation given widespread and repeat use of the 10-item ECDI within many sub-Saharan African contexts at

great cost and burden to families assessed. Because LMICS face many challenges related to priorities for research funding, priorities for intervention and general issues with population health needs and circumstances such as high rates of infant and child mortality as well as large numbers of children not reaching their full developmental potential.

To remain innovative, research must be able to implement and de-implement what is not working to improve and strengthen the credibility of evidence-based practices. The processes of implementation and dissemination science such as the diffusion of findings or interventions and dissemination (active spreading and open sharing of data) are aspects that the MICS has had a huge success in advancing. However, a more neglected process is mis-implementation (where ineffective programs are continued or effective ones stopped) (Colditz & Emmons, 2018; Rabin & Brownson, 2018). According to Rabin & Brownson (2018), research must welcome the process of de-implementation or stopping of practices that have been over-used. To prevent the MICS from falling into the continuation of an ineffective practice spectrum, it must take time to review findings from different studies that use the surveys and address findings that cast aspersion to the validity and reliability of the ECDI.

In conclusion, this study recommends that the MICS program consider the implementation science process of substitution (where the ECDI may be replaced with a more productive and accurate measure) (Rabin & Brownson, 2018), or a re-design where a gold standard instrument is added to the survey.

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Table 2.1
A comparison of some instruments used to measure Early Childhood Development (ECD)

Test (Number of Items assessed)	Child Age (Mths)	Broad Criterion measure					
		Cognition	Receptive/ Expressive language (Communication)	Fine/Gross Motor	Problem Solving	Social-Personal	Adaptive Skills
MICS ECDI	36-48	X	X	X	X	X	
Bayley-III (89)	0-42	X	X	X			
ASQ-3 (45)	1-66		X	X	X	X	
Denver-II (37)	0-71		X	X		X	
BDI-2, Battelle (46)	0-83	X	X	X		X	X
SFI MacArthur (208)	8-18		X				
SFII, MacArthur(100)	19 -30		X				
WHO-Motor (6)	4-24			X			

Source: Adapted from (Rubio-Codina, Araujo, Attanasio, Muñoz, & Grantham-McGregor, 2016)

Table 2.2 Evolution of the 10-Item Early Childhood Development (ECDI)

18-item ECDI	10-item ECDI
Language	**Literacy-numeracy**
CE6. Can (name) identify/name at least ten letters of the alphabet?	EC8. Can (name) identify or name at least ten letters of the alphabet?
CE7. Can (name) attach sounds to most or more than half of the letters?	
CE8. Can (name) read at least four simple, one-syllable, popular words?	EC9. Can (name) read at least four simple, popular words?
Cognitive	
CE9. Is (name) interested in numbers, counting, sorting or adding?	EC10. Does (name) know the name and recognize the symbol of all numbers from 1 to 10 most of the time?
CE10. Does (name) know the name and recognize the symbol of all numbers from 1 to 10 most of the time?	
CE11. When you compare two numbers up to 10, does (name) know which one is bigger most of the time?	
Physical	**Physical**
CE12. Is (name) able to use and manipulate small objects and toys?	EC11. Can (name) pick up a small object with two fingers, like a stick or a rock, from the ground?
CE13. Is (name) sometimes too tired, sleepy or sick to play?	EC12. Is (name) sometimes too sick to play?
CE14. Is (name) sometimes too hungry to play?	
Approaches to learning	**Approaches to learning**
CE15. Does (name) do everyday routine activities without being reminded? Activities such as brushing teeth, tidying up after play or a meal, or helping with chores?	EC13. Does (name) follow the simple directions on how to do something correctly?
CE16. Does (name) follow the simple directions on how to do something correctly?	EC14. When given something to do, is (name) able to do it independently?
CE17. Is (name) able to work on a task, including play tasks, by himself/herself?	
Social	**Social-emotional**
CE18. Does (name) play with siblings or other children for a considerable time without getting into trouble?	EC15. Does (name) get along well with other children?
CE19. Does (name) show respect for other children?	
CE20. What is (name)'s ability to get along with other children? Would you say it is very good, average, or poor/bad?	
Emotional	

CE21. How often does (name) bully other children or is mean to other children?	EC16. Does (name) kick, bite, or hit other children or adults?
CE22. How often does (name) kick, bite, or hit other children or adults?	EC17. Does (name) get distracted easily?
CE23. Does (name) often get very easily/quickly distracted?	

Source: (Loizillon et al., 2017)

Table 2.3.
Demographic characteristics of sample used in the study (n=11,073)

Characteristic	N mean (%)
Age	
3 years	5,643 (51)
4 years	5,430 (49)
Gender	
Male	5,632 (51)
Female	5,441 (49)
Dwelling	
Rural	8,140 (74)
Urban	2,933 (26)
Mother's age	
15-29 years	4,172 (41)
30-39 years	4,425 (44)
40-49 years	1,556 (15)
Mother's Educational Level	
None	3,141 (28)
Primary/Non formal	4,123 (37)
Secondary/Higher	3,808 (34)

Table 2.4.
Correlation of ECDI items among 3-to 4-year- olds in a Nigerian sample (n=11,073)

	ECDI Domains	1	2	3	4	5	6	7	8	9	10
1.	Can identify letters	1									
2.	Read four words	.62	1								
3.	Numbers 1 to 10	.76	.60	1							
4.	Pick small object	.20	.18	.21	1						
5.	Too sick (not)	.03	.02	.06	-.11	1					
6.	Follows directions	.21	.18	.21	.31	-.07	1				
7.	Conducts a task	.18	.16	.19	.25	-.04	.56	1			
8.	Gets along well	.14	.12	.15	.32	-.12	.34	.27	1		
9.	Kicks or bites (not)	.00	.01	.00	-.09	.19	-.07	-.01	-.10	1	
10	Distracted (not)	.02	.01	.01	-.02	.20	-.04	.01	-.11	.25	1

Note: All correlations were statistically significant ($p<.001$) except for the socioemotional variable (9) and the literacy and numeracy items (1, 2, 3); and the socioemotional variable (10) and the literacy and numeracy items (1, 2, 3), physical (4) and cognitive (7)

Table 2.5.
Prevalence of Children who are on track on the ECDI items (n=11,073)

ECDI Domains	Yes N (%)	Domain level (On track)
Literacy-numeracy		
Can identify or name at least ten alphabet letters	3,804 (35)	
Can read at least four simple, popular words	2,703 (24)	4,702 (42)
Knows the name and symbol of all numbers from 1 to 10 most of the time	3,977 (36)	
Physical		
Can pick up a small object with two fingers	8,865 (80)	10,150 (92)
Child is sometimes too sick to play (recoded)	5,259 (47)	
Approaches to learning/ Cognitive		
Follows simple directions to do something correctly	8,339 (75)	8,885 (80)
Conducts a task independently	7,318 (66)	
Social-emotional		
Gets along well with other children	9,876 (89)	
Kicks, bite, or hit other children/adults (recoded)	6,611 (60)	10,910 (99)
Child gets distracted easily (recoded)	6,259 (57)	

Table 2.6.
Uniqueness, Communality & Item Reliability Coefficients for ECDI Items (n=11, 073)

ECDI Items	Mean (SD)	Kmo	Smc	Com	Overall Alpha	Age 3	Age 4	Urban	Rural	Yes Edu	No Edu	Igbo	Yoruba	Hausa
Can identify letters	.34 (.47)	.70	.64	.72	.58	.56	.58	.55	.59	.50	.58	.58	.57	.61
Read four words	.24 (.43)	.84	.45	.51	.60	.59	.60	.59	.61	.55	.59	.61	.61	.63
Numbers 1 to 10	.36 (.48)	.70	.63	.71	.58	.57	.58	,54	.59	.50	.58	.59	.56	.62
Pick small object	.80 (.40)	.83	.16	.23	.66	.64	.66	.66	.65	.61	.59	.65	.65	.64
Too sick (recoded)	.47 (.50)	.66	.09	.17	.69	.67	.70	.68	.68	.63	.62	.69	.68	.67
Follows directions	.75 (.43)	.68	.38	.50	.65	.63	.66	.65	.64	.60	.58	.65	.65	.63
Conducts a task	.66 (.47)	.67	.34	.44	.66	.63	.67	.65	.65	.60	.59	.66	.64	.64
Gets along well	.89 (.31)	.79	.17	.25	.66	.64	.67	.67	.66	.62	.59	.67	.67	.65
Kicks (recoded)	.60 (.49)	.63	.10	.19	.69	.67	.69	.68	.66	.62	.62	.69	.68	.67
Distracted (recoded)	.56 (.50)	.58	.10	.20	.69	.67	.69	.67	.68	.61	.62	.70	.66	.66
Overall	4.6 (.40)	.72			67	.66	.68	.67	.67	.62	.62	.68	.67	.67

Table 2.7.
Three Methods Exploratory Factor Analysis of ECDI indicators, Oblimin oblique rotation (N=3,691)

ECDI Domains	ECDI Items				Principal Axis Factors (paf)				Iterated Principal Factors (ipf)				Principal Component Factors (pcf)			
		Kmo	Smc	Com	1	2	3	4	1	2	3	4	1	2	3	0
Literacy-Numeracy	Can Identify letters	.70	.64	.72	.85				.89				.91			
	Read four words	.84	.45	.51	.71				.70				.84			
	Numbers 1 to 10	.70	.63	.71	.84				.87				.90			
Physical	Pick small object	.83	.16	.23			.44				.50			.53		
	Too sick (not)	.66	.09	.17				.34				.36			.64	
Cognitive/ Learning	Follows directions	.68	.38	.50		.64				.38				.83		
	Conducts a task	.67	.34	.44		.69				1.0				.80		
Socio-emotional	Gets along well	.79	.17	.25			.41				.60			.60		
	Kicks or bites (not)	.63	.10	.19				.44				.52			.68	
	Distracted (not)	.58	.10	.20				.45				.52			.73	
	Overall	.72														

Notes: Kmo –Kaiser-Meyer-Olkin measure of sampling adequacy, smc – squared multiple correlations of variable with all other Items, com – communalities or index of expression of common variance/ how much default model explains variation in item

Table 2.8.
Full CFA Estimates and select fit indices for modified 1-factor and a 4-factor model of ECDI items (N=3690)

	1-factor ECDI Model		4-Factor ECDI Model	
Factor loadings (Observed -> Latent Construct)	Unstandardized coefficients (SE)	Standardized coefficients (SE)	Unstandardized coefficients (SE)	Standardized coefficients (SE)
Measurement model				
Can identify letters	1***	.87 (.01)***	1 ***	.88(.01)***
Read four words	.69 (.02)***	.68 (.01)***	.69 (.02)***	.68 (.01)***
Numbers 1 to 10	1.0 (.02)***	.87 (.01)***	1.0 (.02)***	.88 (.01)***
Pick small object	.26 (.02)***	.27 (.020***	1***	.67 (.06)***
Too sick (not)	.04 (.02)	.03 (.02)	-.34 (.05)***	-.18 (.02)***
Follows directions	.29 (.02)***	.30 (.02)***	1***	.84 (.02)***
Conducts a task	.27 (.02)***	.26 (.02)***	.85 (.04)***	.64 (.06)***
Gets along well	.13 (.01)***	.18 (.02)***	1 ***	.63 (.03)***
Kicks or bites (not)	-.02 (.02)	-.02 (.02)	-.54 (.07)***	-.21 (.02)***
Distracted (not)	.00 (.02)	.00 (.02)	-.41 (.06)***	-.16 (.02)***
Measurement Error Variances				
Can identify letters/	.05 (.00)	.25(.01)	.05 (.00)	.23 (.01)
Read four words	.10 (.00)	.54 (.01_	.10 (.00)	.54 (.01)
Numbers 1 to 10	.06 (.00)	.25 (.01)	.06 (.00)	.25 (.01)
Pick small object	.15 (.00)	.93(.01)	.09 (.01)	.55 (.07)
Too sick (not)	.25 (.01)	1.0 (.00)	.24 (.01)	.97 (.01)
Follows directions	.17 (.00)	.91(.01)	.06 (.00)	.30 (.03)
Conducts a task	.21 (.00)	.93 (.01)	.13 (.00)	.59 (.02)
Gets along well	.09 (.00)	.97 (.01)	.06 (.00)	.60 (.04)
Kicks or bites (not)	.24 (.01)	1.0 (.00)	.23 (.01)	.96 (.01)
Distracted (not)	.25 (.01)	1.0 (.00)	.24 (.01)	.98 (.01)
R-Squared (Overall parameter fit)				
Can identify letters		.76		.77
Read four words		.46		.68
Numbers 1 to 10		.75		.75

Table 2.8.
Full CFA Estimates and select fit indices for modified 1-factor and a 4-factor model of ECDI items (N=3690)

Pick small object	.07	.44
Too sick (not)	.00	.03
Follows directions	.08	.70
Conducts a task	.06	.41
Gets along well	.03	.40
Kicks or bites (not)	.00	.04
Distracted (not)	.00	.02
Overall	.88	.99
Fit Statistics		
Chi-squared (df)	1600.28 (34)***	503.25 (29)***
RMSEA	0.10	.067
CFI	.82	.94
TLI	.76	.91
SRMR	.10	.05
CD	.88	.99
AIC	37,669.56	36,582.54
BIC	37,863.18	36,806.23

Note: p<.001***, p<.01**, p<.05*.

Table 2.9.
Estimates from a 1PL and 2PL IRT Model of the ECDI items among 3-4 year-old Nigerian Children (n=581)

			1PL IRT Model Estimates		2PL IRT Model Estimates	
Items	Item Definition	Yes (%)	Mean (SD) (listwise)	Difficulty (SE)	Difficulty (SE)	Discrimination (SE)
	1PL overall item discrimination .99 (.05)***					
Can identify letters	Can (name) identify or name at least ten letters of the alphabet?	34	.36 (.48)	.69 (.11)***	.20 (.00)***	4855 (Constr)
Read four words	Can (name) read at least four simple, popular words?	24	.27 (.45)	1.18(12)***	-.52 (.05)***	3.35 (.42)***
Numbers 1 to 10	Does (name) know the name and recognize the symbol of all numbers from 1 to 10 most of the time?	37	.39 (.49)	.54 (.11)***	.16 (.04)***	4.4 (.54)***
Pick small object	Can (name) pick up a small object with two fingers, like a stick or a rock, from ground?	80	.81 (.40)	-1.71(.14)***	-1.89 (.26)***	.94 (.16)***
Too sick	Is (name) sometimes too sick to play? (Recoded)	47	.51 (50)	-.04 (.10)***	6.8 (142.1)	-.00 (.10)
Follows directions	Does (name) follow the simple directions on how to do something correctly?	75	.75 (.43)	-1.34 (.13)***	-1.22 (.13)***	1.33 (.18)***
Conducts a task	When given something to do, is (name) able to do it independently?	67	.65 (.48)	-.75 (.11)***	-.97 (.16)***	.84(.13)***
Gets along well	Does (name) get along well with other children?	89	.89 (.30)	-2.54 (.19)***	-2.33 (.30)***	1.20 (.21)***
Kicks or bites (not)	Does (name) kick, bite, or hit other children or adults? (Recoded	60	.43 (.50)	.37 (.10)***	7.6 (19.7)	.04 (.10)
Distracted (not)	Does (name) get distracted easily? (Recoded)	57	45. (.50)	.24 (.10)*	1996 (202)	.00 (.10)

Likelihood-ratio test Chi-squared (8) = 492.42, p<.001
Note: All coefficients/coefficients are statistically significant at same value of p<.001***

Figure 1 Standardized coefficients of a confirmatory factor analysis for a 4-factor ECDI model

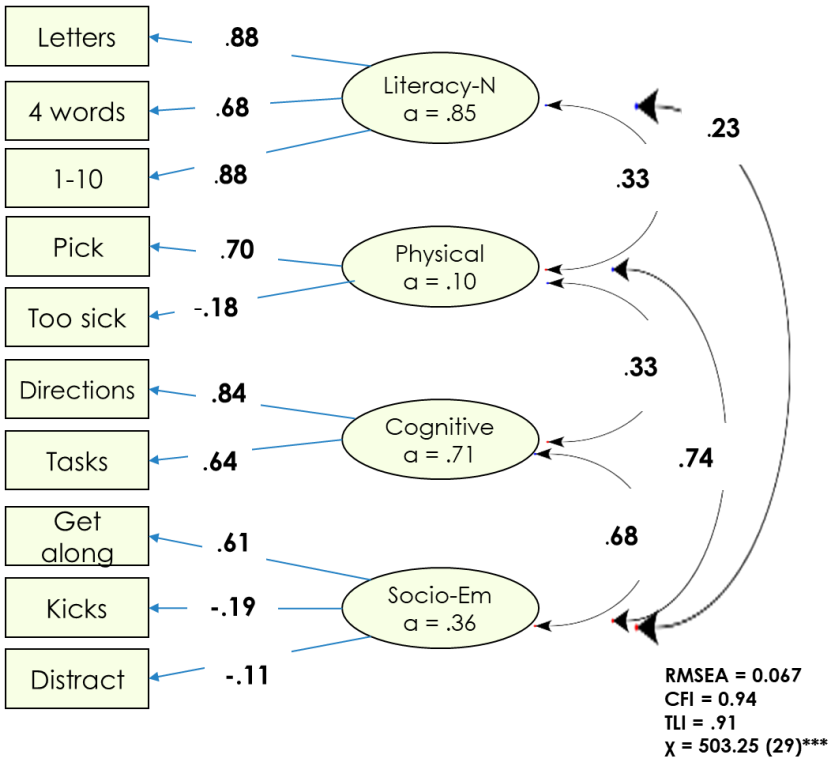


Figure 2.2. Standardized Coefficients of a Confirmatory Factor Analysis for a one-factor ECDI model

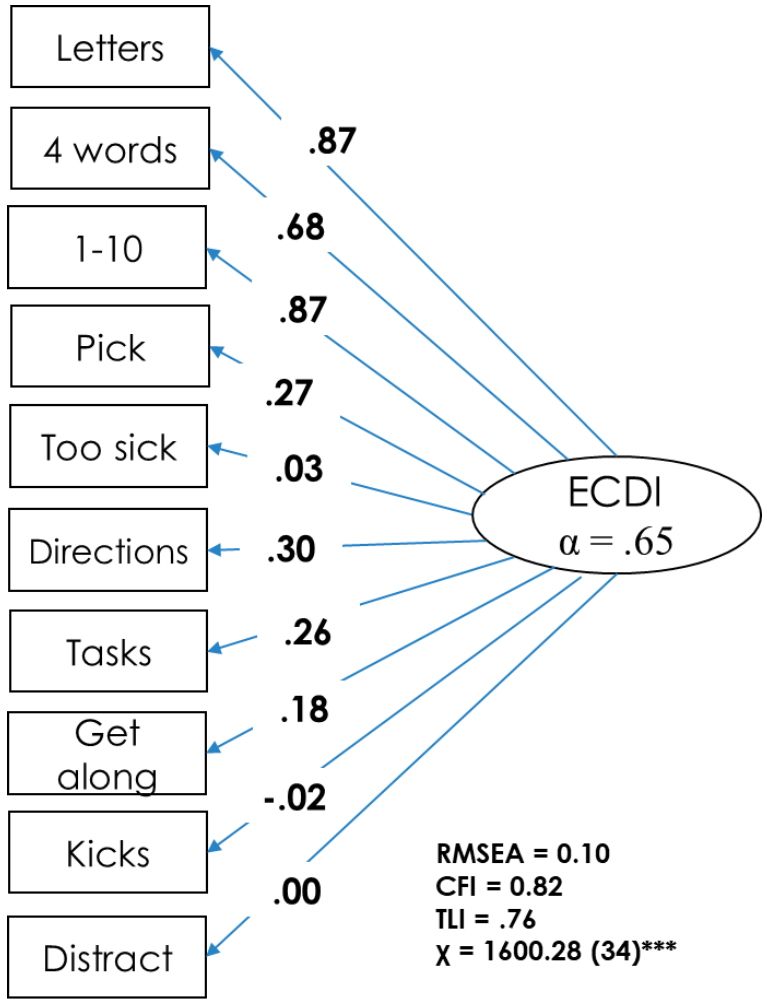


Figure 2.3. Item Characteristic Curves for items in the ECDI Index

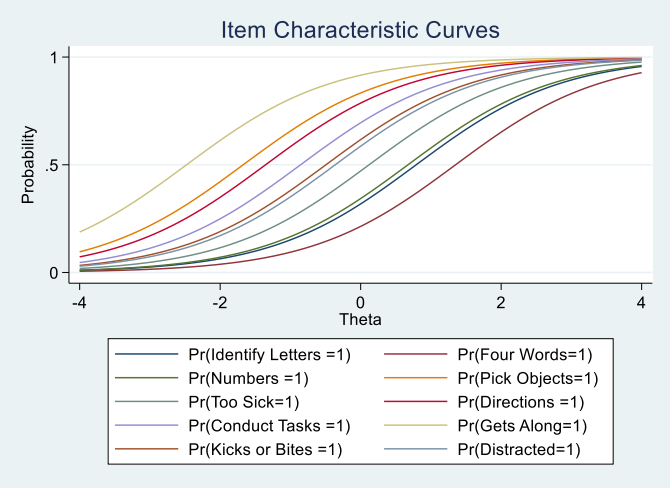


Figure 2.3b. Item Characteristic Curves showing difficulty level of each Variable

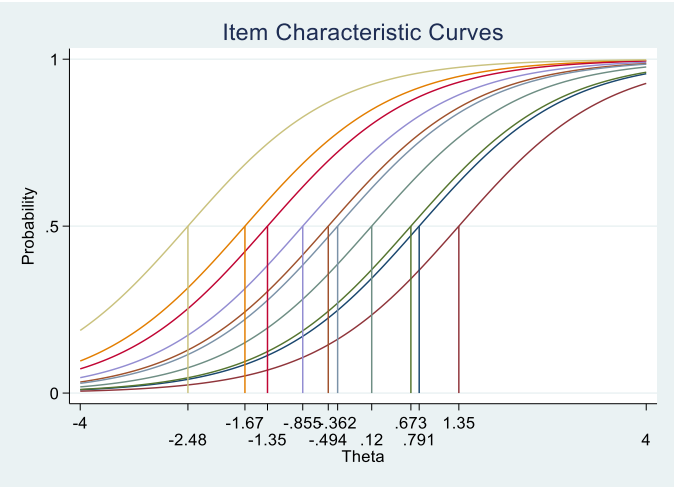


Figure 2.4. Test Characteristic Curve for all ECDI Items

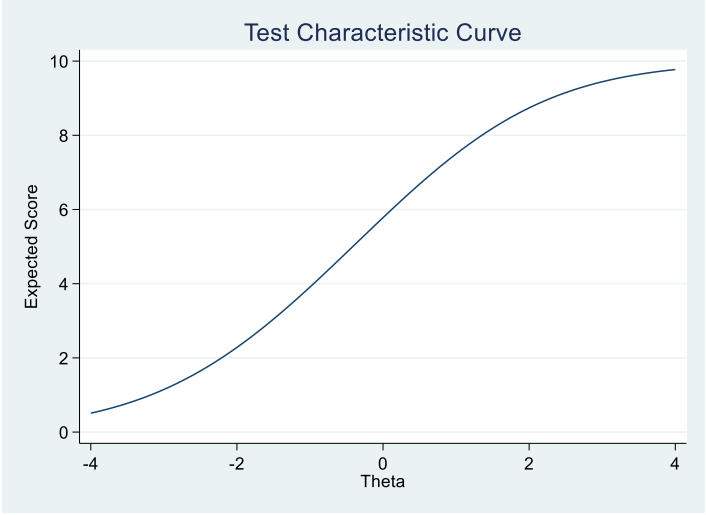


Figure 2.5. Item Information Function Curves for ECDI items 1 PL Model

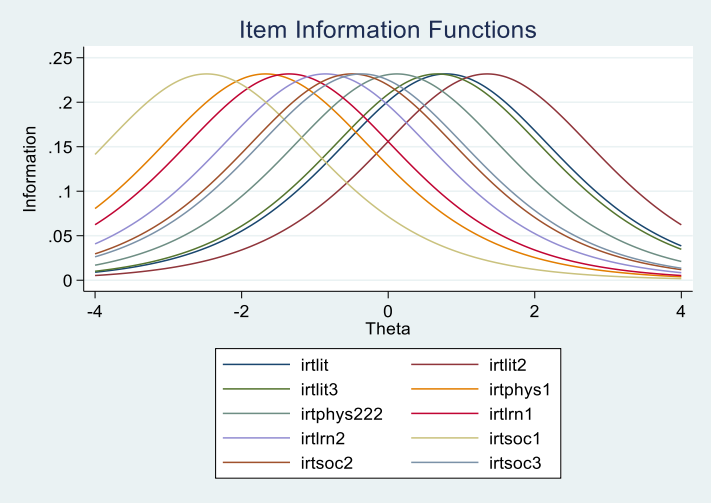
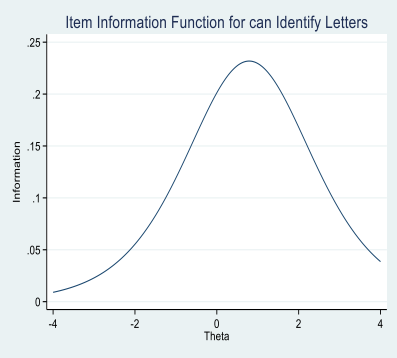
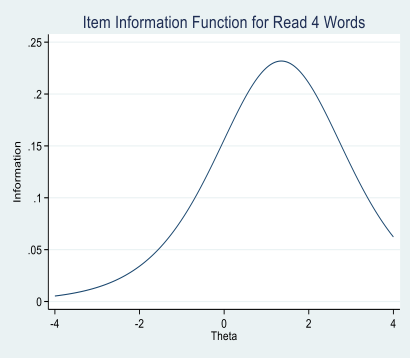
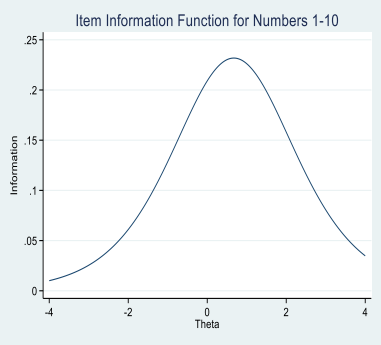
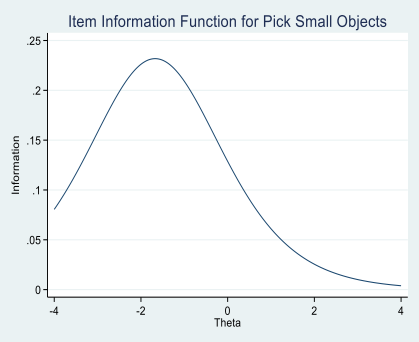


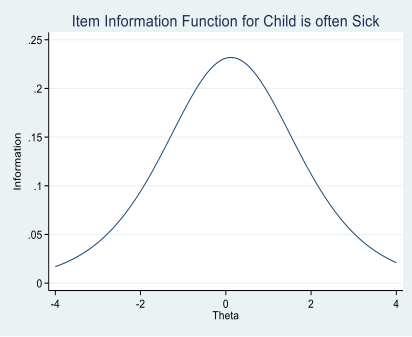
Figure 2.6. Item 1- 10, Item Information Function for each ECDI variable, domain rows

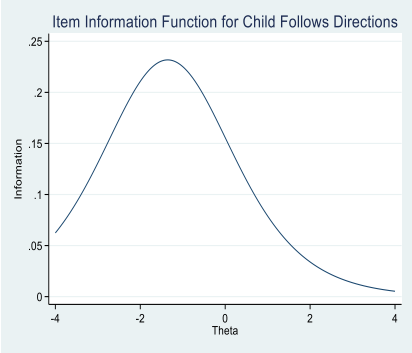

Item Information Function for can Identify Letters
Information
Theta

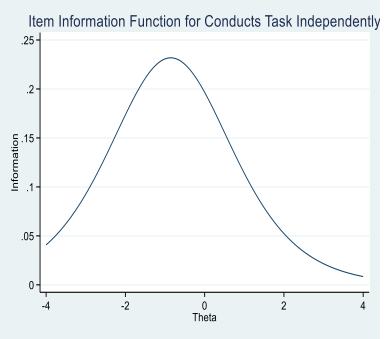

Item Information Function for Read 4 Words
Information
Theta

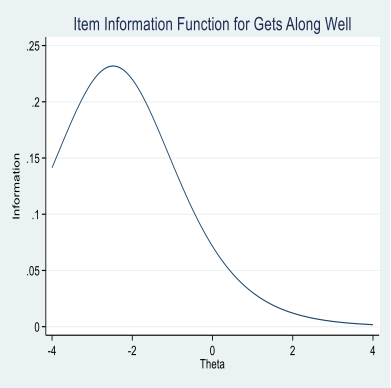

Item Information Function for Numbers 1-10
Information
Theta

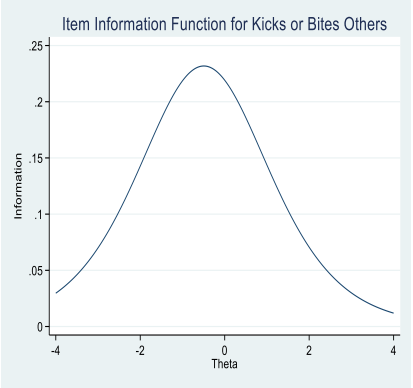

Item Information Function for Pick Small Objects
Information
Theta


Item Information Function for Child is often Sick
Information
Theta


Item Information Function for Child Follows Directions
Information
Theta


Item Information Function for Conducts Task Independently
Information
Theta


Item Information Function for Gets Along Well
Information
Theta


Item Information Function for Kicks or Bites Others
Information
Theta

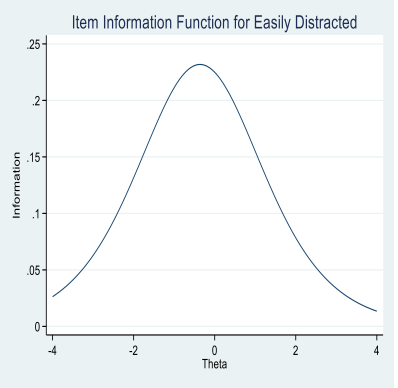

Item Information Function for Easily Distracted
Information
Theta

Figure 2.7. Overall Test Information Function

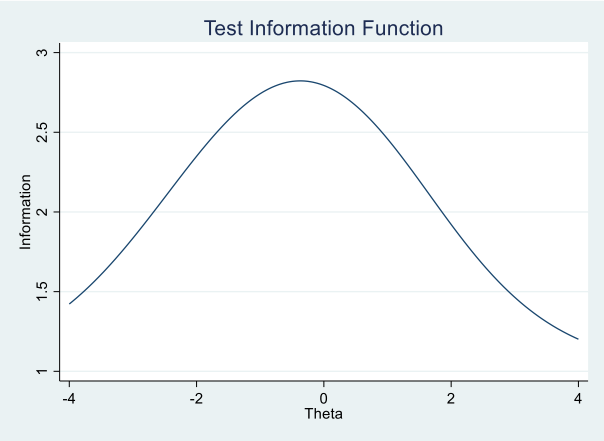


Figure 2.8. 1pl Model Misfit Sample

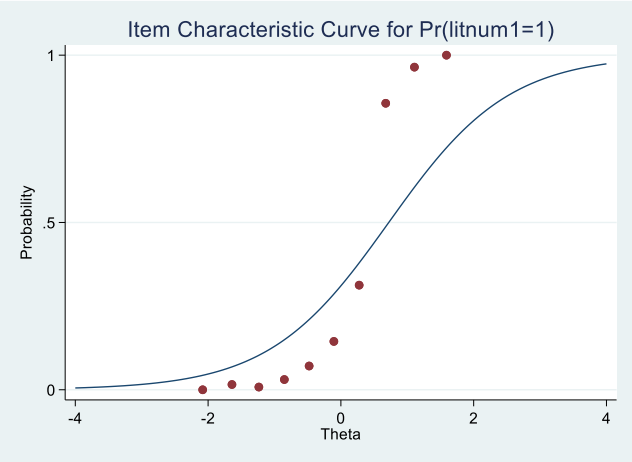


Figure 2.9. Sample: A comparison of literacy and a socioemotional variable

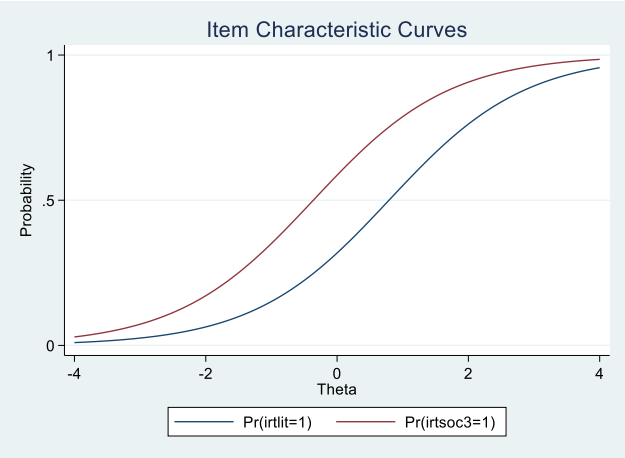


Figure 2.10. Test Information Functions for 2PL Model Items depicting high discrimination and difficulty for the first two literacy-numeracy items and overall low discrimination of the items

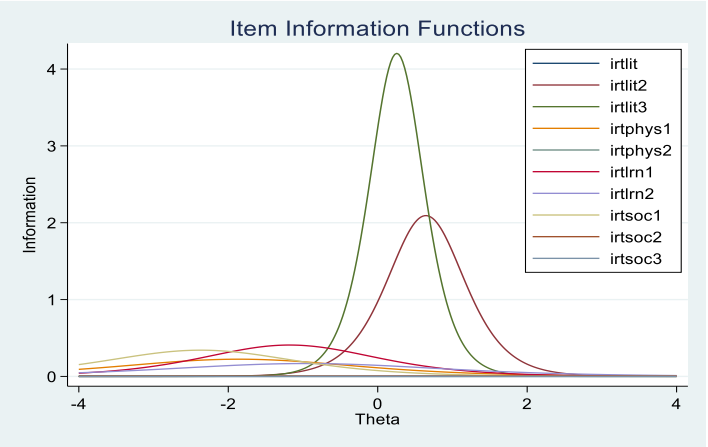


Figure 2.11. Test Information Function of the 2PL IRT Model

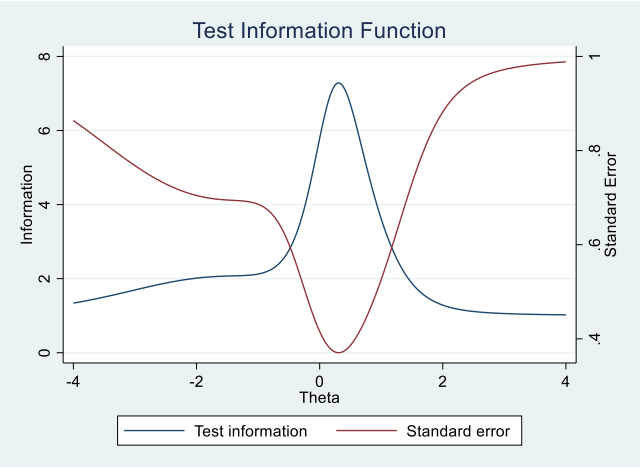


Figure 2.12. Test Characteristic Curve at score lines (2 7)

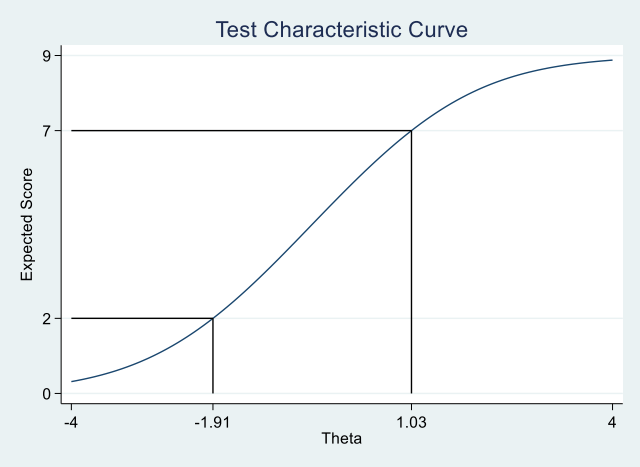


Figure 2.14 Graph of ECDI response

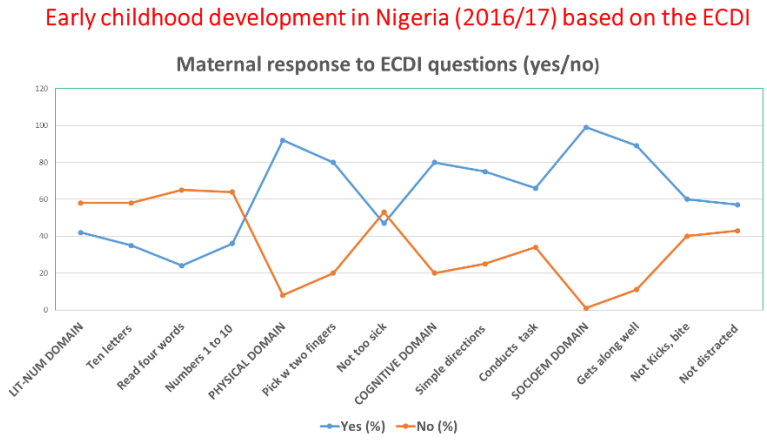
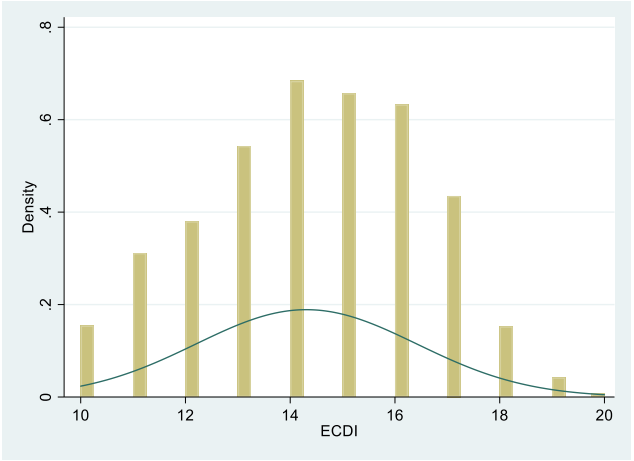


Figure 2.13. Histogram of ECDI items scale



Chapter III. Variations in Risk and Protective Factors for Cognitive and Socioemotional Development among 3- to 4-Year-Old Children in Nigeria: A Multilevel Modeling

Introduction

For children that overcome Nigeria's high child mortality rate of 132 deaths per 1000 live-births (National Population Commission [Nigeria] & ICF, 2019), there is the additional and often less obvious hurdle of not reaching their full potential in life. With minor differences across contexts, children in their first five years of life undergo rapid changes in aspects of human functioning such as cognitive, motor, physical, and socio-emotional skills development (Fernald, Kariger, Engle, & Raikes, 2009; Shonkoff, 2003). Studies indicate that sub-Saharan Africa (SSA) has the largest number of affected children, 44% of 3- to 4-year-olds (29.5 million) who are at risk of low cognitive and socioemotional development (McCoy et al., 2017). Based on the Multiple Indicators Cluster Surveys (MICS), Nigeria records the highest number of children with low cognitive and/or socioemotional development (6.0 million) globally, second only to India (17.2 million) and China (6.7 million) (McCoy et al., 2017). In addition, Nigeria is one of 34 countries where over 60% of the children are at risk for poor developmental outcomes because of stunting and extreme poverty (Lu, Black, & Richter, 2016).

At the global level, the WHO notes that about 5% of children below 14 years may have some form of preventable of developmental delay (Bello, Quartey, & Appiah, 2013). Further, developmental delays that hinder a child's functions in basic life processes such as speech, movement, cognitive or social interaction occur in as much 5-15% of the overall population of young children (Demirci & Kartal, 2018). Developmental delays may be pointers to more serious disorders including disorders of the motor, cognitive or neurobehavioral areas such as attention deficit hyperactivity, the autism spectrum or other learning disorders of childhood.

There is an estimated loss of over 20% in adult economic and social potential from children who survive but experience developmental delays (Lu et al., 2016; UNICEF, 2013) - a social work and public health scale exposure that over 279 million children under five face in low- and middle-income countries (LMICs) (Grantham-Mcgregor et al., 2007; Lu et al., 2016). Previous studies establish a myriad of consequences of developmental delay that include a lack of school readiness and academic success, emotional and behavioral problems - resulting in productivity loss, poor economic outcomes, social costs, public health costs and poorer health in adulthood (Demirci & Kartal, 2018; Fernald et al., 2009). However, most studies in early childhood development (ECD) in SSA are broad, highlighting primarily the prevalence of delays. When not focused on child/infant mortality, stunting, or immunization programs, these studies address issues of enrolment in universal childhood education (The World Bank, 2013; Yoshikawa, Wuermli, Alice, Raikes, Kim, & Kabay, 2018). More so, prevalence studies on ECD in SSA are more generalized, conducted in teaching hospitals in institutes of higher learning, do not capture the overall population, and do not take into consideration the heterogeneous and multi-cultural nuances that characterize African countries.

Nigeria is a multiethnic, multicultural, multi-language country with a pervasive north-south religious divide that reflects on the socioeconomic and political milieu of the 36 states and Federal Capital Territory (FCT), Abuja (National Population Commission [Nigeria] & ICF, 2019). Most early childhood studies in Nigeria examine the nutritional and infectious diseases' impact on child survival (Adekanmbi, Kayode, & Uthman, 2013; Akombi, Agho, Hall, Astell-burt, & Renzaho, 2017; USAID, 2018). This is in addition to interventions on child development that have focused on expanding access to early education (Olusanya, 2011), most of which start late, after the most sensitive periods of growth (Grantham-Mcgregor et al., 2007; Shonkoff, Radner, & Foote, 2016). Few studies, if any, in the Nigerian setting, and with a nationally

representative sample have examined how known risk and protective factors for cognitive and socioemotional development are associated with factors in the child's ecology, and especially across the 36 states and FCT.

This study extends prior research on ECD in Nigeria in significant ways. First, we adopt a social ecological model of child development and the social determinants of health framework, and use a variety of risk and protective factors at child, maternal and macro levels to examine their association with child outcomes. We also define child outcomes based on three domains of the early childhood development index (ECDI), namely the literacy, cognitive and socioemotional domains. These selected domains provide a more accurate assessment of child development rather than the full 10-item ECDI scale (Loizillon, Petrowski, Britto, & Cappa, 2017). We exclude items in the physical domain and an item in the socioemotional domain adjudged in previous studies and by our preliminary analysis to be inappropriate milestones, skills or behaviors for children in the 3 to 4 year age range (Fernald et al., 2009; McCoy, Waldman, CREDI, & Fink, 2018). Thus, using items from the literacy, cognitive and socioemotional domains, this study provides a more accurate picture of child developmental status of Nigerian children (albeit as reported by mothers), and how they are associated with the predictors.

Further, the use of the socio-ecological model of child development embedded within the social determinants of health framework provides utility to policy and practice interventions. In addition, the study's use of a multilevel model analysis to investigate the child-associated, maternal/household factors, and state-level influences on child outcomes takes into consideration the nested nature of the data, and prevents ecological fallacy that may result from the heterogeneous nature of the Nigerian context, and clustered nature of the study design (Raudenbush, Bryk, Congdon, & Toit, 2019).

Background to the Study

Early childhood development (ECD) has been described as a multidimensional and on-going process with peaks and lows during the period of zero to eight years (Fernald et al., 2009; Kang, Aguayo, Campbell, & West, 2018). The development of most life skills and milestones in the early years depend on biopsychosocial factors at the child, maternal, household and community levels. Some developmental challenges children face have their foundations in prenatal conditions and socioeconomic factors including risks associated with poverty, maternal depression, infectious diseases, and child malnutrition (Black et al., 2017).

Risk and protective factors. In the context of a child's ecology, risk factors are psychosocial adverse events or stressors that predispose a child to negative outcomes (Betancourt & Khan, 2008). Protective factors are those exogenous elements or interventions that work in favor of the child and that are associated with desirable outcomes against the prevailing odds. Public health or social work interventions are additional supports created to counter deficiencies or stressors especially those arising from risks or adverse events.

Globally, the risk factors that have been associated with developmental delays in children include an increased odds of delays when a birth is cesarean (1.81), is a higher birth order or low birthweight (McDonald, Kehler, Bayrampour, Fraser-Lee, & Tough, 2016). Other studies highlight the impact of maternal mental health problems that lead to long-term adverse outcomes for the child. Adverse conditions in parents' lives such as domestic violence, mental health problems such as anxiety, or depression may impede various aspects of maternal engagement with child (Engle et al., 2007; Okewole, Adewuya, Ajuwon, Bella-Awusah, & Omigbodun, 2016), and precipitate or worsen the presentation of developmental delays. When parents, especially a mother, are distressed, there is a strong indication she may not be able to discharge her nurturing duties effectively (Biel, 2018; Wesseldijk et al., 2018). Adverse childhood events

such as divorce or separation, death, abuse, mental illness or drug use disorders in a parent's life impact child development (Gundersen & Ziliak, 2014). For instance, in their study where 34% of mothers had a history of a mental health problem, 17% of the children experienced developmental delay where low maternal community engagement and low parent child interaction were identified as risk factors at year one (McDonald et al., 2016).

On the other hand, other studies have shown that maternal education lowers risk of developmental delays by 14.56 fold (McDonald et al., 2016; Walker et al., 2011). Additionally, traumatic events are less likely to occur when children live in a home with both biological parents. Living with both biological parents is a protective factor for children (Bramlett & Radel, 2014) that can facilitate a balanced development, and reduce both the likelihood of occurrence, and the negative outcomes of adverse events. Other protective factors for developmental outcomes include having social support for parents, optimism, access to maternal healthcare utilization and conducive living environments (McDonald et al., 2016).

Early childhood education (ECE) is both a protective and intervention factor for children. When children are enrolled early in high quality preschool programs, their learning and cognitive outcomes improve (Britto & Ulkuer, 2012; Engle et al., 2011). In addition, being part of the larger learning community affords the child opportunity for further socio-emotional development and increased accountability on their wellbeing from the mesosystem. Studies indicate that parental support for learning is a boost for ECD (Wachs & Rahman, 2013). Some studies found that mother/father support for learning produced positive outcomes such as lower cognitive scores for children (if care and learning is provided outside the home), while children from homes with poor support for learning received the most benefits from outside early learning programs (Cotton & Wikelund, 1989).

Closely related to parental support for learning is the availability of learning resources such as books in the home. Having at least one children's book in the home, irrespective of other maternal SES factors increases a child's numeracy and literacy skills (Manu, Ewerling, Barros, & Victora, 2018; UNICEF, 2012). Likewise, the availability of homemade or external toys and playthings improve ECD (Loizillon et al., 2017). It is not clear whether these factors are associated with family income or parental awareness of their benefits. A child's birth registration is also an important factor for their development as a birth certificate is first, their right, and increases their access to targeted health or welfare programs specific to their age. Being registered at birth also prevents children from being forced into early marriage and, ensures that resources for their development are allocated to their macro-system (Jeong, Bhatia, & Fink, 2018; Ogwumike & Ozughalu, 2018; UNICEF, 2017a).

At the level of influence of a child's macro system, low maternal community engagement, and low parent child interaction were identified as risk factors for children with developmental delays at year one (McDonald et al., 2016). Poverty both at the family and macro-community level leaves lasting impacts on child development. Data in place show that children living in poverty experience more challenges as adults with respect to high school graduation and college completion (Bornstein et al., 2012; Ratcliffe, 2015).

Children experience neglect when their safety from harm and protection are taken for granted. When parents or caregivers leave children alone or in the care of other children, this is a form of neglect (UNICEF, 2009). The neglected children are more vulnerable to risks, violence, abuse or unexpected injuries (Olusegun & Idowu, 2016). In addition, previous studies have associated harsh discipline with internalizing and externalizing problems in children (Bender et al., 2007; Cuartas et al., 2019). Physical punishment, verbal name calling (psychological aggression) or manipulation of privileges (often nonviolent) are notable ways in which parents

call their children to order (Lansford & Deater-deckard, 2012), but may turn abusive and affect child development when unchecked. The data in place indicate that about 300 million children (2 to 4 years) experience violent discipline from caregivers worldwide (UNICEF, 2017c).

Studies also hint at the influence of genes in about half of developmental delays in children, and note that by increasing the interaction of nurture and the environment, more positive outcomes can be achieved (Shonkoff, 2003; Zandi, Wilcox, Dong, Chon, & Maher, 2012). Tied to the environment where a child is raised is the role of caregivers in providing nurturing care, stimulation, and an emotional presence that builds secure attachment and facilitates wholesome development in children (Elgar, McGrath, Waschbusch, Stewart, & Curtis, 2004; Scherer et al., 2019; Walker et al., 2011).

Another protective factor for ECD is nutrition, which is linked to economic resources and parental knowledge of good nutritional practices. Micronutrient supplementation is known to ensure normal brain development, improve cognition and academic performance in children (Kang et al., 2018), while preventing stunting or wasting. Deficiencies in micronutrients such as in Iodine affect neural/brain development that could also result in intellectual disability (Briggs, 2014). Family factors that include parental socioeconomic status or place of residence may predispose a child to ECD facilitators such as nutritious meals, good learning opportunities and health services.

The Nigerian Context

Demography. Nigeria is the most populous of Africa's 54 countries with over 200 million people from over 374 identifiable ethnic groups and 3,000 indigenous languages spread across her 36 states and FCT, Abuja (National Malaria Elimination Programme (NMEP), National Population Commission (NPopC), National Bureau of Statistics (NBS), & ICF International, 2016; UNICEF, 2017b; United Nations, 2017) see figure 3.1. Socio-culturally,

multiple identities typify the average Nigerian at different levels, intersecting, and affecting outcomes in health and wellbeing (Adebayo & Olonisakin, 2018). Within Nigeria's diverse climate and topography, the Hausa-Fulani in the north (35%), Yoruba in the southwest (20%), and Igbos in the southeast (17%) constitute the predominant groups in the multiethnic, political, economic and power distribution in the country (NMEP, NPopC, NBS & ICF, 2016).

Political. Nigeria gained independence from British rule in 1960. The British transfer of power at the end of colonial rule favoring more compliant ethnic groups has been attributed with the longstanding and lingering hegemony, political, and social inequality that plague the country (Archibong, 2018; Fenske & Zurimendi, 2017; Kuznar, 2019). There are sustained debates over the constitution, inequalities among the Muslim-north and predominantly Christian south, and the ethnic conflicts arising from the distribution of Nigeria's oil revenue and governance. Nigeria has survived turbulent periods including coups, counter-coups, a devastating civil war, and a period of military rule that ended in 1999 (Iheanacho & Eme, 2017).

A significant oil-producing country having one of the largest economies in Africa, Nigeria has not conscientiously managed her oil boom and wealth to advantage over the years, leaving over 40% (82 million) of her citizens living on less than $1 a day (Fenske & Zurimendi, 2017; National Bureau of Statistics, 2020). Despite the growth of Nigeria's economy which varies across geographical zones, states, between rural and urban areas within states, the rural areas host a larger proportion of the population (Dauda, 2017).

There is a complex and high level of inequality in Nigeria that is strongly tied to the influence of ethnic politics, nepotism, and corruption on development (Archibong, 2018). A glaring urban-rural divide presents a huge disparity in access to health, education and other social services between the very- rich and extremely poor separated by very thin geographic and cultural lines. There is a high level of underemployment evidenced by the breadth of informal

and unofficial employment that constitute a high percentage of the country's economic engagement profile, and speaks to the low risk-averse, and inadequate social protection in the country (Kuznar, 2019).

Conflict. Conflict from ethnic clashes and the Boko Haram insurgency in the northeast are some of the burgeoning challenges impeding child development in Nigeria (Howell, Waidmann, Holla, Birdsall, & Jiang, 2018; Iheanacho & Eme, 2017; Odozi & Oyelere, 2019). Nigeria's conflict has been allegedly responsible for the highest number of lives lost in Africa this decade compared with previous conflicts in Rwanda and the DRC (Bakken & Rustad, 2018; UNICEF, 2019). Nearly 2.4 million people have been displaced in the affected regions (UNHCR, 2018). While the most severely affected areas in Nigeria has been the North East (Borno, Adamawa and Yobe states) (UNHCR, 2019), other communities have been victim to attacks from herdsmen or militant groups from aggrieved oil-producing communities (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017).

Studies and reports note the adverse effects of Nigeria's conflict on food security (FAO Representation in Nigeria, 2016), education, (mental) health, loss of land and freedoms, and social life (Adepelumi, 2018; Collins, 2017; Dunn, 2018). Economic losses in the hardest hit areas such as Maiduguri include over 126 industries closed, schools and over 5,000 shops abandoned (Iheanacho & Eme, 2017). Notably as a result of on-going conflict, over 101 enumeration areas could not be reached during the MICS survey used for this study, thus affecting the sampling frame of the survey (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017).

Ethnicity. Nigeria's myriad cultural and ethnic groups, religious divide, and layers of regional sociopolitical differences make it important to unveil factors at different levels that may influence outcomes in early childhood. Contextually, living in the northern region of the country,

and being a Muslim has been associated with lower indices for most developmental measures and outcomes in education, health and wealth (Adebayo & Olonisakin, 2018; Jimoh, Adaji, et al., 2018). There is also a strong association between low socioeconomic status and maternal health outcomes across Nigeria's geopolitical zones showing that over a 31-year study period, a clear attendant pattern of health and development outcomes exist across ethnicities (Adeyanju, Tubeuf, & Ensor, 2017; Peter & Ahuru, 2017).

Maternal wellbeing. Women in Nigeria have a high, mean fertility rate of 5.5 children in their lifetime (National Population Commission [Nigeria] & ICF, 2019). Recent studies indicate that the social context, social identities, fertility and gender beliefs, lack of autonomy, and cultural barriers affect maternal health and wellbeing (Ononokpono, 2015). Past studies also note the role of maternal education, poverty, early marriage, limited access to care, transportation, distance, and costs as some of the challenges faced by mothers of young children in Nigeria (Agunbiade & Udenkor, 2012; Ekpenyong, Bond, & Matheson, 2019; Ikechukwu, Ofonime, Kofoworola, & Asukwo, 2020; Jimoh, Anyiam, & Yakubu, 2018; National Population Commission [Nigeria] & ICF, 2019).

Child development in Nigeria. Nigeria's young population has a growth rate of about 3.2 % (NMEP, NPopC, NBS & ICF, 2016). Youth, 0-24 years make up over 62% of the population, that includes children in the 0 -5 year range (16% or 31.8 million) (UNICEF, 2017b). Over 6 million of under-3 to 4-year- olds are at risk for developmental delays, with 10.5 million children of primary school age currently out of school. Over 1.3 million children live in the context of conflict and displacement (Kimball, 2016; McCoy et al., 2017; UNICEF, 2017b). As noted earlier, existing empirical research on childhood development in Nigeria have focused on infant and child mortality, survival, and nutritional status (Adedini, Odimegwu, Imasiku,

Ononokpono, & Ibisomi, 2015; Adekanmbi et al., 2013; Harttgen, Lang, Santer, & Seiler, 2017), relying heavily on the Mosley and Chen 1984 analytical framework.

A few studies have examined developmental and neurological processes, such as a cross-sectional study of children 6 to 59 months (n=415) in a city in Northern Nigeria using a locally validated Schedule of Growing Skills II (DGS II) assessment tool that found of a large prevalence (35.4%) of developmental delay (Jimoh, Anyiam, et al., 2018) in the manipulative domain. A multilevel study in Nigeria found that acute respiratory infections linked to the use of biomass, kerosene or charcoal cooking fuel, or overcrowding affected child development, and was associated with contextual or community-level differences (Adesanya & Chiao, 2016). Interestingly, the study noted children born to mothers that are more educated were more prone to infections (perhaps due to likelihood of employment and less time at home with the children or lower level of understanding or recall by uneducated mothers).

Other studies highlight women's work (and wealth) and its positive impact on child nutrition especially in rural areas (Uthman, 2008). A study of the association between nutrition and development of under-five children (n=415) in Nigeria using the Schedule of Growing Skill II instrument found that 35.5% of the children experienced delays especially in the manipulative domain (Jimoh, Anyiam, et al., 2018). Another study used the Denver pre-screening instrument to examine the developmental capacities of Nigeria infants and children 2-72 months - noting that most of the children were at risk for developmental delays and retardation from pre and postnatal factors (Akinsola, 2014). A study in Yaoundé, Cameroun found the prevalence of developmental delay (51.7%) among a sample of children 5-72 months (Nguefack et al., 2013), higher than delays (34.5%) reported in a similar study of Nigerian children (Adebami, Onigbinde, Joel-Medewase, Oyedeji, & Afolabi, 2011). Another study showed that about 44.6%

of the children in a Ghanaian sample (another west African ecology similar to Nigeria) had one form of developmental delay or the other (Bello et al., 2013).

The macro-level. Previous studies emphasize the fact that where a child is born, and resides in Africa influences their health and survival (Boco, 2010). At the Nigeria macro levels, the federal ministries translate policies and programs to the state, and local governments that oversee the local communities. The government structures facilitate goods and services, exposures to both opportunities and adversities, including basic service such as water, power, and infrastructure that enable families to live effectively.

Residential contexts have been known to affect health behaviors through prevailing social norms, educational exposure, presence of social infrastructure or other forms of stresses (Datta et al., 2006). Nigeria's multicultural environment, attitudes, foods, and behaviors are unique to specific regions, and up to the most heterogeneous urbanized areas; there are still elements of norms and attitudes that prevail over geographical areas. For instance, in the Northern regions, tied to cultural influences and practices, early marriages, the lowest levels of education, and health outcomes have been recorded for children (Antai, Wedrén, Bellocco, & Moradi, 2010).

Macro factors such as budgetary allocation to advance the wellbeing of children and their families can be a protective factor. For instance, Nigeria had allocated less than 12% of its budget to education from 1999-2014, well below the stipulated 26% recommended by UNESCO (Yaro, 2018). Nigeria was also the least funded in education among several countries sampled by the World Bank. Past studies highlight the height of deprivation children under seven years in Nigeria face where over 45.1% lack appropriate living conditions, access to water, and sanitation (Popoola & Adeoti, 2016). There is also a high level of seasonal rural-urban migration of children and their families in the Nigeria ecology that affects the resources and stability required for child development (Antai et al., 2010).

Policy provisions. Several policies have been developed or updated in Nigeria over the years to facilitate and guide early childhood development, and foster the rights of children (Salami, 2016; UNESCO, 2006). While most of these policies revolve around early childhood education (ECE), their contents and sub-sections reflect an appreciation of both the health, physical, social, and cognitive development needs of children. Some policy documents such as the National Policy on Education has undergone five revisions over three decades and includes all levels of education. Other policies such as the Early Childhood Development Standards for Nigeria, the Guidelines for Implementing National Policy on Integrated Early Childhood Development in Nigeria, the National Minimum Standard for Early Child Care Centers in Nigeria, or the recent National Policy for the Integrated Early Childhood Development in Nigeria (2017) address early childhood care, frameworks, institutions, curriculum, funding, and requirements for advancing the wellbeing of children in Nigeria (Salami, 2016).

Most of the policies cover early childhood care; development and education, and appear fall under the jurisdiction and responsibility of the educational sector. The Nigeria National Policy for Integrated Early Childhood Development (IECD) has objectives that aim to ensure that the care and support, a spirit of enquiry and creativity, social and culturally appropriate norms, including adequate nourishment are built into child development programs (Salami, 2016). While this ECD policy has been described as too general without appropriate detail to guide educators and practitioners (Newman & Obed, 2015), there is a need for more concrete alignment of policies with current research on early childhood development, and an integrated approach that requires multidisciplinary collaboration. Nigeria also ratified and adopted the Child Rights Act, with provisions to ensure that every child has a right to survival and development. Flowing from the macro level, the extent of awareness, acknowledgement, and

resources allocated to ensure that the tenets of the Child's Rights are upheld reflect the culture of the society (Briggs, 2014). An instance is the promotion of birth registration.

Further, inadequate funding and resources, lack of human resources and specialized professionals (including patterns of teacher deployment), unequal transmission of policy infrastructure at all levels of government and communities limit the effectiveness of these well-laid out documents (Salami, 2016; Yaro, 2018). Other factors such the lack of social protection to cushion low family socioeconomic context, cultural background, safety and distance to ECE centers have been shown to affect enrolment and possibly the effective implementation and translation of these policies at the micro levels in Nigeria (Delprato & Sabates, 2014).

As noted, beyond studies focusing on Malaria, stunting and immunization against early childhood diseases, few if any, studies highlight the cognitive or socioemotional development of children in Nigeria. Given the short and sensitive window of ECD, the often-irreversible changes, and the long-term impact of developmental delays that result when a child's development is not an intentional process, this study presents a significant opportunity and responsibility to bridge this gap. In view of all the levels of influence interacting to affect outcomes for the Nigerian child, this study will be guided by the socio-ecological model of child development and the social determinants of health framework to investigate the child, maternal and household factors, and state-level influences on child outcomes.

Theoretical Framework

This study draws from the socioecological model of child development (Bronfenbrenner, 1997) and the social determinants of health framework, SDOH (Solar & Irwin, 2010) to examine the levels of influence on child outcomes. The social ecological model of child development emphasizes the role of processes and conditions interacting in the nested layers of a child's environment to influence outcomes (Bronfenbrenner, 1997; Wethington, 2005). The theory

hypothesizes that the child's microsystem comprising ontogenetic aspects namely gender, age, nutritional outcomes, overall health, their proximal influences, engagement with the mesosystem, and the politico-cultural climate of their society interact to influence developmental outcomes.

The SDOH framework relies on the concept of 'social position' and illustrates the influence of contextual inequalities on health outcomes (Solar & Irwin, 2010; World Health Organization, 2011). Social position comprises an individual's background and circumstances of life, stratifications, exposures, susceptibilities, and the consequences of these on their health (Garbarski, 2010; Solar & Irwin, 2010). Based on the conditions of where individuals reside, make a living, or have recreation, if any, social inequalities differentially affect their health outcomes. As reflected in the SDOH framework, beyond the individual level, there is a social production of disease and the political economy of health that generates decisions or preserve inequalities and inequities in health flowing from the institutional level (Conrad & Kern, 1994).

As reflected in the adapted framework (figure 3.2), this study posits that structural determinants such as economic and sociocultural factors in the child's macro context (state level) factors influence a child's micro context – the structural determinants (such as his/her family's socioeconomic position), and intermediary determinants (such as material circumstances and biopsychosocial factors). These structural determinants interact with child-level factors to impact equity in outcomes within their macro landscape (Bharmal, Derose, Felician, & Weden, 2015; Solar & Irwin, 2010; Viner et al., 2012).

Study Purpose and Aims

According to Solar and Irwin (2010), governments have the onus of fostering equity in health outcomes. In using a multilevel model, this study draws from these frameworks, and takes into consideration the dependencies between individual observations and the role their proximal, and policy-level factors may play in influencing outcomes.

Research questions. Drawing upon these theoretical frameworks, the study investigated how child individual factors interact with maternal and household factors and the macro level to influence child outcomes. We will examine the variations in risk and protective factors related to child outcomes across the states. The analysis will seek to address the following research questions:

i. *By how much and how significantly do 3- to 4-year old children across Nigerian states vary in their learning, cognitive, and socioemotional development outcome score (hereafter, child outcome score). What proportion of this variance in child outcome score lies at the state level? Further, what is the reliability of the sample mean of each state's child outcome score as an estimate of its true population mean?*

ii. *What is the mean child outcome score across the states when controlling for factors in the levels of influence of the child at the individual (ontogenetic), maternal (microsystem), and state macro levels?*

iii. *How is maternal level of education associated with child predictors and how do these effects vary across states?*

iv. *Does attendance to an early education program differ across states in their association with the individual (ontogenetic), maternal (microsystem), and state macro levels? (In essence, how does the regression equation differ from state to state? Is there a correlation between the intercepts and slopes)?*

v. *Does the household wealth index moderate the relationship between attending an early education program and child outcome scores? Is there an interaction effect?*

vi. *Does living in aggregated (state-level) household wealth index moderate the relationship between a child's health status and their child outcome score? Is there an interaction effect?*

Methods

Research Design and Data Sets. The study used data from the fifth round of the Multiple Indicator Cluster Survey (MICS) conducted by a collaboration between the Nigeria Bureau of Statistics (NBS), and the United Nations Children's Fund (UNICEF). The MICS, facilitated by UNICEF for over two decades in 116 countries are household surveys that provide internationally comparable estimates of adult and child socioeconomic and health indicators (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). The sampling frame is the updated Nigeria 2015 population-housing census, with primary sampling units (PSUs) in both rural and urban areas. The PSUs are census enumeration areas (EAs) within each of Nigeria's 36 states, and located within its six geopolitical zones. Based on a two-stage sampling process, the study was designed so that weights can be applied for reporting results as the sample was stratified by state (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). The final sample was drawn from 2239 EAs excluding 101 EAs in conflict-affected states.

The MICS study administered four sets of questionnaires namely the household questionnaire for basic characteristic and demographic information, the individual women questionnaire for all women 15 to 49 years, the individual men questionnaire for one man in every two households 15 to 49 years, and the under-5 children questionnaire administered to mothers/caretakers of all under-5 years children (NBS & UNICEF, 2017). The questionnaires were customized, pretested, data collectors trained, and survey piloted in purposively selected areas. The data collection team used the Computer Assisted Personal Interviewing (CAPI) instrument to gather data electronically, and transmitted to a central server using CSPro CAPI application, version 5.0.

This study merged the household, individual women and focal child data, and obtained aggregated state-level data on maternal and early childhood measures from the Nigeria 2017 MICS 2016-17 survey report (NBS & UNICEF, 2017). In addition, aggregated data on the median years of maternal education computed for each state was obtained from the Nigeria 2018 National Demographic health survey report for women approximately 14 - 59 years old to provide a community-level picture of the impact of maternal educational levels (NPC & ICF, 2019). The DHS is a nationally representative study that employs national probability samples of households based on a three-stage cluster sampling technique to elicit information on the child, maternal, paternal, and household health (NPC & ICF, 2019). A summary of the proposed and actual budget for each state and the FCT that corresponds with the period the MICS was conducted in the country, was obtained from the National Population Commission and the Budget report, a nonprofit source that monitors and provides data on the budget of the states (BudgiIT, 2018). The final sample for the present study included 11,207 mother-child dyads (approximately 96% of the original sample) who responded to the early childhood development index (ECDI), nested within the 36 states and Federal Capital.

Measures. The dependent variable was the c*hild outcome scale*. Seven items (Cronbach alpha = 0.70) from the MICS 10-item ECDI screener (Loizillon et al., 2017) were selected based on their internal consistency and performance in previous analysis and were used to construct the scale. The seven items were from three domains namely the literacy/numeracy (3 items) that asked, (i) if the child can name or identify at least 10 items of the alphabet; (ii) if the child can name and read at least four simple, popular words; and (iii) if the child knows the name and recognizes the symbol of all numbers from 1 to 10.

The child cognitive/approaches to learning domain comprised two items that asked (iv) if the child is able to pick small objects with two fingers; (v) if the child follows simple directions

on how to do something correctly. The socio-emotional domain (2 items) asked (vi) if the child is able to do something independently when given a task to do; (vii) if the child gets along well with other children (viii) if the child kicks, bites or hits other children or adults. One item from the socioemotional domain that asked if child was always distracted, and two from the physical domain that asked if child was frequently sick and if they could perform the pincer grasp were removed. These items performed poorly in the scale and were not suitable as shown in findings from a previous analysis and extant literature.

Predictors. In line with the theoretical framework and based on the reviewed literature**,** the predictors were grouped into level-1 (individual child and mother-related variables) and for level 2, aggregated data at the state level. Level-1 variables and covariates include the child's gender (male or female), age (3 or 4 years), if child attends an early education program (yes or no), the number of picture books the child has at home (none, 1-3 or 4 or more books), and child's anthropometric measure was used to compute their nutritional status (stunting). The stunting measure was derived from the child's height-for-age (HAZ) expressed as z-scores based on the WHO child growth standards. The z-scores were re-coded such that scores above negative two standard deviations (-2 SD) from the median of the reference population were not stunted and underweight; between -2SD and -3SD were moderately stunted or underweight while z scores below minus 3 standard deviations (-3SD) from the median were considered severely stunted or overweight respectively.

Maternal individual level-1 predictors include the mother's level of education (higher, secondary/secondary technical, primary, non-formal, or none), mother's age (15 -49 years), the number of stimulating activities the mother engaged the child in the past three days (telling stories, reading, walking, singing or playing with the child) ranging from zero to six. Other variables include the household place of residence (rural or urban), and the household wealth

quintile –a computed measure based on the different material resources such as television, car, type of roofing, flooring, source of water or toilet facilities available (NBS & UNICEF, 2017). The wealth quintiles were categorized into five equal groups each comprising 20% of the population. For this analysis, the fourth and richest quintiles were merged and the other categories – the middle, second and poorest quintiles were unchanged.

Level-2 predictors. The unit of the second level measure is the 36 states of Nigeria including the FCT, Abuja (n=37). The state-level predictors include the percentage of children in the state with whom an adult household member engaged in four or more stimulating activities, the median years of education completed by women in the state, aggregated household rural-urban divide in the state (inversed to account for skewness), and the state 2016 budget (logged to account for skewness).

Analytical approach. The measures were examined to ensure normality (state budget was transformed to a log value due to the skewness and disparity between states with very low budgets and outlying richer states). We tested for multicollinearity among the measures. Univariate analysis was employed to explore the sample characteristics. Pearson's chi-squared test and cross-tabulations were used to highlight the association between maternal level of education, the child outcome scale and the predicting variables. Pairwise correlations of the variables was also examined. To avoid ecological fallacy where *"relationships between characteristics of individuals are wrongly inferred from data about group*s" and Type 1 error, we use a multilevel regression to examine the association between the variables (Hox, Moerbeek, & van de Schoot, 2018; Raudenbush et al., 2019). Testing various multilevel models, we were able to address problems of non-dependence and enhance the opportunity to test substantive hypotheses about the variables presented at the state level in comparison to the child at the household level.

We used the restricted maximum likelihood estimation method (reml) for estimation since the level-2 variables are smaller (less than 50) and to provide an unbiased and more suitable comparison of the random effects (Hox et al., 2018). Also, the reml considers the degrees of freedom of the fixed effects in its estimation of the variance components (Luke, 2004). Using the Wald test, we also tested for the significance of the fixed and variance effects components. In addition, tests of the residuals was also conducted to meet assumptions of multilevel models. In all, two-level regression models were fitted for 11,207 mother-child dyads at level- 1, nested within 37 states/ FCT at level -2 using the mixed commands in the STATA 16 software. Equations and diagnostics were generated using the HLM8 software. The models with the lowest log likelihood and Akaike Information Criterion (AIC) values determined goodness of fit.

Model specifications. We tested several models and will report seven. The model specifications based on classes of multilevel models (Luke, 2004; Woltman, Feldstain, Mackay, & Rocchi, 2012) presented on table 2 aim to identify the important influences on child developmental outcomes - *child outcome score*, (ECDX) from contextual factors (see table 3.1).

Results/Findings

We examined the micro and macro-level correlates of child literacy, cognitive and socioemotional outcomes in a scale of *child outcomes score*, to show the extent to which contextual factors are associated with macro or state level variations. The test for multicollinearity with an initial regression analysis yielded a variation of .51% (R-squared) for all the available predicting child outcomes but with high multicollinearity. After dropping the predictor that measures percent of children attending early education at the state level, the variance inflation factor (vif) reduced to a mean 2.84.

Descriptive Statistics. Of the 11,207 3-to 4-year-old children in the sample (state mean = 303), 51% were three years old and 49% were female. Most of the children, 61%, were not enrolled in an early education program, and 74% did not have a single color or picture book in their home. In terms of their nutritional status, more than half of the sample (58%) were not stunted while 21% were equally moderately stunted and severely stunted respectively. The mean age of mothers in the sample was 31 years. Only 8% (880) of the mothers in the sample had some form of higher education, and 27% (2,979) had secondary/secondary technical education. Besides those with primary (17%) and non-formal education (20%), 28% of the mothers did not have any form of education at all (see table 3.2.).

In terms of activities mothers engaged their children in, 30% of the women supported their children's learning with four or more activities while 31% of the mothers did not engage in any activity at all with their child. There was a near even distribution of the household wealth quintile, where the children reside in homes across the poorest (23%), second quintile (22%), middle quintile (19%) and a combination of fourth and richest quintiles (26%). Further, 73% of the mother-child households resided in rural areas.

Across the states, on average, the mean percentage of children engaged by at least one adult in four stimulating activities was about 65%. Only an average of 39% of the children were enrolled in an early education program across the states while on the long run, 62% on average were completing primary school. Used as a predictor to highlight education as a value in the child's cultural milieu, the mean median years of women's education completed across the states ranged from zero in several states to 11 years in others (mean 4.86). In addition, ranging from 6.6% to 89.9% across the states, the median percent of mothers knowledgeable about how to register their child's birth was 32%.

Bivariate analysis of mother's level of education that was seen in reviewed literature as an important child risk and protective factor is presented in table 3.3. Overall, mothers that had higher education were more likely (84%) to respond in the affirmative that their child was on track on all the developmental domains while only 11% and 17% of mothers with non-formal and no education respectively responded with a yes to the question about their child's developmental ability. Similarly, compared with mothers with higher (16%) or secondary education (33%), mothers with non-formal education (89%) and no education at all (83%) were more likely to respond that their children were not meeting the developmental milestones. All these associations were statistically significant ($p<.001$).

There were also statistically significant differences in level of stunting in relation maternal level of education. Slightly more than half of the children in the sample (58%) were not stunted, while 21% were both either moderately or severely stunted respectively. Less children of mothers that had higher education (4%) or secondary (9%) were severely stunted compared to children from mothers who had no education (29%) or non-formal education (36%). In terms of the cultural distribution of maternal education, more mothers that were Hausa had no education (36%) and non-formal education (38%) compared with the other ethnic groups. There was also a statistically significant difference across ethnicities in the number of children reaching the developmental milestone, based on the mother's response to the ECDI screener. For instance, mothers who identified as Hausa were more likely to respond their children were not on track (81%) compared with Yoruba (25%), Igbo (24%), and all other ethnic groups combined (54%). In addition, mothers in households computed to be in the poorest wealth quintile were more likely to report that their child was not on track (90%) compared with 28% of those in the upper and rich quintiles. These associations were also statistically significant ($p<.001$).

A stepwise approach of adding child, mother/household and state-level blocks of variables was used to build a parsimonious multilevel predictive model of variations in child outcomes based on the data available. We used the statistical significance level of <.05 to test for level of significance. **For model 1**, a one-way random effect ANOVA and unconstrained model, we estimated the intercept for each state, the predicted outcome score for a child when all predictors equal zero. This model answered the question of *w*hat the mean child outcome score at the state level is, indicating that the grand mean (average intercepts) of child outcome score from the scale (of learning, cognitive and socioemotional outcomes, range 0-10) was 5.15 (standard error .26, p<.001). Children across the states were likely to have a child outcome score from 4.64 – 5.66 (the 95% confidence interval).

Random effects. The unexplained variance at level-2 or variance in mean child outcome between states was 2.43, and the random intercept or variance in mean within the states at level-1 was 6.02 (unexplained variance at level-1), indicating that most of the variance in the outcome is at the child-level, and unexplained, although a substantial proportion is between states. A test of the null hypothesis that state level variance is zero is rejected as the results show that Var (uoj) = $\tau 00 = 2.43$ (=4892, df 36, p<.001) and was statistically significant, indicating a significant variation among states in child outcome.

To answer the research question, *"What is the proportion of the variance of the child outcome score lying at the state level?"* the intra class correlation coefficient (ICC), .29. Indicated that 29% of the variability in child outcome score is accounted for by the grouping structure of the states, indicating a substantial clustering. This value can also be interpreted as the correlation between two randomly chosen children that are in the same state. In addition, given this moderately high value, we infer that a multilevel model incorporating states is justified

(most literature note an ICC of 5% (.05) and above is worth using a multilevel model). The significance level of the variability at state level (p<.001) indicates that states make a difference.

In addition, in response to the research question regarding the reliability of each state's sample mean as an estimate of its true population mean, we computed the reliability:

λ_j = Reliability ($Y_{.j}$) = $\tau_{00} /[\tau_{00} + (\sigma^2/n_j)] = 2.43 /2.43 +(6.02/303) =2.43/2.45 = 0.99$

This is an overall reliability index indicating that the sample means of the population tends to be approximately 99% reliable. Thus, we can infer that the reliability of β_{0j} is positively associated with the sample size of the data, such that as the size gets higher, the reliability increases. Testing the hypothesis, H0: τ_{00} =0 for the χ^2 statistic with jn-1 df, the test statistic χ^2 was 4892 with *df*=36, *p*<.001 indicating that states vary significantly from each other in terms of child development outcomes (See Table 3.4 and 3.5).

Model 2. Here, we added all the level-1 child predictors in a one-way ANCOVA model with random intercepts. We assumed that the intercepts varied across states but the variance of the level-1 predictors is the same across the states. An estimation of the fixed-effects yielded a new intercept (7.48) which is now the child outcome score for a child when all child level-1 predictors equal to zero. All child predictors were statistically significant in their association with the child outcome score. Specifically, for each child that does not attend an early education program, the child outcome score is predicted to be lower by 2.31 units (5.17) with an attendant lower standard error. There were also predicted lower child outcome score where a child had no books in the home (by 1.84 units) compared with having at least 1-2 books (.44 units); where child is severely stunted (- .57 units) compared with a child that is moderately stunted (-.45), when all other predictors are controlled. Compared with a three-year-old child, being older (4 years) is associated with a unit lower child outcome score by .63. All the associations at the child level were statistically significant (p<.001) except for the effect of child's gender.

At the level-2 variance estimates, a coefficient of .31 related to the intercepts, and 4.12 to the level-1 variance, both reduced from the null model as the addition of child predictors explained more of the variation. The test of the intercepts was statistically significant indicating that there is still some unexplained variance at both state level (.31) and individual (4.12). However, a significant variation across states still exists (ICC = .06), although reflecting a reduction in the relative share of between state variance when all the child-associated predictors accounted for within state variation.

The Wald chi^2 is 5180.39 ($p<.001$), being significant suggests that one of our regression slopes is non-zero. An examination of the proportion of variance explained at each level by comparing the current variance estimates of model 2 to the null model was 2.49-.31/2.49 = .87.5 and 6.02-4.12/6.02 = .31.6 (Sampson, Raudenbush, & Earls, 1997). These values indicate that after controlling for child's factor predictors, the clustering effect is decreasing, and the model explained 87.5% of the within-state variance and 31.6% of between state variance in child outcome scores. For the total variance explained by the model, [(6.02+2.49 - .29-4.18)/ (6.02+2.49) = 3.98/8.45=.472], there is a multilevel model R-squared of 47.2%. This R-squared is defined as the proportional reduction in prediction error. For an acceptable or fit model, the variances are the lowest where level-1 variances show the proportional reduction of error for predicting an individual outcome while for the level-2, show the proportional reduction of error for predicting a state-level mean (See table 3.6). The best fitting and preferred models have the smallest residuals (Luke, 2004).

***Model 3*.** In a similar random intercept model with only mother and household predictors, the mean child outcome score was lower, 6.94 (.18), a 1.79 units lower from the null model. The results indicate that when all other factors are controlled, there is an associated .36 unit lower child outcome score for when the mother does not engage the child in stimulating

activities, an increasing loss in average units of child outcomes for lower levels of the wealth quintile where the poorest quintile is lower by 1.62 units. Maternal educational level also exerts significant impact on the child outcome score where the highest effect is felt in mothers with no education (1.77 units). All associations were statistically significant (at $p<.001$). For every additional year of a woman's age, there is a predicted associated higher child outcome score by .01 units ($p<.001$) while living in a rural area was also associated with a .13 unit higher child outcome score ($p<.05$).

In Model 4, we examined the combined effect of both child and maternal/household predictors on child outcome score. There is a higher intercept, 8.59 (.17), $p<.001$) - the child outcome score for a child with all mother and child predictors equal to zero. The values of all predictors were lower in their effect sizes but remained statistically significant except for place of residence, child gender and mother's age. For instance, predictors such not attending early education (-1.93), not having books (-1.32), being in the poorer wealth quintiles (-.91), informal and no maternal education (.82) and ethnicity, specifically being Hausa (-.21) are associated with predicted lower child outcome score. The Wald chi2 is statistically significant inferring that one of the intercepts is not a zero. In this model, after adjusting for maternal and combined maternal/child level-1 variables) respectively, there remained less unexplained state-level variation albeit still significant at the less than 5% level.

Model 5 featured a regression with a means-as-outcomes approach, and sought to answer the question of whether states with higher budgets, higher levels of median years of maternal education, higher percentages of children engaged in stimulating activities, and poorer levels of aggregated mean household wealth quintile- also have higher childhood outcome scores, while excluding all level-1 predictors. Thus, we estimated the variation in the child outcome score using level-2 predictors, while aggregating the data to the acceptable state level and no within

state assessment to highlight the intercept effect. There was a lower coefficient for the constant or intercept (3.39), which represents the predicted child outcome score when all state level predictors are zero. A range of plausible values for the child outcome score when all the state predictors are zero is $3.39 \pm 1.96*(3.39)^{1/2}$ = (-.22, 7.0). Thus for a state having 0% median years of maternal education (which several states had), there was an associated lower child outcome score, less by 3.39 units.

The percentage of children engaged by an adult in at least four activities at the state level, representing a child rearing norm, had a weak but statistically significant positive association with child outcome scores (.03, p=.001). Also noteworthy is the association of the aggregated household wealth quintile with child outcome score. As state-level household wealth drops across the quintile (poorer), there is a predicted -1.32 unit lower child outcome score and this association is statistically significant (p<.001). For each percent increase in median years of maternal education in a state, there was an associated/predicted lowered child outcome score, less by .03 units, an association that is not statistically significant (p>.05). The budget effect (unconditional expected mean of log of budget from a positively skewed distribution is -.20) = .63 implies that each billion naira increase in a state's budget is associated with a child outcome score that is .61 units higher, a non-statistically significant association. The unexpected ambiguous budget effect may be different if this were solely the education budget of the state and may be a function of inequality – where an increase in state resources does not equal to fair distribution of those resources.

The residual variance at level-1 is now 6.02 same as the residual variance of 6.02 in the one-way ANOVA with random effects (unconditional model) indicating more unexplained variation at level 1. The variance component representing variation between states decreased from 2.49 in the null model to .18, indicating that the level-2 variables explain a significant

amount of the state-to-state variation in mean child outcome score. The variance explained at level 1 by this model is 6.02 -6.02/ 6.02 = 0% suggesting that state level variables as predictors of child outcome score were lower within state variance by 0%. The ICC dropped to .03, suggesting that the addition of these predictors resulted in a decrease in variations for the residuals in level-2 –the correlation between two randomly chosen children in the same state when state-level variables are used.

Model 6 is a random intercepts and slopes model (a random coefficients regression) of all level-1 and level-2 predictors and, where level-1 intercepts and slopes are allowed to vary across the states (unstructured) including a random slope (for a child who does not attend an early education program, the predictor with the most effect on child outcome score). Overall, there were lower coefficients for all variables but in the same patterns as models 2 to 5. The state-level predictors continued to be associated with lower effect sizes (and their effect sizes were no longer statistically significant) when individual-level predictors are controlled. Further, the ICC was higher at .05 since we are considering more random variation at the individual-level.

The residuals were lower as well, and the random coefficient of not attending an early education (tau squared) was .26 and statistically significant, signaling that not attending early education and its impact on child outcomes may vary from state to state, and that 95% of the states have slopes that fall between .09 and 2.94 ($1.92 \pm 2*\sqrt{26}$). A low covariance (-.09) implies that there is a negative but not significant covariation between someone not getting early education and the state in which they reside.

Model 7 featured cross-level interactions in a random intercepts and slopes class model (intercepts and slopes-as-outcomes). Based on the literature, and while retaining the random slope for not attending an early education program, we tested level-1 intercepts and slopes using level-2 predictors with two cross-level interactions (between two level-1 predictors and a level-1

and a level-2 predictor) to see if there are modifications on their associations with child outcome score. The coefficient for the effect of not attending early education was significantly higher in this model (-2.23) than all models including the coefficients for the wealth quintiles, and all were statistically significant. While not statistically significant, the effect of aggregated mean lower wealth quintile on child outcomes had the highest association with child outcomes at the state level (-.24). The effect of living in a rural area was similar across models and highest in model 7 (-.13). The ICC for model 7 was lower (.05) which when compared to the null model indicates that more variation is accounted for by the interactions within the states rather than between the states.

There were statistically significant cross-level interactions between a child that is frequently sick (level-1), and the state mean wealth quintiles (aggregated poorer wealth quintile) (.32, $p<.001$). The positive effect size indicates that poorer households at the state-level act to heighten the effects of being frequently sick on child outcomes. For instance, household or family level gains or efforts on child outcome scores achieved by early education may be jeopardized by the environmental context –a resource-constrained environment, where perhaps there are fewer amenities, speaking to the need to address the health and social infrastructure in the rural areas.

The second interaction between not attending an early education program and different levels of the household wealth quintile (from the richest to the poorest) were all statistically significant (.36, .61, .94, $p<.001$ respectively). These positive and significant interaction effects indicate that increasing levels of household poverty was associated with the more detrimental effects of not attending an early education program on child outcomes. Thus in answering the question of whether families with less income have a different influence the relationship between not attending early education and child outcome scores - (does wealth moderate the effect of

early education on child outcomes?) –wealth moderates the relationship between early education and child outcomes, an effect that increases at lower wealth quintiles. Thus, even when poor families make the effort to enroll a child in an ECE program, paid or government sponsored, the impact of their socioeconomic status or poverty may impede the potential positive effect expected in child outcomes.

Further, by including the cross-level interactions, the intercept effect increased from 5.15 in the null model to 7.15. The AIC of model 7 (see table 5) and residuals were the lowest making it a preferred model. Overall, the addition of level-1 and level-2 variables and interaction terms changed the ICC to 0.5, maintaining that state-level clustering is an important consideration in the variations in child outcomes.

Discussion

This study used multilevel modeling to disentangle the dynamics between the levels of influence for cognitive and socioemotional outcomes across the socioecological levels of a child's development, and with consideration to other social determinants of equity in their development. Guided by the socioecological model of child development and the social determinants of health framework, we observe the association between structural determinants both at the household and state level with child outcomes. We accommodated the hierarchical nature of the MICS data for appropriate estimates of the standard error and accounted for the clustered nature of the children within households in states of Nigeria. The study tried to decompose the heterogeneous nature of the Nigerian context including the differential wealth status of states and families, high rural-urban divide, ethnicity, the impact of learning resources, nutritional status and parental involvement on the child's outcomes. We also examined the interplay of individual factors with societal outcomes in the child's ecology such as the median

years of maternal education, adult engagement with child or the wealth of the state the child lives in.

Indeed, findings indicate that factors in the maternal and household environment are strongly associated to the child's development. In line with previous studies (Efevbera, Bhabha, Farmer, & Fink, 2017; McCoy et al., 2017), the mean score for child outcomes (range 0-10) was less than half (4.60 [2.89]). When examined in the multilevel model, the mean score across states when there is no predictor was 5.15, and the clustering nature of the states accounted for 29% of this variation. The heterogeneous context and layers of the environment show evidence of influence on child development in Nigeria.

In terms of the child sociodemographic factors, the findings corroborates with other studies that more than half of the world population reside in rural areas (Avan & Kirkwood, 2010), where there are less amenities, higher levels of poverty, and practices that impede child development. In this representative sample, over 73% of the 3- to 4-year-old Nigerian children lived in rural versus urban areas with less resources and infrastructure to support their development. Again, attending an early childhood program, having children's books and the stimulation these afford the child, rank highest among the predictors of child outcome score. Encouragingly, these determinants can be addressed by policy and practice interventions.

Also, in line with past studies (Adedokun, Adekanmbi, Uthman, & Lilford, 2017; Adeyanju et al., 2017; Burroway & Hargrove, 2018), differing levels of maternal education exerted a strong influence on all factors used to predict child outcomes, with mothers in the higher education level indicating better indices for child outcomes overall, further underscoring the importance of maternal education. There was an important distinction between mothers with primary education, non-formal education, and no education at all, and their associations with child outcomes. The evidence suggests that under the name of non-formal education, Nigerian

women may assume they have an education whereas the outcomes for their children are in the same category as women who did not have any education at all. Further, in line with other studies (Burroway & Hargrove, 2018; Yaya et al., 2017), higher levels of maternal education was associated with lower prevalence of stunting, more activities the mother engages with the child and less numbers of children reported as being frequently too sick to play – all of which were significant predictors of child outcome score.

The multilevel models highlighted the impact of different levels of the child's ecology on child outcomes. The first model with no predictors indicated that there was as much as 29% variation at the state level. However, with the addition of child, maternal and state-level predictors across models, the impact of state factors reduced to 5% (in the model without interactions), which is still noteworthy (Hox et al., 2018). This reduction in variation implies that more policy efforts could be channeled to evidence-based interventions at the child and family level that will directly affect outcomes for the child.

The difference between outcomes among three and four year olds, where mothers of the older children were more likely to respond with a yes to the screening questions, was similar in all models (ranging from .60 to .70) and was an important pointer that perhaps some of the developmental skills asked for the child were still evolving with age. This difference in outcomes by age call for more sensitive and graduated instruments that are more specific to milestones expected for each age group. Contrary to other studies (Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006) being a girl-child in Nigeria was not a protective factor, and its weak effect on child outcomes was not statistically significant in all the models.

After adjusting for child, mother and state-level variation, there remained less variation between the states even though the residuals were still significant at less than 5% level. The pattern of residuals was similar in the full models. The state factors had some statistically

significant effect on child outcomes primarily in model 5. Young children living in a state where at least one adult engaged them in four or more activities were more likely to have higher mean child outcome score (an increase of .04 units, $p<.001$). In a state where there was a higher percentage of mothers that know of the importance of, and how to register their child's birth, the child outcomes were also positive albeit small (.01, $p<.05$).

In addition, with each additional median years of maternal education in a state was associated with .11 unit of higher child outcome score ($p<.05$). The median years of maternal education had the strongest effect at the state level, but these effects reduced when individual maternal and child predictors were added. The more rural a state was, the lower the child outcomes. It is interesting that states with high budgets did not necessarily have better child outcomes -which may speak to the low level of state's programs at the early education level, quality of ECD programs as implemented, or inequality in resource distribution as noted in other studies (Yaro, 2018) - factors that call for further investigation. However, the study notes that the state budget may be too broad, as opposed to an education department specific budget in predicting state investment in ECD.

Limitations of Study

Several study limitations must be noted. First, the outcome variable, derived from items in the child literacy-numeracy, cognitive and socioemotional development domains of the ECDI are self-reports from the mothers, and not direct assessments of the child (Fernald et al., 2009). Aina and Morakinyo (2001) note that the current routine questioning of mothers is an impressionistic method for assessing developmental milestone, and argue for the need for proper and validated direct assessment instruments with strong psychometric properties to be used among children in Nigeria (Aina & Morakinyo, 2001). In addition, being a population-based

measure, the questions in the ECDI, and in the absence of a gold standard instrument for ECD in the survey may not be providing the best estimates of child developmental status.

Another obvious limitation is that this being a cross-sectional study, causal inferences cannot be made. Non-verification, and factors associated with responses for children provided by their mothers, incomplete or inaccurate answers, and recall bias among mothers, especially considering the age range of children and the timing of the interview may be challenging. We also did not estimate the influence of the father's educational level and engagement with child development processes. We acknowledge that father reports and direct assessments of children would greatly enhance the findings for ECD in Nigeria (Jeong et al., 2019)

Another limitation of the study is that for a multi-level model, the study would have benefitted from a closer macro level in the child's ecology rather than the states, given the huge disparity and heterogeneity within states in terms of rural urban divide, ethnicities, and many other indices measured. For instance, a study in Nigeria used primary sampling units consisting of enumeration areas as the smallest geographic clusters rather than states (Antai et al., 2010), and they may have obtained estimates that are more realistic given the disparities.

Further, while this study used nationally representative data, some enumeration areas in the north could not be assessed because of conflict (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). The decision to exclude 101 enumeration areas has major limitations for generalizing these findings to conflict affected regions. It will be important for future research to understand the situation of ECD and outcomes for children in these regions.

Given the nature of the study design, other community or state characteristics that reflect the culture or norms were not available for this study. The lack of explanation for variance in disparity in child outcomes not provided by the data may point to risk factors occurring long

before the outcomes, including genetic or parental factors not included in the data (Braveman & Barclay, 2009). For instance, there are no measures of parental mental health, stress experienced during pregnancy, or from poverty that may lead to unexplained adverse outcomes or poor functioning in children. Some socially accepted behaviors, cultural practices, or technicalities such as location or distance to schools modeled in previous studies (Osorio, Bolancé, & Madise, 2012), and shown to affect child outcomes were not available for this study.

Potential Implications and Future Research

There is a broad stream of literature on child wellbeing for Nigeria and SSA, yet few examine the largely unseen aspect of early childhood development, making it a less tangible objective for research and intervention investments. More so, because the few studies on ECD have focused on more neurological outcomes including autism or clinical diagnoses in health facility settings, or areas where researchers have access to funding, there may be less attention to research on ECD in Nigeria. However, studies and research in other contexts underscore the need to give this issue more intentional thought and attention, and we draw from these to advance some implications of this study.

Social determinants of health framework (SDOH). Health and developmental outcomes are influenced more by healthier neighborhoods and living conditions in homes, and not just by medical care and personal behavior (Braveman, Egerter, & Williams, 2011; Shonkoff, 2003). Nigeria needs basic infrastructure at all levels of the community that improve living conditions and guarantee social protection to reduce the perpetuation of cycles of poverty. Priorities for ECD include the need to apply the SDOH, and improve the places where children live, work and grow. In support of the social determinants of health framework that guided this study, addressing the structural determinants such as family wealth quintile, maternal education level, availability of learning resources, health status such stunting and a child being frequently sick

that were important predictors of child outcomes deserve emphasis. Most of the significant child predictors such attending early education, stunting, availability of children's books are outcomes emanating from influences in the ecological layers that need to be addressed. The framework can be adopted as an example of a holistic guide to ensure that no aspects of the risk and protective are not left out in intervention planning

A life course approach. Previous studies also discuss the inequalities in development that begin prior to conception, the need to apply a long-term view, and advocate for widespread adoption of "UNICEF recommendations. UNICEF stresses the need for "a global prevention strategy with the following actions: (1) support caregivers; (2) help children manage risks; (3) change attitudes and norms that encourage violence; (4) provide support services for children; (5) implement child protection laws; and (6) conduct data collection and research" (Black et al., 2017). In line with the ecological model of child development, sensitivity to the influence and impact of time (chromosphere) to the window of child development is needed to create an urgency in ECD issues. There is a strong need for longitudinal research to support a life course approach and intervention for ECD in Nigeria.

Adopting mixed methods methodologies to unpack issues. As highlighted in the findings, increasing levels of maternal education is associated with improved outcomes for the child, which was attenuated across the models when child and state factors were added to the models. However, some of the interesting findings related to the cultural milieu is the consistent low level of maternal education, state median years of education, stunting and lower child outcomes related to ethnicity. In all the models, being of the Hausa ethnicity was associated with statistically significant poorer child outcomes than being from the Yoruba or Igbo ethnic groups respectively – in line with past studies (Adebayo & Olonisakin, 2018; Jimoh, Adaji, et al., 2018). Beyond the findings from other studies that continue to emphasize these and the attribution to

practices related to the predominant religion (which had low effects in the pre-analysis), future studies can use mixed method methodologies to try to unpack the mechanisms through which ethnicity and related cultural practices might affect outcomes in order to uncover points of leverage for interventions.

This study extends prior research on early childhood development in Nigeria by examining several risk and protective factors at child, maternal and state-levels using a nationally representative sample of Nigerian children. Findings will add value to policy as states reconsider their strategy and funding obligations to early childhood development, poverty at the family level and education of girls and mothers. For children living in conflict-affected areas or displacement centers in Nigeria, these findings suggest additional risk for poorer outcomes in those unstable settings. Further, the study points to the need for more intervention research in Nigeria that is directed at family-based prevention, and found to be successful in other settings. For instance, evidence-based studies (Betancourt et al., 2020) in Rwanda, linked to other platforms including social protection, health, and nutrition were found to be effective, cost-friendly, and provide opportunities for immediate strategies such as child stimulation, and quick-win opportunities during the most sensitive periods of child development.

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Table 3.1 Description of key variables

Measure	Question/Description	Coding
Child Outcome Score/Scale Items	Can (name) identify or name at least ten letters of the alphabet? Can (name) read at least four simple, popular words? Does (name) know the name and recognize the symbol of all numbers from 1 to 10 most of the time? Does (name) follow the simple directions on how to do something correctly? When given something to do, is (name) able to do it independently? Does (name) get along well with other children? Does (name) kick, bite, or hit other children or adults?	1 Yes 2 No
Child gender	Sex of focal child	0 Male 1 Female
Child age	How old is (name)?	3 years 4 years
Stimulating activities with child	in the past 3 days, did you or any household member age 15 or over engage in any of the following activities with (name): 1. Read books 2. Told stories 3. Sang songs 4. Took outside 5. Played with 6. Named/counted	0 4 or more activities 1 1-3 activities 2 No activity
Number of children's books or picture books for child	How many children's books or picture books do you have for (*name*)?	None, One, Two, Three, Four, Five, Six, Seven, Eight, Nine, Ten or more books (Recoded to 0 3-10 books 1 1-2 books 2 None
Child nutritional status	Computed from child anthropometry: Result of height / length and weight measurement Child's weight	0 Not stunted 1 Moderately stunted 2 Severely stunted

Attends early education	Does (name) attend any organized learning or early childhood education programme, such as a private or government facility, including kindergarten or community child care?	0 Yes 1 No
Sometimes to sick to play	Is (name) sometimes to sick to play?	0 No 1 Yes
Place of dwelling	Area	1 Urban 2 Rural
Mother's age	How old are you?	15 – 49 years
Mother's level of education	What is the highest level of school you attended?	None 0 Non formal 1 Primary 2 Secondary/Sec technical 3 Higher 4
Household wealth quintile	Computed from questions about household material possessions (household's cumulative living standard	Richest 5 Fourth 4 Middle 3 Second 2 Poorest 1
Religion	What is the religion of the head of this household?	Religion 1 Religion 2 Religion 3 Other religion (specify) 6
Ethnicity	Ethnicity of head of household	Hausa 3 Yoruba 2 Igbo 1 Other ethnic groups 0

Table 3.2. Summary of model specific specifications for the multilevel modeling

Model	Specification and estimation technique	Independent variables
Model 1	An unconditional random effects model where the dependent variable, the child outcome scale is allowed to vary randomly. In the model-1, there are no covariance at all, but rather a random effects analysis of variance (ANOVA) to show if there are any within state or between state differences in child outcomes and provide a justification for a multilevel model ECDXij = γ00 + u0j+ rij	No predictors
Model 2	A random intercepts model or one-way random effects ANCOVA to show the effects of the child level-1 predictors independently and yield more accurate estimates of the intercepts) (Woltman et al., 2012) ECDXij = γ00 + γ10*BOOKXij + γ20*ERLEDUij + γ30*STUNTij + γ40*CHDAGEij + γ50*CHDSEXij + u0j+ rij.	*Child variables* 1. Age 2. Sex 3. Early education 4. Nutritional Status 5. Picture books
Model 3	A random intercepts ANCOVA model with emphasis on individual mother-related and household level-1 variables. Mixed Model equation: $ECDX_{ij} = \gamma_{00} + \gamma_{10}*NWEALTH_{ij} + \gamma_{20}*EDUMOM_{ij} + \gamma_{30}*RURBAN1_{ij} + \gamma_{40}*MOMAGE_{ij} + u_{0j} + r_{ij}$	*Mother variables* 1. Mother's age 2. Support for learning 3. Education level 4. Wealth index 5. Place of residence 6. Ethnicity
Model 4	We analyze a combination of child and maternal/household factors in a random intercept approach. Mixed Model equation: $ECDX_{ij} = \gamma_{00} + \gamma_{10}*NWEALTH_{ij} + \gamma_{20}*EDUMOM_{ij} + \gamma_{30}*RURBAN1_{ij} + \gamma_{40}*BOOKX_{ij} + \gamma_{50}*ERLEDU_{ij} + \gamma_{60}*STUNT_{ij} + \gamma_{70}*MOMAGE_{ij} + \gamma_{80}*CHDAGE_{ij} + \gamma_{90}*CHDSEX_{ij} + \gamma_{100}*MOMACTIV_{ij} + u_{0j} + r_{ij}$	Both child and mother variables (in model 2 & 3)
Model 5	A means-as-outcomes model with emphasis on level-2 predictors. Mixed Model equation: ECDXij = γ00 + γ01*CMPLTPRj + γ02*MOMBREGj + γ03*BUDGETj + γ04*MEDYRj + γ05*ACTIVITYj + u0j+ rij	*State-level variables* 1. 2016 budget, log 2. % Children engaged stimulation 3. Aggregated mean wealth quintile 4. Median years of mother education

Model 6	Model 6 is a random intercepts and slopes model (a random coefficients regression model) where level-1 intercepts and slopes are allowed to vary across level-2 predictors –and a random slope (early education from level-1).	All level-1 and level-2 variables with early education as a random slope
Model 7	Model 7 is also in the random intercepts and slopes class featuring intercepts and slopes-as-outcomes as outcomes. Based on literature, we tested level-1 intercepts and slopes using level-2 predictors with two cross-level interactions (between 2 level-1 predictors and a level-1 and a level-2 predictor) to see if there are modifications on their different impacts on child's outcome.	All level-1 and level-2 variables with interaction terms

Table 3.3.
Descriptive statistics of sample (mother-child dyad n=11,207; states n=37)

Unit of observation	N (%)	Mean (SD)	Min	Max
Level 1 -Child				
Child outcome scale	11,207	4.60 (2.89)	0	10
Age		3.5 (.50)	3	4
3 years	5,717 (51)			
4 years	5,490 (47)			
Sex		1.49 (.50)	1	2
Female	5,515 (49)			
Attends Early Education Program		1.61 (.49)	1	2
Yes	4,382 (39)			
No	6,825 (61)			
Nutritional Status (Height for age z-score)		.63 (.81)	0	2
Not stunted	6,528 (58)			
Moderately stunted	2,351 (21)			
Severely stunted	2,328 (21)			
Number of books		.74 (1.63)	0	10
3-10 books	725(6)			
1-2 books	2,132 (19)			
None	8,350 (74)			
Sometimes too sick				
Yes	5,885 (53)	1.47 (.50)	1	2
Level 1 (Mother)				
Mother's support for child learning		2.30 (2.12)	0	6
4 or more activities	3,410 (30)			
1-3 activities	4,315 (39)			
No activity	3,482 (31)			
Maternal household wealth index		2.3 (1.18)	1	4
Poorest	2,605 (23)			
Second quintile	2,481 (22)			
Middle quintile	2,124 (19)			
Fourth quintile (Richest)	3,997 (36)			
Maternal education level		1.94 (.79)	1	3
Higher education	880 (8)			
Secondary school/technical	2,979 (27)			
Primary	1,950 (17)			
Non-formal	2,217 (20)			
None	3,181 (28)			
Religion of household head				
Christianity	4, 496 (40)			
Islam	6,572 (59)			
Traditional/none	139 (1)			

Place of residence		1.73 (.44)	1	2
Rural	8,218 (73)			
Urban	2,989 (27)			
Mother's age		31 (6.61)	16	49
Ethnicity of household head				
Hausa	5,390 (48)			
Yoruba	1,107 (10)			
Igbo	1,233 (11)			
Other ethnic groups	3,477 (31)			
Level-2 (States)				
% Children engaged in 4 activities or more		64.61 (16.8)	36.3	94
% Children in early childhood education		38.98 (30.2)	4.4	97.1
Aggregated household wealth quintile (Poorest)		.00 (.70)	-1.29	.93
% Children completing primary school		62.3 (21.32)	6.3	115.6
% Mothers knowledgeable birth registration		32.18 (20.1)	6.6	89.9
Median years of maternal education completed		4.86 (4.86)	0	11.4
State aggregated rural-urban divide		.00 (20)	-.63	.26

Table 3.4
Cross-tabulation of child factors with mother's educational level (mother-child dyad n=11,207)

Unit of observation	Higher N (%)	Secondary education N (%)	Primary education N (%)	Non-formal N (%)	None N (%)	χ^2 (p-value)
Child outcomes scale						
Yes, child can do (mean)	741 (84)	1,984 (66)	865 (44)	239 (11)	535 (17)	3.1e+03 ***
No, child cannot (mean)	139 (16)	995 (33)	1,085 (56)	1,978 (89)	2,646 (83)	
Attends Early Education Program						
Yes	760 (17)	2,054 (47)	877 (20)	233 (5)	458 (10)	3.5e+03***
No	120 (2)	925 (14)	1,073 (16)	1,984 (29)	2,723 (40)	
Nutritional Status (HAZ z-score)						
Not stunted	775 (88)	2,260 (76)	1,206 (62)	816 (37)	1,471 (46)	1.4e+03 ***
Moderately stunted	72 (8)	459 (15)	416 (21)	613 (28)	791 (25)	
Severely stunted	33 (4)	260 (9)	328 (17)	788 (36)	919 (29)	
Sometimes too sick						
Yes	389 (7)	1,494 (25)	996 (17)	1,213 (21)	1,793 (30)	55.88 ***
Number of children picture books						
3 - 10 books	255 (35)	347 (48)	88 (12)	7 (1)	28 (4)	2.9e+03***
1 - 2 books	363 (17)	1,051 (49)	396 (19)	98 (5)	224 (11)	
None	262 (3)	1,581 (19)	1,466 (18)	2,112 (26)	2,929 (35)	
Mother's support for child learning						
4 or more activities	597 (18)	1,502 (44)	532 (16)	263(8)	516 (15)	2.1e+03***
1-3 activities	200 (5)	958 (22)	871 (20)	830 (19)	1,456 (34)	
No activity	83 (2)	519 (15)	547 (16)	1,124 (32)	1,209 (35)	
Maternal household wealth index						
Poorest	5 (0.2)	93 (4)	244 (9)	938 (36)	1,325 (51)	5.0e+03 ***
Second quintile	13 (0.5)	283 (11)	482 (19)	728 (29)	938 (36)	
Middle quintile	55 (3)	617 (29)	531 (25)	377 (18)	544 (26)	
Fourth/Richest quintile	807(20)	1,986 (50)	693 (17)	174 (4)	337 (8)	
Place of residence						
Rural	303 (4)	1,711 (21)	1,469 (18)	1,922 (24)	2,813 (34)	1.6e+03 ***
Urban	577 (19)	1,268 (42)	481 (16)	295 (10)	368 (12)	

Ethnicity						
Hausa	169 (3)	596 (11)	607 (11)	2,069 (38)	1,949 (36)	4.1e+03 ***
Yoruba	244 (22)	488 (44)	235 (21)	4 (0.4)	136 (12)	
Igbo	201 (16)	668 (54)	273 (22)	6 (0.5)	85 (7)	
Other ethnic groups	266 (8)	1,227 (35)	835 (24)	138 (4)	1,011 (29)	

Note: p<.05*, p<.01**, p<.001***

Table 3.5.
Correlation of Child Outcome Scale with Level -1 (Maternal and Child Predictors)

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1.	Child outcome scale	1										
2.	Child age	.17***	1									
3.	Child sex	.02**	-.01	1								
4.	No early Education	-.63***	-.09***	-.00	1							
5.	No picture book	-.53***	-.07***	-.02	.54***	1						
6.	Stunting (HAZ)	-.34***	-.09***	-.01	.34***	.27***	1					
7.	Mother age	.08***	.06***	.01	-.08***	-.06***	-.07***	1				
8.	Low wealth quintile	-.52***	-.00	-.00	.54***	.45***	.35***	-.06***	1			
9.	Rural residence	-.32***	-.01	-.00	.29***	.29***	.19***	-.06***	.51***	1		
10.	Fewer stimulation	-.29***	.04***	-.01	.30***	.33***	.16***	.02	.32***	.18***	1	
11.	Low Mom education	-.45***	.01	-.01	.48***	.41***	.27***	.01	.55***	.33***	.32***	1

Note: p<.05*, p<.01**, p<.001***

Table 3.6.
Correlation of Child Outcome Scale with Level -2 (State-level predictors)

		1.	2.	3.	4.	5.	6.	7.
1.	Child outcome scale	1						
2.	% Children engaged in 4 activities or more	.48***	1					
3.	State aggregated household wealth (Poorest)	-.50***	-.87***	.1				
4.	% Children attending early education	.50***	.90***	.90***	1			
5.	% Mothers knowledgeable birth registration	.41***	.73***	-.81***	.79***	1		
6.	Median years of maternal education completed	.47***	.84***	-.87***	.92***	.70***	1	
7.	State budget	.19***	.42***	-.42***	.35***	.29***	1	

Note: p<.05*, p<.01**, p<.001***

Table 3.7. Two-level multi-level model Hierarchical Linear Models of proximal and state-level predictors of early childhood outcomes [n=11,207] level 1 nested within level-2 states [n=37])

	Model 1 β (SE)	Model 2 β (SE)	Model 3 β (SE)	Model 4 β (SE)	_Model 5 β (SE)	Model 6 β (SE)	Model 7 β (SE)
Intercept γ_{00}	5.15 (.26) ***	7.48 (.12)***	6.94 (.18)***	8.59 (.17)***	3.39 (.96)***	7.17 (.92)***	7.15 (.93)***
Level-1 Fixed Effects							
Child							
Sex (female)		.04 (.04)		.04 (.04)		.04 (.04)	.04 (.04)
Age (4 years)		.63 (.04)***		.70 (.04)***		.70 (.04)***	.70 (.04)***
Early education program (No)		-2.31 (.05)***		-1.93 (.06)***		-1.92 (.10)***	-2.23 (.13)***
Sometimes too sick (Yes)		-.52 (.04)***		-.53 (.04)***		-.53 (.04)***	-.53 (.03)***
Number of books							
1-2 books		-.44 (.08)***		-.25 (.09)**		-.26 (.09)**	-.24 (.09)**
None		-1.84 (.09)***		-1.32 (.09)***		-1.30 (.09)***	-1.26 (.09)***
Nutritional Status (HAZ score)							
Moderately stunted		-.45 (.05)***		-.32 (.05)***		-.32 (.05)***	-.31 (.05)***
Severely stunted		-.57 (.05)***		-.38 (.05)***		-.37 (.05)***	-.37 (.05)***
Mom support for child learning							
1-3 activities			-.36 (.06)***	-.12 (.05)*		-.11 (.05)*	-.09 (.05)
No activity			-.36 (.06)***	-.17 (.06)**		-.16 (.06)**	-.15 (.05)**
Household wealth index							
Middle quintile			-97 (.07)***	-.57(.06)***		-.55 (.06)***	-.69 (.08)***
Second quintile			-1.56 (.08)***	-.90 (.07)***		-.88 (.07)***	-1.23 (.11)***
Poorest quintile			-1.62 (.08)***	-.91 (.08)***		-.87 (.08)***	-1.56 (.16)***
Maternal education level							
Secondary			-.76 (.09)***	-.35 (.08)***		-.36 (.08)***	-.32 (.08)***
Primary			-1.39 (.10)***	-.65 (.09)***		-.66 (.09)***	-.61 (.09)***
Non-formal			-1.66 (.11)***	-.83 (.10)***		-.84 (1.0)***	-.81 (.10)***
None			-1.77 (.10)***	-.82 (.09)***		-.83 (.09)***	-.80 (.09)***

Place of residence (Rural)			-.13 (.06)*	-.10 (06)		-.12 (.06)*	-.13 (.06)*
Mother's age			.01 (.00)***	.00 (.00)		.00 (.00)	.00 (.00)
Ethnicity							
Igbo			.68 (.13)***	.29 (.11)**		.21 (.11)	.20 (.11)
Yoruba			.66 (.12)***	.18 (.10)*		.13 (.11)	.12 (.11)
Hausa			-.43 (.07)***	-.21 (.06)**		-.20 (.06)**	-.19 (.06)**
Level-2 Fixed Effects							
Aggregate mean wealth quintile					-1.32(.25)***	-.17 (.24)	-.24 (..24)
% Children engaged stimulation					.03 (.01)***	.02 (.00)	.02 (.01)
State budget (Log)					-.20 (.16)	-.08 (.15)	-.10 (.16)
Median years of mum education					.03 (.04)*	-.03 (.03)	-.04 (.03)
Interaction terms							
No early Edu*Middle wealth q.							.36 (.11)**
No early Edu*Second wealth q.							.61 (.13)***
No early Edu*Poorest wealth q.							.94 (.18)***
Mean wealth quintile* Sick							.32 (.06)***
Random Components							
Level-2 intercept	2.49 (.59)	.31 (.07)	.36 (.09)	.14 (.04)	.18 (.08)	.18 (.06)	.19 (.06)
Level-1 intercept	6.02 (.08)	4.12 (.06)	5.00 (.07)	3.90 (.05)	6.02 (.08)	3.88 (.05)	3.85 (.05)
Random slope (no early Edu.)						.26 (.09)	.34 (.11)
Slope-intercept covariance						-.08 (.05)	-.09 (.06)
Model fit							
Wald Chi^2		5180***	2499***	6600***	418.47***	3131***	3013***
ICC	.29 (.05)	.07 (.01)	.07 (.02)	.03 (.00)	.03 (.01)	.05 (.01)	.05 (.01)
AIC	52106	47844	50032	47295	52036	47276	47224
Reliability	.99	.95	.97	.97	.92		
	Model 1 β (SE)	Model 2 β (SE)	Model 3 β (SE)	Model 4 β (SE)	Model 5 β (SE)	Model 6 β (SE)	Model 7 β (SE)

Note: p<.05*, p<.01**, p<.001***

Figure 3.1. Map of Nigeria showing the 36 states and Federal Capital Territory, Abuja

Figure 3.2. Adapted Theoretical Framework of the Social Determinants and Ecological Model of Child Development

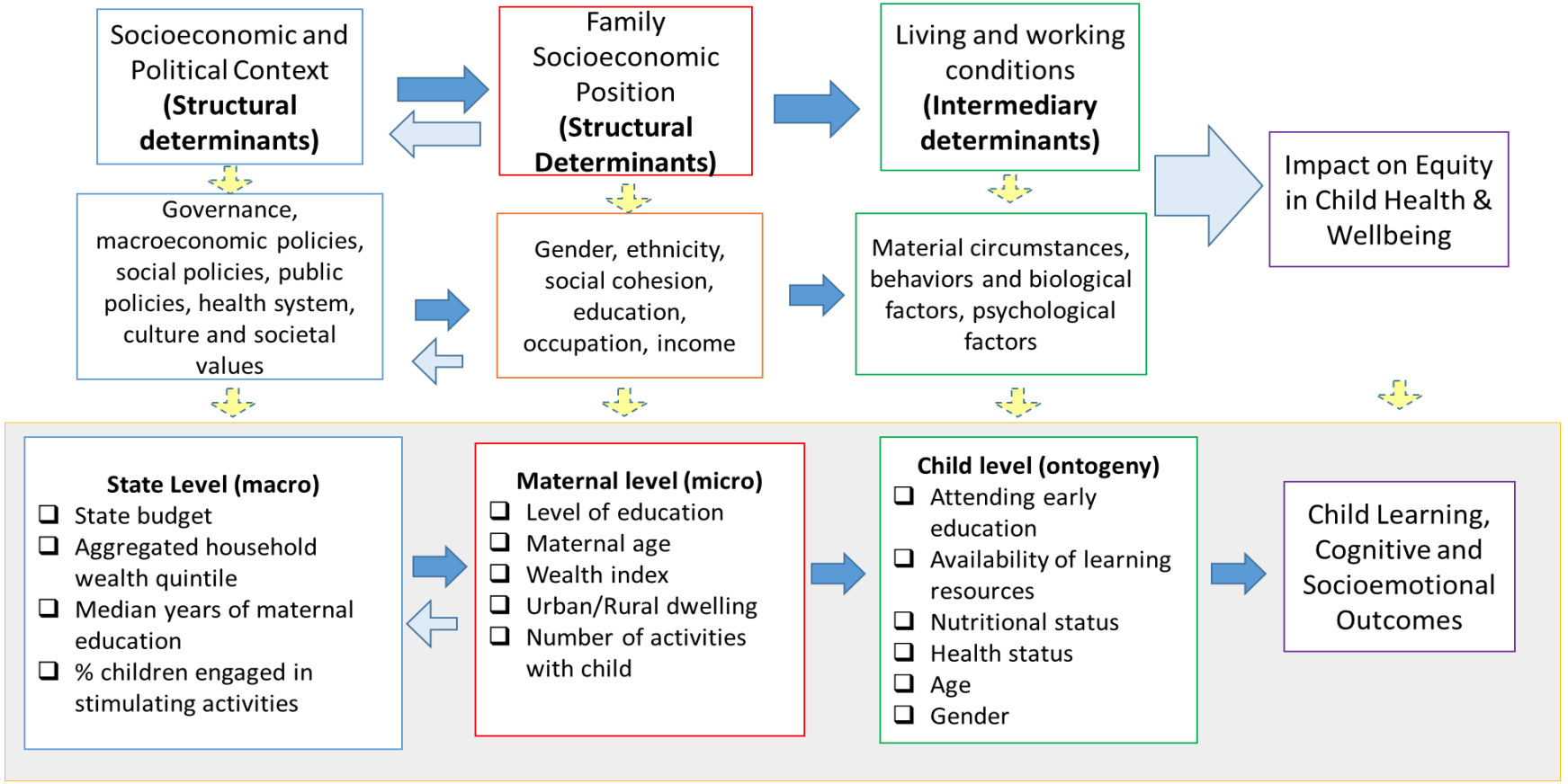


Figure 3.3 Distribution and Association of Household Wealth Quintiles and ECD Risk and Protective Factors (p <.001)

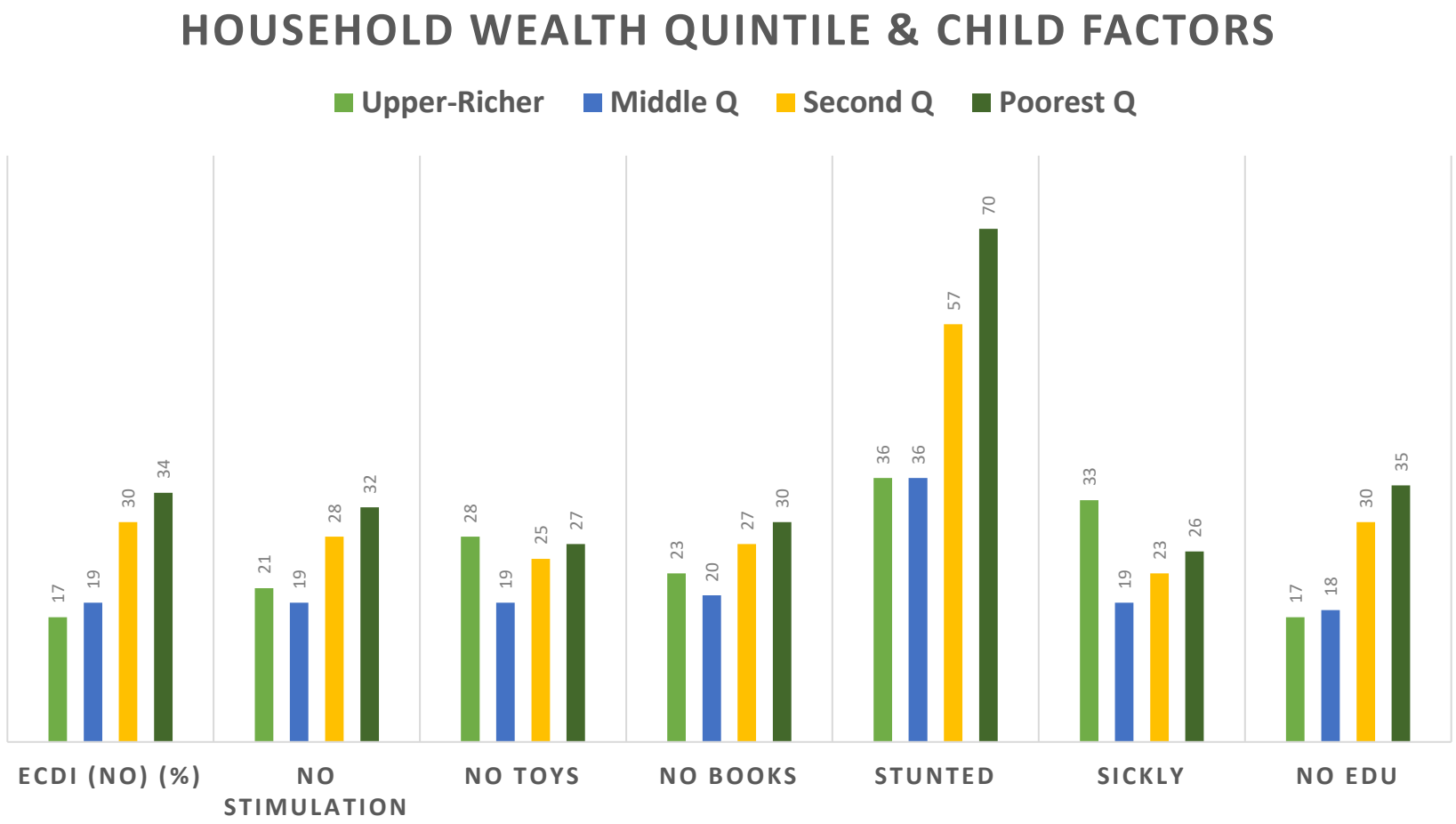
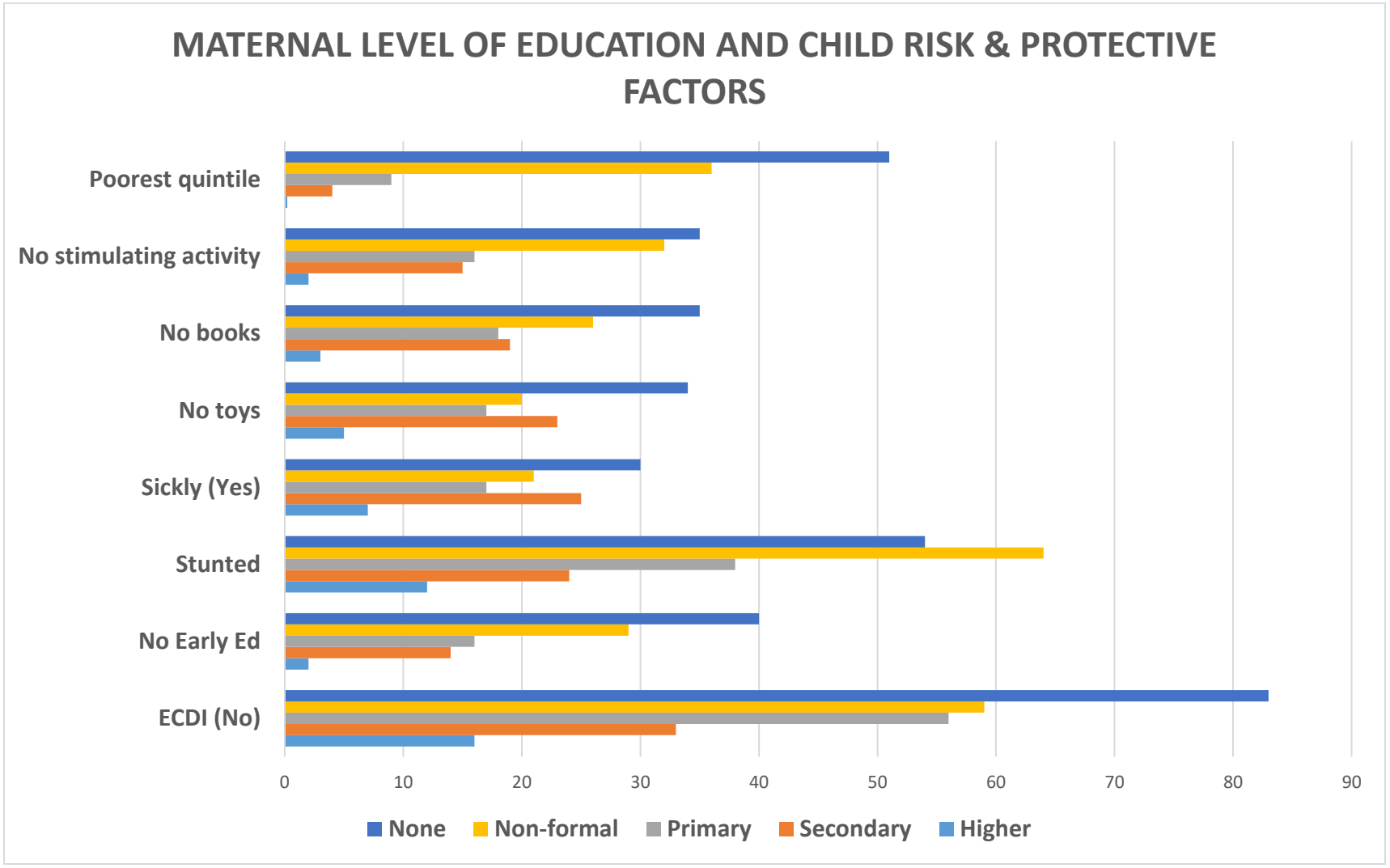


Figure 3.4 Distribution and Association of Maternal Level of Education and ECD Risk and Protective Factors (p <.001)



Chapter IV. Maternal Subjective Wellbeing, Cognitive, and Socioemotional Outcomes among 3– to 4- Year-Old Children in Nigeria

Introduction

Subjective wellbeing (SWB) has been defined as a combination of the eudemonic (positive functioning), and the hedonic (happiness and life satisfaction) features of an individual's wellbeing (Diener, 1984; Keyes, 2006). The nascent level of research on maternal wellbeing in sub Saharan Africa (SSA) calls for measures that can track the adverse consequences of poor mental health. This is especially true for Nigeria where the burden of common mental health disorders such as anxiety and depression is often underestimated (Abdulmalik et al., 2019; Gureje, Uwakwe, Oladeji, Makanjuola, & Esan, 2010; Mnookin, 2016). As a proxy for mental health, measures of SWB comprise the positive affect, negative affect, and life satisfaction with the affect portions being the emotional aspects while the life satisfaction aspect is viewed as the cognitive-judgmental or information appraisal based aspect (Diener, Emmons, Randy, & Griffin, 1985; van Hoorn, 2007).

Previous studies describe high levels of SWB as a state of broad mental health where an individual is flourishing (Howell, Keyes, & Passmore, 2013; Keyes, 2002). Few studies have examined the Subjective wellbeing (SWB) particularly of women and much less its association child literacy, cognitive, and socioemotional outcomes in Nigeria. Given the growing significance of maternal wellbeing and its impact on child developmental trajectories, it is essential to understand how measures of a mother's SWB are associated with child development outcomes. Previous research indicate that a mother's physical, emotional, and mental wellbeing affects her child (Goodman & Gotlib, 1999; Rose-Jacobs et al., 2008).

During early childhood's developmental window, socioeconomic factors associated with maternal SWB may expose a child to adverse experiences that affect development and predispose the child to later life disadvantage in health, cognition, and overall wellbeing (Black et al., 2017; Engle et al., 2011). Evidence from factors in a child's proximal environment indicate that childhood adversity leads to toxic stress and adverse outcomes for the child (Center on the Developing Child, 2007). Considering that children live and grow in family niches, the risks from low levels of maternal SWB can be extended to children (Bronfenbrenner, 1997), and these outcomes are largely unknown and need to be highlighted. This study thus aims to examine how the factors associated with SWB among a representative sample of women in Nigeria may be associated with early childhood outcomes, specifically in the literacy-numeracy, approaches to learning and socioemotional domains.

Significance

This study will add to the discourse on SWB in the Nigerian setting given the findings that high levels of SWB are associated with an increase in a country's wealth or gross domestic product (GDP) (Diener, Lucas, & Scollon, 2006; Lim, Cappa, & Patton, 2017). Indeed, while Nigeria's GDP has been rising for the past 15 years (Ibikunle, 2019), the very low life expectancy for men and women (53 and 56 years respectively) (Alloh & Regmi, 2017), and high infant mortality (Alloh, Regmi, Onche, Teijlingen, & Trenoweth, 2018; Izugbara & Wekesah, 2017) do not represent a commensurate association with the increasing wealth of the country. This disparity in health and wellbeing outcomes requires an investigation of the factors that may help explain these outcomes.

More so, pockets of research in Nigeria paint a gloomy picture of the prevalence of common mental health disorders among pre- and postpartum women (Iheanacho et al., 2015).

Barriers such as the dearth of a specialized workforce for mental health, issues of stigma, cultural practices, and nuances from multi-language interpretation of issues stifle progress in measuring mental health and wellbeing (Iheanacho et al., 2015). Perhaps, the framing of mental health issues through the positive and negative affect measures addressed in SWB may speak to a strengths-based approach to addressing mental health in the Nigerian culture, and provide utility in addressing these gaps.

However, few studies and interventions, if any, address the issue of SWB or maternal mental health, especially in Africa (Botha, Booysen, & Wouters, 2018). Most studies in other contexts (discussed in the literature review) have focused on a component of the SWB construct - life satisfaction and its influence on child cognitive and non-cognitive skills (Berger & Spiess, 2011; Nikolaou, 2012, 2017; Richter, Bondü, Spiess, Wagner, & Trommsdorff, 2018), and have been in Western and High-Income Countries (HIC). Encouragingly, the Sustainable Development Goals (SDGs) now includes a mental health target indicating the recognition of the importance mental health research in sub-Saharan Africa (SSA) (Lund et al., 2010).

In addition, the SWB construct's inclusion for the first time in the UNICEF Multiple Indicator Cluster Surveys (MICS) in Nigeria in 2016/2017 provides a unique opportunity to examine its utility in a nationally representative sample, and as a proxy for mental health estimations. The importance of examining SWB as a proxy for mental health also comes in the wake of Nigeria's projected population rise (Izugbara et al., 2017; Rahman et al., 2013 and its implications for child and maternal wellbeing (National Bureau of Statistics & UNICEF, 2017; UNICEF, 2017; United Nations, 2017). More so, the SWB module in the MICS was administered only to young men and women, 15 to 24 years old whose reproductive, economic,

and social decisions have impact on the future of Nigeria's children (National Bureau of Statistics & UNICEF, 2017).

Review of the Literature

Subjective wellbeing. Subjective wellbeing measures an individual's evaluation of their life. Subjective wellbeing highlights an individual's satisfaction with their past, present, positive emotions, and outlook toward the future (Diener, 1984; Lim et al., 2017). Subjective wellbeing is distinct from other measures of wellbeing because it is defined by the individuals themselves (Lim et al., 2017; Prasoon & Chaturvedi, 2016). Subjective wellbeing is measured via three components –positive affect (PA), negative affect (NA), and life satisfaction, summing up a sense of contentment one has about life (Diener & Biswas-Diener, 2002; Diener et al., 1985; Prasoon & Chaturvedi, 2016). As a measure of psychological wellbeing, SWB has roots in thinkers such as Aristotle and Maslow who studied and promoted the concept of self-actualization, full-functioning, and full development, which were all used to develop a model of mental wellbeing (Ryff, Lee, & Keyes, 1995).

In their study of five European countries using the MICS SWB construct, Lim, Cappa, and Patton (2017) found that young adults 20 -24 years were likely to less satisfied with life compared with those in the 15 -19 years category. In addition, being married, higher wealth quintile, having children, tertiary education, and residing in a rural area were associated with increasing the odds of life satisfaction (Lim et al., 2017). They also note that across the general population, countries of sub-Saharan African origin, Syria, and Afghanistan scored the lowest in life satisfaction.

As a population-based measure, SWB has been associated with the wealth of a nation and the level of human rights appropriated to individuals (Diener et al., 2006). A study highlighted

elements that accounted for 85% of the variation in wellbeing at the national level namely the country's GDP, life expectancy, rates of divorce and political stability (Diener et al., 2006), most of which change with time. Moreover, country political ideology contexts, climatic conditions, and individual situational factors such as unemployment are associated with levels of SWB but these associations are found to differ by country contexts.

Previous studies using indicators of SWB, namely happiness and life satisfaction showed statistically significant correlations with mental health where mental health is defined as a self-evaluation of life satisfaction, and the absence of depression or anxiety (Lombardo, Jones, Wang, Shen, & Goldner, 2018). In a study of over 460,000 participants in Canada, self-reported mental health was found to be strongly associated with life satisfaction where people with poor mental health had life satisfaction levels that were very low (Lombardo et al., 2018). Also, in a non-representative study of 364 youth in Turkey, depression, and anxiety were found to be associated with life satisfaction and hope (Guney, Kalafat, & Boysan, 2010).

Scholars hint at the heritability of SWB (Bartels & Boomsma, 2009) while others indicate that SWB is mostly associated with personality where negative or positive emotionality attributable to genes is a predominant indicator of SWB (van Hoorn, 2007), and where separate constructs of SWB chart to distinct personality traits (Bartels & Boomsma, 2009). Other factors such as better health, being married, or female are associated with higher levels of SWB (van Hoorn, 2007). Further, these studies suggest that SWB has a non-linear relationship with age where younger persons have a higher SWB that decreases over time and increases again as they age (van Hoorn, 2007).

Subjective wellbeing and mental health. Scholars suggest that mental health is a broad state of SWB (hedonic and eudemonic), including the absence of common mental disorders

(Keyes, 2006; Diener & Tay, 2016). Keyes notes that the best mental state to be in is when one is flourishing (opposite of languishing) and where no diagnostic and statistical manual of mental disorders, including major depression, is found (Keyes, 2002). Dimensions of psychological distress, an aspect of mental health are embedded in SWB. For instance, measures of SWB ask questions that relate to the possession of quality relations with others, the capacity to effectively manage one's life and the surrounding world; and a sense of self-determination – aspects of mental health which Heady and colleagues argue should be added to every population survey (Heady, Kelley, & Wearing, 1993). The SWB construct and questions relating to life satisfaction, optimism, and overall happiness present a positive framing of issues and a strengths-based approach to assessing wellbeing (Saleebey, 2008).

Subjective wellbeing is also classified as a measure of population health with previous studies demonstrating a strong positive relationship between SWB and a country's GDP (Levin et al., 2011; Lim et al., 2017; Prince et al., 2007). The MICS SWB construct comprises measures of happiness, life satisfaction, and optimism. Many studies have established the relationship between life satisfaction and mental health in general populations (Fergusson et al., 2015; Lombardo et al., 2018). For instance, a study found a positive association between life satisfaction and mental health problems such as measures of depression, anxiety, and alcohol dependence in a birth cohort of individuals aged 18 -35 years (Fergusson et al., 2015). Optimism or perception of a better future has been described as an 'inclination to hope' (Conversano et al., 2010). Optimism as a positive orientation toward life and measure of SWB is associated with quicker recovery, planning, problem solving and better mental health outcomes (Achat, Kawachi, Spiro, DeMolles, & Sparrow, 2000). The inclusion of happiness in the definition of SWB was previously viewed as unscientific (Heady et al., 1993) but many studies

in economics and psychology have continued to advance the construct as examining SWB is deemed an important element that therapists must consider when addressing wellbeing (Diener et al., 2017).

Subjective wellbeing in Nigeria. The number of studies focused on SWB in sub Saharan Africa are few and in between (Addai, Opoku-Agyeman, & Amanfu, 2014; Afolabi & Aina, 2014; Botha et al., 2018; Ebrahim, Botha, & Snowball, 2013; Tsai & Dzorgbo, 2012). Some of these studies used measures of SWB in the World Values Survey while others have used various composite constructs that represent SWB, with the life satisfaction scale being a common thread across board. A study in Ghana defined and measured SWB using the perceived security and avowed happiness variables and found that lower educational levels (particularly insufficient credentials) compared with those without education was associated with the lowest level of happiness (Tsai & Dzorgbo, 2012). The study examined the association of reciprocity in social networks with SWB and found that other factors such as number of marriage partners (polygyny being a common practice) and higher earning power affected a sense of security in wellbeing and noted that women and their SWB benefit less than the men do from the integrated relationships.

A study in the south western part of Nigeria examined the gender differences in the effect of religion on the SWB of male and female older adults (Afolabi & Aina, 2014). Subjective wellbeing was measured using scales of self-esteem, life satisfaction in various domains, quality of life, and health status. The study noted that the older adults (n=300) may evaluate their life differently as a result of their experiences and that the women were more likely to score higher in self-esteem and life satisfaction, which oddly was associated with lower level of education and subsequently lower aspirations (Afolabi & Aina, 2014). A study in Ghana found that religious

affiliation and relevance was associated with SWB, albeit weakly (Pokimica, Addai, & Takyi, 2012).

In another study, the SWB of female teachers (n=240) in a state public school in south-south Nigeria was strongly associated with social relationships in the work environment (Uche & Ngwu, 2017). A study of primarily educated adults (n=544) in a south-west Nigerian state examining the association of the life satisfaction index with various psychosocial outcomes such as extraversion, death anxiety and agreeableness found that family relationships was the primary predictor of life satisfaction, interacting with psychosocial factors to predict wellbeing (Adebayo & Arogundade, 2011). The psychological wellbeing of postpartum mothers (n=258) in Nigeria, encompassing happiness, peace, fulfillment and life satisfaction among was strongly associated with emotional (social support), along with age and level of education (Adejuwon, Adekunle, & Ojeniran, 2018).

Maternal Subjective Wellbeing. Studies examining constructs of SWB such as life satisfaction in other contexts find that overall life satisfaction for women decreases with age, whereas increases in personal income elevate SWB (depending on the county context), and stage of the life course (Jan & Masood, 2008). The increase in life satisfaction with income was found to decline over time in other studies (see e.g., Heady et al., 1993). In addition, scholars also indicate that the health status of individuals, genes, widowhood, recent unemployment, and social relationships affect SWB (Diener et al., 2017; Ebrahim et al., 2013).

Maternal SWB in Nigeria: Issues and challenges. Recent surveys indicate overall improvements in maternal wellbeing in Nigeria (Adebowale & Udjo, 2016; Ekpenyong, Bond, & Matheson, 2019; Okonofua et al., 2017). Maternal mortality rate in Nigeria has reduced to 512 per 100,000 live births (National Population Commission [Nigeria] & ICF, 2019). However,

most Nigerian women and mothers still live in a context where poverty, cultural practices, and festivals are known to restrict their movement, limit their options for livelihoods, and preclude their participation in decisions regarding their health care and wellbeing (Ekpenyong et al., 2019; Ikechukwu, Ofonime, Kofoworola, & Asukwo, 2020). Other factors such as early marriage, poverty, logistic barriers including limited access to care, transportation, distance, and costs mitigate the ease with which the mothers, many of whom reside in rural areas attend to their personal and children's health care needs (Ekpenyong et al., 2019; Iheanacho et al., 2015; Jimoh, Adaji, et al., 2018).

In many Nigerian settings, majority of the women between the ages of 15 to 16 years are married, often to older men, bear children early and too often, and rely heavily on traditional birth attendants, including traditional care procedures performed on children (Agunbiade & Udenkor, 2012; Jimoh, Anyiam, & Yakubu, 2018; National Population Commission [Nigeria] & ICF, 2019). Conditions of maternal reproductive health and services have been found to affect maternal and wellbeing in African settings (Fisher et al., 2012; Rotheram-Fuller et al., 2018; World Health Organization, 2014).

Past studies in Nigeria note that higher levels of education among the women folk is a most significant factor for the use of services and better outcomes for the children (Adedokun et al., 2017; Burroway & Hargrove, 2018). The impact of maternal education at the community level defining the cultural milieu was also found as a significant factor in child and maternal wellbeing in Nigeria (Adedokun, Adekanmbi, Uthman, & Lilford, 2017; Adeyanju, Tubeuf, & Ensor, 2017; Burroway & Hargrove, 2018). In addition, studies on maternal wellbeing among Nigerian women indicate that income and employment are the primary mechanisms in the linkage between maternal education and the skills it imbues the woman with to advance child

outcomes particularly health (Adeyanju et al., 2017). Studies also highlight differences in the way Nigerian women and men spend money -with women directing more resources towards health care and development of the children (Burroway & Hargrove, 2018).

However, fewer women in Nigerian own assets, investments, or are engaged directly in agriculture or industry at a commercial level thus extending the poverty level among the women and negatively impacting outcomes for their children (Matthew, Adeniji, Osabohien, Olawande, & Atolagbe, 2020). Also important is the influence of the increasing use of information and communication technology in accessing maternal and child health information in Nigeria that is associated with maternal socioeconomic status (Obasola & Mabawonku, 2017).

There are indications that a mother's feelings about her health and welfare, including her satisfaction with life, may influence her decisions and health behaviors including those that affect her children. However, in a study of maternal SWB and its association with routine immunization among noncompliant mothers in Northern Nigeria, findings reveal that compliant and noncompliant mothers were similar in their SWB levels, and only the mother's attitude toward the Polio vaccine was most associated with noncompliance (Umeh et al., 2018). In their qualitative study of primarily single adolescent mothers' SWB in south-west Nigeria, Agunbiade and Udenkor (2012) found that despite numerous challenges and poor subjective wellbeing, the young mothers were resilient, optimistic, and intent on using their agency to advance their wellbeing and that of their children (Agunbiade & Udenkor, 2012).

Maternal SWB and Early Childhood Outcomes

Children enter developmental niches and grow according to ideals from the prevailing culture and, guided by their parents or caregivers. Tied to a child's proximal environment, several factors and events in the earliest years of life interact to affect the developmental journey

(Braveman & Barclay, 2009; Bronfenbrenner, 1997; Center on the Developing Child, 2007; Monk, Georgieff, & Osterholm, 2013). When children have physical contact with others, primarily, the loving contact from a mother, their neural circuits are stimulated, growth and gene transcription occurs, shaping their sensory-motor functions (Cozolino, 2017).

Children need this nurturing care in health, nutrition, security, responsive caregiving and early learning (Black et al., 2017; Frongillo, Kulkarni, Basnet, & Castro, 2017) to reach their development potential. Resources –social or economic that parents have at their disposal are a strong determinant of stability and subsequent cognitive and emotional development in their children (Braveman, Egerter, & Williams, 2011). Subsequently, a mother's physical, emotional, and mental wellbeing and satisfaction with life reflect on her ability to nurture and facilitate affects outcomes for her child (Black & Surkan, 2015).

A study of 291 mother-child dyads in Germany indicated that higher levels of maternal life satisfaction were associated with positive parenting practices such as more developmental activities conducted with the child and subsequently, child outcomes (Richter et al., 2018). However, the authors note that maternal satisfaction did not directly influence the child prosocial behavior or verbal outcomes domain. Their previous study suggests that activities or time spent with a child do not mediate the relationship between maternal life satisfaction and skills attained by the child (Berger & Spiess, 2011). Other studies establish that when maternal life satisfaction (an element of the SWB construct) is increased by 10%, there is a commensurate increase in child social and self-regulation skills, a statistically significant association which interestingly did not pertain with paternal life satisfaction (Nikolaou, 2017). Another study showed that maternal life satisfaction is associated with child outcomes but is mediated by stimulating activities (Lerner & Galambos, 1985).

Berger and Spiess (2011) also found that SWB is associated with maternal personality traits (such as openness, conscientiousness, extraversion, neuroticism, and agreeableness) which is, in turn, associated with a child's non-cognitive skill outcomes. However, the findings also note that the mother's personality trait is not a significant confounding factor in the association between child outcomes and maternal life satisfaction (Berger & Spiess, 2011). In line with this finding, another study (Desjardins, Zelenski, & Coplan, 2008) indicates that SWB is a moderator of the association between maternal personality and maternal parenting styles. On a similar note, and in a sample of 258 nursing mothers in Nigeria, personality trait and social support were jointly associated with maternal wellbeing outcomes measured via the general health questionnaire (Adejuwon et al., 2018).

Another study showed that only the mother's estimation of their subjective happiness was a predictor of child behavior problems, while both life satisfaction and happiness were associated with a child's prosocial behavior and adverse conduct problems (Brajsa-Zganec & Hanzec, 2014). In a sample of 2-3-year-olds and 5-6-year-olds in a longitudinal study in Germany, maternal life satisfaction was significantly associated with decreased behavioral problems and increased cognitive function in children (Berger & Spiess, 2011).

A study in Nigeria found that 30% of pregnant women examined warranted some psychiatric attention; 12.5% presented with psychiatric disorders; and 8.3 percent with depression (Okewole, Adewuya, Ajuwon, Bella-Awusah, & Omigbodun, 2016). Other studies (Iheanacho et al., 2015) indicate that 10% of Nigerian women in their sample experience depression during pregnancy while 20% of the women experience postnatal depression. With a dearth of specialized mental health services (World Health Organization, 2008), over 50 percent of these women are missed as they seek alternate maternal services in non-hospital settings, from

untrained and unregulated TBAs, religious organizations, prayers, celebrations (Baumgartner, Kaaya, & Siril, 2015) and a general shortage of mental health specialists. In the current study setting, Nigeria, previous studies indicate that factors such as the sex of a child, if female, having a preterm baby, marital status and adverse life events (Adewuya et al., 2006; Adewuya, Fatoye, Ola, Ijaodola, & Ibigbami, 2005; Okewole, Adewuya, Ajuwon, Bella-Awusah, & Omigbodun, 2016; World Health Organization, 2008) are associated with poor maternal mental health and depression.

Overall, all mothers are at risk for mental health and wellbeing problems (Stewart, Robertson, Dennis, Grace, & Wallington, 2003), that are interconnected with adverse, long-term outcomes for their children (Chilton, Chyatte, & Breaux, 2007; Gundersen & Ziliak, 2014). In this study, we argue that factors affecting a mother's mental health and subsequently, her SWB will influence her interactions with and outcomes for her child. For this study, we posit that based on the theory posed by the family stress and investment models, a more resourced and socially positioned mother has a higher level of life satisfaction. She is in a better mental state that is more sensitive and responsive to the needs of her child, and better equipped to facilitate developmental processes and activities for her child (Berger & Spiess, 2011; Conger et al., 1992).

Theoretical Framework

This study will draw from the family stress theory (Conger et al., 1992) and the family investment model (Conger & Donnellan, 2007) to underscore the interplay of family circumstances primarily socioeconomic status, parental emotional response, and their influence on child development. The basic premise of the family stress model is that the way parents experience and manage stressful conditions have an impact on their emotion and behavior and

that parents' altered behavior may play a role in outcomes for their children (Conger et al., 1992; Conger, Elder, Lorenz, Simons, & Whitbeck, 1994). The family stress model assumes that the strain and pressure that result from unconducive conditions are instrumental to mood and behavior changes among family members and, alter the course of parents' and consequently, children's lives.

The family stress model highlights the association between low family income, unstable work, debt-to-asset ratio, and income loss to economic pressure that affects other areas of family functioning, namely parents' emotional distress and marital conflict, which give rise to disrupted parenting (Conger et al., 1992), see figure 1. The framework argues that stressful family situations may give rise to an increase in domestic violence, child abuse or neglect and other disruptive family situations that undermine a child's sense of security (Heckman, Pinto, & Savelyev, 2012). Further, the relationship of financial distress to marital relationship outcomes had an impact on children's lives (Conger, Conger, & Martin, 2010). Parents' depressed moods were found to be associated with marital conflict, which affected the mother's nurturing or involved parenting that is associated with adjustment problems in the child. Findings showed that the discord in parental emotional and behavioral status is likely to lead to interpersonal conflict and withdrawal (disruptions in parenting) and it may lead to harsh, inconsistent, uninvolved parenting that ultimately leads to lower cognitive, learning, and emotional and behavioral outcomes for children (Conger et al., 2010).

The family stress model (see figure 4.1) was used to illustrate the association between lower family income, parental depressive symptoms, and child outcomes in a sample from rural Minnesota. Lower income was associated with disruptive parenting practices, and poor parent-child relationships and findings were consistent with the model (Lee, Anderson, Horowitz, &

August, 2009). A longitudinal study of 134 families in Kansas with children in the first three years also used the family stress model to show that resources are a significant mediator to child outcomes for affected parents (Muslow, Caldera, Pursley, Reifman, & Huston, 2002). Muslow and colleagues (2002) noted that a mother's level of satisfaction, especially with their employment, spousal relationship, or support from extended family, also affected their parenting activities.

Additionally, the family investment model (see figure 4.2) posits that higher income and educational levels will predispose parents to greater investments (substantial and interpersonal) made toward their children's developmental processes (Conger & Donnellan, 2007). Investments such as learning materials, direct or indirectly involved stimulation, material provisions for a higher standard of living, and residential location are examples of wellbeing factors that emanate from economic wellbeing, and that help a child developmentally. Besides, economic pressure and parental distress, including psychological, are negatively associated with parenting practices by reducing communication and affection toward their children (Lee et al., 2009). Further, in the face of stressful financial events or stressful economic status (if any), a mother's emotion and behavior may be altered. These will affect the resources invested toward child development (provision of play materials, children's books or facilitation of enrollment in early education) and her disposition to nurturing, involved parenting (number of stimulating activities with the child), and ultimately early childhood outcomes.

Using the Investment Model, Hartas (2011) examined the link between family income and how a child performs cognitively and linguistically (Hartas, 2011). Although their findings showed that socioeconomic risk factors had a stronger effect on language/literacy than on social competence, they noted that a mother's education was more effectual than family income in

accessing resources and fostering cognitive stimulation for the child. Another use of the family investment model confirmed that a positive association exists between parental SES and the child's responsive communication and vocabulary development (Sohr-Preston et al., 2013).

Based on the family stress theory and the investment model, family economic hardship leads to family economic pressure, and both affect parent's emotional and behavior, and child outcomes. In addition, using the models, the impact of lack or poverty resulting from low income is a significant mental health determinant with studies suggesting that there are more detrimental outcomes for children when the mother's mental health is affected than is the case with the father (Watkins, Pittman, & Walsh, 2013). This study adapted both models to posit that the socioeconomic status of a mother (measured by the household wealth index, mother's education, and context -rural or urban) will affect the mother's emotional state (examined through her subjective wellbeing, and consisting of her level of life satisfaction, overall happiness and optimism). As depicted in figure 4.3, we hypothesized that her subjective wellbeing and socioeconomic status may play a role in the amount of resources and time invested in child development.

Purpose and Aims of the Study

The objective of this study was thus to examine the hypothesized pathways in the adapted family stress theory and family investment model using the maternal SWB constructs and child literacy-numeracy, cognition, and socioemotional variables measured in the MICS, and in the Nigerian setting. The analysis addressed the following hypotheses:

1. Mothers with higher levels of education, living in urban areas, and having higher family wealth index (socioeconomic status) will have higher levels of subjective wellbeing

2. Mothers with higher levels of subjective wellbeing (life satisfaction, overall happiness and, optimism for a better future) will be more involved and invest more resources toward their child's development and thus have higher child development coefficients
3. Higher levels of education, family wealth index, and living in urban areas (higher socioeconomic status) will be associated with more resources for child development and better outcomes

Methods

Data set. Data for this study was obtained from the 2016/2017 Multiple Indicator Cluster Surveys (MICS) facilitated by UNICEF. The MICS are household surveys that provide internationally comparable estimates of adult and child socioeconomic and health indicators. Designed to support the measurement of Sustainable Development Goals (SDGs) indicators, the survey contains household, women, men, and child modules. The sampling frame for the study was the 2006 population-housing census, updated in 2015 (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). Questions were administered to 33,901 households (response rate 98.9%) to women and men ages 15- 49 years. Only women 14 -24 years old were administered the subjective wellbeing module. These mothers or primary caregivers provided information on the focal child under 3-4 years old.

Measures. The structural and measurement models comprised exogenous and endogenous variables in four latent variables, the maternal SWB construct, maternal socioeconomic construct, investments in child development and the child outcomes construct.

Socioeconomic status: As shown in figure 3, the first latent exogenous measure comprised items measuring the household wealth quintile, maternal level of education, and family's geographic context. Maternal level of education was recoded into a binary variable for

women with secondary school education/above or primary, non-formal/none. The household wealth index quintile was recoded into households in the lower and upper quintiles while the geographic location was a binary measure indicating rural or urban residence. A covariate, mothers or caregiver age was recoded into two categories 15-19 years and 20-24 years.

The SWB latent construct. As defined by the MICS, the SWB latent endogenous construct consists of the life satisfaction, overall happiness, and perception of a better future variables (National Bureau of Statistics (NBS) & United Nations Children's Fund (UNICEF), 2017). *The life satisfaction* measure were nine items that asked for the woman's level of satisfaction with family life, friendships, current job, health, where she is in life, where she lives, how people around generally treat her, the way she looks, her life, and her overall life satisfaction. Optional responses include "very satisfied, somewhat satisfied, neither satisfied nor unsatisfied, somewhat unsatisfied or very unsatisfied." As most of the women were not in school or employed, items asking for the level of satisfaction in those areas were not included. The remaining seven items (alpha, .85) were used to create a life satisfaction scale and recoded to a dichotomous variable of women who were either satisfied with life or not. Preliminary confirmatory factor analysis for the life satisfaction variables showed adequate fit to one factor.

The overall happiness variable asked, "First, taking all things together, would you say you are very happy, somewhat happy, neither happy nor unhappy, somewhat unhappy or very unhappy? This variable was recoded to a dichotomous variable of women who were or were not happy overall. In addition, the perception of future wellbeing or a better life variable asked two questions (a weak alpha, .53): "compared to this time last year, would you say that your life has improved, stayed more or less the same, or worsened, overall and, in one year from now, do you expect that your life will be better, will be more or less the same, or will be worse, overall?"

These variables were recoded, combined to create a scale, and converted to a dichotomous variable that measures optimism.

Investment and resources for child development: The third latent endogenous measure for investments or resources toward child development comprised three items that include the number of color or picture books a child had (none or more than 1). Another item measured the number of stimulating activities (such as reading books/picture books, telling stories, singing to or with child, taking child outside the home, playing with child or naming/counting/drawing for or with the child) that the mother/caregiver engaged with the child in the past three days. The number of stimulating activities was converted to a scale and recoded to none or more than one. The third item asked if the child is enrolled in an early education program, a binary variable coded as yes or no.

Child outcome: The fourth and ultimate endogenous measure represents the child's developmental status. Eight items from the literacy-numeracy, approach to learning, and socioemotional domains (alpha = .70) taken from the MICS 10-item early childhood development index (ECDI) were used for the latent outcome construct. Two items in the physical domain that asked if the child was frequently too sick to play or if the child could perform the pincer grasp were dropped based on findings in chapter 2 that indicated that they were not ideal milestones for this age group, and did not perform well in the scale. The items in the literacy-numeracy domain asked caregivers if the focal child can name or identify at least ten items of the alphabet; if child can name and read at least four simple, popular words; and if the child knows the name and recognizes the symbol of all numbers from 1-10. The cognitive or approaches to learning domain had two items that asked if the focal child follows simple directions on how to do something correctly and if child can do something independently when given a task to do. The

socio-emotional domain asked if child gets along well with other children; if child kicks, bites or hits other children or adults; and if child gets easily distracted (Loizillon, Petrowski, Britto, & Cappa, 2017). Scales of each domain were created and recoded to a binary "yes or no" item.

Analytical Approach. A descriptive analysis of the sample, and a non-parametric analysis of the SWB construct in relation to other maternal, and child predictors was carried out. We also conducted a confirmatory factor analysis of each of the latent variables – socioeconomic status, SWB, investment and learning resources, and child outcomes and examined their goodness of fit statistics. A structural equation model (SEM) was conducted to test the hypotheses about the relationship between the mother's SWB, socioeconomic status, investment and resources, and child's literacy, learning, and socioemotional outcomes.

Model Specification and Identification. As shown in the hypothesized model (figure 4), this study examined the association between the primary construct, maternal SWB and child literacy, cognitive, and socioemotional outcomes, and covariates maternal SES and child investment and resources. There are 12 regression coefficients, 12 error variances, and six co-variances (30 parameters) to be estimated. With 12 observed variables (12 (12+1)/2), there are 78 data points; thus the model is over-identified with 48 degrees of freedom (Byrne, 1998).

Figure 4. Hypothesized SEM model and specifications of a fully latent framework of the association between maternal SWB and child literacy, learning approach and socioemotional indicators

Results

Descriptive Statistics. Of the women aged 15 -24 years (n=12,637) who responded the SWB questions, approximately 1,576 women had a focal child aged three or four years that were eligible for the childhood outcome questions. Overall, the final sample comprised 1,434 women

and their children (see table 4.1). Mothers 20-24 years old (90 % of the sample) were more likely to have had a secondary education and above (94%) than the women aged 15-19 years-old, a statistically significant association. Most of the women (95%) were in a union, with 88% currently married 88% and 6% living with a man. Seventy percent of the women had a primary level or no formal education, 72% were not formally employed, 72% had Islam as the religion of their head of household and, 82% lived in rural areas. The focal children in the sample were aged three years (57%), four years (43%), including 49% females.

Fewer children in the study (26%) were enrolled an early childhood education program irrespective of their age (4-year-olds, 29%, and 3-year-olds, 24%). Attending early education was positively correlated with number of books in the house (.53), mother's education (.47), wealth quintile (.41), and negatively correlated with living in an urban area (-.16). In terms of additional learning resources available to the child, 50% of the children had at least one toy, whether homemade, bought, or objects found lying around the house.

Further, only 17% of the children in the sample had at least one children's book or picture book in their homes. On average, more children (30%) had not been engaged in any stimulating activities by their mother in the past three days, however 56% of the children had been engaged in at least one stimulating activity. The number of stimulating activities was positively and statistically correlated with higher level of maternal education (.24), household wealth (.23), number of books in the house (.24), and negatively correlated with living in an urban area (-12). The three items that constitute the SWB construct (life satisfaction, overall happiness and, optimism for a better future) had an internal consistency value, Cronbach's alpha of .64. On average, 61% of the women were happy with their lives overall, 69% were optimistic in their perception of a better future wellbeing, while 61% were satisfied with their lives overall. There

was no statistically significant difference in the means of levels of the subjective wellbeing construct between the two age groups of the women.

Correlation of key variables. There was a strong correlation among the SWB items ranging from .60 between overall happiness and life satisfaction to a medium correlation, .29 between overall happiness and optimism. The items that constitute SWB had weak correlations with other hypothesized family, mother/child, and situational variables and not significant, except for variables such as the household wealth quintile and mother's educational level. Life satisfaction was associated with an increase in stimulating activities engaged with the child (.24, p=.05). (See table 1 demographic and frequencies of variables examined). In addition, life satisfaction was mildly but statistically significantly correlated with other variables including religion (.14), living in urban area (.10), wealth (.10), and mother's education (-.10).

Model estimates and fit assessment of the four latent constructs. Confirmatory factor analysis for the four latent measurement models, namely socioeconomic status, the SWB construct, child investment/resources, and the child outcomes with three indicators each (just identified models) were saturated. Each of the 12-factor loadings for the four measurement models were statistically significant ($p<.001$) and strong. For the socioeconomic latent variable, standardized factor loadings include .88 (.02) from household wealth quintile, .62 (.02) from mother's educational level and .58 (.02) from rural dwelling. For the SWB latent construct, factor loadings were .77 (.03), .68 (.03), and .42 (.02) from the life satisfaction, overall happiness and optimism predictors respectively. Factor loadings to the investment and resources toward child development include .44 (.03) from stimulation activities, .72 (.03) from early education, and .75 (.03) from picture books available in a child's home.

For the ultimate child development outcome latent construct, factor loadings from the literacy/numeracy .23 (.06), cognition and approaches to learning .80 (.18), and socioemotional development .24 (.06) were also statistically significant. All the latent constructs had acceptable fit statistics, and required no modifications (see tables 2 and 3). However, as latent constructs, the variables had lower than preferred internal consistency as shown by their Raykov's factor reliability coefficient –socioeconomic status latent (.64), subjective wellbeing latent (.67), investment/resources latent (.67), and child outcome latent (.47). Coefficients greater than or equal to 0.7 are usually preferred (see table 4.2).

Structural regression of final model. An initial analysis of the final model revealed a good fit between the model and the data using recommended standards (Schreiber, Nora, Stage, Barlow, & King, 2006). The chi-squared value of 258.83 with 48 degrees of freedom was statistically significant ($p<.001$), other fit statistics were within the normal range. The pattern of standardized coefficients in the final model was similar to the initial and pattern of the CFA of the latent constructs, see table 4. There was an observed strong and statistically significant covariance between maternal SES, representing living in a rural area, lower levels of maternal education, and household wealth and the child and outcomes (.58, $p<.001$). This large statistically significant value is the correlation between the two latent constructs. Similarly, and as expected, maternal SES had a strong covariance with resources invested in child development (.74, $p<.001$). There was also a high, negative, and statistically significant covariance between investment and resources for child development and the child outcome latent construct (-.79, $p<.001$). This implies that the observed variables in the child outcome (not attending early education, no stimulation activities, and no children's books) had a negative and strong covariance with child outcomes.

When modifications were requested, a suggested addition of the covariance between the error term of living rural and household wealth quintile yielding a covariance of .34 (.02) that was statistically significant at p<.001. The modified model with error terms of being rural and wealth quintile was a better model than the first with lower chi-squared and degrees of freedom that was statistically significant (148.48 (47), P<.001). Other fit indices such as the CFI (0.97) is within the ideal >0.90 value, RMSEA =0.043 is less than 0.08, TLI = 0.95 within the recommended greater than 0.95 value while the SRMR = 0.035 is within the ideal recommended value of less than 0.08 (see figure 4.2). At the equation-level goodness of fit, the overall R-squared for the model was 1.0, suggesting that the variables in the data had an 100% success of predicting the model, with the subjective wellbeing latent and socioemotional items accounting for the least variation in the child outcomes, having the lowest R-squared values .02 and .00 respectively (see table 4.4).

Discussion.

Findings from this statistically representative study suggest an average to a high level of SWB among the women in the sample. There were no statistically significant differences in the prevalence of the SWB constructs, overall happiness, life satisfaction, and perception of a better future, among the two age groups of women (15-19 years and 20 -24 years) and their means across most variables used for the study. However, there were statistically significant differences between the two age groups of women regarding their area of dwelling (rural or urban), educational level, and employment. In addition, women (overall 62%) who identified their religion as Islam (65%) were more likely to note that they were very satisfied with their life compared with Christians (54%) and traditional beliefs (50%). Women who identified their ethnicity as Hausa (67%), Igbo (53%) and Yoruba (33%) said they were very satisfied with their

lives. These differences were statistically significant. There was no statistically significant difference between women who had secondary education and higher (59%) and those who had primary and lower (63%) who noted that they were very satisfied with their lives. Similarly, women that noted they were satisfied with life overall did not differ from those that engaged in more than three activities with their children (63%) and those that did not (59%).

Many of the household and maternal variables that have been found to affect mental health in other studies in Nigeria such as loss of a child and income (Adewuya et al., 2005) were weak and not statistically significant in their association with the maternal SWB construct. Other than the SWB variables' strong correlation with each other, only the household wealth index, employment, and religion variables were significantly associated with maternal SWB, albeit with low effect sizes. Thus, while the SWB constructs examine the eudaimonic and hedonic aspects of mental health, the way the items on the MICS SWB module were phrased may be too broad to capture the specific mental wellbeing *affect* of the mother.

Further, the findings suggest that the SWB construct comprising overall happiness, life satisfaction, and perception of a better future has a very weak and inverse association with the latent variable for the child representing child literacy-numeracy, approaches to learning, and socioemotional outcomes. This weak direct path does not change when standardized or estimated indirectly through maternal influence on learning resources such as facilitating attendance to early education, the number of books or stimulating activities engaged in with the child (total effects of SWB to child = -.04).

The results also highlight the positive strength of association between family investment and learning resources comprising such as facilitating attendance to early education, the number of children or picture books available in the home, and the number of different stimulating

activities that the mother had engaged the child. The child resources latent variable had the most robust path to child outcomes (total effects, .79, p<.001). On the other hand, maternal SWB had a low and non-statistically significant path coefficient to investment and available resources for child development. This result suggests that maternal optimism, happiness or overall life satisfaction did not affect the processes or resources she mobilized toward the child nor the child development outcomes, or that the variables examined in the SWB construct are insufficient in capturing her mental state.

Directly to the child outcomes, the socioeconomic factors that include living in an urban area, being in the upper wealth quintile, and having some secondary education or higher had a weak effect on child outcomes with a coefficient of .09, that increased to a moderate coefficient that was not statistically significant (.58, p >.001) when standardized. Contributing significantly to the socioeconomic latent were maternal level of education (.77), household wealth quintile (.71), and rural/urban divide (.42). Overall, maternal socioeconomic status had a strong total effect and covariance with child outcomes (total effects .58) which may be attributed to its effect on investment/resources for learning (total effects = .74, p<.001), underscoring the direct and indirect importance of socioeconomic factors to child development. An error coefficient of .13 was associated with child outcomes suggesting that a few more factors are involved in its variation that are not included in the data. Although the covariance estimates do not say much about the direction of influence of these constructs, there is little concern that the relationships are spurious given the theoretical basis of the analysis. In line with the family stress and investment models, represent the association between socioeconomic status that translate into resources invested toward the child's development.

Limitations.

The limitations of this study need to be acknowledged. First, the study is cross-sectional nature and does not provide an opportunity to assess variables at more than one-time point, thus limiting causal inferences. Further, only mothers 15-24 years who are older adolescents and youth self-reported their SWB measures. Their life priorities based on age may affect their response to the SWB questions. There is also the possibility that examining life satisfaction, optimism, and happiness in the Nigerian population overlooks the impact of the country's collectivist culture, natural often-rural settlements, and social support that may mediate self-reported life satisfaction and overshadow the impact of neurological stress processes. However, recent studies also note a decrease in the role of family networks and reciprocity of support that had previously buffered poverty and lack in African settings (Tsai & Dzorgbo, 2012).

Indeed, most surveys in sub Saharan Africa do not have variables or measures that grasp the impact of the prevailing toxic stress from adversity and poverty in daily living encountered by the populace, especially women who produce over 80% of food in LMICS (Ivers & Cullen, 2011). Ignoring the impact of toxic stress, whose etiology is mostly unseen, may yield misleading results about mental health and subjective wellbeing in the Nigerian ecology. Another limitation of this study is that the conceptual basis of using measures of life satisfaction as a proxy for mental health may be problematic in the Nigerian setting, given the internalized or gendered position of the women may have been normed to, or accept as their lot in life may precipitate biased responses from her. Further, there are no other gold-standard measures for mental health outcomes in the survey to compare their association with SWB for validity purposes. This study is further limited by the nature of assessment of child development where questions about a child's developmental progress and milestones are maternal self-report rather

than direct assessments of the child and the HOME environment. Maternal self-reports while not standard are also subject to recall bias and social desirability.

Conclusion

This study set out to examine the association between maternal SWB and child outcomes in the literacy-numeracy, approaches to learning, and socioemotional development domains. The aim was also to examine the extent to which the SWB construct captures, and can be used as a proxy for mental health assessments given the positive association between SWB constructs such as life satisfaction and mental health problems (measures of depression and anxiety). We also set out to examine the association of covariates, resources invested in child's learning with maternal socioeconomic status measured by her level of education, context of residence - urban or urban, and her household wealth index. In addition, the study tested the hypothesis that mothers with higher levels of subjective wellbeing (life satisfaction, overall happiness and, optimism for a better future) will be more involved in child processes. Overall, we sought to examine the interplay of these factors and their impact on child outcomes.

Definition and application to the context. We noted that the definition and measure of SWB may be ambiguous in the Nigerian setting as intoned by several other studies/settings and suggestions that SWB may not be as systematic a measure (van Hoorn, 2007). Previous key studies have argued for, and established the association of SWB with mental health outcomes (Howell et al., 2013; Keyes, 2006). Yet, in examining maternal SWB and its subsequent association with child outcomes, this study hoped to extend the eudaimonic aspects of SWB as a proxy and precursor to mental health, raise awareness, and enhance the development of more responsive interventions. However, from our analysis, SWB though associated with child outcomes was found to be negligent in that effect, thus weakening the objective of proposing

SWB as a bridge to open up discussions on the mental health and its intergenerational risk factors in the population.

While SWB is widely accepted in the social policy sector, in GDP studies, and human development index studies of countries, it may not be the ideal proxy for mental health in sub-Saharan Africa even at the population level. In addition, Diener et al (2006) note that in an original treadmill theory of hedonic wellbeing, people's response to good and bad events which reflect on their happiness or not, and which emotions are often short-lived, change and revert to a neutral state with circumstance, may affect SWB outcomes. Thus, SWB examined via short-lived reactions such as happiness may not be a responsive measure to track or screen for mental health or illness (Diener et al., 2006). However, there was also an absence of a gold standard mental health measure in the MICS that could have been used to make a case for SWB as a rigorous but positive and strengths-based measure of mental health. There are brief mental health measures available that have been adapted for Nigeria that could be incorporated into the MICS (Gureje et al., 2010).

Further, the use of individual concepts in the SWB construct for analysis did not highlight strong associations with the child outcomes either, contrary to findings from some studies (Adejuwon et al., 2018; Berger & Spiess, 2011; Richter et al., 2018). In line with surmises from previous studies (van Hoorn, 2007), future study designs need to link SWB measures to more objective, biological measures that can be used to inform health interventions and policy.
Are Nigerian women really satisfied with life? Analysis from the study appears to imply so. We ascertained that the mothers residing both in Nigeria's rural and urban communities were faring well based on their responses as shown in the SWB measures. Most of the mothers adjudged themselves to be very satisfied with their lives in areas of family life, friendships, current job,

health, where they are in life, where they live, how people around generally treat her, the way she looks, and her overall life satisfaction. Most of the women were also very happy overall and optimistic about the future.

Subjective wellbeing and socioeconomic status. It is important to highlight the alignment of this study with the family stress theory and investment model. There was a weak but positive association between the SWB constructs and maternal socioeconomic status, which is in line with previous studies that note the non-linear relationship between wealth and life satisfaction (Addai et al., 2014; Heady et al., 1993; Jan & Masood, 2008). However, the impact of maternal socioeconomic status on child outcomes is in line with numerous studies cited and within the context. The SWB construct was weakly associated with most sociodemographic and economic measures of the mother including the child indicators.

Our findings also corroborate with the studies that showed that low levels of education is associated with lower aspirations and subsequently higher levels of life satisfaction (Afolabi & Aina, 2014). Maternal education albeit was associated with better child outcomes. In line with studies that find that socioeconomic risk factors particularly mother's education was more effectual than family income in accessing resources and fostering cognitive stimulation for the child (Hartas, 2011), this study showed that both maternal level of education (.73) and family wealth index (.74) were equally strong and similar in their contribution toward child outcomes. Of importance is the study that reiterates maternal education as a major antidote and gateway mediating most outcomes for the Nigerian child (Burroway & Hargrove, 2018).

The family stress theory also hints at maternal emotional status and its association with maternal behavior and child outcomes. Our study showed that maternal activities with her child was a strong predictor of child outcomes, however the study is limited in its ability to link

maternal engagement with child to stressors as indicated by the theory. Our study highlighted the effect of family investment, access to early education and learning resources, which had the most substantial association with child outcomes and is moderated by maternal socioeconomic status. Only 26% of the children of mothers 15 – 24 years old in the nationally representative sample attended an early childhood education program. While this low percentage is a cause for concern, it is important to note that the older children (four years-old) were more likely to be in school.

Further, living in an urban area and maternal life satisfaction was not associated with an increase in early education attendance. It is not clear from the data, the reasons associated with the low level of attendance, whether logistic, and awareness or due to a lack of resources. An important lead up to the implications of early childhood education to child outcomes is the call for longitudinal follow up of children in this age range, linking their outcomes to that of the caregiver mental health, education, and supports.

On the role of investments into child development, of 1,539 children ages 3-4 years in this sample, only 37 children had 4-10 children's books; 229 children had 1-3 books while 1,273 (83%) of the sample had no children's books or picture books in their home. These findings indicate an overall low level of family investment in time and resources toward child development. While higher levels of maternal education is associated with more activities with child, it is not clear what other reasons may be affecting the low level of engagement –whether it is a lack of time, awareness or unconducive living environment, as noted in other Nigerian studies.

Implications and Future Directions

***Investment in early education and learning resources*.** The association of early learning resources with child outcomes is significant. The very low prevalence estimates for attendance to

early education or number of books available to children call for attention and a need for policy makers, civil society organization, nonprofits and communities to invest in resources that support families to invest in resources that aid literacy and overall development of the child. There is a need for a campaign by the ministries of education and nonprofits to effectively distribute books to homes. These institutions can also collaborate with survey organizers such as UNICEF to make every survey an intervention encounter, distributing books and other learning resources to families with children under five.

Continued efforts should be directed at increasing opportunities for quality early learning opportunities and the provision of learning resources for children. The literature revealed that complaints over logistic barriers such as transportation and distance to services limited maternal access and use of health services (Adeyanju et al., 2017). There is a need to investigate the association of these factors to attendance to early education. For instance, the level of access to, distance, and mode of transportation to centers of ECE for families with children and its association with child outcomes should be investigated. It is important for policy makers to ensure that these barriers, if any, are planned for and eliminated promptly, barring findings from research, and given short but sensitive window of early childhood.

Maternal education/empowerment and Telehealth. Further, education facilitates literacy, which in turn promotes health and wellbeing and this is especially the case in health literacy that includes the skills needed to access health services (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). Our study highlights the significance of maternal education to child outcomes.

Studies from Nigeria attest to the increase in the use of information and communication technology to disseminate health and development information (Obasola & Mabawonku, 2017), and maternal access to information as a form of empowerment. Technology for health

(telehealth) and learning applications can be an important avenue for policymakers and early childhood development practitioners to promote practices that support ECD while subsidizing the cost and ensuring alternative power supplies and ease of use of information that aid telehealth. In line with studies on the impact of maternal education, and the need to support the girl child, this is a parallel opportunity to take advantage of the technological revolution going on in the world to advance development in the mother-child dyad.

Eliminating cultural barriers. Other studies in Nigeria have highlighted the impact of negative cultural beliefs and practices that mitigate against maternal and child health and note the influence of opinion leaders in communities (Ikechukwu et al., 2020). As with community participatory methods that advanced maternal reproductive health and family planning in the 90s, policy makers can harness the influence of traditional leaders to reinforce recommended practices that benefit the dyad. An important avenue to leverage the promotion of childhood development is the engagement of opinion leaders, traditional rulers, and to promote the adoption of positive childhood development practices.

Addressing disparities through family strengthening programs. There is an increase in the incidence of maternal mental health problems globally with attendant impact on child wellbeing. The disparities in health and development are complicated by the dearth of contextually relevant research/interventions that address the problems. This study calls attention first to the need to include in SSA studies, simple, gold standard, culturally validated mental health measures that are informed by the context and are thus more responsive to the status of families in the LMICs.

This study calls for research and interventions that highlight and address these disparities.

An important direction for researchers in Nigerian and LMICs would be to advance intervention research on the challenges of early childhood and subsequently advance evidence-based family strengthening programs. Social protection interventions that build parenting skills, improve communication at the parental and child level, reduce the use of harsh discipline (Betancourt et al., 2020, 2017) have assisted families to achieve cohesiveness and connectivity in other settings. Importantly, programs that support families to come out of poverty raise the bar and bring improvement overall.

Efforts to increase maternal education and empowerment, educate whole communities on family principles, and early childhood development practices, and reduce the incidence of family stressors will go a long way to strengthen families. Family strengthening intervention studies when adapted across the Nigerian landscape will strengthen attachment, build resilience, and foster a conducive environment for both mother and child to thrive and succeed.

This study aimed to advance the discourse on maternal SWB and child outcomes in the Nigerian setting given the findings that high levels of SWB are associated with mental health outcomes and reflect increases in a country's gross domestic product (GDP) (Lim et al., 2017). The continued disparities seen in Nigeria despite the increase in GDP (Ibikunle, 2019), is a pointer to the pervasiveness and negative impact of cumulative disadvantage from poverty, chronic stress and low socioeconomic status, especially in the rural areas. This disparity in health and wellbeing outcomes across the teeming population requires an investigation of the factors that may help explain these outcomes so that appropriate and evidence-based interventions can be supported. Finally, the study calls for efforts to address factors that predispose families to cycles of disadvantage that adversely affect child development and improve outcomes for future generations.

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Table 4.1.
Descriptive statistics and measures (n=1,557)

	N (%)	Women 15 -19 years	Women 20 -24 years	χ^2
Mother's age		156 (10%)	1,402 (90%)	
15 -19 years	156 (10)			
20 -24 years	1,402 (90)			
Religion				
Traditional/none	18 (1)			
Christianity	415 (27)			
Islam	1,115 (72)			
Household wealth quintile				
Lower quintiles (Poorest/second)	857 (55))			
Mid to upper quintiles	691 (45)			
Currently living with a man (Yes)	1,472 (95)	138 (10)	1,315 (91)	4.78*
Educational level				
None/Primary/non formal	1,085 (70)	125(12)	944 (88)	12.74***
Secondary/Higher	470 (30)	27 (6)	440 (94)	
Rural Dweller	1,275 (82)	139 (91)	1,120 (81)	10.25***
Employed	435 (28)	31 (20)	396 (29)	4.61*
Ever lost a child (Yes)	226 (17)			
Subjective Well-being				
Very satisfied overall	963 (61)	93(61)	853 (62)	0.01
Overall happiness	969 (62)	105 (11)	850 (89)	3.4
Optimism	1,072 (69)	104 (10)	956 (90)	0.03
Child				
Child's age				
3 years	879 (57)			
4 years	674 (43)			
Child's sex				
Female	763 (49)			
Literacy-numeracy (On track)	502 (33)	37 (24)	465(34)	5.33*
Approaches to learning (On track)	1,187 (77)	111(73)	1,076 (78)	1.74
Socioemotional (On track)	1,514 (99)	150 (99)	1,364 (99)	0.02
Attends early education	405 (26)	24 (16)	381 (28)	9.72**
Stimulating activities (None)	703 (46)	135(89)	1,135 (82)	4.4*
Has at least 1 toy (Home or shop)	777 (50)	64(42)	708 (51)	4.49*

Note: p<.001***, p<.01**, p<.05*.

Table 4.2.
Coefficients from CFA of Maternal Household Socioeconomic Status (n=1,434)

Factor loadings (Observed -> Latent Construct) *Measurement model*	Unstandardized coefficients (SE)	Standardized coefficients (SE)
Wealth	1	.88 (.02)***
Mother's education	.76 (.05) ***	.62 (.02)***
Rural-urban	.60 (.04) ***	.58(.02)***
Measurement Error Variances		
e.Wealth	.04 (.01)	.04 (.04)
Mother's education	.13(.01)	.03 (.12)
Rural-urban	.10 (.00)	.03 (.00)
e.Latent SES construct	.14 (.01)	1
Fit Statistics		
Overall parameter fit		.82
Chi-squared (df)		(0)***
SEA		0.00
CFI		1.0
TLI		1.0
SRMR		0.0
CD		.82

Note: p<.001***, p<.01**, p<.05

Table 4.3.
1.1 Coefficients from CFA of the Maternal Subjective Wellbeing Construct (n=1,434)

Factor loadings (Observed -> Latent Construct) *Measurement model*	Unstandardized coefficients (SE)	Standardized coefficients (SE)
Life satisfaction	1	.77 (.03)***
Overall happiness	.89 (.08)***	.68 (.03)***
Optimism	.51 (.01)***	.42 (.04)***
Measurement Error Variances		
e.life satisfaction	.10 (.02)	.41 (.05)
e.overall happiness	.12 (.01)	.53 (.02)
e.optimism	.18 (.01)	.83 (.06)
e.Latent construct SWB	.14 (.01)	1
Fit Statistics		
Overall parameter fit		.72
Chi-squared (df)		(0)***
RMSEA		0.0
CFI		1.0
TLI		1.0
SRMR		0.0
CD		0.72

Note: p<.001***, p<.01**, p<.05

Table 4.4.
Coefficients from CFA of the Child Investment and Resources construct (n=1,434)

Factor loadings (Observed -> Latent Construct) *Measurement model*	Unstandardized coefficients (SE)	Standardized coefficients (SE)
Stimulation	1	.44 (.03)***
Early education	1.61 (.13) ***	.72 (.04)***
Children's Books	1.42 (.11) ***	.75 (.03)***
Measurement Error Variances		
e.Has early education	.09 (.01)	.48 (.04)
e.Stimulation	.16(.01)	.80 (.12)
e.Children's books	.06 (.01)	.44 (.00)
e.Latent construct	.04 (.01)	1
Fit Statistics		
Chi-squared (df)		(0)***
Overall parameter fit		.72
RMSEA		0.00
CFI		1.0
TLI		1.0
SRMR		0.0
CD		.72

Note: p<.001***, p<.01**, p<.05*

Table 4.5. Coefficients from CFA of Child literacy-numeracy, learning and socioemotional (n=1,434)

Factor loadings (Observed -> Latent Construct) *Measurement model*	Unstandardized coefficients (SE)	Standardized coefficients (SE)
Literacy-numeracy	1	.23 (.04)***
Approaches to learning	2.71 (1.26***	.80 (.18)**
Socioemotional	.88(.17)***	.24 (.06)***
Measurement Error Variances		
e.Literacy-numeracy	1.02 (.)	.94 (.03)
e.Approaches to learning	.25 (.20)	.37 (.29)
e.Socioemotional	.75 (.04)	.94 (.03)
e.Latent construct	.06 (.03)	1
Fit Statistics		
Chi-squared (df)		(0)***
Overall parameter fit		.65
RMSEA		0.0
CFI		1.0
TLI		1.0
SRMR		0.0
CD		.65

Note: p<.001***, p<.01**, p<.05*

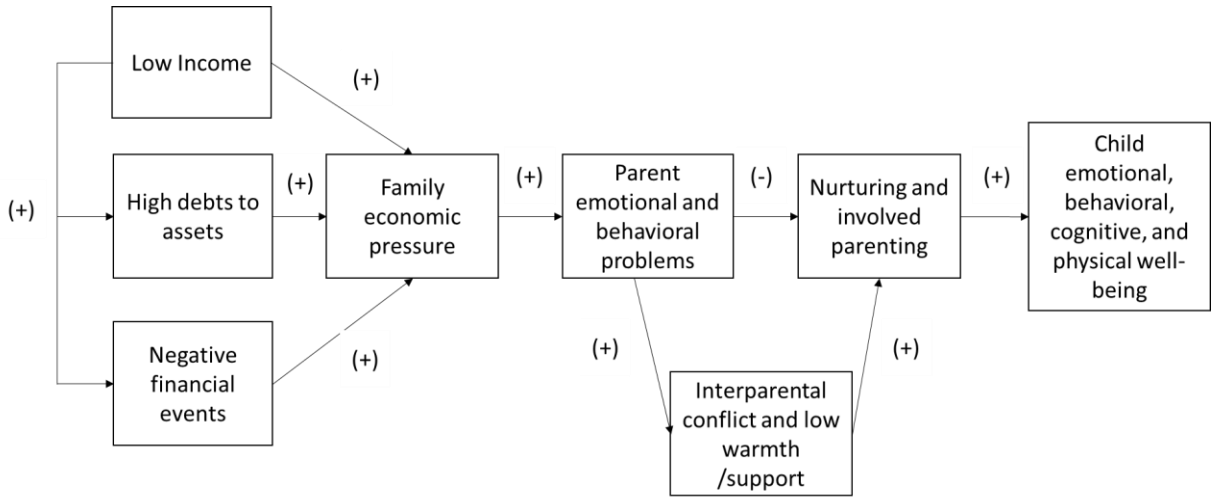
Table 4.6. Path Coefficients and Fit Indices for Modified Model of Child Literacy-numeracy, Learning and Socioemotional outcomes (N=1,434)

Factor loadings	Unstandardized coefficients (SE)	Standardized coefficients (SE)
Structural Model Covariance		
Maternal SES * SWB	.00 (.00)**	.08 (.04)*
Maternal SES * Child investment	.05 (.02)***	.74 (.03)***
Maternal SES * Child outcomes	-.09 (.01)***	-.58 (.05)***
SWB * Child outcomes	-.00 (.01)	-.00 (.03)
SWB * Child investment	.00 (.00)	.02 (.04)
Child investment * Child outcomes	-.27 (.01)***	-.79 (.05)***
Errors rural * wealth	.04 (.00)***	.33(.03)***
Measurement Model		
Maternal SES		
-Rural/Urban	1	.42 (.03)***
-Wealth	1.87 (.13)***	.71 (.02)***
-Mother's educational level	2.23 (.17)***	.77 (.02)***
SWB		
-Life satisfaction	1	.76 (.03)***
-Overall happiness	.90 (.08)***	.69 (.03)***
-Optimism	.52 (.05)***	.41 (.03)***
Child investment/ resources		
-Early education	1	.80 (.02)***
-Stimulating activities	.55 (.04)***	.43 (.03)***
-Children's books	.72 (.03)***	.67 (.02)***
Child development outcome		
-Literacy-numeracy	1	.94 (.06)***
-Approaches to learning	.17 (.03)***	.20 (.03)***
-Socioemotional	.06 (.03)*	.07 (.04)*
Measurement error variances		
-Rural/Urban	.12 (.01)	.83 (.02)
-Wealth	.09 (.01)	.50 (.03)
-Mother's educational level	.09 (.01)	.40 (.03)
-Life satisfaction	.10 (.01)	.42 (.05)
-Overall happiness	.12 (.01)	.53 (.04)
-Optimism	.18 (.01)	.83 (.02)
-Early education	.07 (.00)	.36 (.02)
-Stimulation	.16 (.01)	.81 (.02)
-Children's books	.08 (.00)	.55 (.02)

-Literacy-numeracy	.13 (.12)	.12 (.12)
-Approaches to learning	.66 (.02)	1.0 (.00)
-Socioemotional	.79 (.03)	.96 (.01)
Latent error variances		
Maternal SES latent	.04 (.00)	1
SWB latent	.14 (.01)	1
Investment/resources latent	.12 (.00)	1
Child outcomes latent	.96 (.13)	1
Fit Statistics		
Chi-squared (df)		148.48 (47)***
RMSEA		.043
CFI		.97
TLI		.95
SRMR		.035
CD		.99

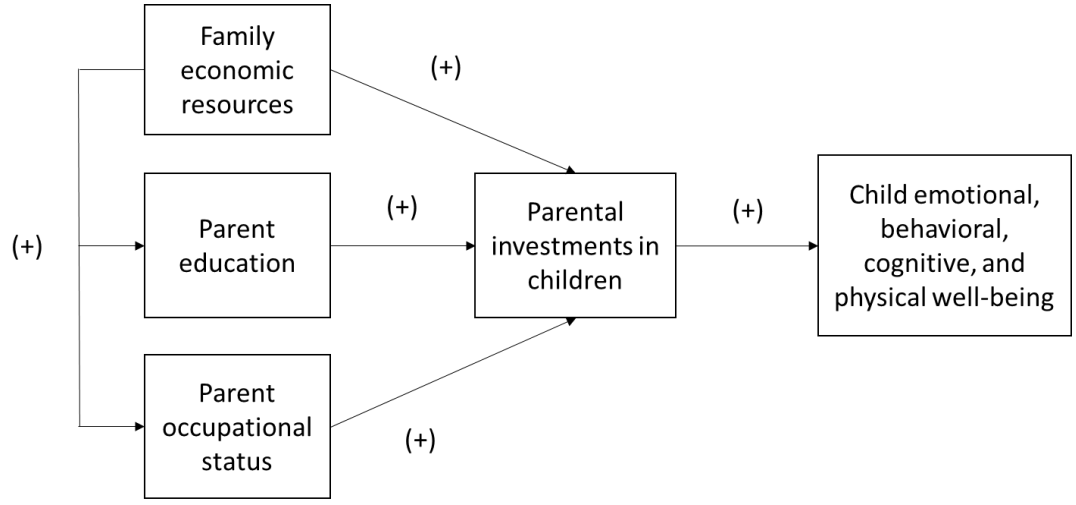
Note: p<.001***, p<.01**, p<.05*

Figure 4.1. The family stress model



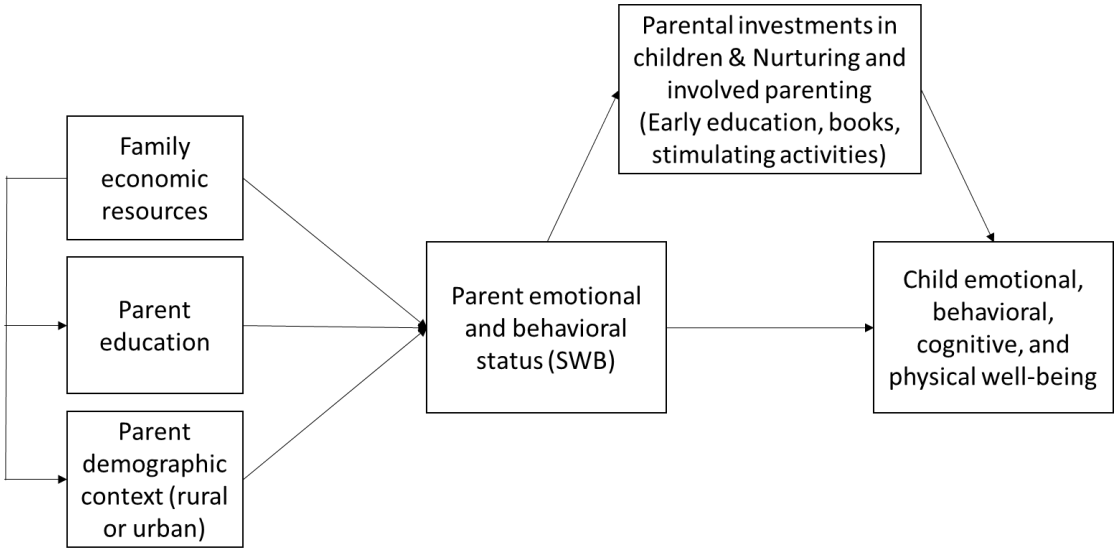
(Source: Conger & Donnellan, 2007)

Figure 4.2. The Family investment model



(Source: Conger & Donnellan, 2007)

Figure 4.3. Theoretical model of the association between maternal subjective wellbeing and child outcomes



(Source: Authors, 2020)

Figure 4.4. Hypothesized SEM model and specifications of a fully latent framework of the association between maternal SWB and child literacy, learning approach and socioemotional indicators

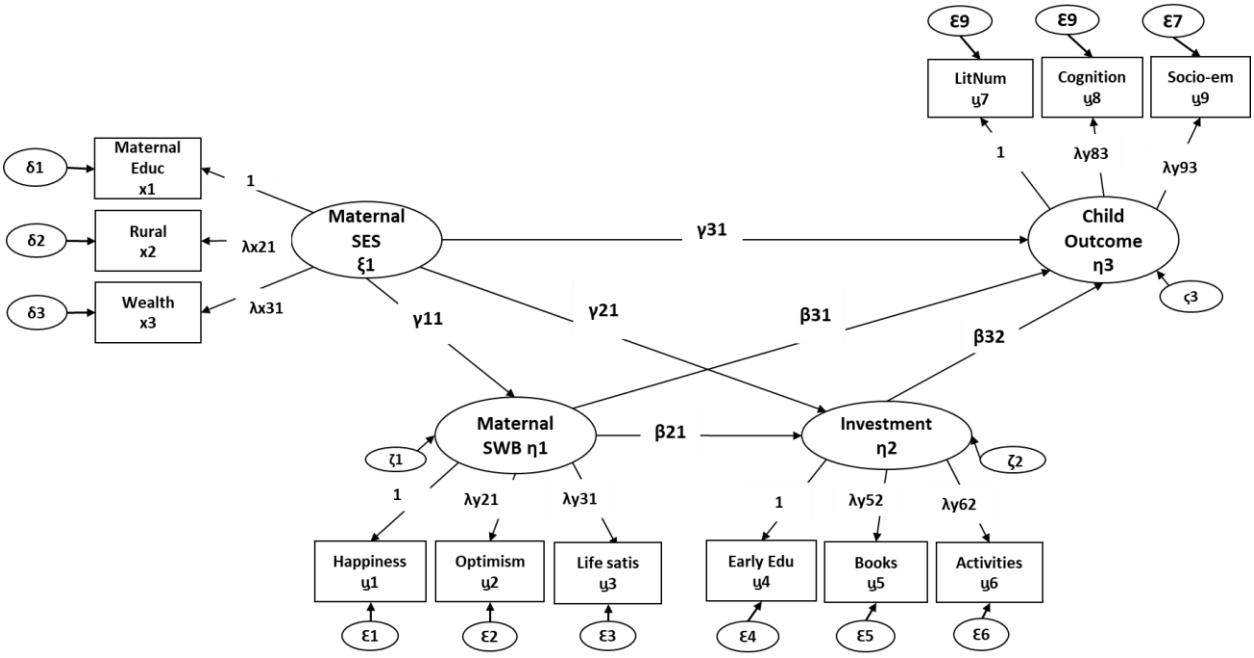
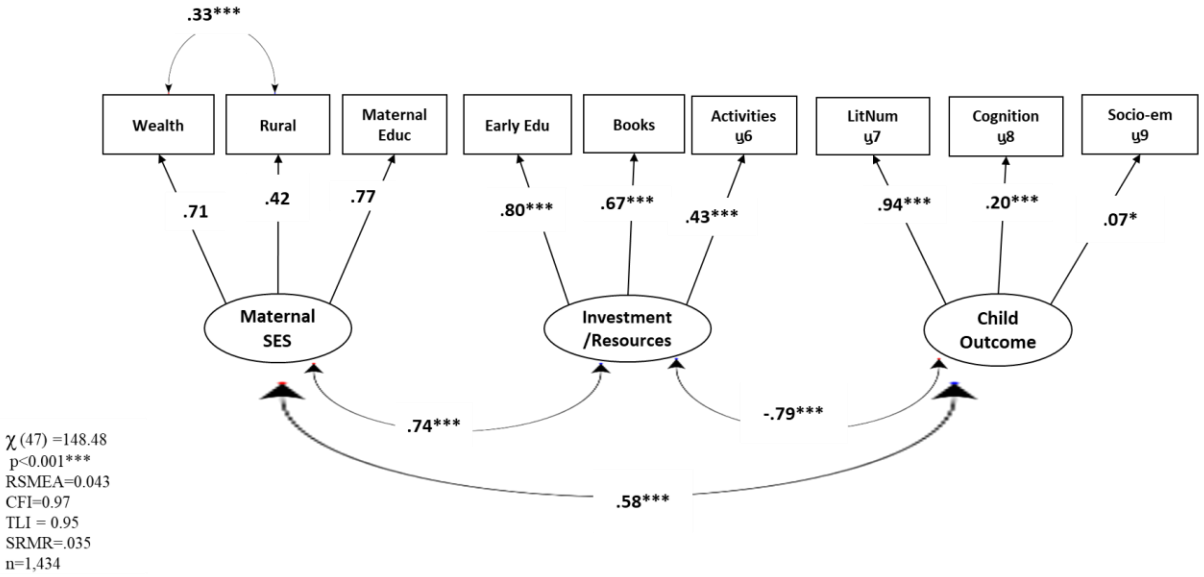


Figure 4.5. Standardized coefficients from the results of a SEM (structural regression) model of child outcomes



Chapter V. Conclusion

Introduction

This dissertation set out to examine the association between risk and protective factors for early childhood development (ECD), and maternal, household and macro-level factors in Nigeria. Using the 10-item ECDI screener in the Multiple Indicators Cluster Survey (MICS), the dissertation addressed three specific aims. The first research aim was the examination of the performance and psychometric properties of the ECDI screener in the Nigerian setting. Second, the study investigated the variations in risk and protective factors across the several levels of influence in a child's developmental ecology. In the third study, the dissertation examined the role of maternal subjective wellbeing (SWB) and household socioeconomic covariates in influencing child outcomes. This concluding chapter provides a summary of key findings, limitations of the study, and overall implications of the study for research, social work policy, and practice.

In the first study, the 10-item ECDI screener was analyzed to determine its construct validity and how it performed among 3-to 4-year-old children in Nigeria. Paper 2 built on the findings from paper 1 and narrowed down the ECDI screener to seven items in three domains. These three domains were selected based on their psychometric performance and appropriateness of the milestones they measured in 3- to 4-year-old children. Using these three domains as a scale of child outcomes, the second study examined the variations in risk and protective factors for ECD across Nigerian states and the Federal Capital Territory, FCT. In the third paper, a structural equation modeling unveiled the covariance of maternal subjective wellbeing (SWB), and covariates such as latent measures for household socioeconomic status, resources invested in children development.

The dissertation was guided by social and behavioral theories and frameworks that took into consideration the social determinants of health and the levels of influence as championed in the ecological model of child development. In addition, the dissertation adapted the family stress and investment model to underscore the interplay between social position and macros factors in their association with child outcomes. Findings from the study add value to the science and literature base on ECD especially in low-and middle-income country contexts (LMICs), strengthened a culturally-sensitive and implementation science approach to research, while building a case for improved advocacy and policy action on the factors affecting child development in the context of their families.

Summary of the Study Aims and Findings

Chapter II. Assessment of the psychometric properties of the MICS Early Childhood Development Index (ECDI) used among 3-to 4-year-old children in Nigeria.

As noted, the second chapter of the dissertation explored the performance and psychometric properties of the Early Childhood Development Index (ECDI) 10-item screener , (Loizillon, Petrowski, Britto, & Cappa, 2017) among 3- to 4-year-old children in Nigeria. Initial findings provided a snapshot of the children and their mothers in the study. Fifty-one percent of the sample were 3-year-olds while 49% were female. Seventy-four percent of the mothers and children lived in rural areas. Most of the mothers responding to the child-questionnaire were between 30-39 years (44%). In line with findings from previous studies (Efevbera, Bhabha, Farmer, & Fink, 2017), over 50% of the children were on track developmentally, especially when all items on the ECDI scale are included. It was also significant that approximately fifty-two percent were often too sick to play, an indication of the health status of these children. Most of the children were on track in their socioemotional development based on the ECDI with, older

children who were 4-years-old reported to meet most of the developmental milestones more than their 3-year-old counterparts did.

Overall, and across the ECDI sub-domains, the results showed that 57% of the children were not on track in the literacy numeracy domain while 8% of the sample were not on track for the physical development tasks. In addition, 20% were not on track in the cognitive development or approaches to learning domain while approximately 1% were not on track socioemotionally. An initial examination of the ECDI showed that across domains, the internal consistency (Cronbach's alpha) of the ECDI among Nigerian children varied. The overall alpha of the 10 ECDI items was .65. Further exploratory factor analysis (EFA) revealed the lack of unity of the items in defining a single construct. In addition, using the one-parameter logistic and two-parameter logistic models (1PL and 2PL) of the item response theory (IRT), the study found that the ECDI was not discriminating in delineating between children with distinct stages of development.

In support of the statistical findings, literature reviews also revealed that the items in the physical domain (the pincer grasp and sickness question) where not appropriate as measures of development for the 3- to 4-year-old age group (McCoy et al., 2016). When the physical domains items were removed, the internal consistency of the instrument improved (.67) and even more (.75) with the socioemotional development question (on distraction) which we adjudge may prove confusing for the literacy level and nuanced multi-language and cultural milieu of Nigeria.

Findings from the first study recommend a review of the items on the ECDI for their appropriateness in capturing the child development milestones. Further, a culture of screening children beyond the anthropometrics conducted during routine immunizations and well child

visits that ensures a regular practice of screening beyond the first year of life is needed. In addition, the study recommends an increase in funding for research on ECD in Nigeria that includes a necessary examination of the psychometric properties of assessment scales, a standard validation and adaptation process to the culture and differences especially as seen in LMIC settings. Most importantly, the study recommends the addition of a gold standard ECD measure to the MICS, and a review of this most useful instrument, the ECDI, to ensure that it is actually providing a true measure of the developmental status of children in the age group and countries surveyed.

Chapter III. Variations in risk and protective factors for cognitive and socioemotional development outcomes among 3– to 4- year-old children in Nigeria: A multilevel modeling approach.

The second study set out to investigate the how individual child factors interact with those of the mother and the household setting, and their variations with the macro level to influence child outcomes. Using a multi-level modeling approach, the study found that as much as 29% variation in child outcomes lie at the state level. However, with consecutive addition of individual child, maternal and state-level predictors, the variation associated with macro factors reduced to 5%. In line with literature on risk and protective factors for ECD in global settings (Wachs & Rahman, 2013), predictors such as not attending an early education program, not having children's or color books in the home, stunting, and frequent sickness were all associated with lower early childhood outcomes. At the microsystem level, there was a similar pattern in the association of maternal level of education, number of stimulating activities with child, and rural residence in their effect on child outcome score. At the state level, lower levels of median years

of maternal education and aggregated household wealth indices were weak, negative but not statistically significant factors predicting child outcomes.

Chapter IV. Maternal subjective wellbeing, and child cognitive, and socioemotional outcomes among 3- to 4-year-old children in Nigeria.

The fourth chapter of the dissertation aimed to highlight SWB as a bridge to opening discussions on the sensitive issue of the influence of maternal mental health on child outcomes in Nigeria. Subjective wellbeing, an individually evaluated measure of life and emotional experience, precursor to mental health, and more accurate indicator of national progress is largely understudied in LMICs (Lim, Cappa, & Patton, 2017). Measuring SWB is pitched as a strength-based alternative (Saleebey, 2008) to strengthening the awareness and discussion on maternal mental health in Nigeria's multicultural and stigma-laden environment for mental health issues (Iheanacho et al., 2015). It was hoped that SWB's positive framing, challenging individuals to view life in the light of their aspirations, capacities and possibilities, as opposed to the usual deficit model especially used for African contexts would provide utility to mental health issues in Nigeria. Using the culturally easier to measure construct, SWB, this study aims to highlight its level, significant predictors and implications for children in the populace.

Thus, in the third study, we explored the association of maternal SWB and child development measures from the ECDI. In line with previous studies that highlight the role of socioeconomic factors in moderate the ways in which a woman's wellbeing influence cognitive outcomes for her child, we tested the hypothesis that maternal mental wellbeing measured by her SWB will be associated with her socioeconomic status, the level of resources invested in her child's development, and ultimately child outcomes.

There was an overall high level of SWB among the women in the sample. Findings from the third study did not find any strong and statistically significant association between the maternal SWB construct comprising overall happiness, life satisfaction, and perception of a better future and the latent measure representing child literacy-numeracy, approaches to learning, and socioemotional outcomes among the Nigerian sample. Neither was SWB strongly correlated with maternal socioeconomic status nor the resources invested in child development. Thus, with respect to the objective of the study, maternal SWB may not be an appropriate proxy to study the impact of maternal wellbeing or mental health on child outcomes. However, the results do highlight the positive strength of association with child outcomes of family socioeconomic status and investment and learning resources comprising such as facilitating attendance to early education, the number of children or picture books available in the home, and the number of different stimulating activities that the mother had engaged the child.

Implications for Research, Social Work Policy and Practice

The life expectancy in Nigeria, one of the lowest in the world is estimated at 53and 56 years for men and women respectively (Alloh & Regmi, 2017; United Nations, 2017). The UN (2017) report projects that Africa's population growth will place Nigeria (currently estimated at over 190 million people) as the 3rd largest country in the world by 2050. The UN report further predict that this spike in population will predispose individuals to increased mental health and other social problems arising from poverty and other social inequalities. This study on risk and protective factors affecting the development of young children in Nigeria is significant given the increasing contribution of common mental health disorders to the global burden of disease (Mnookin, 2016; Patel et al., 2016; Vigo, Thornicroft, & Atun, 2018) and their implications for research. Here are some considerations:

Need to promote early childhood development research, interventions and longitudinal studies. More focused research on ECD is needed in Nigeria to provide empirical evidence for policy decisions and funding. Studies need to use longitudinal data to highlight the benefit of the often-high investments in ECD that policy makers can use to advocate for increased ECD spending. Added to a longitudinal approach is the need for practitioners in Nigeria to adopt a life-course perspective. A life course approach takes into account the multiple stages of life the child will go through, and operates from a long term perspective that takes into consideration the linkages of each stage, and the interplay of the contexts of the physical, psychosocial and biological influences, and how early life will shape health going forward. For instance, policy makers and practitioners must plan with critical and sensitive periods or critical windows of child development as a guiding framework, institute social protection structures that reduce cumulative disadvantage and ensure supports that mitigate the impact of negative trajectories or intergenerational cycles of risk (Braveman & Barclay, 2009).

Early childhood education (ECE). This study draws attention to the benefits of early childhood education and its link to readiness or preparedness for primary education that is one of the Sustainable Development Goals (SDGs). While ECE is recommended for Nigerian children, the resources required to achieve all aspects of ECD may be lacking (Olusanya, 2011). As a Child Rights issue, early childhood development must be presented with empirical evidence to policy makers and practitioners in its role to determines economic growth and development at the national level (Shehu, 2018). The consistent low literacy levels, out of schoolchildren particularly females in the northern parts of the country needs to be addressed head-on. While the gender effects from this study are low, previous research in Nigeria, note that male children are given preference over girls with respect to school developmental opportunities (Shehu, 2018).

State investments. While the statistical analysis of this study did not associate the budget of states as a major predictor of child outcomes in a statistically significant manner, it is both an indictment to the states, the low level of level of ECD outcomes even in the richer states. There are more private bodies involved in ECE than government sponsored programs reflecting the very limited government apparatus for social protection especially at the childhood level. It is common knowledge that anyone seeking to make progress in his or her children's education would embark on costly private education. In line with past studies (Yaro, 2018), this study recommend that government build institutional capacities, avoid the politicization of education, adapt, extend its proposal for widespread exemplary programs such as the Head Start programs in the United States, and develop appropriate laws and support that can put the children on a good start and footing.

Diversify the overall preference for higher education investment to include ECE. Despite the increasing evidence highlighting the importance of ECE and the increased number of ECE centers and their multiple programs in Nigerian, there is still a widespread macro/policy related preference for investment in higher education (Colletta & Reinhold, 1997; The World Bank, 2005; Yaro, 2018). While the ownership of state universities or higher education centers is a political target tied to budgetary allocations, Nigerian states need to refocus on the young, and while ECD does not immediately reflect a tangible achievement for immediate governments, there is a need to adopt a long-range view of development.

Dealing with the shortage of personnel and trained staff and specialists. The ECDI used to highlight the developmental status of children in this study were mother-reports of their children's developmental status of their children. Ideal examinations of children's development include a combination of responses from caregivers and direct observation from trained

specialists. For larges surveys such as the MICS and for routine monitoring of ECD among Nigerian children, there is a need for more trained personnel, including trans-diagnostic or task-shifting strategies to ensure that no child is missed. Nigeria lost a lot of work force from the massive brain drain that occurred during the military dictatorship and structural adjustment era. Previous studies note the lack of personnel and trained early childhood professionals and workers, a major impediment to the implementation of government policies (Olusanya, 2011).

Parenting skills and low-cost stimulation. Findings from the dissertation indicate a low to moderate level of engagement of mothers and any adult at all with the children on stimulating activities that have been shown to cost effective in facilitating early childhood development. In line with existing studies that highlight the role of stimulation, time invested in nurturing children (Hollowell et al., 2019), and the seeming cost-effective nature of this effective intervention, there is a need for more awareness on the role of nurturing care and stimulating activities. Family strengthening programs should be created to build capacity on how parents can take advantage of simple serve and return strategies, and invest time to interact to their children (Center on the Developing Child, 2007; Shonkoff, Jack, Radner, & Foote, 2017; Wakhweya, Dirks, & Yeboah, 2008)

Prioritizing girls and maternal education. Indeed this study establishes in line with previous studies that higher levels of maternal education, is a predictor of better child outcomes. Given the strategic roles mothers play in outcomes for their children, many studies highlight the importance of ensuring girls education especially in sub Saharan setting (Ssewamala, 2004).

Increase awareness, research and diversity of early childhood interventions. Most ECD programs in Nigeria are narrow in focus. When not focused on child/infant mortality, stunting, or

immunization outcomes, these address issues of universal childhood education (The World Bank, 2013; Yoshikawa, Wuermli, Alice, Raikes, Kim, & Kabay, 2018).

Increase resources invested in child development. Tied to the role that state governments can play in improving child outcomes and implementing provisions laid out in the early child hood development policies is the development of task forces that institute and equip early learning centers, and distributing learning resources such as books to families. In line with previous studies that highlight challenges impeding the implementation of education policies such as inadequate resources, inconsistencies in implementation and bureaucratic weakness (Yaro, 2018) need to be addressed. Studies in Northern Nigeria recommended widening access and coverage for preschool attendance so that the marginalized and poor who often have parents with low levels of education can take advantage (Delprato, Dunne, & Zeitlyn, 2016).

Reduce poverty for all round impact. Through all models of the study, we see the strong impact of the different levels of wealth on child outcomes, even as they interact with attending early education. In line with the literature review, an important implication of this study is that the poverty level in Nigeria affects families and child outcomes in the most negative ways. Many studies in SSA have examined the effect of poverty alleviation programs such as conditional cash transfers and asset building programs aimed at improving health behavior and outcomes (Haines & Palmer, 2014; F.M. Ssewamala et al., 2018; Fred M. Ssewamala, Sperber, Zimmerman, & Karimli, 2010). An example is being implemented in northern Nigeria to improve uptake of immunization and other nutrition-based interventions to improve child outcomes. However, the findings are still inconclusive (Aiyede, Sha, & Haruna, Bonaventure Olutayo, Akinpelu Olanrewaju Ogunkola, Emmanuel Olawale Best, 2017; Oduenyi, Ordu, & Okoli, 2019; Okoli et al., 2014).

Social protection, policy, and monitoring. Policies and projects that aim to lift households out of poverty will make a huge difference such as including conditional cash transfers to defray costs (Delprato & Sabates, 2014). The welfare provisions in Nigeria though developed and outlined in policy documents are not fully or adequately implemented. From the idea of social security to safety nets to protect citizens, many poverty alleviation programs in Nigeria have not been sustained, mired by politics and corruption. Nigeria needs to be more intentional in its social protection programs which could either be public interventions assisting with the management of income risk or measures that provide a basic income to all in need or through a tiered approach that focuses on meeting needs as a human right. A social protection program that ensures income security, creation of job opportunities and access to health is needed. Education and other financial services will benefit the child as families flourishing. Several programs such as the directorate of foods, roads and rural infrastructure have been implemented over the years. The income support of children /basic income guarantee (COPE) scheme focused on children focused on promoting self-reliance and growth among beneficiary families –supporting education, maternal health services particularly for single mothers and widows and with conditional cash transfers

Integrating positive cultural practices. There is the potential for disparity (potentially avoidable difference in ECD outcomes) because of customs at the ethnic level, and social disadvantage resulting from educational opportunities being fewer in the rural areas. Given the strong reliance on, and influence of ethnicity on child outcomes, there is a need to acknowledge and integrate positive cultural practices, knowledge and beliefs in to social work practice rather than shelving them off. As opined in a recent study,

"*Appreciating and incorporating these (positive cultural practices) practices into social work education, practice, policy, and research makes indigenization of social work authentic within the African context. The indigenous practices and beliefs are moorings for social work values such as dignity and worth of a person and respect for relationship …".* (Olaore & Drolet, 2017).

When these existing practices are acknowledged from a place of cultural humility, there is more likelihood for new ideas to take root. Ziegler (2019) in their study of the place of international social work speak of 'decolonized social development strategies' for social work practice in countries such as Nigeria that aim to address structural problems, strengthening people's and institutional capacities in ways that empower social workers and the profession to address problems.

Taken together, these three studies contributed to the understanding of the profile of 3- to 4-year-olds in Nigeria, and the interplay of risk and protective factors affecting their developmental status. This study highlighted the significant risk and protective factors, including disparities across the multiethnic, conflict-affected, and diverse socioeconomic groups of the country. Results from this study will be useful, given its theory-driven nature, prospect for generalizability, and strengths-based approaches. These results have potential to contribute to science on child wellbeing in a representative low- and middle-income country context, such as Nigeria by strengthening the discourse on the use of culturally sensitive and validated measures for ECD.

By highlighting the interplay of risk and protective factors through this study, the findings provide researchers and practitioners' with objective levers for integrating social work and mental health services into existing structures to improve maternal and child wellbeing.

Further, by providing a comprehensive analysis of the ECDI instrument, this study advanced an implementation science approach to the use and development of research instruments in African contexts. In addition, by focusing on previously understudied aspects of child development in Nigeria, this dissertation advanced knowledge that is useful for designing research in the ECD sector, and provides pointers to intervention points for advancing ECD in Nigeria.

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