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Role of Resources for Care in Improving Care Behaviors, Children's Nutritional Status and Early Childhood Development in Low- and Middle-Income Countries

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ROLE OF RESOURCES FOR CARE IN IMPROVING CARE BEHAVIORS, CHILDREN'S NUTRITIONAL STATUS AND EARLY CHILDHOOD DEVELOPMENT IN LOW- AND MIDDLE-INCOME COUNTRIES

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ABSTRACT

Poor child growth and suboptimal early childhood development are global health problems. Provision of appropriate care may help to achieve optimum child growth and development. Maternal resources for care such as education, knowledge, health, autonomy, reasonable workload, and social support may be needed to provide appropriate care behaviors, and improve children's nutritional status, and early childhood development. The overall goal of this research was to understand the role of resources for care in improving care behaviors, child nutritional status, and early childhood development. The baseline Alive & Thrive household surveys from Bangladesh, Vietnam, and Ethiopia were used. We examined the structures and equivalence of resources for care measures. Multiple regression analysis was used to examine the association between maternal resources for care and care behaviors. Path analysis was used to determine the paths through which maternal resources for care are associated with height-for-age z scores and motor and language development.

The factor analysis demonstrated that a three-factor solution best explained the structure of resources for care in Bangladesh and a two-factor solution best explained the structure in Vietnam and Ethiopia. The structure of resources for care was similar in some instances but differences also existed across settings. For the measures that were scales, the order of the percentage of the affirmative responses was similar across settings, but a few differences were also found. Resources for care were associated with

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the care behaviors of exclusive breastfeeding, minimum meal frequency, dietary diversity, improved drinking water source, improved sanitation, cleanliness, child immunization, psychosocial stimulation, and adequate care. The associations differed by the types of resources for care, care behaviors, and study settings. Resources for care were associated with children's height-for-age z scores, motor development, and language development through direct and indirect paths. Care behaviors mediated the associations of resources for care with child outcomes. Children's physical growth also partially explained the associations between resources for care and child development. Findings suggest that strengthening resources for care among mothers will be beneficial in improving care behaviors, children's nutritional status, and early childhood development.

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LIST OF ABBREVIATIONS

BMI .... Body mass index

EBF .... Exclusive breastfeeding

ECD .... Early childhood development

HAZ .... Height-for-age z scores

IYCF .... Infant and young child feeding

LAZ .... Length-for-age z scores

OR .... Odds ratio

SD .... Standard deviation

SRQ .... Self-reporting questionnaire

UNICEF .... United Nations Children's Fund

WHO .... World Health Organization

CHAPTER 1

INTRODUCTION

Over the past decade, there has been an increased priority to improve children's growth, development, and survival (Black et al., 2013; Shawar & Shiffman, 2017). Despite the progress, undernutrition and suboptimal development are common in many parts of the world, particularly in low- and middle-income countries (Black et al., 2017; UNICEF, WHO, & World Bank Group, 2018). The burden of child stunting (i.e., low height-for-age) is considerable in Asia and Africa (UNICEF et al., 2018). Suboptimal early childhood development (ECD) is also highly prevalent these regions (Black et al., 2017; McCoy et al., 2016).

Childhood undernutrition and suboptimal ECD have multiple adverse consequences. Undernourished children have higher chances of acquiring infectious diseases like diarrhea (Rice, Sacco, Hyder, & Black, 2000). In addition, undernutrition may have negative effects on cognitive, motor, and psychosocial function of children (Black et al., 2013). Furthermore, child malnutrition is linked to the considerable proportion of childhood mortality (Black et al., 2008; Pelletier, Frongillo, Schroeder, & Habicht, 1995; Rice et al., 2000). Both childhood undernutrition and suboptimal ECD are related with poor educational attainment and productivity, which may be followed by intergenerational cycle of poverty, malnutrition, and poor development (Black et al.,

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2013; Black et al., 2017). These adverse consequences can be prevented by providing nurturing care to meet children's needs (Britto et al., 2017).

Care behaviors or practices represent provision of environment that support children's growth and development (Engle, 1999; Engle, Menon, & Haddad, 1999). Care behaviors such as infant and young child feeding (IYCF), health-seeking, hygiene, and family care foster growth and development (Britto et al., 2017; Doherty, Buchy, Standaert, Giaquinto, & Prado-Cohrs, 2016; Engle, 1999). Despite the importance of care behaviors, their adoption and continuation may be constrained. The unavailability or inadequacy of resources to support care may be one of constrains to appropriate care behaviors (Engle, 1999; Engle et al., 1999).

Resources among caregivers facilitate provision of appropriate care to the family members including children (Engle, 1999; Engle et al., 1999). The extended care model of the United Nations Children's Fund (UNICEF) has identified six major categories of resources for care: education and knowledge, physical health, mental health, autonomy, reasonable workload and time availability, and social support (Engle, Menon, & Haddad, 1997; Engle et al., 1999). Provision of adequate resources influences both amount and quality of care received by children (Engle, 1999). Previous studies have looked at the effects of one or few categories of resources for care, but there is a lack of research that has employed comprehensive measures of resources for care. Little is known about the structures and measurements of resources for care. Additionally, some types of resources for care and care behaviors have received more attention than others. Furthermore, there is a lack of understanding about the mechanisms through which

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resources for care influence children's nutritional status and ECD (Engle, 1999; Engle et al., 1997; Engle et al., 1999). The present research intends to fill the identified research gaps and provide deeper understanding regarding the role of resources for care on care behaviors and child outcomes.

The overall goal of this dissertation was to understand the role of maternal resources for care on care behaviors, children's nutritional status, and ECD. The Alive & Thrive baseline surveys from Bangladesh, Vietnam, and Ethiopia were used. Three manuscripts were developed as parts of this dissertation research. The first manuscript examined the factor structure of maternal resources for care measures and compared with the theoretical construct. The manuscript also examined if the measures of resources for care showed equivalence across contexts. The aim of the second manuscript was to examine whether maternal resources for care are associated with care behaviors, specifically IYCF, hygiene, health-seeking, and family care. The third manuscript aimed to determine the paths through which maternal resources for care are associated with height-for-age z scores (HAZ), motor development, and language development.

This study incorporated comprehensive measures of resources for care and was guided by a theoretical framework which is based on the UNICEF's extended model of care, theoretical explanations, and previous research (Bronfenbrenner, 1994; Engle et al., 1997; Engle et al., 1999). The framework emphasizes that resources for care play a crucial role on care behaviors, children's growth, and development. This dissertation research helped us to understand the structure and equivalence of resources for care

measures, and the associations of resources for care with care behaviors and child outcomes. The research incorporated multiple measures of resources for care that influence care behaviors, child growth and development. We believe that this research contributed to better understanding of resources for care, including the mechanisms through which they influence growth and development. Additionally, the research helps to identify specific areas for interventions to promote health and well-being of children.

This dissertation research has been organized in five chapters. Chapter 2 includes background of the child growth and development, care behaviors, resources for care, and integrated intervention. The chapter also includes research gaps, conceptual model guiding this research, and research significance. Chapter 3 includes research methodology. Chapter 4 presents the results in the form of three manuscripts. Chapter 5 summarizes the findings, and presents implications and recommendations as well.

CHAPTER 2

BACKGROUND AND SIGNIFICANCE

This section includes literature review pertinent to our research. At the
beginning of this section, literature review on child undernutrition and ECD is presented.
This sub-section presents prevalence of poor growth and suboptimal child development,
especially in the context of low- and middle-income countries. This sub-section also
provides understanding about the consequences of poor growth and development. In
the following part, literature review on care behaviors, resources for care, and
integrated intervention is described. This literature review helped us to understand the
current problems regarding poor care behaviors. The literature review also helped us to
explore the existing knowledge about the effects of resources for care on care behaviors
and children's growth and development. In the following part of this chapter, gaps in
the literature are presented. Finally, a conceptual model guiding this study and study
significance are presented.

2.1 Childhood Undernutrition and Early Childhood Development

Stunting or low height-for-age is a pervasive problem in many low- and middle-
income countries. In 2017, 151 million children under the age of five years were stunted
worldwide, and more than two-third of all stunted children lived in lower-middle
income countries (UNICEF et al., 2018).

Early child development is a process of acquiring skills relevant to make progress in the contemporary society (Najman, Bor, Morrison, Andersen, & Williams, 1992). The process takes place in specific socio-economic and cultural contexts (Black et al., 2017). Child development incorporates multiple dimensions such as motor, language, and socioemotional (Black et al., 2017; Najman et al., 1992). The early period of life is critical for development as it is the time when brain develops rapidly and sensitivity to environmental exposures is higher (Prado & Dewey, 2014; Wei et al., 2015). Many children around the world are unable to attain the optimal development (Black et al., 2017; McCoy et al., 2016). More than 250 million <5 years old children in low- and middle-income countries are at risk of not being able to reach their developmental potential (Black et al., 2017). Another study which included 35 low- and middle-income countries estimated that 36·8% of 3-year-olds and 4-year-olds do not attain cognitive and/or socioemotional skills (McCoy et al., 2016). The largest number of affected children lived in sub-Saharan Africa (43.8%), followed by South Asia (37.7%), and the East Asia and Pacific region (25.9%) (McCoy et al., 2016).

Attainment of optimum growth and development is influenced by multiple conditions such as health, responsive caregiving, and genetic inheritance (Black et al., 2013; Black et al., 2017; Grantham-McGregor et al., 2007). Children's growth and development are also influenced by the social and environmental contexts of children, which ranges from immediate setting like home to wider context like national policies (Britto et al., 2017).

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Child undernutrition and suboptimal development have both short-term and long-term adverse consequences, not only for the individuals affected but also for the societies in which they live (Black et al., 2017; Grantham-McGregor et al., 2007; Martorell, 1999; Victora et al., 2008). Child undernutrition can increase mortality from infectious diseases such as diarrhea and acute respiratory infection (Rice et al., 2000). Child undernutrition can also lead to impaired brain structure and neurological function, and inadequate psychosocial stimulation (Brown & Pollitt, 1996; Prado & Dewey, 2014; Larson, Martorell, & Bauer, 2018). Undernourished children are likely to have suboptimal motor and cognitive development, behavioral problems, and deficient social skills (Martorell, 1999). In addition, undernutrition may increase risk of deaths among children through mechanisms like decreasing immunity, increasing risk for infectious diseases, and altering metabolism (Black et al., 2008; Martorell, 1999; Pelletier et al., 1995). Both undernutrition and suboptimal development have been linked with reduced work capacity during the adult years of life which may lead to intergenerational cycles of poverty, malnutrition, and suboptimal development (Larrea & Kawachi, 2005; Victora et al., 2008).

2.2 Care Behaviors

Care behaviors indicate the provision of food, health care, psychosocial stimulation, and emotional support to meet needs of children for growth, development, and survival (Engle, 1999). Appropriate care behaviors can ameliorate effects of the adverse conditions like poverty (Purcell-Gates, 1996). Children's growth and development are not only influenced by the presence of care behaviors but also by the

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way care behaviors are performed, for example, affection and responsiveness (Engle, 1999). Specific care behaviors relevant to our research are discussed below.

2.2.1 Infant and Young Child Feeding Practices

The World Health Organization (WHO) recommends infants to be exclusively breastfed until the age of six months, and thereafter recommends providing nutritiously appropriate, adequate, and safe complementary foods, and continuing breastfeeding up to 2 years and beyond (Arabi, Frongillo, Avula, & Mangasaryan, 2012; WHO, 2008). Appropriate feeding practices help to meet nutritional needs of children and may also improve children's well-being (Allen & Hector, 2005; Arabi et al., 2012).

Breastfeeding not only help to meet the nutritional needs of children and provide immunological protection, but also improves mother-infant attachment (Allen & Hector, 2005; Brandt, Andrews, & Kvale, 1998). Optimal breastfeeding is also positively associated with child survival and breastfed children have higher chances of survival than non-breastfed children (Joshi et al., 2014). Additionally, in low- and middle-income countries, early initiation of complementary food is associated with an increased risk of infectious disease like diarrhea (Bhandari et al., 2003). Breastfeeding exclusively for the first six months after birth has also proven to be beneficial for high-risk children like low-birthweight infants. Low-birthweight infants who had been exclusively breastfed for six months after birth were less likely to encounter childhood illnesses like diarrhea, respiratory infections, and had higher rates of catch-up growth than low-birthweight infants who were partially breastfed or not breastfed at all (Agrasada, Ewald, Kylberg, & Gustafsson, 2011).

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Positive links between breastfeeding and children's nutritional status have also been found. A study from Ethiopia reported that children who were breastfed exclusively for the first six months of life were less likely to be stunted as compared to their counterparts (Fikadu, Assegid, & Dube, 2014). Additionally, longer duration of breastfeeding was positively associated with cognitive and motor development in 2- and 3-year-old children (Bernard et al., 2013). Benefits of breast milk on cognitive and motor development of premature infants have also been found (Bier, Oliver, Ferguson, & Vohr, 2002). Other studies have also linked exclusive breastfeeding (EBF) to high intelligence quotients (Jedrychowski et al., 2012), motor development (Vestergaard et al., 1999) and language development (Vestergaard et al., 1999). On the other hand, breastfeeding may not influence gross and fine motor skills in a similar way. Infants who had never been breastfed were more likely to have gross motor coordination delays than infants who had been breastfed exclusively for at least 4 months, even after controlling for biological, socio-economic, and psychosocial conditions. In contrast, the relationship between breastfeeding and fine motor development was explained by these conditions (Sacker, Quigley, & Kelly, 2006).

Inclusion of a variety of foods in children's diet is important to ascertain dietary quality and to meet nutritional needs (Onyango, Koski, & Tucker, 1998). Dietary diversity can be measured by dietary diversity score which counts the number of food groups consumed over a given reference period, or minimum dietary diversity, which includes receiving food from at least four of the seven food groups: grains, roots, and tubers; legumes and nuts; dairy products; meat, fish, and poultry; eggs; vitamin A rich fruits and

vegetables; and other fruits and vegetables (WHO, 2008). Both measures of dietary

diversity have been associated with improved nutritional status of children. A study by

Hatloy and colleagues reported that dietary diversity score was positively associated

with children's nutritional status, particularly in urban areas (Hatløy, Hallund, Diarra, &

Oshaug, 2000). A study based on data from India reported that both dietary diversity

score and achieving minimum diet diversity (≥ 4 food groups) were important

determinants of nutritional status among 6-23.9 months old children (Menon, Bamezai,

Subandoro, Ayoya, & Aguayo, 2015). Additionally, Onyango et al. found that dietary

diversity had strong and consistent associations with anthropometric measurements of

toddlers in Kenya (Onyango et al., 1998).

Nutritional need, especially caloric need of children, can be ensured by meeting

minimum number of meals: two times for breastfed infants of 6–8.9 months, three

times for breastfed children of 9–23.9 months, and four times for non-breastfed

children of 6–23.9 months (WHO, 2008). Despite the recognition about the importance

of meeting minimum number of meals, evidence regarding its effects on children's

nutritional status is inconsistent. Marriott and colleagues found no effect of feeding

frequency on child stunting (Marriott, White, Hadden, Davies, & Wallingford, 2012).

The effects of complementary feeding, particularly dietary diversity on child

development has also been found (Black, 2003a; Black, 2003b; Demment, Young, &

Sensenig, 2003). A of lack of dietary diversity can lead to deficiencies of micronutrients

like iron, zinc, iodine, and vitamin B12 which are needed for the proper functioning of

various organs including brain (Black, 2003a; Black, 2003b). Longitudinal studies have

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linked iron deficiency in early years of life with poor cognitive and motor function in later childhood (Lozoff, Jimenez, Hagen, Mollen, & Wolf, 2000; Lozoff, Jimenez, & Wolf, 1991). A review by Grantham-McGregor and Ani also suggested that iron deficiency anemia among children may lead to poor cognitive, motor, and behavioral development; however, the findings were not consistent, and several studies did not link anemia with poor development (Grantham-McGregor & Ani, 1999). Similarly, a review by Black which aimed to investigate the role of zinc in children's cognitive and motor functioning found benefits of zinc for vulnerable children but lacked a clear consensus (Black, 2003b).

2.2.2 Hygiene Practices

Drinking water source that is adequately protected from outside contamination especially feces is essential to prevent infectious diseases such as hepatitis A, diarrhea, cholera, and typhoid (Bradley & Putnick, 2012; Pullan, Freeman, Gething, & Brooker, 2014). Improved sanitation which includes the facilities that prevent human urine and feces from human contact is also important to prevent the transmission of infectious diseases (Bradley & Putnick, 2012; Pullan et al., 2014). Infections caused by poor water and sanitation may impair dietary habits and food absorption and increase the risk for undernutrition (Aguayo & Menon, 2016). Additionally, enteric infections lead to chronic immune activation and there is a diversion of nutrients to fight infections rather than to support growth (Mbuya & Humphrey, 2016).

Lack of an improved sanitation facility within household is one of the major contributors of poor nutritional status among children (Fink, Günther, & Hill, 2011; Islam

et al., 2013; Pongou, Ezzati, & Salomon, 2006; Rah et al., 2015). Negative effects of unimproved drinking water on children's nutritional status have also been found (Islam et al., 2013; Pongou et al., 2006). A study conducted in Ethiopia reported that children of households that use water from the unimproved source were more likely to be stunted than their counterparts, however, the effect of unimproved water source was not seen for wasting (Alemayehu et al., 2015).

Other hygiene practices like proper handwashing and improved cleanliness have also been linked with improved nutritional status among children. Rah and colleagues demonstrated that children of caregivers who reported washing their hands with soap either before a meal or after defecation had a lower likelihood of being stunted (Rah et al., 2015). The protective effects of the handwashing practice against child stunting were stronger among children from households which had access to improved water and sanitation (Rah et al., 2015). This evidence demonstrates the significance of improved water and sanitation in enhancing the effects of other hygiene practices.

Poor hygiene practices can also lead to suboptimal ECD. A multi-country prospective cohort study found that improved water and toilet accesses at one year of age were associated with higher child development in later years of life (Dearden et al., 2017). A study from Brazil also found that household and community cleanliness were associated with child development (Santos et al., 2008). Infection, gut inflammation, stunting, and anemia may be the potential mechanisms through which poor hygiene may have negative effects on child development (Ngure et al., 2014). Additionally, children who are sick and have poor growth may lack energy to interact and explore the

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environment and are also less likely to receive stimulation from the caregivers (Dearden et al., 2017; Larson et al., 2018).

2.2.3 Health-Seeking Practices

Poor health-seeking behaviors are one of the major causes of child mortality and morbidity (Kolola, Gezahegn, & Addisie, 2016). It is estimated that about 20% of < 5 years old children's deaths are attributable to vaccine preventable diseases (Haji et al., 2016). Immunization plays a critical role in controlling and even eradicating infectious diseases (Andre et al., 2008; WHO, 2013). Immunization is regarded as an efficient and cost-effective intervention against infectious diseases (Andre et al., 2008; Haji et al., 2016).

Positive effects of immunization on children's health and well-being have been documented (Andre et al., 2008; WHO, 2013). Bloss and colleagues found that vaccines are protective against stunting among Kenyan children (Bloss, Wainaina, & Bailey, 2004). Additionally, infectious diseases like measles can cause encephalitis which in turn may lead to various problems including poor cognitive development, behavioral difficulties, and motor dysfunction (WHO, 2019). Other studies have also linked infectious diseases with poor child outcomes including suboptimal child growth (Bloss et al., 2004; Hwang et al., 2013; Sachdeva et al., 2010). Vaccines can also prevent disease like poliomyelitis which is known to have negative effects on motor neurons and alter movement of muscles (WHO, 2015). Beside immunization, maternal health-seeking behaviors have been linked with improved nutritional status of children (Pongou et al., 2006).

Some studies have demonstrated mixed effects of immunization and infections. A study by Berendsen and colleagues presented a time-dependent pattern regarding the effects of Bacillus Calmette-Guerin vaccine on childhood stunting. The study reported that Bacillus Calmette-Guerin vaccination was associated with lower odds of stunting for children vaccinated early in life, but the effect was in a negative direction if children were vaccinated later in infancy (Berendsen, Smits, Netea, & van der Ven, 2016). A study conducted in Jamaica reported that childhood parasitic infection impaired memory and reasoning ability of children but there was no effect on attention or fine motor skills (Sternberg, Powell, McGrane, & Grantham-McGregor, 1997). This mixed evidence warrants further investigation to understand the effects of immunization on children's growth and development.

2.2.4 Family Care Behaviors

Family care behaviors include provision of warmth, responsiveness, appropriate limit setting (disciplinary practice), and encouragement for learning and exploration (Kariger et al., 2012). Psychosocial stimulation which refers to the social, emotional, and cognitive interactions between caregivers and children, is a major determinant of children's well-being (Engle, 1999; Engle et al., 1999). Responsive and developmentally appropriate interactions between caregivers and children are important to enhance neurocognitive processing and brain functioning (Engle et al., 2007; Kariger et al., 2012). Additionally, appropriate interactions between caregivers and children improve emotional closeness and feelings of acceptance and worthiness among children (Bornstein & Putnick, 2012).

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Involvement of caregivers with children in activities like reading books; telling stories; singing songs or lullabies; going outside the housing enclosure; playing; and naming, counting, and drawing things are considered to stimulate children and promote learning (Bornstein & Putnick, 2012; Kariger et al., 2012). Joint book reading helps children to grasp vocabulary and concepts; however, this activity requires a literate caregiver (Bornstein & Putnick, 2012; Bus, Van Ijzendoorn, & Pellegrini, 1995). Storytelling, which is a part of linguistic, educative, and leisure activity in many cultures, could also have beneficial effects on child development (Bornstein & Putnick, 2012). Storytelling exposes children to complex vocabulary and improves children's creativity and imagination, and its positive effect on success in school has also been found (Bornstein & Putnick, 2012). Singing songs and lullabies could improve emotional bonds between caregivers and children and may help in sustaining children's attention (Bornstein & Putnick, 2012; Nakata & Trehub, 2004). Involvement of caregivers with children in naming, counting, and drawing things may provide a foundation of learning and creativity (Bornstein & Putnick, 2012). Similarly, other activities like playing with children and taking them out of housing enclosures foster confidence to engage in the society (Bornstein & Putnick, 2012).

Psychosocial caregiving in early childhood is linked with social and cognitive development (Engle et al., 1999; Narvaez et al., 2013). A study based on the Multiple Indicator Cluster Surveys found associations of family care behaviors with literacy-numeracy and learning development of 36-59 months old children (Frongillo, Kulkarni, Basnet, & de Castro, 2017). Intervention studies also demonstrate that enhancing

maternal responsiveness is positively associated with sociability, self-regulation, exploration, secure attachment, cooperation, and fewer behavioral problems among children (Boom, 1994; Boom, 1995). Psychosocial stimulation also improves development among vulnerable groups of children like undernourished (Hamadani, Huda, Khatun, & Grantham-McGregor, 2006) and low-birthweight children (Walker, Chang, Younger, & Grantham-McGregor, 2010).

Negative effects of inadequate psychosocial stimulation on child development have also been found by other studies. A study by Wei and colleagues linked inadequate psychosocial stimulation with delays in achieving developmental milestones (Wei et al., 2015). Additionally, motor development of biologically healthy children can be negatively influenced by improper use of toys. Involvement of caregivers in the activities with children could prevent or minimize these types of adverse effects (Barros, Fragoso, Oliveira, Cabral Filho, & Castro, 2003).

There is a mixed evidence regarding the associations between psychosocial stimulation and physical growth. An intervention study from Jamaica found no effect of stimulation on children's growth (Walker, Powell, Grantham-McGregor, Himes, & Chang, 1991). In contrast, a study from Colombia found that the children who received food supplementation and psychosocial stimulation had higher growth and sustained intervention effect than those who received only food supplementation (Super, Herrera, & Mora, 1990). Psychosocial stimulation may make children more active and confident which may help in locating and using resources for optimal growth (Super et al., 1990).

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Inadequate care, which is leaving a child without an adult's supervision may also negatively influence children's well-being. Accidental injuries (for example, burns, falls) are common among children who do not receive adequate supervision (Forjuoh, 2006), however, little is known about the effects of inadequate care on children's growth and development.

2.3 Resources for Care

Resources in a broader sense represent entities that allow individuals to make life choices (Hobfoll, 2002; Kabeer, 1999). Resources are either centrally valued in their own (for example, health and self-esteem) or help to obtain centrally valued entities (for example, money) (Hobfoll, 2002). Resources represent not only current allocation or access but also indicate future claims and expectations (Kabeer, 1999). Although resources include economic, human, and social conditions that promote the ability to make choices, economic dimension of resources has received greater attention in the past than others (Hanson, McLanahan, & Thomson, 1995).

The ecological system theory conceptualized by Bronfenbenner has emphasized on the importance of children's context. Development of human, particularly during childhood takes place through interaction with people, objects, or symbols in the immediate environment. The environment is composed of structures at various levels: microsystems, mesosystems, exosystems, macrosystems, and chronosystems. Microsystems include immediate physical, social, and symbolic environment experienced by children (for example, family). Mesosystems comprise a system of microsystems i.e. the linkages and processes between multiple microsystem settings

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(for example, relation between home and school). Exosystems include the linkages and processes taking place between multiple settings, at least one of the setting do not include child, but indirectly influences child's immediate environment (for example, linkages between home environment and parent workplace). Macrosystems include broader pattern of micro, meso, and exosystems. Chronosystems indicate change or consistency in respect to characteristic of child and his or her environment (for example, change in family structure) (Bronfenbrenner, 1994). Other researchers have also acknowledged that ecological conditions ranging from the most proximal (for example, family) to the most distal (for example, policy) may impact children (Britto et al., 2017; Vygotsky, 1978).

Families play a significant role in growth and development of young children due to several reasons. Families, especially mothers, create the first environment in which children interact since their birth. They also create the environment in which children spend most of their time. Additionally, other environmental conditions are influenced by family level environments (Bronfenbrenner, 1994; Frongillo et al., 2017; Maggi, Irwin, Siddiqi, & Hertzman, 2010). Family level environments including characteristics of mothers could influence children considerably. Poor availability of resources to care for children can decrease opportunities and increase risk for poor child outcomes (Engle et al., 1999; Maggi et al., 2010).

Resources for care are conditions that provide capability to the caregiver for delivering time, attention, and support to children. These time, attention, and support help to meet children's psychosocial and physical needs (Engle, 1999; Engle et al., 1999).

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Women play a significant role as caregivers in many cultures around the world and are actively involved in various household activities such as food preparation, feeding children, psychosocial stimulation, and hygiene and health-seeking practices (DiGirolamo & Salgado de Snyder, 2008; Smith, Ramakirshman, Ndiaye, Haddad, & Martorell, 2003). Resources available to mothers may be crucial for children's health and well-being of (Engle, 1999; Heaton, 2015). Distal environment such as national, community, and household conditions may also influence care behaviors, child growth and development (Britto et al., 2017; Engle et al., 1999). These conditions may even influence resources required by caregivers to perform care behaviors (Engle et al., 1997; Engle et al., 1999).

The UNICEF's extended model of care has identified six categories of resources for care: caregiver's education and knowledge, physical health, mental well-being, autonomy, reasonable workload and availability of time, and social support (Engle et al., 1997; Engle et al., 1999). Education and knowledge are conditions that improve ability of the caregiver to provide care. Health status of the caregivers facilitates translating knowledge into practice, whereas, autonomy reflects caregivers' role in decision-making and allocation of household and community resources (Carlson, Kordas, & Murray-Kolb, 2015; Engle et al., 1999). Finally, reasonable workload and social support represent family- and community-level resources that improve capacity of the caregivers to provide care (Engle et al., 1999).

Caregiver's education, knowledge, and health that are needed to apply information or understanding into practice indicate human resources (Engle, 1999).

Caregiver's autonomy and control over resources, and time to provide care reflect economic dimension (Engle, 1999). Support from family and community like childcare support represents social or organizational dimension (Engle, 1999). Some measures of resources for care may not have the same meaning across cultures, therefore, it is important to examine if measures are consistent (i.e. equivalent) across contexts (Engle et al., 1999). Achievement of equivalence allows us to compare the research findings across contexts (Kankaraš & Moors, 2010; Leroy, Ruel, Frongillo, Harris, & Ballard, 2015; Mullen, 1995).

2.3.1 Education and Knowledge

Education and knowledge help mothers to acquire and process information, be receptive to modern medicine, and be adaptive to the new roles and environment (Engle et al., 1999; Glewwe, 1999; Wachs, 2008). Maternal education has been associated with various care behaviors such as complementary feeding, hygiene, health-seeking, and family care (Abuya, Onsomu, Kimani, & Moore, 2011; Engle et al., 1999; Fatiregun & Okoro, 2012; Patel et al., 2012; Semba et al., 2008). On the other hand, the association of maternal education on breastfeeding is inconsistent. Some studies have demonstrated positive effects of maternal education on breastfeeding, whereas it has also been found that maternal education may not positively influence breastfeeding practices, especially EBF (Engle et al., 1999; Ickes, Hurst, & Flax, 2015).

Previous research indicates protective effect of maternal education against childhood undernutrition. A study by Semba and colleagues found that formal education of mothers lead to decrease in the odds of child stunting in both urban and rural

settings of Bangladesh and Indonesia (Semba et al., 2008). In contrast, some studies have found negative or no effects of maternal education on children's nutritional status. A study by Maddah and colleagues found that, although some level of education protects against poor nutritional status of children, higher levels of education may negatively influence children's nutritional status. The study reported that children of mothers with college education were at a greater risk of being stunted than those of mothers with 5–12 years of schooling (Maddah, Mohtasham-Amiri, Rashidi, & Karandish, 2007).

Positive impacts of maternal education on psychosocial stimulation and child development have also been reported. Maternal education was related to better psychomotor performance of children (Venetsanou & Kambas, 2010). Magnuson et al. found positive effects of improvement in maternal educational status on children's language development (Magnuson, Sexton, Davis-Kean, & Huston, 2009). Improvement in education of mothers was associated with improved expressive and receptive language skills among children in cases when educational status of mothers was low previously. Improvement in the education was also associated with improvement in some aspects of home environment like maternal responsiveness and provision of learning materials. Home environment partially mediated the associations between improved maternal educational status and language development (Magnuson et al., 2009).

Although higher education is often associated with greater knowledge, sometimes knowledge may have independent effects on behavioral and health

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outcomes (Engle, 1999; Glewwe, 1999; Streatfield, Singarimbun, & Diamond, 1990). Therefore, knowledge among caregivers may have a positive effect on care received by children, irrespective of educational status of the caregivers (Streatfield et al., 1990). A study from Ghana found that nutrition-related knowledge among mothers was independently associated with children's nutritional status but maternal education was not independently associated with the nutritional status (Appoh & Krekling, 2005). Despite the importance of maternal knowledge on care behaviors and child outcomes, it has not received similar attention as maternal education.

2.3.2 Physical Health

Poor physical health could be a barrier to translate the acquired knowledge and understanding into practice (Engle et al., 1999). Many women from low- and middle-income countries experience various physical health problems including nutritional ones like low body mass index (BMI), short stature, and anemia, which may negatively influence care behaviors and children's growth and development (Black et al., 2013; Victora et al., 2008). Undernourished mothers are more likely to have co-morbidities and lack energy which may negatively influence child outcomes (Haddad, 1999; Kulasekaran, 2012; Walker, 1997). The effects of maternal height on child stunting could also be due to genetic and environmental factors (Addo et al., 2013).

Poor physical health may also contribute to psychological problems that may compound the effect of poor physical health. For example, iron deficiency anemia is not only associated with physical symptoms such as fatigue and malaise but is also related to stress and cognitive impairment (Beard et al., 2005). Additionally, undernourished

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mothers are less likely to be an active caregiver as compared their counterparts (Rahmanifar et al., 1993). Vitamin deficiencies have also been linked with poor caregiving. A study conducted in Egypt found that vitamin B-6 deficiency among mothers was associated with poor caregiving practices such as being less responsive to infant vocalizations and ineffective responses to infant distress (McCullough et al., 1990). Additionally, poor maternal physical health may negatively influence care behaviors and children's health outcomes by contributing to poverty. Women with poor physical health and nutrition are not only likely to be less economically productive and but also have higher healthcare expenses (Black et al., 2008; Victora et al., 2008).

Maternal undernutrition such as low BMI and short stature could increase complications during pregnancy and delivery (for example, obstructed labor, intrauterine growth retardation, and pre-term birth), which may compromise children's growth and development (Black et al., 2008; Brabin, Verhoeff, & Brabin, 2002; Kozuki et al., 2015; Young et al., 2015). A study which included surveys from 54 low- and middle-income countries found that maternal height was inversely associated with child mortality and malnutrition (Özaltin, Hill, & Subramanian, 2010). Additionally, low maternal BMI or height have been positively associated with not meeting recommended complementary feeding (Patel et al., 2012; Senarath, Godakandage, Jayawickrama, Siriwardena, & Dibley, 2012). There is a dearth of research that has looked at the effects of maternal BMI and stature on various care behaviors and child outcomes (Engle et al., 1999; Walker et al., 2011).

2.3.3 Mental Well-being

Poor mental well-being is a significant problem among women from diverse socio-economic stratum and cultures (Field, 2010). Although maternal mental well-being could influence care behaviors and children's growth and development, mental health issues have not received much attention in low- and middle-income countries (Rahman, Iqbal, Bunn, Lovel, & Harrington, 2004; Santos, Santos, Silva, Hasselmann, & Barreto, 2011).

A study from Brazil found that the infants of mothers with common mental disorders, as measured by the Self-Reporting Questionnaire-20 (SRQ-20), were twice more likely to have moderate or severe malnutrition. The study further reported that quality caregiving can mediate the association between maternal mental health and child undernutrition (Santos et al., 2011). A study conducted in Bangladesh, Ethiopia, and Vietnam found positive associations of maternal common mental disorders with child stunting and underweight in Bangladesh and Vietnam, respectively (Nguyen et al., 2014a). A qualitative systematic review by Dennis and McQueen also found that mental health problems can negatively influence breastfeeding practices such as low self-efficacy regarding breastfeeding, difficulty in breastfeeding, and decreased breastfeeding duration (Dennis & McQueen, 2009). Chronic mental health problems may have greater negative effects on care behaviors and child outcomes than episodic ones (Rahman et al., 2004).

Mothers with sound mental health are more available to help their children to regulate negative moods and to be involved in their children's learning and exploration

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(Cummings & Cicchetti, 1993; Zahn-Waxler, Iannotti, Cummings, & Denham, 1990). They are also more likely to show responsiveness and be engaged in verbal dialogue with their children (Zahn-Waxler et al., 1990). In contrast, maternal mental health problems can compromise positive care behaviors like IYCF, vaccination, psychosocial stimulation, mother-child interaction, and safety practices (Field, 2010; Paulson, Dauber, & Leiferman, 2006). Research shows that mothers with mental health problems were less likely to use expressive language such as suggestions, explanations, and references (Filed, 2010), and were more likely to provide punitive punishment to the children (Chung, McCollum, Elo, Lee, & Culhane, 2004).

Research has linked maternal mental health problems with poor behavioral, cognitive, and language functioning of children (Field, 2010). Infants of mothers with mental health problems were also more likely to exhibit socioemotional problems, such as irritability and hostility, and were also more likely to have poor motor development (Field, 2010; Tran et al., 2014). In a study from Bangladesh, caregiving home environment like parental responsiveness and opportunity to play, explained the associations of maternal depression symptoms with child development (Black et al., 2007).

Not all studies have found negative effects of mental health problems. A study by Medhin and colleagues found that there was no significant difference between prevalence in underweight or stunting among infants of mothers who had common mental disorders and those who did not (Medhin et al., 2010). Similarly, a study by Chung and colleagues reported no effect of maternal mental health problems on

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breastfeeding for ≥ 1 month (Chung et al., 2004). This inconsistent evidence warrants more investigation into the effects of mental health on care behaviors and child outcomes.

2.3.4 Autonomy

Maternal autonomy indicates ability of mothers to have control over resources and choices which could influence themselves and their family, including young children (Carlson et al., 2015). It includes involvement in decisions related to various issues such as finances, childcare, work, socialization, family planning, and household expenditures (Carlson et al., 2015; Engle, 1999). Involvement in income-generating activities is linked with greater control of household resources; however, in some contexts being employed does not automatically involve control of the income (Engle et al., 1999; Nsamenang, 1992).

Mothers are more likely to favor their children while allocating extra resources under their control than fathers (Carlson et al., 2015; Engle et al., 1999). Additionally, women are more likely to allocate more for health and nutrition-related expenditures if they have control over income as compared to men (Quisumbing & Maluccio, 2000). Several studies have demonstrated the importance of maternal autonomy on child outcomes (Doan & Bisharat, 1990; Engle, 1999). Maternal autonomy can buffer the effect of poverty, and children living in female-headed low-income households are less likely to be malnourished than children living in low-income households led by males (Johnson & Rogers, 1993). Lower level of maternal autonomy may negatively influence health-seeking practices as well. A study by Malhotra and colleagues found that lower

level of maternal autonomy was associated with higher odds of incomplete child immunization and not seeking treatment for child's acute respiratory infection (Malhotra, Malhotra, Østbye, & Subramanian, 2014).

Higher involvement of mothers in budgeting household expenses has been positively associated with psychosocial stimulation among children (Peter & Kumar, 2014). Although there is some evidence that maternal autonomy may influence children, the association of maternal autonomy with child development has not been studied in detail. Additionally, little is known about the mechanism through which maternal autonomy may influence child outcomes.

2.3.5 Reasonable Workload and Availability of Time

Household work is gendered in many socio-cultural contexts; women are more involved in household chores irrespective of participation in income-generating activities (Brown & Haddad, 1995; Engle et al., 1999; Warren, 2003). Household chores are often time-intensive, especially in the context of low- and middle-income countries (Engle et al., 1999). Additionally, women are involved in other non-paying jobs such as helping family in agriculture, which decreases their availability of time for rest, leisure, and care for children (Bardasi & Wodon, 2010; Brown & Haddad, 1995).

The effects of maternal employment on care behaviors and children's health outcomes are mixed (Bamji & Thimayamma, 2000; Engle et al., 1999). While maternal employment increases household income and may improve women's status, it also increases workload which could compromise care practices (Engle et al., 1999; Kulwa, Kinabo, & Modest, 2006; Maddah et al., 2007). A mother's engagement in intensive or

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low-paying work, or her lack of control over her income and lack of a competent alternate caregiver, decrease the quality of care behaviors and negatively influence child health (Engle, 1991; Engle et al., 1999). In contrast, involvement of mothers in higher-paying occupations, control over income, and availability of a competent alternate caregiver could improve health outcomes of children (Engle, 1991; Engle et al., 1999).

A few studies have found associations of number of hours worked outside home with care behaviors and children's growth. Returning to full-time work early after delivery was positively linked with early cessation of breastfeeding, but there was no effect of part-time work on the continuation of breastfeeding (Fein & Roe, 1998). A study by Kulwa and colleagues found a negative association of number of hours worked outside home with HAZ of children (Kulwa et al., 2006). Early return to work by mothers after delivery has also been negatively associated with care behaviors and health outcomes such as reduction in immunization (Berger, Hill, & Waldfogel, 2005), behavioral problems (Berger et al., 2005), and poor cognitive development (Waldfogel, Han, & Brooks-Gunn, 2002). Studies have also indicated the negative effect of maternal workload on breastfeeding practices, particularly EBF until the age of six months (Agunbiade & Ogunleye, 2012; Tan, 2011). Heiland and colleagues found that long working hours reduce mother-child quality interaction time and time reading together. Additionally, no evidence that father or other relative invested time on children to compensate for the reduced maternal time was found (Heiland, Price, & Wilson, 2017). The effect of maternal employment may also depend on age of a child. Negative effect of maternal employment is found to be higher for infants, but the effects of maternal

employment are neutral or positive among older children (Engle, 1999; Waldfogel et al., 2002). Maternal employment may also improve ability to invest in children (Engle et al., 1999). A study found that employment reduced time duration spent by mothers with their children but when mothers were at home, they decreased other activities to provide more time to children to compensate for work-time (Huston & Aronson, 2005).

Most of the previous studies have focused only on the maternal involvement in income generating activities, whereas, workload has received less attention. Additionally, the effects of maternal employment on care behaviors and child outcomes are inconsistent. Furthermore, little is known about the mechanisms through which maternal workloads can influence children's growth and development.

2.3.6 Social Support

Social support includes perceptions of support and receipt of supportive behaviors such as provision of information, affection, and tangible-aid (Coyle, 2011; Haber, Cohen, Lucas, & Baltes, 2007). Support may help mothers to provide better care to their children, and in turn, may influence growth and development (Coyle, 2011; Engle et al., 1999). Social support, including perceived interpersonal relationships, is also known to have a buffering effect on stress, eventually improving capacity to provide care (Cohen & Wills, 1985). Independent effect of maternal social support has also been acknowledged, and studies have linked higher levels of maternal social support with better care behaviors (Shin, Park, & Kim, 2006; Tuan, Nguyen, Hajeebhoy, & Frongillo, 2014).

Children's fathers are important sources for instrumental, informational, and emotional support; these supports may influence care behaviors and children's growth and development (Engle et al., 1999; Meadows, 2011). Supports from fathers are important particularly if mothers lack other resources such as autonomy and education (Jahn & Aslam, 1995). Additionally, availability and affordability of childcare facilities are limited in low- and middle-income countries which increase the need for support from family and friends (Engle et al., 1999). Social support in the form of alternate caregivers is considered important; and unavailability of childcare support from other adults is associated with poor nutritional status among children, irrespective of employment status of mothers (Nakahara et al., 2006). Social support in household chores is also considered critical, particularly in the settings where household works are gendered, and females are expected to perform the chores (Poortman & Van der Lippe, 2009). Social support in household chores helps mothers to reduce workloads, spend more time with their children, and provide quality care (Engle et al., 1999; Gibson & Mace, 2005).

Higher level of social support to mothers has been associated with improved IYCF practices (Powell, Davis, & Anderson, 2014), psychosocial stimulation (Peter & Kumar, 2014), nutritional status (Gibson & Mace, 2005; Surkan, Ryan, Vieira, Berkman, & Peterson, 2007) and cognitive and socioemotional development among children (Sommer, Whitman, Borkowski, & Gondoli, 2000). In contrast, a few studies have reported null or negative effects of social support on care behaviors and children's growth and development. For example, a longitudinal study by Cycyk and colleagues

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reported that social support was not related to both maternal mental health and language development of children (Cycyk, Bitetti, & Hammer, 2015). Maternal kin support may be protective for children of mothers who are teens and belong to low-income families. On the other hand, having co-residence of multigenerational families may not always be beneficial and sometimes may even have a negative effect on child development (Black & Nitz, 1996). Other research has also demonstrated that the effects of social capital and support may vary across social groups (Moore, Daniel, Gauvin, & Dubé, 2009). These mixed results demand further investigation in the role of social support. Additionally, most of the previous studies have looked at the moderating effect of social support on stress and health outcomes, and more research to determine the independent effect of the social support on care behaviors and growth and development is required.

2.4 Integrated Interventions

Integrated interventions have shown positive effects on growth and development of children (Yousafzai, Rasheed, Rizvi, Armstrong, & Bhutta, 2014). Integrated interventions are promising in terms of additive or synergistic effects, reduction of duplication of work, and cost-effectiveness (Frongillo, Tofail, Hamadani, Warren, & Mehrin, 2014; Ruel, Alderman, & Maternal and Child Nutrition Study Group, 2013; Yousafzai et al., 2014). In the case of low- and middle-income countries, integrating interventions to promote conditions of women and enhance her capacity to perform care behaviors seems promising (Black & Dewey, 2014; Ruel et al., 2013). Integration of interventions to protect and promote physical and mental health, social

status, decision-making, and overall status of women has been identified as one of the potential approaches to combat poor child growth and development (Black & Dewey, 2014; Ruel et al., 2013).

Despite the acknowledgement about significance of integrated programs, little is known about the degree to which programs should be integrated (Engle et al., 2007). Understanding the structures of various resources for care measures has a potential to aid in developing and implementing integrated interventions. This will inform policymakers about the effective ways to combine the interventions (Nores & Barnett, 2010).

Additionally, it is recommended that co-occurring conditions such as stunting and lack of stimulation should be addressed together for maximum effect (Engle et al., 2007). Understanding multiple mechanisms through which resources for care may influence child outcomes will help policymakers and program implementers in addressing risk factors that co-occur and coordinating the interventions effectively to minimize duplication of work (Engle et al., 2007; Nores & Barnett, 2010).

2.5 Gaps in the Literature

Although there is some evidence that various categories of resources for care have effects on care behaviors and child outcomes, studies that employ comprehensive approach by including all categories of resources for care are needed. Additionally, some resources for care (for example, education) have received greater attention than others (for example, workload and availability of time). We also lack understanding about the structure and equivalence of resources for care measures.

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There is limited literature on the paths through which resources for care are associated with children's growth and development. Even among the few studies which have examined the paths, there is a lack of studies that have considered a wide range of care behaviors as potential mechanisms for the associations. For example, studies that attempt to explain the association of resources for care with ECD have included only psychosocial stimulation as a potential mechanism but did not consider paths through other care behaviors. Additionally, majority of the previous studies include a single study setting, therefore, little is known about the socio-cultural variation regarding the role of resources for care on care behaviors and child outcomes. Furthermore, some of the present literature indicate non-consensus findings about the role of resources for care on care behaviors and child outcomes, warranting further investigation.

2.6 Conceptual Model

The conceptual model (Figure 2.1) to guide our study is based on the extended model of care developed by the UNICEF (Engle, 1999; Engle et al., 1999). Resources for care are central in the model and has six categories: caregiver's education and knowledge, physical health, mental well-being, autonomy, reasonable workload and availability of time, and support from family and community. The model depicts that in order to perform appropriate care behaviors, the caregiver requires sufficient capability and support from the family members and the society (Engle et al., 1997; Engle et al., 1999). The resources for care are also major determinants of children's growth and development, and the effect may occur either directly or through care behaviors (Cleland & Van Ginneken, 1988; Engle et al., 1999).

The conceptual model is also guided by theoretical explanations and previous studies. Care behaviors, child growth and development are influenced by multiple conditions ranging from immediate surrounding like family to distal ones like policy (Britto et al., 2017). Ecological systems theory by Brofenbrenner highlights that children's development is influenced by the environment in which they grow, including the individuals in the surrounding (Brofenbrenner, 1994). Socio-cultural theory also supports that caregivers play a critical role in children's life (Vygotsky, 1978). Additionally, researchers have emphasized that only provision of counseling to the caregivers may not be enough to improve care behaviors; there is a need to address resource constraints which prevent them from translating the advice into practice (Engle et al., 1999; White & Masset, 2007). Resources have also been identified as pre-conditions that influence the process of decision-making and drive the caregiver to take appropriate decisions (Kabeer, 1999). In other words, resources help to build capabilities in individuals for making appropriate choices which in turn leads to positive behavioral or health outcomes (Engle et al., 1999; Kabeer, 1999).

The conceptual model guiding this study incorporates all categories of resources for care and depicts that care received by children can be influenced by the caregiver's education and knowledge, physical health, mental well-being, autonomy, reasonable workload, and social support. Our research focused on four domains of care behaviors: IYCF, hygiene, health-seeking, and family care. The conceptual model depicts that resources for care influence care behaviors. The conceptual model also illustrates that resources for care can be associated with child nutritional status, specifically HAZ

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through a direct path or through care behaviors. The model also presents that resources

for care can be associated with child development, specifically motor and language

development, directly or indirectly through care behaviors and/or child nutritional

status (i.e. HAZ).
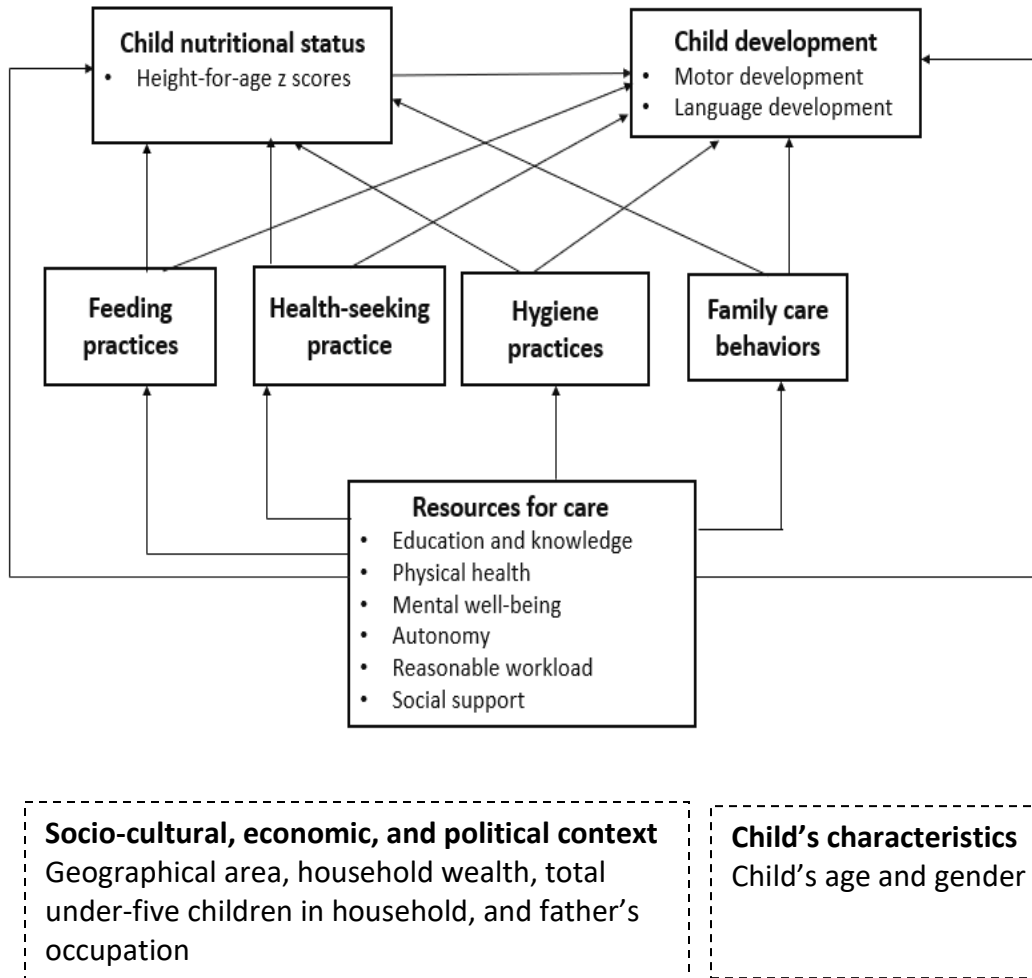
Figure 2.1. Conceptual model depicting the role of resources for care on care behaviors, nutritional status, and early childhood development.

2.7 Study Significance

Childhood undernutrition and suboptimal ECD are global problem with higher prevalence in low- and middle-income countries (Black et al., 2013; Black et al., 2017; McCoy et al., 2016). Resources available to mothers may help to improve care behaviors, which in turn, may influence children's nutritional status and ECD. Additionally, improved children's physical growth may positively affect ECD (Engle, 1999; Engle et al., 1999; Larson et al., 2018). Therefore, the use of a comprehensive and integrated approach is warranted to assess the contributions of a wide range of resources for care on care behaviors, growth, and development of the children (Engle et al., 1999; Peter & Kumar, 2014).

Programs that focus on improving children's growth and development are more effective if an integrated approach is incorporated (Frongillo et al., 2014; Yousafzai et al., 2014). Understanding the structure of resources for care measures may provide evidence for implementing the integrated programs, yet, there is little or no data. This study provides scientific knowledge for implementing integrated interventions that aim to benefit mothers and children. Additionally, this research allows us to understand the role of children's nutritional status in explaining the associations of resources for care with ECD, which provides evidence for the integrated nutritional and ECD interventions. Our research also investigated if the measures of resources for care showed equivalence across contexts. Understanding about the equivalence helps to make meaningful comparisons of the findings across settings (Kankaraš & Moors, 2010; Mullen, 1995).

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Provision of resources to care could play a critical role in improving care behaviors, children's nutritional status, and ECD. Previous studies have worked extensively on the effects of some of the categories of resources for care (for example, education) on care behaviors, growth, and development. On the other hand, there is little or no evidence on the effect of some categories of the resources (for example, workload) (Engle et al., 1999). We included all categories of resources for care which helped us to gain deeper understanding and provide evidence for developmental projects that aim to improve children's growth and development.

This research also helped to understand the mechanisms through which resources for care were associated with children's nutritional status and ECD. Through this research, we expanded our knowledge about the mediating effects of care behaviors on the relationships of resources for care with children's physical growth, motor development, and language development. We also improved our understanding about the mediating role of children's nutritional status in the associations between resources for care and child development. Additionally, the path analysis allowed us to determine the direct effects of resources for care on child growth and development.

This study is based on data that were collected in countries which have some of the highest burdens related to poor care behaviors, child undernutrition, and suboptimal ECD (Arabi et al., 2012; Bornstein & Putnick, 2012; Grantham-McGregor et al., 2007; Kariger et al., 2012; McCoy et al., 2016; UNICEF et al., 2018). Assessing the capacity and ability of caregivers to exhibit appropriate care in these settings is crucial

(Engle et al., 1999). This research helped us to highlight the specific areas in which intervention should be focused to promote growth and development of children.

Socio-cultural variation in provision of care is well-documented and these variations may contribute to health and developmental outcomes of children (Engle, 1999). Our study includes socio-culturally diverse countries: Bangladesh, Ethiopia, and Vietnam, which allowed us to compare the country-specific study findings. Inclusion of these countries also improved generalizability of this research in the low- and middle-income settings.

Overall, improving childhood growth and development is a major challenge in many low- and middle-income countries including Bangladesh, Ethiopia, and Vietnam. Our research aimed to examine the factor structure of maternal resources for care measures and compare with the theoretical construct. This research also aimed to examine if measures of resources for care showed equivalence across contexts. Other aims include examining associations between resources for care and care behaviors and understanding the mechanisms through which resources for care are associated with children's nutritional status and ECD. Our research provides evidence to develop and implement interventions and policies that aim to promote appropriate care behaviors and children's growth and development.

CHAPTER 3

METHODOLOGY

3.1 Study Design and Setting Description

This research is a cross-sectional and used the Alive & Thrive baseline data that were collected in Bangladesh, Vietnam, and Ethiopia. The Alive &Thrive is an initiative which aims to support children's survival, growth, and development by improving IYCF practices (Nguyen et al., 2017). The description of each country is provided below.

Bangladesh

Bangladesh is a lower-middle-income country in South Asia (World Bank, 2018a). The country has made remarkable progress in terms of economic growth and health in recent decades, yet substantial proportion of people live in poverty in the country. Additionally, high population density and sustained growth in the recent years have caused infrastructure deficit (World Bank, 2018b). There are also high burdens of childhood illnesses, malnutrition, suboptimal development, and mortality. About 36% of under-five years old children were stunted in 2014 (World Bank, 2018c). Suboptimal ECD is also prevalent in Bangladesh. In 2010, low cognitive and socioemotional development were present among 11.8 % and 30.1% of the 3-and 4-years-old children, respectively (McCoy et al., 2016).

Vietnam

Vietnam is a lower-middle-income country located in Southeast Asia (World Bank, 2018a). The country has made significant economic and social progress in the past decades, but still has a large economic, gender, and ethnic inequalities (World Bank, 2018d). Childhood malnutrition and suboptimal ECD are also major problems in the country. About one-fourth (24.6 %) of the children were stunted in 2015 (World Bank, 2018c). In 2010, about 8 % and 10% of the children were unable to achieve optimal cognitive development and socioemotional development, respectively (McCoy et al., 2016).

Ethiopia

Ethiopia is a low-income country located in Sub-Saharan Africa (World Bank, 2018a). In the past decades, Ethiopia has made a significant progress in many health and social indicators, but many challenges persist (World Bank, 2018e). About 38% of < 5 years old children were stunted in 2016 (World bank, 2018c) in Ethiopia. Suboptimal childhood development is another challenge for the country (Hanlon et al., 2016; Servili et al., 2010).

3.2 Data and Study Population

We baseline data that were collected in 2010 as part of the Alive & Thrive project. For this dissertation research, we used data collected at the household level in Bangladesh, Vietnam, and Ethiopia. Households were selected from twenty sub-districts (*upazilas*) in Bangladesh, forty communes in Vietnam, and seventy-five enumeration areas in Ethiopia. The baseline surveys included 4400, 4029, and 3000 households in

Bangladesh, Vietnam, and Ethiopia, respectively (Ali et al., 2011; Nguyen et al., 2010; Nguyen et al., 2014a; Saha et al., 2011). Three sampling frames were developed from the household listings in all countries. The sampling frame of Bangladesh represented the <6 months, 6 to 23.9 months, and 24 to 47.9 months age categories. The sampling frames of Vietnam and Ethiopia included <6 months, 6 to 23.9 months, and 24 to 59.9 months age categories. Children were randomly selected from the households until the estimated sample sizes were met for each age category (Ali et al., 2013). Detailed descriptions of the sampling procedure can be found elsewhere (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011).

For the data collection, a structured questionnaire was administered to the mothers via face-to-face interviews (Ali et al., 2011; Ali et al., 2013; Nguyen et al., 2010; Saha et al., 2011). Training was provided to an experienced team of data collectors. Electronic weighing scales were used to measure weight. Length/height boards were used to measure length or height. Standardization exercises for anthropometric measurements were conducted to ensure precision and accuracy. The measurements were taken twice by trained personnel. The third measurement was taken if the differences between two measurements were significant. The average estimation of the measurements was used (Nguyen et al., 2010). Informed consent for the participation in the study was obtained from the mothers before data collection. The data collection procedure was approved by the institutional review board at the International Food Policy Research Institute and institutional review boards in each country (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011). Index/youngest children and their mothers were

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included in our research. We used the de-identified data, and it was exempted by the institutional review board of the University of South Carolina.

3.3 Measures

Child nutritional status

In this research, HAZ was used as a measure of children's nutritional status. The WHO growth standards were used to develop the measure (de Onis et al., 2004; Mei & Grummer-Strawn, 2007). Children's weights were measured by using electronic weighing scales. Children's standing heights or recumbent lengths were assessed by using collapsible height/length boards which were locally manufactured (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011).

Early childhood development

Two measures of ECD were used: motor and language development. Data on child development were not available for Ethiopia. In Bangladesh and Vietnam, motor development was assessed using 29-itemed instrument (Table 3.1). Motor development was assessed through mothers' reporting, and for a few items, children were required to demonstrate motor activities. One point was assigned to each affirmative response or observation, then a variable indicating motor development was created by adding the scores.

Table 3.1. Items used to measure motor development.

S.N.	Items
1.	She can pull to sit. Her head is steady and straight
2.	Raises head and chest when lying on stomach
3.	Can turn and roll over
4.	Holds head steady when held sitting (head does not fall to the side or bob up and down)

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5. She can make crawling (swimming) movements but with tummy touching the ground
6. She can sit with the support of leaning against an object or person
7. She can sit without support
8. She can raise her tummy off the floor and support herself on her hands and feet or knees
9. When she is lying on her stomach, with her head and chest raised, she can move across the floor by using her arms and legs. Her stomach remains on the floor
10. She can crawl
11. She is able to stand if she holds on to something or someone to help support herself
12. She can walk when both hands are held
13. She can walk with only one hand held
14. She can stand for a moment on her own
15. She can stand alone for a long time
16. She can bend down (at the waist) and straighten up again without falling. (Knees are straight, or are just slightly bent)
17. She can take at least a few steps alone (Without the help of a person or object)
18. She can run
19. She can walk up steps (walking on feet; not crawling)
20. She can throw a ball overhand (Throwing with hand raised up near head)
21. She can walk up and down steps (Walking on feet; not crawling)
22. She can kick a ball forward
23. She can walk forward along a straight line (10 paces) (within 6 cm of tape) *
24. She jumps with both feet (Both feet are off the ground at the same time)
25. She can stand on one foot for several seconds *
26. She can walk backward along a straight line (10 paces) (within 6 cm of tape) *
27. She can stand on tiptoe (heels are off the ground for four steps) *
28. She can skip using alternate legs *
29. She can hop 20 times on one leg *

Note: * denotes the child required to demonstrate the skill.

Language development was assessed using 21-itemed instrument in Bangladesh and 20- itemed instrument in Vietnam (Table 3.2). Mothers were asked questions on language development and a point was assigned to each response which indicated achievement of the milestone. The scores were added to develop an overall language development.

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Table 3.2. Items used to measure language development.

S.N.	Items
1.	Makes sounds in play when alone
2.	Makes sounds like da, ba, ga, ka, ma
3.	Makes sounds like ma-ma, da-da, ba-ba
4.	Imitates single sounds like da, ba, ma or repetitions
5.	When he's holding something and I ask him to give it to me, he does
6.	He can say one word
7.	Waves bye-bye at the right time
8.	He points and makes sounds when he wants something
9.	If I ask him he can point to a cat or a chicken
10.	He can say 3 words
11.	If I ask him, he can point to a person that is walking
12.	He can say 6 words
13.	He uses the words "me" and "you"
14.	He is constantly asking the names of objects
15.	He asks a lot of questions beginning "What"? "Where"? and "Who"?
16.	He can say many words (20 or more)
17.	He uses plurals when he speaks
18.	He can tell me what a knife is for
19.	He can tell people his full name
20.	He can tell me the opposite of the word "big"
21.	He can talk about things that happened the past *

Note: * the question was asked only in Bangladesh.

Care behaviors

Infant and young child feeding practices. We used three measures of feeding practices: EBF, minimum meal frequency, and diet diversity. Exclusive breastfeeding indicates the proportion of 0-5.9-month-old infants who are fed exclusively with breastmilk (WHO, 2008). Minimum meal frequency represents the proportion of children between the ages of 6 to 23.9 months who received solid, semi-solid, and soft foods (plus milk feeds for non-breastfed children) minimum number of times or more (WHO, 2008). Dietary diversity score includes number of food groups consumed by 6-23.9 months old children. The measure is based on count of seven food groups: grains,

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roots and tubers; legumes and nuts; dairy products; flesh foods; eggs; vitamin A rich fruits and vegetables; and other fruits and vegetables (WHO, 2008). The information related to IYCF was based on the past 24-hour dietary recall by mothers.

Hygiene practices. We used three measures of hygiene practices: improved drinking water source, improved sanitation, and cleanliness. Improved drinking water source indicates a source that is adequately protected from feces and other contaminants (Pullan et al., 2014). Improved sanitation indicates a facility which separates excreta from contact with human and is not shared with other households (Pullan et al., 2014). Both measures of water and sanitation were binary. A variable denoting cleanliness was developed using hygiene spot check data of house interior, house exterior, and face, hands, hair, and clothes/body of a mother and her child. One point was assigned for each observation indicating "clean". This was followed by addition of the scores to create the cleanliness variable (total possible score of 10).

Health-seeking practice. Child immunization status was used as a measure for health-seeking practice. Child immunization is a binary variable, and a child (≥ 12 months) was considered immunized if he/she had received essential vaccines such as Bacillus Calmette-Guerin vaccine, Diphtheria-Pertusis-Tetanus vaccine, polio vaccine, hepatitis B vaccine, and measles vaccine (Animaw, Taye, Merdekios, Tilahun, & Ayele, 2014; Oyo-Ita, Nwachukwu, Oringanje, & Meremikwu, 2012; Uddin, Koehlmoos, Saha, & Khan, 2010). Data on the immunization were collected from the immunization cards or mothers.

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Family care behaviors. Psychosocial stimulation and adequate care represented family care behaviors (Kariger et al., 2012). Psychosocial stimulation denoted the number of learning and school-readiness promoting activities in which an adult was engaged with a child in past 3 days (total possible score of 6). The activities included reading books; telling stories; singing songs; taking outside; playing; and naming, counting and drawing things. Data on psychosocial stimulation were only available for Bangladesh and Vietnam. Adequate care represented not leaving a child alone or with a minor for more than an hour. Data on both variables were based on mother's reporting.

Resources for care

All resources for care variables except those related to physical health were based on self-reporting by mothers. Physical health variables were based on the anthropometric data. Measures of maternal resources of care are described below.

Education and knowledge. Women's education level differs across the countries; therefore, different cut-offs were used for education depending on the country's context (Nguyen et al., 2014a). In manuscripts 1 and 3, years of schooling was used to represent educational status. In manuscript 2, categorical variable of maternal education was used and "1-5 years of schooling" was the reference group for all three countries. Maternal knowledge incorporated knowledge related to breastfeeding, complementary feeding, iron deficiency symptoms, vitamin A sources, iodine fortification, food diversity, and hand washing. One point was assigned for each correct response which was followed by the addition of the scores (total possible scores: 22 for Bangladesh and 23 for Vietnam and Ethiopia).

Physical health. Maternal height was one of the measures of physical health. Maternal BMI, which is calculated as weight in kilograms divided by height in meters squared, also represented physical health. Height was measured using the height boards. Weight was measured by using electronic weighing scales (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011). In manuscript 1 and 3, continuous variable of BMI was used. In manuscript 2, a binary variable was created using the continuous BMI variable; mothers were categorized as well-nourished (BMI of ≥18 kg/m^2) and underweight (BMI of <18.5 kg/m^2) (WHO, 2016).

Mental well-being. The SRQ-20 was used to collect data on mental health. The scale includes twenty questions on psychological and somatic symptoms (WHO, 1994). The instrument is considered reliable and has been validated in several low- and middle-income countries (WHO, 1994). One point was assigned for each item which indicated absence of the symptoms in the past four weeks and then the scores were added (total possible score of 20). The data was based on maternal reporting.

Table 3.3. Items used to measure mental well-being.

S.N.	Items
1.	Do you often have headaches?
2.	Is your appetite poor?
3.	Do you sleep badly?
4.	Are you easily get frightened?
5.	Do your hands shake/tremble?
6.	Do you feel nervous, tense or worried?
7.	Is your digestion poor?
8.	Do you have trouble thinking clearly?
9.	Do you feel unhappy?
10.	Do you cry more than usual?
11.	Do you find it difficult to enjoy your daily activities?
12.	Do you find it difficult to make decisions?

13. Is your daily work suffering?
14. Are you unable to play a useful part in life?
15. Have you lost interest in things?
16. Do you feel that you are a worthless person?
17. Has the thought of ending your life been on your mind?
18. Do you feel tired all the time?
19. Do you have uncomfortable feelings in your stomach?
20. Are you easily tired?

Autonomy. Financial and decision-making autonomy were the measures of autonomy. Mothers were considered financially autonomous if they were employed and had freedom to use the earned money. Decision-making autonomy variable was developed by assigning one point for each item which indicated mother's involvement in the decision-making process (total possible score of 11). The items used to assess decision-making autonomy were related to major purchases; cooking; visiting family, friends, or relatives; healthcare visit; family planning; and care of children including child feeding.

Reasonable workload/time availability. We lacked data on overall time spent by mothers on work and leisure, therefore, maternal employment status (employed vs not employed) was used to reflect reasonable workload. Women are typically more engaged in household work than men regardless of the employment status, especially in low- and middle-income countries (Fuwa, 2004; Lennon & Rosenfield, 1992). Therefore, in our research being employed indicated higher workload.

Social support. We used two measures of social support: support in household chores and perceived instrumental support. Support in household chores indicated support received by mothers in chores such as cooking, washing clothes, fetching water, fetching fuel, cleaning house and around house, taking care of the youngest child,

feeding the youngest child, assisting the youngest child to bathe, and going to the market to buy food for the house. Support in chores variable was developed by assigning one point for each item that indicated receiving support and adding the scores (total possible scores: 8 for Bangladesh and 9 for Vietnam and Ethiopia). Perceived instrumental support represented potential help with accommodation, money, and food. A point was assigned if mothers responded that they will get support when they are in need. The scores were added to develop the perceived instrumental support variable (total possible scores of 3).

Covariates

Child's age and gender were the covariates at the child level. Father's occupation was also one of the covariates. Total number of < 5 years children in the household and household wealth index were the covariates at household level. Household wealth index was constructed using principal component analysis and then the first component scores were extracted (Vyas & Kumaranayake, 2006). To construct the household wealth, we used information related to house and land ownership, quality of house, access to services in the household (for example, electricity, cooking fuel), and household assets.

3.4 Statistical Analysis

We conducted separate analysis for each country by using Stata version 14. Descriptive statistics were reported in mean, standard deviation (SD), or percentage. A p-value of < 0.05 was considered as statistically significant. The statistical analyses by manuscript are described below.

Manuscript 1

This study used data pertaining to the mothers of the index/youngest children only (Bangladesh n=4400, Vietnam n=4029, Ethiopia n=2746). We performed factor analysis with varimax method of orthogonal rotation to examine the structure of the resources for care (Ford, MacCallum, & Tait, 1986). The variables included in the factor analysis were maternal education, knowledge, height, BMI, mental well-being, financial autonomy, decision-making autonomy, employment status, support in chores, and perceived instrumental support. The lowest to highest number of factors were examined until the most interpretable solution was found (Ford et al., 1986). Eigenvalue and scree test guided the retention of the factors (Ford et al., 1986). Internal consistency reliability coefficients (Cronbach's alpha) were calculated for the scales that were used to measure resources for care. This paper also examined if the measures of resources for care showed equivalence across countries. For the scales used to measure resources for care, the order of the items based on the percentage of affirmative responses was depicted in graphs (Frongillo, 1999; Mullen, 1995). We used Bangladesh as a reference, i.e., the percentage of affirmative responses for the items were arranged in ascending order for Bangladesh, then the items for the other two countries based on the sequencing of the items for Bangladesh were plotted. We developed separate graphs for each scale.

Manuscript 2

Multiple regression analysis was used to examine the associations of resources for care with EBF (children <6 months: Bangladesh n=977, Vietnam n=948, Ethiopia

n=602), complementary feeding (children 6-23.9 months: Bangladesh n=1211, Vietnam n=1095, Ethiopia n=870), hygiene practices (children 0-47.9/0-59.9 months: Bangladesh n=4400, Vietnam n=4029, Ethiopia n=2746), immunization (children 12-47.9/12-59.9 months: Bangladesh n=2983, Vietnam n=2607, Ethiopia n=1800), and family care behaviors (children 6-23.9 months: Bangladesh n=1211, Vietnam n=1095, Ethiopia n=870 and children 24-47.9/59.9 months: Bangladesh n=2180, Vietnam n=1972, Ethiopia n=1254) (Animaw et al., 2014; Uddin et al., 2010; WHO, 2008). The analysis for family care behaviors was broken into two groups because resources for care can have differential effects by child's age (Engle et al., 1999). The family care behaviors measured may not present much variation in < 6months old children. Therefore, we did not include < 6 months old age group in analysis for family care behaviors. The analyses that involved IYCF practices and immunization were also restricted by child's age; the selections of the age groups were guided by previous research and recommendations (Animaw et al., 2014; Uddin et al., 2010; WHO, 2008).

In this manuscript, we included nine measures of maternal resources for care: education, knowledge, height, well-nourishment, mental well-being, decision-making autonomy, employment status, support in chores, and perceived instrumental support. Separate regression models were run for each measure of care behaviors. Each model included all measures of resources for care. The models were adjusted for covariates: child's age and gender, father's occupation, household wealth, and number of <5 years children in the household. We also accounted for the geographic clustering using the

primary sampling units (sub-districts, communes or enumeration areas) as random effects.

Manuscript 3

Path analysis models using the Stata sem command were run to understand the mechanisms through which maternal resources for care were associated with HAZ, motor development, and language development of 12-23.9 months old children (Bangladesh n=803, Vietnam n=635, Ethiopia n=546). We restricted analysis by children's age because the children belonging to younger age group may lack significant variation in terms of psychosocial stimulation (Larson et al., 2018). Additionally, ≥ 24 months old children would have achieved their motor and language milestones and may not present much variation (Frongillo et al., 2016).

Resources for care can be associated with HAZ, language, and motor development through direct or indirect paths. The potential indirect paths through which resources for care may be associated with HAZ are through dietary diversity, cleanliness, immunization, psychosocial stimulation, and adequate care. The potential indirect paths through which resources for care can be associated with child development are through dietary diversity, cleanliness, immunization, psychosocial stimulation, adequate care, HAZ, dietary diversity and HAZ, cleanliness and HAZ, immunization and HAZ, psychosocial stimulation and HAZ, and adequate care and HAZ. We calculated the effects by multiplying the unstandardized regression coefficients of the paths. The models included all measures of resources for care, and the analyses were adjusted for child's age and gender, father's occupation, total number of <5 years

old in the household, and household wealth. The geographical clustering was also accounted.

In this paper, we used nine measures of resources for care: maternal education, knowledge, height, BMI, mental well-being, decision-making autonomy, employment status, support in chores, and perceived instrumental support. We used only one measure for each care behavior domain to reduce the possibility of the shared variation (except for family care behaviors). Two measures of family care behaviors were used (psychosocial stimulation and adequate care) because these two variables are theoretically distinct and did not had a strong association in our datasets.

CHAPTER 4

RESULTS

4.1 Manuscript 1

FACTOR STRUCTURE AND EQUIVALENCE OF MATERNAL RESOURCES FOR CARE IN
BANGLADESH, VIETNAM, AND ETHIOPIA [1]

ABSTRACT

Resources for care such as education, knowledge, health, autonomy, reasonable workload, and social support are crucial for children's growth and development. The study aimed to examine: 1) the factor structure of maternal resources for care measures and compare with the theoretical construct and 2) if the measures of resources for care showed equivalence across contexts. The study included 4400, 4029 and 2746 mothers from Bangladesh, Vietnam, and Ethiopia, respectively. The factor analysis demonstrated that a three-factor solution best explained the structure of resources for care in Bangladesh and a two-factor solution best explained the structure in Vietnam and Ethiopia. In Bangladesh and Vietnam, the first factor was associated with financial autonomy and employment. In Bangladesh, the second factor was associated with education, knowledge, body mass index, mental well-being, and perceived support, and the third factor was associated with decision-making autonomy and support in chores. In Vietnam, second factor was associated with education, knowledge, mental well-being, and perceived support. In Ethiopia, the first factor was associated with decision-making autonomy, financial autonomy, and employment; the second factor was associated with education and knowledge. For scale measures, the order of the items based on the percentage of affirmative responses was similar across countries and they had a high internal consistency. The measures of resources for care were structurally similar and equivalent across countries and can be used to measure and compare resources for care in low- and middle-income countries. Additional work examining the structure and equivalence of resources for care in other settings is warranted.

INTRODUCTION

Despite attention from international communities and inclusion on the global agenda, poor child growth and development remain significant problems especially in low- and middle-income countries (Black et al., 2013; Black et al., 2017). Among several determinants of child growth and development, appropriate care is a critical one (Britto et al., 2017; Engle, Menon, & Haddad, 1999). Although the importance of care has been recognized, unavailability or inadequacy of resources available to caregivers can constrain provision of appropriate care (Engle et al., 1999).

Resources enhance ability of the individuals to make life choices and equip them for providing time, attention, and support to meet various needs of the household members, including children (Engle et al., 1999; Kabeer, 1999). The extended model of care by the United Nations Children's Fund (UNICEF) highlights that care behaviors and child outcomes are influenced by various attributes of caregivers (Engle, Menon, & Haddad, 1997; Engle et al., 1999; Peter & Kumar, 2014). The model has identified six categories of resources for care: education and knowledge, physical health, mental health, autonomy, reasonable workload and availability of time, and social support (Engle et al., 1997; Engle et al., 1999). Caregiver's education and knowledge are conditions which can improve capacity to provide care. Caregiver's health is an individual condition that helps to transform acquired knowledge into practice (Engle et al., 1999). Autonomy reflects ability of caregivers to make decisions, and control resources in household and community (Carlson, Kordas, & Murray-Kolb, 2015; Engle et

al., 1999). Reasonable workload and social support reflect family- and community-level resources that help strengthen caregiver's ability to provide care (Engle et al., 1999).

Socio-cultural and ecological systems theories also assert the critical role of caregivers and social environment on children's development and well-being (Brofenbrenner, 1994; John-Steiner & Mahn, 1996; Vygotsky, 1978). Brofenbrenner's ecological systems theory indicates that children's development depends on the environment in which children grow, including the people in the surrounding (Brofenbrenner, 1994). Socio-cultural theory by Vygotsky highlights the impact of caregivers, society, and culture on children's life (John-Steiner & Mahn, 1996; Vygotsky, 1978). Resources available to the caregivers are important to identify and address children's need, and the national, community, and household contexts could drive availability of the resources (Black et al., 2017; Britto et al., 2017; Engle et al., 1999).

Mothers are children's primary caregiver in almost all socio-cultural settings around the world (Coller & Kuo, 2015). Typically, mothers create the first environment to which children are exposed after birth. Children also spend most of the time during the early period of life with their family, especially mothers (Coller & Kuo, 2015; Frongillo, Kulkarni, Basnet, & de Castro, 2017; Maggi, Irwin, Siddiqi, & Hertzman, 2010). The caregiver's role in children's well-being is greater in settings where there is low accessibility of institutions or programs that promote nurturing care (for example, preschool programs) (Borisova, Pisani, Dowd, & Lin, 2017). Additionally, many programs that are focused on improving child health are operated through mothers, and mothers with less resources may not be able to take advantages of those programs (Tripathy et

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al., 2010; Walker et al., 2011). Therefore, building capabilities among caregivers, particularly mothers, could improve children's well-being (Borisova et al., 2017; Engle et al., 1999).

There are multiple categories of resources for care and there are several ways of assessing them. For example, maternal education can be measured by years of schooling or literacy depending on the context. Data on education can also be collected using various methods like self-report and school records (Engle, 1999). Some measures of resources for care are theoretically related, whereas other resources for care are distinct (Engle et al., 1999; Peter & Kumar, 2014). Additionally, some types of resources for care can be measured in a more objective way (for example, height) or have been validated across many cultures, (for example, assessment of mental well-being using self-reporting questionnaire-20) (Tuan, Harpham, & Huong, 2004; WHO, 1994). On the other hand, some measures may not have the same meaning across cultures which may reduce their applicability across cultures (Engle et al., 1999; Taylor et al., 2004). Equivalence denotes that measures are consistent across contexts (Leroy, Ruel, Frongillo, Harris, & Ballard, 2015). Demonstration of the equivalent measures across countries is essential to compare the research findings across contexts (Kankaraš & Moors, 2010; Mullen, 1995).

Understanding the structure and equivalence of the resources for care may improve the assessment and help in meaningful comparisons of the findings across cultures (Kankaraš & Moors, 2010; Mullen, 1995). Additionally, integrating interventions to promote capabilities of mothers could be cost-effective in improving child outcomes

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and the improved understanding on structures and equivalence of resources for care may help to develop and implement integrated interventions (Black & Dewey, 2014; Frongillo, Tofail, Hamadani, Warren, & Mehrin, 2014; Ruel, Alderman, & Maternal and Child Nutrition Study Group, 2013; Yousafzai, Rasheed, & Siyal, 2018). The objectives of the study were to examine: 1) the factor structure of maternal resources for care measures and compare with the theoretical construct and 2) if the measures of resources for care showed equivalence across contexts.

METHODS

Participants

The study used the baseline data from household surveys collected in Bangladesh, Vietnam, and Ethiopia as a part of impact evaluation of the Alive & Thrive project in 2010. The Alive & Thrive is an initiative that aims to increase survival, prevent illnesses, and support optimal growth and development of children by improving child feeding practices (Nguyen et al., 2017). Mothers and their children under the age of five years were included in the surveys (Bangladesh: 0-47.9 months, Vietnam and Ethiopia: 0-59.9 months). For this study, we used data pertaining to the mothers of youngest/index children only. The study samples were 4400, 4029, and 2746 mothers from Bangladesh, Vietnam, and Ethiopia, respectively. The sample sizes for factor analyses were slightly lower in all three countries (Bangladesh: 4396, Vietnam: 4022, and Ethiopia: 2740) because of missing data in a few cases for some variables.

Procedure

Informed consent for participation was obtained from the mothers. Detailed description of the data collection procedure can be found elsewhere (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011). The ethical approval for the data collection was obtained from the institutional review board of each country and the International Food and Policy Research Institute. The datasets used for this study were de-identified, and the study was exempted by the institutional review board of the University of South Carolina.

Measures

The data on resources for care were specific to the mothers of the children less than 5 years of age. The measures of resources for care used were maternal education, knowledge, height, body mass index (BMI), mental well-being, financial autonomy, decision-making autonomy, employment, support in chores, and perceived instrumental support. Information on all variables was reported by the participants (mothers), except the information pertaining to physical health which was based on the anthropometric measurements.

Education and knowledge. Maternal years of schooling was used to represent educational attainment. Maternal knowledge was related to knowledge of the mothers on breastfeeding, complementary feeding, food diversity, iron deficiency symptoms, vitamin A sources, iodine fortification, and hand washing. The variable was developed by assigning a point for each correct answer, with a total possible score of 22 for Bangladesh, and 23 for Vietnam and Ethiopia.

Physical health. Maternal height and BMI (kg/m^2) were the measures of physical health. Heights and weights were measured by using height boards and electronic scales, respectively (Ali et al., 2011; Ali et al., 2013; Nguyen et al., 2010; Saha et al., 2011). Mother's height and weight were measured twice by trained personnel and a third measurement was taken if the differences between two measurements was significant. The average estimation of the measurements was used (Nguyen et al., 2010).

Mental well-being. Mental well-being was measured by using the Self-Reporting Questionnaire-20 (SRQ-20) (WHO, 1994). The scale includes twenty questions on psychological and somatic symptoms over the past four weeks. The variable was developed by assigning one point for each response which indicated the absence of the symptoms and then the scores for each item were added (total possible score was 20). A higher score of the variable indicated greater level of mental well-being.

Autonomy. Two measures of maternal autonomy were used which were financial and decision-making autonomy. Financial autonomy (yes vs no) represented the mothers' control over money. The decision-making autonomy denoted maternal involvement in household-related decisions such as major purchases; cooking; working to earn money; visiting family, friends, or relatives; healthcare visit; family planning; and care of children including child-feeding. A point was assigned if mothers solely or jointly made the decisions, then the scores were added with total possible score of 11. A higher score of the variable indicated higher level of decision-making autonomy.

Workload. We did not have data on overall workload of mothers, therefore, maternal employment status (employed vs not employed) was used as a measure of reasonable workload. Household work is often gendered around the world, especially in low- and middle-income countries, and employed mothers are typically engaged in majority of the household work as well (Fuwa, 2004; Lennon & Rosenfield, 1992). Therefore, in our study being employed indicated higher workload.

Social support. Two measures of social support used were support in household chores and perceived instrumental support. The support in chores indicated receiving help from others in household tasks such as cooking, washing clothes, fetching water, fetching fuel, cleaning house and around house, taking care of the youngest child, feeding the youngest child, assisting the youngest child to bathe, and going to the market to buy food for the house. Perceived instrumental support indicated potential help with accommodation, money, and food. A point was assigned for each item if support in chores (total possible score was 8 in Bangladesh and 9 in Vietnam and Ethiopia) or perceived support (total possible score was 3) was reported, followed by addition of the scores. A higher score denoted higher level of support for both social support variables.

Equivalence

Equivalence helps to demonstrate that measures are consistent across context (Leroy et al., 2015). There are four main types of equivalence which are construct, item, measurement, and scalar equivalence. Construct equivalence indicates same construct is measured across contexts. In item equivalence, each item is perceived and

interpretable in the same way across contexts (Leroy et al., 2015). Item equivalence is observed when items are equally relevant and acceptable across contexts (Herdman, Fox-Rushby, & Badia, 1998). Measurement equivalence denotes construct, item, and unit are same across contexts (Leroy et al., 2015). Measurement equivalence helps us to compare if same instrument achieves acceptable levels of resources for care in terms of psychometric properties (Herdman et al., 1998; Kankaraš & Moors, 2010). Scalar equivalence is like measurement equivalence but in this equivalence the definition of zero is the same across contexts (Leroy et al., 2015). Although scalar equivalence is desired to have for the comparisons across contexts, it is difficult to achieve (Leroy et al., 2015). This study examined measurement equivalence because it is relatively easier to achieve than scalar equivalence and can be used for the meaningful comparisons across contexts (Leroy et al., 2015; Mullen, 1995).

Statistical analysis

Statistical analysis was conducted separately for each country using Stata version 14. Descriptive statistics were presented in mean and standard deviation (SD) or percentage. Factor analysis with varimax method of orthogonal rotation was performed to examine the structure of the resources for care. The orthogonal rotation produces statistically uncorrelated factors (Ford, MacCallum, & Tait, 1986). The analysis included ten variables which represented the resources for care: maternal education, knowledge, height, BMI, mental well-being, financial autonomy, decision-making autonomy, employment status, support in chores, and perceived instrumental support. We examined the lowest to highest number of factors until we found the most interpretable

solution (Ford et al., 1986). Internal consistency reliability coefficients (Cronbach's alpha) for each scale measures were also calculated. The retention of the factors was based on the eigenvalue and scree test (Ford et al., 1986). For the scale measures, the order of the items based on the percentage of affirmative responses was depicted in graphs (Frongillo, 1999; Mullen, 1995). While developing the graphs, Bangladesh was used as a reference, i.e., the percentage of affirmative responses for the items were arranged in ascending order for Bangladesh, which was followed by plotting the items for the other two countries based on the sequencing of the items for Bangladesh. Separate graphs were developed for each scale.

RESULTS

Maternal education level was highest in Vietnam, followed by Bangladesh, and then Ethiopia (Table 4.1). The mean knowledge scores were 9.76, 9.01, and 8.88 in Bangladesh, Vietnam, and Ethiopia, respectively. Maternal height was highest in Ethiopia (157 cm), followed by Vietnam (153 cm), and Bangladesh (151 cm). Maternal BMI was about 20 kg/m^2 in all three countries. Mental well-being was highest in Vietnam (mean=15.1), followed by Ethiopia (mean=14.2) and Bangladesh (mean=13.1). Financial autonomy was highest in Vietnam (73.0 %) and was only 8.28 % and 4.70 % in Ethiopia and Bangladesh, respectively. Decision-making autonomy had a mean of about 9 in Vietnam and Ethiopia and had a slightly lower mean in Bangladesh (8.33). A substantial percentage of mothers were employed in Vietnam (89.2%) and Ethiopia (48.2 %), but only a small percentage of mothers were employed in Bangladesh (6.20 %). Support in chores had means of 4.48, 4.73, and 3.13 in Bangladesh, Vietnam, and

Ethiopia, respectively. Perceived instrumental support was highest in Bangladesh, with the mean of 2.73, followed by Vietnam (mean=2.52) and then Ethiopia (mean=1.09).

The factor analysis showed that three-factor rotated solution best explained the structure of resources for care in Bangladesh (Table 4.2). The first factor was associated financial autonomy and being employed, with loadings of 0.898 and 0.897, respectively. The second factor was associated with five variables which were education, knowledge, BMI, mental well-being, and perceived instrumental support, with factor loadings of 0.514, 0.450, 0.319, 0.330, and 0.283, respectively. The third factor was associated with two variables which were decision-making autonomy and support in chores. The factor loading of decision-making was positive (0.425) but the loading of support in chores was negative (-0.391). Maternal height was not associated with any of the factors.

In Vietnam, the two-factor rotated solution best explained the structure of resources for care (Table 4.2). The first factor was associated with two variables: financial autonomy (factor loading=0.724) and being employed (factor loading=0.646). The second factor was associated with four variables: education, knowledge, mental well-being, and perceived instrumental support, with the factor-loadings of 0.539, 0.539, 0.266, and 0.306, respectively. Maternal height, BMI, and support in chores were not associated with any of the factors. Additionally, decision-making autonomy was associated with both factors.

In Ethiopia, the structure of resources for care was best explained by two-factor rotated solution (Table 4.2). The first factor was associated with three variables: decision-making autonomy, financial autonomy, and employment, with factor loadings

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of 0.316, 0.413, and 0.508, respectively. The second factor was associated with two variables which were education (factor loading=0.417) and knowledge (factor loading=0.368). Maternal height, BMI, mental well-being, support in chores, and perceived social support were not associated with any specific factor.

The internal consistency reliability coefficients for mental well-being were 0.890, 0.882, and 0.891 in Bangladesh, Vietnam, and Ethiopia, respectively. Decision-making autonomy also had a high internal consistency with the reliability coefficients of 0.838, 0.712, and 0.863 in Bangladesh, Vietnam, and Ethiopia, respectively. Support in chores had a high internal consistency reliability (Bangladesh α=0.923, Vietnam α=0.877, Ethiopia α=0.936). The internal consistency reliability coefficients of perceived social support were high in Bangladesh (α=0.874) and Ethiopia (α=0.806) but was only 0.589 in Vietnam.

A three-factor solution best explained the structure of resources for care in Bangladesh, and that a two-factor solution best explained the structure in other two countries (Table 4.2). In some instances, the correlations of observed variable with the theoretical construct or latent variables were similar across contexts (for example, financial autonomy and employment were related to the same factor in all three countries). This indicates that construct equivalence was achieved to some extent. In the present study, the number and types of items used to develop mental well-being, decision-making autonomy, and perceived instrumental support variables were consistent across countries. In Bangladesh, only eight items were used to create support in chores variable because substantial percent of mothers responded as "not applicable"

for one of the items; in other two countries nine items were used. Additionally, in general the scales to measure the resources for care had high internal consistency reliability coefficients across contexts which signifies that the items are measuring the same underlying trait (Herdman et al., 1998).

In some cases, the order of the percentage of the affirmative responses for the items differed across countries, but in general the order was similar across countries. The order of the mental well-being items based on the percentage of affirmative responses were similar in Vietnam and Ethiopia (Figure 4.1). The order of the affirmative responses for the decision-making autonomy, household chores, and perceived instrumental support items were also similar across all three countries (Figures 4.2-4.4); however, the affirmative response for item 7 of support in chores which represented support in fetching or collecting fuel was lower in Vietnam than Bangladesh. The affirmative response for item 7 of support in chores had lower prevalence in Ethiopia than other two countries. Item 8 of support in chores which indicated receiving support in going to market to buy food for the family had a higher percentage of affirmative response in Bangladesh than other two countries. Item 9 of support in chores which represented fetching or collecting water was not included in Bangladesh, and the affirmative responses of this item had a lower prevalence in Vietnam than Ethiopia.

DISCUSSION

The prevalence or mean of maternal resources for care was similar across countries for some resources (for example, BMI), but different for many others. In

Bangladesh, a three-factor solution best explained the structure of resources for care, whereas in Vietnam and Ethiopia, a two-factor solution best explained the structure.

Although the overall structure of maternal resources for care differed by country, there were similarities in many instances. In all three countries, maternal financial autonomy and employment loaded on the same factor. In Ethiopia, decision-making autonomy loaded along with these two variables. Loading of financial autonomy and employment in the same factor was expected because in our study to be financially autonomous the mothers needed to meet two criteria which were being employed and having authority to use the earned money. Women with greater decision-making tend to be employed. Additionally, being financially autonomous may empower women to be involved in decision-making in the household (Acharya, Bell, Simkhada, Van Teijlingen, & Regmi, 2010). Maternal education and knowledge also loaded on same factor in all three countries. Formal education transmits health and nutrition-related information directly. Education also provides skills to get knowledge from other media like newspaper and internet and provides other opportunities and confidence which could enhance knowledge (Ruel et al., 2013).

In Bangladesh, education, knowledge, BMI, mental well-being, and perceived instrumental support loaded on same factor. In Vietnam, maternal education, knowledge, mental well-being, and perceived instrumental support loaded in the same factor. Education and knowledge enhance individual health directly by increasing utilization of healthcare services and indirectly by encouraging health promoting behaviors (Leigh, 1983). Educated individuals also tend to have higher perceived support

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and this in turn may influence health by improving health behaviors and psychological conditions (Ross & Wu, 1995; Thoits, 1995). Maternal BMI and mental well-being loaded on same factor in Bangladesh. The association between mental and physical health could be bi-directional. Women with higher mental well-being may consume nutritious food, have better physical health, and have optimal metabolism which are positively associated with BMI (Ackerson & Subramanian, 2008; Rao, Asha, Ramesh, & Rao, 2008; Walker, McGee, & Druss, 2015). Poor physical health and malnutrition may also lead to poor mental well-being through various processes like psychological stress, decreased social interactions, and adverse economic conditions (Jacka, Maes, Pasco, Williams, & Berk, 2012; Prince et al., 2007).

In Bangladesh, maternal decision-making autonomy and support in chores loaded on same factor and the latter one had a negative factor loading. The negative effect of increased autonomy among women has been seen in patriarchal societies where women are often expected to perform their gender roles. A study from Bangladesh found that the effect of women's autonomy is context-specific and in culturally conservative areas women's autonomy was positively associated with the intimate partner violence among the women (Koenig, Ahmed, Hossain, & Mozumder, 2003). Our study area in Bangladesh was a rural setting which may have culturally ingrained gender roles. Therefore, increased decision-making autonomy may have negatively influenced the support in household chores in this setting. Additionally, women with higher decision-making may have more confidence and opportunities

leading to the greater involvement in household chores and not asking help from others.

The percentage of affirmative responses for a few items markedly differed across countries. Previous studies also suggest that the resources for care are influenced by context. For example, a study conducted in India and Pakistan reported that geographic region played a strong and consistent role in determining the levels and patterns of women's autonomy, whereas religion and nationality played a modest and inconsistent role (Jejeebhoy & Sathar, 2001). The differences across our study settings may also be explained by socio-cultural characteristics of the geographical region. For instance, women's involvement in household decision-making may be influenced by ethnic identities, social relations, and patriarchal relations (Jejeebhoy & Sathar, 2001; Senarath & Gunawardena, 2009). Therefore, being employed and financially autonomous may be insufficient for improving decision-making autonomy in some settings. This explanation is supported by a study from Bangladesh which found that gender inequalities in seeking healthcare was present even after socio-economic interventions (Ahmed, Adams, Chowdhury, & Bhuiya, 2000). Additionally, household structure and family environment may influence the resources available to women (Hindin, 2005). A study conducted in Zimbabwe, Zambia, and Malawi found variations in the determinants of women's chronic energy deficiency across countries and highlighted critical role of the socio-demographic characteristics of household on women's health (Hindin, 2005).

In general, the order of the items based on the percentage of affirmative responses was similar across countries, but some differences across countries occurred.

In Bangladesh, only eight items were included for measuring support in chores as substantial proportion of mothers responded as not applicable for one of the items. The differences in performances of some items across countries warrant the need of validation of measures that are contextually sensitive. The scales measuring mental well-being, decision-making autonomy, and support in chores had high internal consistency in all three countries. The scale measuring perceived instrumental support had high internal consistency in Bangladesh and Ethiopia, but the reliability coefficient was slightly lower in Vietnam. These results support that the scales have a good precision and their items measure the same construct. Previous studies have also used similar instruments in various contexts (Fantahun, Berhane, Wall, Byass, & Högberg, 2007; Hanlon et al., 2008; Senarath & Gunawardena, 2009; Tuan et al., 2004; WHO, 1994).

The strengths of this study were large sample sizes and inclusion of three socio-culturally diverse countries. We also used comprehensive measures of maternal resources for care and examined the structure which had not been investigated in previous studies. The method of data collection for some variables decreased the chances of biases. Maternal height and BMI were based on the anthropometric measurement rather than self-reported information. Additionally, the instrument used to collect data on mental well-being was validated for low- and middle-income settings. On the other hand, most data used in the study were based on self-reporting, but actions were taken to reduce the chances of biases (for example, providing training to the data collectors, using valid and reliable tools). We did not have information on

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overall workload, therefore, employment status was used to reflect the workload. Our study did not examine the influence of underlying conditions at the household and community level which may influence structure of the maternal resources for care.

In conclusion, we examined the factor structure and equivalence of the measures of resources for care. In Bangladesh, a three-factor rotated solution best explained the structure of resources for care. In Vietnam and Ethiopia, a two-factor rotated solution best explained the structure. In general, the structure of resources for care was similar across countries. For the scale measures of resources for care, the order of the percentage of affirmative responses for the items was similar across countries. Additionally, the scales had a high internal consistency. The findings support the use of the scales to measure and compare resources for care in low- and middle-income countries. Studies that examine the structure and equivalence of resources for care in other settings may help to develop the contextually sensitive and robust instruments to measure resources for care.

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Table 4.1. Maternal resources for care in Bangladesh, Vietnam, and Ethiopia.

	Bangladesh (n=4400)	Vietnam (n=4029)	Ethiopia (n=2746)
	Percent or mean ± SD		
Resources for care			
Years of schooling	4.82 ± 3.71	8.99 ± 3.46	1.56 ± 2.62
Knowledge (Range: B=0-22; V and E=0-23)	9.76 ± 2.24	9.01 ± 3.08	8.88 ± 2.97
Height, centimeters	151 ± 5.51	153 ± 5.26	157 ± 6.04
Body mass index	20.4 ± 3.18	20.1 ± 2.53	20.0 ± 2.17
Mental well-being (Range: 0-20)	13.1 ± 5.19	15.1 ± 4.50	14.2 ± 4.96
Financial autonomy, %	4.70	73.0	8.28
Decision-making (Range:0-11)	8.33 ± 2.69	9.06 ± 2.03	9.12± 2.59
Employed, %	6.20	89.2	48.2
Support in chores (Range: B=0-8; V and E=0-9)	4.48 ± 3.04	4.73 ± 3.09	3.13 ± 3.47
Perceived support (Range: 0-3)	2.73 ± 0.761	2.52 ± 0.809	1.09 ± 1.22

Note: B=Bangladesh, V=Vietnam, E=Ethiopia.

Table 4.2. Rotated factor loadings for factor solutions of maternal resources for care in Bangladesh, Vietnam, and Ethiopia. [a]

Resources for care	Bangladesh (n=4396)			Vietnam (n=4022)		Ethiopia (n=2740)	
	F1	F2	F3	F1	F2	F1	F2
Education	-0.0337	*0.514*	-0.0400	0.0385	*0.539*	-0.00770	*0.417*
Knowledge	-0.0249	*0.450*	0.0340	0.0644	*0.539*	0.0897	*0.368*
Height	-0.0267	0.133	-0.0443	-0.0154	0.0874	-0.0829	0.183
Body mass index	-0.0121	*0.319*	0.0705	-0.0665	0.0599	0.0324	-0.0117
Mental well-being	-0.0294	*0.330*	-0.0177	-0.0490	*0.266*	0.153	0.166
Decision-making	0.0520	0.0843	*0.425*	0.326	0.318	*0.316*	0.0683
Financial autonomy	*0.898*	-0.000300	0.0133	*0.724*	0.0998	*0.413*	0.121
Employed	*0.897*	-0.0208	-0.0102	*0.646*	-0.0641	*0.508*	-0.0308
Support in chores	0.0393	0.113	*-0.391*	-0.00380	0.134	0.108	0.00650
Perceived support	-0.0515	*0.283*	0.0975	0.0787	*0.306*	0.219	0.206

[a] Italic typeface indicates variables associated with the factor.
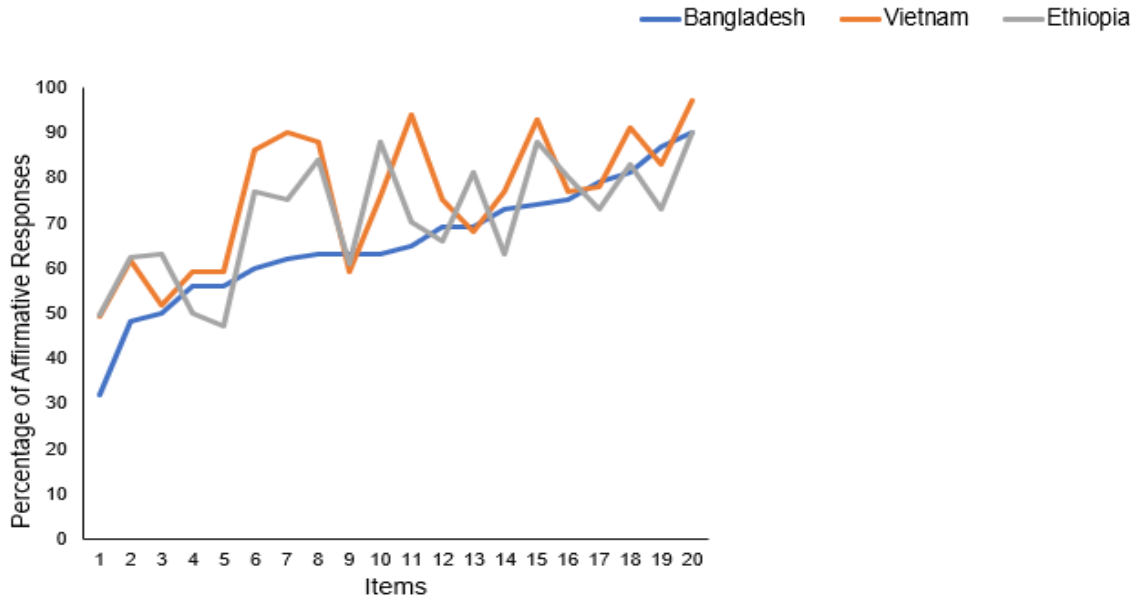
Figure 4.1. The order of the percentage of the affirmative responses for mental well-being items.
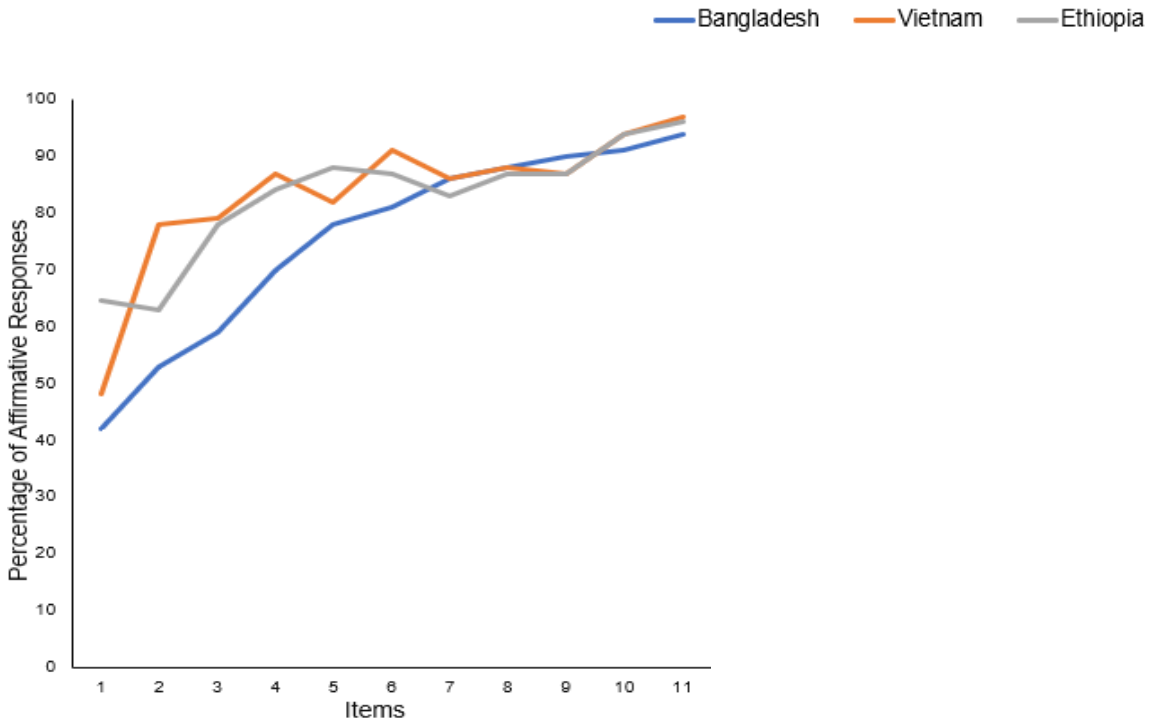
Figure 4.2. The order of the percentage of the affirmative responses for decision-making items.

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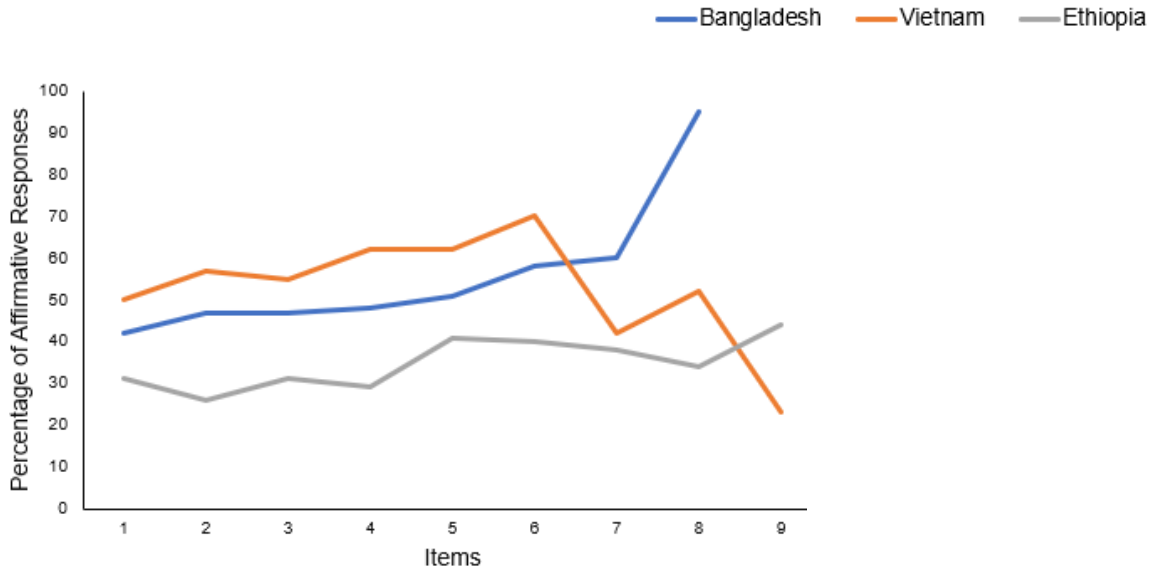
Figure 4.3. The order of the percentage of the affirmative responses for support in chores items.
Note: Only 8 items included for Bangladesh.
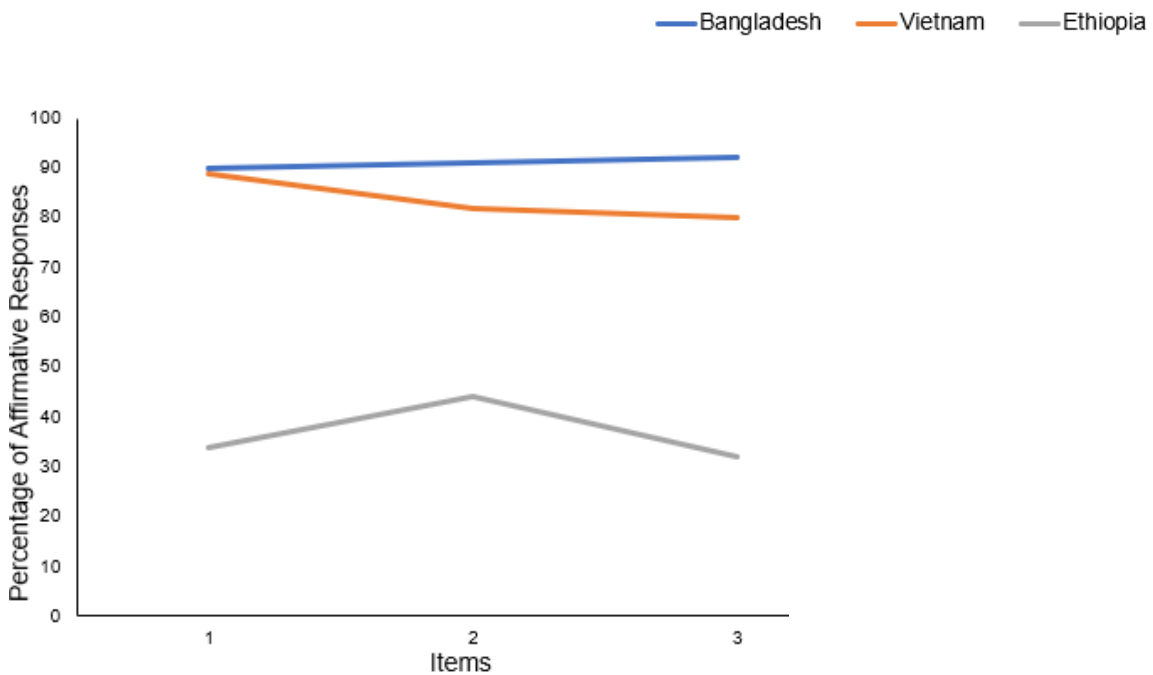
Figure 4.4. The order of the percentage of the affirmative responses for perceived support items.

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4.2 Manuscript 2

ASSOCIATIONS OF MATERNAL RESOURCES WITH CARE BEHAVIORS IN BANGLADESH,
VIETNAM, AND ETHIOPIA DIFFER BY TYPE OF RESOURCE AND CARE BEHAVIOR[2]

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[2] Basnet, S., Frongillo, E.A., Nguyen, P.H., Moore, S., Arabi, M. To be submitted.

ABSTRACT

Care is important for children's growth and development but lack or inadequacy of resources for care can constrain appropriate caregiving. The objectives of this study were to examine whether maternal resources for care are associated with care behaviors and to determine if some resources for care are more important than others. This study used baseline Alive & Thrive household surveys from Bangladesh, Vietnam, and Ethiopia. Measures of resources for care were maternal education, knowledge, height, nourishment, mental well-being, decision-making autonomy, employment, support in chores, and perceived support. Multiple regression analyses were conducted to examine the associations of resources for care with exclusive breastfeeding, minimum meal frequency, dietary diversity, improved drinking water source, improved sanitation, cleanliness, child immunization, psychosocial stimulation, and adequate care. The models were adjusted for covariates at child, parents, and household levels, and accounted for geographic clustering. All measures of resources for care had positive associations with care behaviors; however, in a few cases, the associations between the resources for care and care behaviors were in the negative direction. Improving education, knowledge, health, autonomy, availability of time, and social support among mothers would facilitate provision of optimal care for children.

Keywords: Resources for care, Infant and young child feeding, Hygiene practices, Immunization, Family care behaviors, Care behaviors

INTRODUCTION

Care behaviors are crucial for children's optimal growth, development and survival. Care received by children has positive impacts on later adult health and productivity (Britto et al., 2017; Engle, Menon, & Haddad, 1999). Care refers to the behaviors that provide time, attention, and support which are essential for children's survival, growth, and development (Engle, 1999; Engle et al., 1999). Both provision and quality of care are critical to children's health and well-being (Engle, 1999). Appropriate care can mitigate or prevent adverse consequences of unfavorable conditions such as poverty, violence, and chronic disease (Britto et al., 2017; Britto & Engle, 2015; Purcell-Gates, 1996). Despite the increasing recognition of importance of care behaviors, substantial number of children do not receive optimal care (Bhutta et al., 2008; Black et al., 2017; Engle et al., 1999) such as optimal feeding (Arabi, Frongillo, Avula, & Mangasaryan, 2012), hygiene (Rah et al., 2015), healthcare (Haji et al., 2016) and psychosocial stimulation (Bornstein & Putnick, 2012).

There are multiple determinants of care behaviors which ranges from social contexts at home to national policies and programs (Britto et al., 2017; Frongillo, Kulkarni, Basnet, & de Castro, 2017). Family is the first environment of a child after birth. It is also the environment in which a child spends most periods of life that are sensitive for growth and development (Frongillo et al., 2017; Maggi, Irwin, Siddiqi, & Hertzman, 2010). Therefore, availability of resources to the caregivers could be crucial in determining care behaviors.

Resources for care enhance caregiver's capabilities in meeting mental, physical, and social needs of household members including children (Engle, Menon, & Haddad, 1997; Engle et al., 1999). Theoretically, caregiver's education and knowledge, physical health, mental well-being, autonomy, reasonable workload/availability of time, and social support are important to provide care (Engle et al., 1997; Engle et al., 1999; Peter & Kumar, 2014). Education and knowledge indicate capacities of the caregivers for providing care (Engle et al., 1999). Physical and mental health are the individual level conditions which help in the translation of the capacities to behaviors. Autonomy indicates ability of the caregivers to have a control in their surroundings (Carlson, Kordas, & Murray-Kolb, 2015; Engle et al., 1999). Reasonable workload and social support are the conditions related to family and community that help in improving caregiver's ability to provide care (Engle et al., 1999). In many societies around the world, mothers are primary caregivers and resources available to them may play a pivotal role on determining care behaviors (Coller & Kuo, 2015; Engle et al., 1999). Understanding the role of maternal resources for care could aid in implementing policies and interventions that aim to improve care behaviors (Peter & Kumar, 2014).

Associations of maternal resources for care with care behaviors have been investigated, yet some types of resources and care behaviors have been studied extensively than others (Engle et al., 1999). Additionally, there is a dearth of research that has included all categories of resources for care and multiple care behaviors. Some studies have shown inconsistent findings on the associations of maternal resources with care behaviors. For example, poor maternal mental well-being was a risk factor for

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decreased self-efficacy regarding breastfeeding, difficulty in breastfeeding, and decreased breastfeeding duration in a qualitative review (Dennis & McQueen, 2009). In contrast, a study by Chung et al. reported no association between maternal mental health and likelihood of breastfeeding for ≥ 1 month (Chung, McCollum, Elo, Lee, & Culhane, 2010). These inconsistent findings warrant further investigation about the role of maternal resources for care on improving care behaviors.

The objective of the present study was to examine whether maternal resources for care influence care behaviors, specifically infant and young child feeding (IYCF) practices, hygiene practices, health-seeking practice, and family care behaviors in Bangladesh, Vietnam and Ethiopia. The study also investigated if some resources for care are more important for care behaviors than other resources for care.

METHODS

Data source and study participants

We used the Alive & Thrive baseline data that were collected in Bangladesh, Vietnam, and Ethiopia in 2010. The Alive &Thrive is an initiative that intends to have positive impact on children's survival, growth, and development by improving IYCF practices (Nguyen et al., 2017). In Bangladesh, 4400 households were selected from twenty sub-districts (*upazilas*). In Vietnam, 4029 households were selected from forty communes representing four provinces. In Ethiopia, 3000 households were selected from seventy-five enumeration areas in two regions (Ali et al., 2011; Nguyen et al., 2010; Nguyen et al., 2014a; Saha et al., 2011). Mothers and their < 5 years old children were included in the surveys (Bangladesh: 0-47.9 months, Vietnam and Ethiopia: 0-59.9

months). Details on sampling procedure can be found elsewhere (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011). In the present study, only data pertaining to mothers and index/youngest children were used.

The surveys received ethical approval from the institutional review board of each country and the International Food Policy Research Institute. This study used de-identified data, and it was exempted by the institutional review board of the University of South Carolina.

Measures

Care behaviors. We used four domains of care behaviors: IYCF, hygiene, health-seeking, and family care. The IYCF measures were exclusive breastfeeding (EBF) (proportion of 0-5.9 months old infants who are exclusively breastfed), minimum meal frequency (proportion of 6-23.9 months old children who receive solid or semi-solid foods at least minimum number of times), and dietary diversity scores (number of food groups consumed by 6-23.9 months old children; range: 0-7) (WHO, 2008). The information related to IYCF practices were based on the past twenty-four hours recall by mothers.

Improved drinking water source, improved sanitation, and cleanliness were used as the measures of hygiene practices. Improved drinking water denotes the source which is adequately protected from outside contamination especially feces (Pullan, Freeman, Gething, & Brooker, 2014). Improved sanitation denotes the toilets or facilities that prevent human urine and feces from human contact (Pullan et al., 2014). Both variables were binary (improved vs unimproved). Cleanliness variable was developed

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using hygiene spot check data of house interior and exterior, and face, hands, hair, and clothes/body of a mother and her child. One point was assigned for each observation indicating "clean", then the scores were summed to create the cleanliness variable (total possible score of 10).

Child immunization status represented health-seeking practice. A child ≥ 12 months was considered fully immunized if he/she had received essential vaccines such as Bacillus Calmette-Guerin vaccine, Diphtheria-Pertusis-Tetanus vaccine, polio vaccine, hepatitis B vaccine, and measles vaccine (Animaw, Taye, Merdekios, Tilahun, & Ayele, 2014; Oyo-Ita, Nwachukwu, Oringanje, & Meremikwu, 2012; Uddin, Koehlmoos, Saha, & Khan, 2010). Information on immunizations were collected from immunization cards or mother's reporting.

We used two measures of family care behaviors: psychosocial stimulation and adequate care (Frongillo et al., 2017; Kariger et al., 2012). Psychosocial stimulation (range:0-6) indicates number of learning and school-readiness promoting activities in which an adult is engaged with a child in past 3 days. The activities included reading books; telling stories; singing songs; taking outside; playing; and naming, counting and drawing things. Information on stimulation were based on mother's reporting and were available only for Bangladesh and Vietnam. Adequate care was defined as not leaving a child alone or with a minor for more than one hour.

Maternal resources for care. The present study used maternal educational attainment, knowledge, height, nourishment, mental well-being, decision-making autonomy, employment, support in chores, and perceived instrumental support as the

measures of resources for care. Education levels differed across our study settings, therefore, different cut-offs were used based on the suitability to the context (Nguyen et al., 2014a). No schooling, 1-5 years of schooling, 6-9 years of schooling, and 10-12 years of schooling were the categories in Bangladesh and Ethiopia. In Vietnam, 1-5 years of schooling, 6-9 years of schooling, and 10-12 years of schooling and college or higher were the categories. In all three countries, 1-5 years of schooling was the reference group. Maternal knowledge was specific to the knowledge on breastfeeding, complementary feeding, iron deficiency symptoms, vitamin A sources, iodine fortification, food diversity, and hand washing. A composite score of maternal knowledge was developed by assigning a point for each correct response (total possible scores: 22 for Bangladesh and 23 for Ethiopia and Vietnam).

Height and nourishment were used as the measures of physical health. Nourishment was categorized as well-nourished (body mass index of ≥18.5 kg/m^2) and underweight (body mass index of <18.5 kg/m^2) (WHO, 2016). Mental well-being was assessed by using the twenty-itemed Self-Reporting Questionnaire- 20 (SRQ-20). The SRQ-20 is a valid and reliable tool to screen mental health in low- and middle-income countries (WHO, 1994). The tool assesses psychological and somatic symptoms by asking mothers whether they had presence of the symptoms in the past four weeks. One point was assigned for each response which indicated the absence of a symptom, then a composite score on mental well-being was developed (total possible score of 20).

Decision-making autonomy reflected involvement of mothers in household decisions about major purchases, cooking, visiting family/friends/relatives, healthcare

visit, family planning, and care of children. A composite score was developed by assigning a point for each response which indicated involvement of mothers in decision-making alone or along with spouse (total possible score of 11). Maternal employment status (employed vs not employed) was used as a measure of reasonable workload. Despite employment status, women are usually more engaged in household work than men; therefore, being employed indicated higher workload in the present study (Fuwa, 2004; Lennon & Rosenfield, 1992).

Support in household chores and perceived instrumental support were used as the measures of social support. Support in chores was created by assigning one point for each response that indicated receiving support in chores and addition of the points (total possible scores: 8 for Bangladesh and 9 for Ethiopia and Vietnam). Perceived instrumental support was developed from three items denoting potential help from spouse or somebody other than spouse with accommodation, money, and food (total possible score of 3).

Our previous work showed that maternal financial autonomy and employment was associated with the same factor with high factor loadings. Therefore, we did not include financial autonomy in this study (only decision-making autonomy was used to represent autonomy). Other measures of resources for care did not had high factor loadings and were not excluded.

Covariates. The covariates at the child level were child's age and gender. Father's occupation was also used as one of the covariates. The covariates at the household level were household wealth and the number of < 5 years old children in the household.

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Household wealth index was constructed using principal component analysis by including the variables on house and land ownership, quality of house, access to services in the household (for example, electricity, cooking fuel), and household assets. Component scores obtained from the first component were used to reflect the household wealth.

Statistical analysis

Separate analyses were run for each country using Stata version 14. Sample characteristics were presented as mean and standard deviation (SD), or percentage. Multiple regression analyses were performed to examine the associations of resources for care with EBF (children <6 months: Bangladesh n=977, Vietnam n=948, Ethiopia n=602), complementary feeding (children 6-23.9 months: Bangladesh n=1211, Vietnam n=1095, Ethiopia n=870), hygiene practices (children 0-47.9/0-59.9 months: Bangladesh n=4400, Vietnam n=4029, Ethiopia n=2746), immunization (children 12-47.9/12-59.9 months: Bangladesh n=2983, Vietnam n=2607, Ethiopia n=1800), and family care behaviors (children 6-23.9 months: Bangladesh n=1211, Vietnam n=1095, Ethiopia n=870 and children 24-47.9/59.9 months: Bangladesh n=2180, Vietnam n=1972, Ethiopia n=1254). The analysis for family care behaviors was broken into two groups because previous studies have found differential effects of resources by child's age. Additionally, the family care behaviors measured may not present much variation in young children (i.e. < 6months), therefore this age group was not included in analysis for family care behaviors (Engle et al., 1999; Larson, Martorell, & Bauer, 2018). The analysis involving IYCF practices and immunization was also restricted by child's age. The

selection of age group was guided by previous research and recommendations (Animaw et al., 2014; Uddin et al., 2010; WHO, 2008).

Separate regression models were run for each measure of care behavior. Each model included all nine measures of resources for care. The models were adjusted for child's age and gender, father's occupation, household wealth, and number of <5 years children in the household. Geographic clustering was accounted using the primary sampling units as random effects. We considered $p<0.05$ as statistically significant. In cases when $p<0.05$ but the magnitude of association was very small, we reported the odds ratios (OR) or coefficients related to 1 SD higher resources for care.

RESULTS

Sample characteristics

The prevalence of maternal 6-9 years of schooling and 10-12 years of schooling was higher in Vietnam than other two countries (Table 4.3). Mean of maternal knowledge scores were 9.76, 9.01, and 8.88 in Bangladesh, Vietnam, and Ethiopia, respectively. More than 70% of mothers were well-nourished in all three countries. The mean of maternal height and mental well-being were higher in Ethiopia and Vietnam, respectively. Decision-making autonomy was slightly higher in Vietnam and Ethiopia than Bangladesh. The prevalence of maternal employment also differed across countries with higher prevalence in Vietnam. Support in chores had means of 4.48, 4.73, and 3.13 in Bangladesh, Vietnam, and Ethiopia, respectively. Perceived instrumental support was higher in Bangladesh and Vietnam than Ethiopia.

Mean age of children was 22-24 months. In all three countries, slightly less than half of the children were females, and most of the households had only one <5 years old child. Most of the fathers were engaged in manual or wage-based work in Bangladesh, whereas as most of the fathers were farmers in Vietnam and Ethiopia.

Care behaviors

Exclusive breastfeeding was higher among infants from Ethiopia than Bangladesh and Vietnam (Table 4.4). Children from Vietnam received better complementary feedings than their counterparts, with 80.9% children meeting the minimum meal frequency and mean dietary diversity score of 4.40. Prevalence of improved drinking water and improved sanitation were higher in Bangladesh and Vietnam, respectively, as compared to their counterparts. Additionally, cleanliness score was higher in Bangladesh and Vietnam than Ethiopia. Prevalence of child immunization was highest in Vietnam, followed by Bangladesh and then Ethiopia. In both Bangladesh and Vietnam, psychosocial stimulation was higher among the older children (24-47.9/59.9 months) than the younger ones (6-23.9 months). Most children received adequate care in Bangladesh and Vietnam; whereas, in Ethiopia, adequate care was received only by about 69% and 64% of younger and older children, respectively.

Associations between maternal resources for care and care behaviors

Infant and young child feeding practices. Education was positively associated with EBF in Ethiopia (6-9 years of schooling: OR=2.80) (Table 4.5). Additionally, education was positively associated with minimum meal frequency (college or higher: OR=2.34) and dietary diversity in Vietnam (6-9 years of schooling: β=0.360, college or

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higher: β=0.490) (Table 4.6). Knowledge was positively associated with EBF in Bangladesh and Vietnam, and dietary diversity in all three countries. Well-nourishment and height were positively associated with EBF in Bangladesh (OR=1.60) and Vietnam (OR=1.26), respectively. Mental well-being was positively associated with EBF in Bangladesh (OR=1.21) and Ethiopia (OR=1.24). Decision-making autonomy and employment were positively associated with dietary diversity (Vietnam) and minimum meal frequency (Bangladesh), respectively. Support in chores was positively associated with minimum meal frequency in Ethiopia and with dietary diversity in Bangladesh and Ethiopia. Additionally, perceived instrumental support was positively associated with dietary diversity in Vietnam and Ethiopia.

Hygiene practices. Education was positively associated with improved drinking water and sanitation in two countries and cleanliness in all three countries (Tables 4.7-4.8). Knowledge was positively associated with improved water in Ethiopia (OR=1.20), improved sanitation in Vietnam (OR=1.17), and cleanliness in Bangladesh (β=0.125) and Ethiopia (β=0.148). In Bangladesh, height was associated with cleanliness (β=0.151), and well-nourishment had associations with improved sanitation (OR=1.34) and cleanliness (β=0.359). Mental well-being was positively associated with improved water in Ethiopia (OR=1.15), improved sanitation in Bangladesh (OR=1.20) and Vietnam (OR=1.16), and cleanliness in all three countries. In contrast, mental well-being had a negative association with improved sanitation in Ethiopia (OR=0.897). Decision-making autonomy had a positive association with cleanliness in Ethiopia (β=0.125). Employment had a negative association with improved sanitation in Bangladesh (OR=0.512) and cleanliness

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in Ethiopia (β=-0.346) and Vietnam (β=-0.224). Support in chores had a positive

association with cleanliness only in Vietnam (β=0.0631). Perceived instrumental support

was positively associated with improved sanitation one country and cleanliness in two

countries.

Health-seeking practice (immunization). Maternal education was positively

associated with child immunization in Bangladesh (10-12 years of schooling: OR=2.54)

(Table 4.9). Knowledge and decision-making autonomy were associated with

immunization in one country and two countries, respectively. Additionally, maternal

employment and perceived instrumental support were positively associated with

immunization in Ethiopia (OR=1.54) and Bangladesh (OR=1.23), respectively.

Family care behaviors. Maternal education was positively associated with

psychosocial stimulation of the older children in Bangladesh and Vietnam (Table 4.10).

In the younger group, there was no association of education with psychosocial

stimulation in Bangladesh and only college or higher education was associated the

stimulation in Vietnam. Additionally, education was associated with adequate care of

younger group in Vietnam and Ethiopia and older children in Bangladesh and Ethiopia

(Table 4.11). Knowledge was associated with psychosocial stimulation (both groups) and

adequate care (older group) in Vietnam. Height was positively associated with

psychosocial stimulation of older children in Vietnam (β=0.0837) and adequate care of

younger children in Bangladesh (OR=1.51). Well-nourishment had a positive association

with psychosocial stimulation of older group in Bangladesh (β=0.202). Mental well-being

was positively associated with psychosocial stimulation in Vietnam (older group) and

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adequate care in Vietnam (older group) and Ethiopia (younger group). Decision-making autonomy was positively associated with older children's psychosocial stimulation in Bangladesh (β=0.103) but had a negative association with older children's adequate care in Ethiopia (OR=0.928). Employment was negatively associated with adequate care of both groups in Bangladesh and older ones in Ethiopia. Support in chores was positively associated with psychosocial stimulation in Bangladesh (younger group) and Vietnam (both groups). In contrast, support in chores had a negative association with adequate care in Ethiopia (younger group). Perceived instrumental support was positively associated with psychosocial stimulation (both groups in Bangladesh and Vietnam) and adequate care (older group in Bangladesh).

DISCUSSION

Higher maternal education, knowledge, height, well-nourishment, and perceived support were positively associated with better care behaviors. Mental well-being, decision-making, employment, and support in chores had positive associations with some types of care behaviors but the associations were in the negative direction in some instances. Education was more consistently associated with care behaviors than other measures of resources for care. Additionally, associations between resources for care and care behaviors differed by study settings and care behaviors.

Education was positively associated with all care behaviors. Knowledge had positive associations with all care behaviors except minimum meal frequency. Mothers with higher education are more likely to have higher health and nutrition-related knowledge, understand health education messages, be receptive to modern medicine,

and be adaptive to their new roles and environment (Engle, 1999; Glewwe, 1999; Wachs, 2008). Educated mothers are also more likely to manage household resources and allocate more resources to children (Wachs, 2008). Knowledge learned outside classroom can also play a critical role in improving maternal responsiveness to children's need (Glewwe,1999). Previous studies have found positive effects of maternal education and knowledge on complementary feeding (Monterrosa, Pelto, Frongillo, & Rasmussen, 2012; Senarath, Godakandage, Jayawickrama, Siriwardena, & Dibley, 2012), food hygiene (Guldan et al., 1993), use of closed latrines (Semba et al., 2008), and immunizations (Abuya, Onsomu, Kimani, & Moore, 2011; Semba et al., 2008).

Height had positive associations with EBF, cleanliness, psychosocial stimulation, and adequate care. Height is the expression of genetic make-up and childhood environment. Short stature reflects economic deprivation and restricted circumstances which may negatively affect care behaviors (Addo et al., 2013; Hernandez-Diaz et al., 1999). Short stature has been linked with poor health, productivity, and learning (Dewey & Begum, 2011).

Well-nourishment was positively associated with EBF, improved sanitation, cleanliness, and psychosocial stimulation. A community-based randomized trial from Guatemala also showed that under-nourished women who had received high energy supplements were more likely to exclusively breastfeed their infants (González-Cossío, Habicht, Rasmussen, & Delgado, 1998). Maternal undernutrition increases morbidity, reduces activity levels and productivity, and diminishes ability to care for herself and family (Kulasekaran, 2012; Walker, 1997).

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Mental health was positively associated with EBF, improved water, cleanliness, psychosocial stimulation, and adequate care. Mental health problems may lead to inappropriate or inadequate care such as suboptimal breastfeeding (Dennis & McQueen, 2009; McLearn, Minkovitz, Strobino, Marks, & Hou, 2006), non-responsive feeding (Hurley, Black, Papas, & Caufield, 2008), poor psychosocial stimulation (Black et al., 2007; McLearn et al., 2006; Murray, Cooper, & Hipwell, 2003) and inadequate health-seeking including immunization uptake (Minkovitz et al., 2005). Women with poor mental health are likely to live in adverse environments, be withdrawn from surrounding, and have lower support system, self-esteem and confidence which may result in less time and capacity to perform care behaviors (Patel, Rahman, Jacob, & Hughes, 2004). Poor mental health is also linked with physical symptoms, fatigue, poor health-seeking practices, and involvement in high-risk behaviors which may compromise care behaviors (Black et al., 2007; Patel et al., 2004). Additionally, poor mental health may negatively influence cognitive functioning, memory, and learning which may increase the likelihood of inappropriate care behaviors (Austin, Mitchell, & Goodwin, 2001). In this study, mental well-being was positively associated with improved sanitation in Bangladesh and Vietnam, but the association was negative in Ethiopia. In Ethiopia, improved sanitation could be influenced by factors other than those related to mother or family like sanitation projects (O'loughlin, Fentie, Flannery, & Emerson, 2006). Additionally, sanitation has been included in agendas of heath sectors and government in the country. There may also be lack of awareness about benefits of improved sanitation in this setting (Kumie & Ali, 2005). Future studies are needed to examine the

causes for the negative association of maternal mental well-being with improved sanitation.

Decision-making autonomy had positive associations with dietary diversity, cleanliness, immunization, and psychosocial stimulation. In contrast, decision-making autonomy was negatively associated with adequate care. Consistent with our findings, previous research shows mixed influence of maternal autonomy. A study from Nicaragua found that children of women who had middle level of autonomy had better complementary feeding practices, and children of women with lowest autonomy had improved breastfeeding practices (Ziaei et al., 2015). Autonomy allows mothers to make decisions in favor of children and they are more likely to spend on health and nutrition (Quisumbing & Maluccio, 2000; Thomas, 1990). On the other hand, autonomy may equip mothers with freedom to move, work, and visit people which may result in leaving children alone or with minors.

Employment had positive associations with minimum meal frequency and immunization but had negative associations with improved sanitation, cleanliness, and adequate care. Employment may improve economic capacity to spend in complementary feeding and healthcare; on the other hand, it may impede care behaviors, especially those that are time-consuming and labor-intensive. Employed mothers are more likely to leave children alone or with minors (Engle et al., 1999). Children are at higher risk of poor care if mothers are involved in jobs that are low-paying, informal, and with poor-working conditions (Engle et al., 1999).

Support in chores was positively associated with minimum meal frequency, dietary diversity, cleanliness, and psychosocial stimulation. Perceived instrumental support was positively associated with dietary diversity, improved sanitation, cleanliness, immunization, psychosocial stimulation, and adequate care. Mothers often have time conflict between childcare and household chores, especially in settings where gender norms related to childcare and household chores are prominent (Nakahara et al., 2006). Both employed and not employed women work long hours on domestic tasks and care for household members which may leave women with "time poverty" or less time for leisure activities (Engle et al., 1999; Nakahara et al., 2006; Warren, 2003). Support in chores provides help with care of children (for example, feeding and bathing). Support in chores also reduces mother's responsibilities, preserves maternal time and energy levels, and consequently enables mothers to provide better care (Nakahara et al., 2006). Perceived support among parents affects parenting practices and child outcomes (Taylor, Conger, Robins, & Widaman, 2015). Perceived support may improve economic security and well-being of parents (Turney, 2013). Additionally, social resources may act as buffer and ameliorate negative effects of adversities like poverty (Evans, Boxhill, & Pinkava, 2008). Social network and support are positively related with optimal maternal behaviors such as more praising children and being less intrusively controlling, less punitive parental attitude, improved maternal-child interaction, and provision of more stimulating environment (Burchinal, Follmer, & Bryant, 1996; Jennings, Stagg, & Connors, 1991; McCurdy, 2005); however, all aspects of social support may not be beneficial (Antonucci, Akiyama, & Lansford, 1998). Support in

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chores had a negative association with adequate care of younger children in Ethiopia. The available social network may be engaged in helping with other chores, therefore, children may be left alone or with minors. Additionally, social relations and support may increase demand and add stress which may compromise care to children (Black & Nitz, 1996; Uchino, Cacioppo, & Kiecolt-Glaser, 1996).

Associations of maternal resources for care with care behaviors differed across study settings. For example, improved maternal knowledge, well-nourishment, and mental well-being had positive associations with EBF in Bangladesh; higher knowledge and height had positive associations with EBF in Vietnam, and maternal education and mental well-being had positive associations with EBF in Ethiopia. Despite these differences across study settings, our study suggests that improvement in status of mothers likely will translate into better care received by children. The differences across study settings may be because care behaviors may be affected by attributes other than those of mothers and families such as government policies, health system, and the private sector (Britto et al., 2017; Maggi et al., 2010; Nguyen et al., 2014b). Contextual factors such as ethnicity, culture, neighborhood, and community shape parenting beliefs and practices (Kotchick & Forehand, 2002). For example, mothers from poorer neighborhoods may display less warmth towards children (Klebanov, Brooks-Gunn, & Duncan, 1994). A study by Wiysonge and colleagues also found that care received by children is shaped by the community and country-level factors. Unimmunized children were more likely to be from urban areas, communities with higher illiteracy rates, and countries with higher fertility rates (Wiysonge, Uthman, Ndumbe, & Hussey, 2012).

These contextual factors also influence the resources available to mothers. For example, a cross-country study found that women's participation in labor force is affected by the attitude of men towards the female labor force participation. Women were more likely to work if men in their country had a favorable attitude towards it (Antecol, 2003).

Our study highlights that associations of resources for care with care behaviors depend on type of care behaviors which has been found in previous studies as well (Guldan et al., 1993; Peter & Kumar, 2014). In some instances, the associations of resources for care with family care behaviors differed between younger and older children. The trend of positive association between resources for care and psychosocial stimulation was seen more among older children than younger ones. This trend could be due to belief that younger children may not need psychosocial stimulation like older ones.

This study included multiple settings which allowed us to compare the findings and increased the generalizability, especially for low- and middle-income countries. Other strengths are large sample size and inclusion of all categories of resources for care and multiple care behaviors. Data on some variables were based on self-reporting but measures were taken to reduce the chances of biases. Training was provided to the data collector to improve data quality. Reliable and validated instruments were used for data collection (for example, SRQ-20). Furthermore, to collect data on IYCF practices, mothers were asked if certain foods and liquids were consumed by the children in the past 24 hours rather than asking direct questions about children's feeding practices. We lacked data on time spent by mothers on work and leisure, therefore, we used maternal

employment as a proxy for workload. Additionally, the cross-sectional nature of the data does not allow us to draw causal inferences. Although we controlled for variables at household, parents, and child level, resources for care and care behaviors can be influenced by other conditions as well like father's knowledge and belief. Furthermore, there may be joint influence of causation and selection (Miech, Caspi, Moffitt, Wright, & Silva, 1999). For example, resources for care may improve hygiene practices and improved hygiene practices may in turn enhance resources for care such as physical and mental health.

In conclusion, maternal education and knowledge, physical health, mental well-being, autonomy, workload, and social support were associated with care behaviors. These findings suggest that resources available to mothers may influence the provision of appropriate care behaviors such as IYCF, hygiene, health-seeking, and family care. Interventions which aim to improve maternal education, knowledge, health, autonomy, and support system are likely to have positive effects on care received by children. Interventions that aim to improve women's status need to focus not only on women but also on their family and community. Additionally, provision of nurturing environment during in-utero and childhood period may help in achieving resources like optimal height. Future studies which examine the association of other types of resources for care (for example, emotional support) with care behaviors may help to further understand the role of resources for care in improving care. Qualitative studies may be helpful to understand the differences in the findings across countries. Additionally, longitudinal studies may provide evidence on causal associations. The findings of this

study reinforce that the provision of resources to mothers are essential to improve care behaviors.

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Table 4.3. Selected sample characteristics in Bangladesh, Vietnam, and Ethiopia.

	Bangladesh (n=4400)	Vietnam (n=4029)	Ethiopia (n=2746)
	Percent or mean ± SD		
Maternal characteristics			
Education, %			
No schooling	26.7	-	64.9
1-5 years schooling	29.1	15.7	24.5
6-9 years schooling	36.6	51.5	8.40
10-12 years schooling	7.60	20.4	2.20
College or higher	-	12.4	-
Knowledge (Range: B=0-22, V and E=0-23)	9.76 ± 2.24	9.01 ± 3.08	8.88 ± 2.97
Height, centimeters	151 ± 5.51	153 ± 5.26	157 ± 6.04
Well-nourished, %	70.6	73.5	75.4
Mental well-being (Range: 0-20)	13.1 ± 5.19	15.1 ± 4.50	14.2 ± 4.96
Decision-making (Range:0-11)	8.33 ± 2.69	9.06 ± 2.03	9.12 ± 2.59
Employed, %	6.20	89.2	48.2
Support in chores (Range: B=0-8, V and E=0-9)	4.48 ± 3.04	4.73 ± 3.09	3.13 ± 3.47
Perceived support (Range: 0-3)	2.73 ± 0.761	2.52 ± 0.809	1.09 ± 1.22
Child characteristics			
Age, months	22.3 ± 14.4	24.7 ± 17.8	22.8 ± 16.5
Female, %	48.4	47.3	48.5
Household characteristic			
Number of <5 years children, %			
1 child	81.7	81.8	62.6
≥ 2 children	18.3	18.2	37.4
Father's characteristic			
Occupation, %			
Unemployed/no husband	2.27	1.00	6.88
Farmer	21.1	45.5	87.2
Manual or wage-based work	32.8	12.9	3.35
Service or salaried work	15.1	11.5	-
Business, trade or self-employed	24.3	29.1	2.57
Others	4.43	-	-

Note: B=Bangladesh, V=Vietnam, E=Ethiopia.

Table 4.4. Prevalence or mean of care behaviors in Bangladesh, Vietnam, and Ethiopia.

	Bangladesh	Vietnam	Ethiopia
	Percent or mean ± SD		
Infant and young child feeding practices			
Exclusive breastfeeding [a], %	49.9	18.4	72.4
Minimum meal frequency [b], %	39.6	80.9	45.8
Dietary diversity score [b] (Range:0-7)	2.85 ± 1.59	4.40 ± 1.59	1.71 ± 1.11
Hygiene practices			
Improved drinking water source [c], %	97.1	79.2	60.0
Improved sanitation [c], %	12.3	80.7	1.06
Cleanliness [c] (Range:0-10)	7.46 ± 2.91	7.13 ± 2.31	5.95 ± 3.09
Health-seeking practice			
Immunization [d], %	83.8	84.9	61.2
Family care behaviors			
Psychosocial stimulation [b] (Range:0-6),	2.80 ± 1.58	2.36 ± 1.52	-
Psychosocial stimulation [e] (Range:0-6),	3.67 ± 1.70	2.51 ± 1.98	-
Adequate care [b], %	97.0	96.3	69.1
Adequate care [e], %	96.1	93.4	64.4

a=0-5.9 months, b=6-23.9 months, c=0-47.9/0-59.9 months, d=12-47.9/12-59.9 months,
e=24-47.9/24-59.9 months.

Table 4.5. Adjusted associations between maternal resources for care and exclusive breastfeeding in Bangladesh, Vietnam, and Ethiopia.

Resources for care	Exclusive breastfeeding (OR)		
	0-5.9 months		
	Bangladesh (n=977)	Vietnam (n=948)	Ethiopia (n=602)
Education			
1-5 years schooling	Reference	Reference	Reference
No schooling	1.36	-	1.47
6-9 years schooling	1.01	0.681	2.80*
10-12 years schooling	1.16	0.749	1.25
College or higher	-	0.456	-
Knowledge	*1.22**	1.11**	1.03
Height	1.01	*1.26**	0.998
Well- nourished	1.60*	0.636	1.21
Mental well-being	*1.21**	1.01	*1.24**
Decision-making	0.996	1.01	1.02
Employed	0.687	1.23	0.670
Support in chores	1.03	0.967	0.958
Perceived support	0.963	0.904	0.880

Notes: Italicized odds ratios are specific to 1 SD higher resources for care.
*p<0.05, **p<0.01, ***<0.001.

Table 4.6. Adjusted associations between maternal resources for care and complementary feeding practices in Bangladesh, Vietnam, and Ethiopia.

Resources for care	Minimum meal frequency (OR)			Dietary diversity (β)		
	6-23.9 months			6-23.9 months		
	Bangladesh (n=1211)	Vietnam (n=1095)	Ethiopia (n=870)	Bangladesh (n= 1211)	Vietnam (n=1095)	Ethiopia (n=870)
Education						
1-5 years schooling	Reference	Reference	Reference	Reference	Reference	Reference
No schooling	1.18	-	1.31	-0.122	-	-0.0115
6-9 years schooling	0.954	1.24	1.17	0.0606	0.360*	0.0570
10-12 years schooling	1.18	1.02	0.962	0.259	0.319	-0.227
College or higher	-	2.34*	-	-	0.490*	-
Knowledge	0.982	1.03	1.05	*0.169***	*0.138**	*0.168***
Height	1.02	1.02	1.01	0.00791	-0.00720	0.00669
Well- nourished	0.905	0.833	0.740	0.0109	-0.0884	0.0103
Mental well-being	1.01	1.02	1.02	-0.00472	0.0190	0.0100
Decision-making	0.998	1.01	1.05	-0.0000203	*0.134**	0.00806
Employed	1.80*	0.844	1.27	0.00560	0.0135	0.00260
Support in chores	1.00	1.02	*1.37***	*0.129**	-0.00447	*0.0733*
Perceived support	0.941	0.807	0.956	0.0555	0.203***	*0.0798*

Notes: Italicized odds ratios or regression coefficients are specific to 1 SD higher resources for care.

*p<0.05, **p<0.01, ***<0.001.

Table 4.7. Adjusted associations of maternal resources for care with improved drinking water and sanitation in Bangladesh, Vietnam, and Ethiopia.

	Improved drinking water (OR)			*Improved sanitation* (OR)		
	0-47.9/0-59.9 months			0-47.9/0-59.9 months		
Resources for care	Bangladesh (n=4400)	Vietnam (n=4029)	Ethiopia (n=2746)	Bangladesh (n=4400)	Vietnam (n=4029)	Ethiopia (n=2746)
Education						
1-5 years schooling	Reference	Reference	Reference	Reference	Reference	Reference
No schooling	0.793	-	0.740*	0.908	-	0.642
6-9 years schooling	1.08	1.28*	0.777	1.19	1.15	0.788
10-12 years schooling	0.996	1.57**	2.80	1.72**	1.39*	0.177
College or higher	-	1.19	-	-	0.686	-
Knowledge	1.03	1.02	*1.20**	0.991	*1.17**	1.17
Height	0.999	0.985	0.986	1.01	0.999	1.02
Well- nourished	1.12	1.03	0.874	1.34*	0.994	1.75
Mental well-being	1.01	1.02	*1.15*	*1.20**	*1.16***	0.897*
Decision-making	1.02	0.985	0.975	0.978	0.977	1.05
Employed	1.03	1.11	0.840	0.512*	1.33	1.77
Support in chores	0.988	0.998	1.02	1.01	1.03	1.09
Perceived support	1.10	1.02	0.936	1.01	1.01	1.62*

Notes: Italicized odds ratios or regression coefficients are specific to 1 SD higher resources for care.
*p<0.05, **p<0.01, ***<0.001.

Table 4.8. Adjusted associations of maternal resources for care with cleanliness in Bangladesh, Vietnam, and Ethiopia.

	Cleanliness (β)		
	0-47.9/0-59.9 months		
Resources for care	Bangladesh (n=4400)	Vietnam (n=4029)	Ethiopia (n=2746)
Education			
1-5 years schooling	Reference	Reference	Reference
No schooling	-0.573***	-	-0.468***
6-9 years schooling	0.400***	0.245**	0.491*
10-12 years schooling	0.553**	0.433***	0.638
College or higher	-	0.591***	-
Knowledge	0.125***	0.0108	*0.148***
Height	*0.151****	0.00785	0.0105
Well-nourished	0.359***	0.0644	0.140
Mental well-being	*0.113***	*0.0712**	*0.246****
Decision-making	0.0248	0.0177	*0.125**
Employed	-0.346*	-0.224*	0.180
Support in chores	0.00603	*0.0631**	0.00373
Perceived support	0.349***	0.0498	0.113*

Notes: Italicized odds ratios or regression coefficients are specific to 1 SD higher resources for care.
*p<0.05, **p<0.01, ***<0.001.

Table 4.9. Adjusted associations of maternal resources for care with immunization in Bangladesh, Vietnam, and Ethiopia.

| | *Immunization* (OR) | | |
| | 12-47.9/12-59.9 months | | |
Resources for care	Bangladesh (n= 2983)	Vietnam (n=2607)	Ethiopia (n=1800)
Education			
1-5 years schooling	Reference	Reference	Reference
No schooling	0.943	-	0.987
6-9 years schooling	1.23	1.08	1.13
10-12 years schooling	2.54**	1.08	1.26
College or higher	-	0.694	-
Knowledge	1.03	1.01	*1.20***
Height	0.998	1.01	0.992
Well-nourished	1.18	0.881	0.858
Mental well-being	0.993	1.02	0.985
Decision-making	*1.14**	*1.49***	0.994
Employed	1.11	0.979	1.54**
Support in chores	0.981	1.02	0.988
Perceived support	1.23**	1.00	1.06

Notes: Italicized odds ratios or regression coefficients are specific to 1 SD higher resources for care.
    *p<0.05, **p<0.01, ***<0.001.

Table 4.10. Adjusted associations of maternal resources for care with psychosocial stimulation in Bangladesh and Vietnam.

| | Psychosocial stimulation (β) | | | |
| | 6-23.9 months | | 24-47.9/24-59.9 months | |
Resources for care	Bangladesh (n=1211)	Vietnam (n=1095)	Bangladesh (n=2180)	Vietnam (n=1972)
Education				
1-5 years schooling	Reference	Reference	Reference	Reference
No schooling	-0.162	-	-0.136	-
6-9 years schooling	0.125	0.0668	0.282**	0.224*
10-12 years schooling	0.125	0.292	0.580***	0.507***
College or higher	-	0.749***	-	1.40***
Knowledge	-0.00389	*0.155**	0.00336	*0.275***
Height	0.0113	-0.00370	-0.00383	*0.0837*
Well-nourished	0.138	-0.00641	0.202**	-0.0441
Mental well-being	0.0104	-0.00610	-0.00551	*0.0844*
Decision-making	0.0195	0.00257	*0.103**	-0.0272
Employed	-0.0799	0.0213	0.208	-0.0733
Support in chores	*0.0981*	*0.173***	0.0126	*0.271***
Perceived support	0.141*	0.205***	0.137**	0.120*

Notes: Italicized odds ratios or regression coefficients are specific to 1 SD higher resources for care.
*p<0.05, **p<0.01, ***<0.001.

Table 4.11. Adjusted associations of maternal resources for care with adequate care in Bangladesh Vietnam, and Ethiopia.

	Adequate care (OR)					
	6-23.9 months			24-47.9/24-59.9 months		
Resources for care	Bangladesh (n=1211)	Vietnam (n=1095)	Ethiopia (n=870)	Bangladesh (n=2180)	Vietnam (n=1972)	Ethiopia (n=1254)
Education						
1-5 years schooling	Reference	Reference	Reference	Reference	Reference	Reference
No schooling	1.20	-	0.773	0.635	-	0.668*
6-9 years schooling	2.61	4.22**	2.41*	2.93**	1.00	0.935
10-12 years schooling	1.14	2.02	1.32	1.06	0.932	3.78
College or higher	-	14.6*	-	-	1.17	-
Knowledge	1.01	0.969	1.05	0.979	1.10**	0.966
Height	*1.51*	1.03	0.996	0.988	1.01	1.01
Well-nourished	0.680	0.447	0.703	0.745	0.978	0.996
Mental well-being	1.04	1.02	*1.23*	1.04	*1.37**	1.02
Decision-making	0.868	0.915	0.966	0.928	0.916	0.928**
Employed	0.248**	1.48	0.836	0.367**	0.363	0.742*
Support in chores	0.968	1.04	0.936 *	0.960	1.01	0.973
Perceived support	1.26	1.25	0.972	1.35**	0.811	1.08

Notes: Italicized odds ratios or regression coefficients are specific to 1 SD higher resources for care.
     *p<0.05, **p<0.01, ***<0.001.

4.3 Manuscript 3

PATHS LINKING MATERNAL RESOURCES FOR CARE TO CHILD GROWTH AND EARLY
CHILDHOOD DEVELOPMENT IN BANGLADESH, VIETNAM, AND ETHIOPIA [3]

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[3] Basnet, S., Frongillo, E.A., Nguyen, P.H., Moore, S., Arabi, M. To be submitted.

ABSTRACT

Suboptimal child growth and development are significant problems in low- and middle-income countries. Maternal resources for care may help to improve growth and development but little is known about the mechanisms. The purpose of this study was to determine the paths through which maternal resources for care are associated with height-for-age z scores (HAZ) and motor and language development of 12-23.9 months old children in Bangladesh (n=803), Vietnam (n=635), and Ethiopia (n=546). We used baseline data from the Alive & Thrive household surveys. The measures of resources for care were maternal education, knowledge, height, body mass index, mental well-being, decision-making, employment, support in chores, and perceived support. Care behaviors measures were dietary diversity, cleanliness, child immunization, psychosocial stimulation, and adequate care. Path analysis models using the Stata sem command were run. The analyses were adjusted for potential confounding factors and geographical clustering. All measures of resources for care had positive associations with children's growth and development through direct or indirect paths; however, education, decision-making, and perceived support also had negative associations with some child outcomes. Resources for care were also associated with HAZ directly or indirectly through cleanliness and immunization. Dietary diversity, cleanliness, immunization, psychosocial stimulation, adequate care, and HAZ mediated the associations of resources for care with child development. Resources for care were also associated with child development through the path of care behaviors and then HAZ. The findings show that the maternal resources affect child growth and development

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through direct and indirect paths. Interventions that help to improve resources among mothers have potential to foster child growth and development.

INTRODUCTION

Poor child growth and suboptimal early child development remain critical problems in low- and middle-income countries (Black et al., 2013; Black et al., 2017; McCoy et al., 2016). Undernutrition decreases immunity power and increases vulnerability to infectious diseases among children (Rice, Sacco, Hyder, & Black, 2000). Additionally, undernutrition can restrict achievement of optimum child development, especially during early period of life when there is a rapid growth of brain. Undernutrition can also negatively influence child development by limiting the ability and opportunities of children to be involved in exploration of environment and learning (Prado & Dewey, 2014). Poor growth and development can negatively affect later adult life by influencing educational attainment and productivity (Black et al., 2017; Britto et al., 2017).

Child growth and development may be influenced by multiple conditions in proximal and distal environment (Frongillo, Kulkarni, Basnet, & de Castro, 2017; Maggi, Irwin, Siddiqi, & Hertzman, 2010). Provision of nurturing care which addresses children's needs is vital for optimal growth and development (Britto et al., 2017). Care behaviors like infant and young child feeding (IYCF), health-seeking, hygiene, and family care have been linked with children's growth and development (Britto et al., 2017; Doherty,

Buchy, Standaert, Giaquinto, & Prado-Cohrs, 2016; Engle, 1999; Frongillo et al., 2017). The first and most important context for the provision of care to young children is home setting, which is often fostered by mothers; therefore, resources available to mothers may be critical for young children (Coller & Kuo, 2015; Engle, Menon, & Haddad, 1999; Frongillo et al., 2017). The unavailability and inadequacy of resources could constrain mother's capacity to fulfill needs of children and promote their well-being (Engle, 1999; Engle et al., 1999). The role of mothers is more important in settings that have low accessibility of institutions and programs that promote nurturing care of children (Borisova, Pisani, Dowd, & Lin, 2017; Engle et al., 1999). The extended care model of the United Nations Children's Fund (UNICEF) emphasizes that care behaviors, and child growth and development are influenced by caregiver's resources such as education and knowledge, physical health, mental well-being, autonomy, reasonable workload/availability of time, and social support. Resources for care improve capabilities and help in meeting children's need and promoting growth and development (Engle, Menon, & Haddad, 1997; Engle et al., 1999; Peter & Kumar, 2014).

Resources available to mothers are associated with child growth and development (Engle et al., 1999), but little is known about the mechanisms through which the association occurs. Additionally, some resources for care are studied extensively like education whereas some have received little attention. This study examined the mechanisms through which various maternal resources for care are associated child growth and development. The first objective was to determine the paths through which maternal resources for care were associated with early child

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growth, specifically height-for-age z scores (HAZ)/ length-for-age z scores (LAZ). In this study, resources for care can be associated with child growth directly or indirectly through care behaviors (Figure 4.5). The second objective was to determine the paths through which maternal resources for care were associated with early child motor and language development. In this study, resources for care can be associated with child development directly or indirectly through care behaviors and/or child physical growth (Figure 4.6).

METHODS

Data source and study population

We used the Alive & Thrive baseline data that were collected in Bangladesh, Vietnam, and Ethiopia in 2010. The Alive &Thrive is an initiative that aims to positively impact children's survival, growth, and development by improving IYCF practices (Nguyen et al., 2017). Households were selected from twenty sub-districts (*upazilas*), forty communes, and seventy-five enumeration areas in Bangladesh, Vietnam, Ethiopia, respectively. The surveys included mothers and their < 5 years old children. Detailed descriptions of the sampling procedure can be found elsewhere (Ali et al., 2011; Nguyen et al., 2010; Saha et al., 2011). Ethical approval for the surveys were obtained from the institutional review board of each country and the International Food Policy Research Institute. We used the de-identified data, and it was exempted by the institutional review board of the University of South Carolina.

In this study, we used data pertaining to mothers and their 12-23.9 months old index/youngest children (Bangladesh: n=803, Vietnam: n=635, Ethiopia: n=546). The

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children belonging to younger age group may lack significant variation in terms of psychosocial stimulation (Larson, Martorell, & Bauer, 2018). Additionally, many children ≥ 24 months would have achieved their motor and language milestones and much variation may not exist (Frongillo et al., 2016). Data on psychosocial stimulation, motor development and language development were only available for Bangladesh and Vietnam.

Measures

Child nutritional status. In this study, HAZ/LAZ was used as a measure of children's growth or nutritional status. Children's weights were measured by using electronic weighing scales (Ali et al., 2013). Children's recumbent length was assessed by using locally manufactured collapsible length boards (Ali et al., 2013). Weight and height were measured twice by trained personnel. The third measurement was also taken if the differences between two measurements were significant. The average estimation of the measurements was used for the study (Nguyen et al., 2010). HAZ was calculated using the World Health Organization (WHO) growth standards (de Onis et al., 2004; Mei & Grummer-Strawn, 2007).

Child development. Language development was assessed using 21-itemed and 20-itemed instruments in Bangladesh and Vietnam, respectively. Motor development was measured using 29- itemed tool in both countries. Information on language development was based on reporting from mothers. One point was assigned to each response by a mother which indicated that her child had achieved the milestone, and the scores were added to develop an overall language development (range: Bangladesh

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0-21, Vietnam 0-20). Motor development was assessed through mothers' reporting, and for some items, children were required to demonstrate motor activities. One point was assigned to each affirmative response or observation, and then a variable indicating motor development was created by adding the scores (range: 0-29).

Care behaviors. Dietary diversity score, cleanliness, immunization, psychosocial stimulation, and adequate care were used as the measures of care behaviors. Dietary diversity score was used to represent IYCF practice. The score indicated the number of food groups consumed by the children (range: 0-7). Information related to dietary diversity was based on the past twenty-four hours recall by mothers (WHO, 2008). Cleanliness was used as a measure of hygiene practice; the variable indicated cleanliness of the house's interior and exterior, and face, hands, hair, and clothes/body of a mother and her child. Information on cleanliness was collected by spot check observations. One point was assigned for each observation indicating "clean", then the scores were summed to create the cleanliness variable (total possible score of 10). In this study, immunization status was used as a measure of health-seeking practice. We considered a child to be fully immunized if he/she had received essential vaccines such as Bacillus Calmette-Guerin vaccine, diphtheria-pertusis-tetanus vaccine, polio vaccine, hepatitis B vaccine, and measles vaccine (Animaw, Taye, Merdekios, Tilahun, & Ayele, 2014; Oyo-Ita, Nwachukwu, Oringanje, & Meremikwu, 2012; Uddin, Koehlmoos, Saha, & Khan, 2010). Data on immunization were collected from the immunization cards or mothers. Psychosocial stimulation and adequate care were used as the measures of family care behaviors (Kariger et al., 2012). Psychosocial stimulation denoted number of stimulating

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activities in which an adult was engaged with a child in the past 3 days (range:0-6). Adequate care indicated not leaving a child alone or with a minor for more than one hour. Information on psychosocial stimulation and adequate care were based on mother's reporting.

Resources for care. The measures of resources for care used were maternal education, knowledge, height, body mass index (BMI), mental well-being, decision-making autonomy, employment, support in chores, and perceived instrumental support. Information on all resources for care variables was reported by mothers, except the information on physical health which was based on the anthropometric measurements.

Maternal education was represented by the years of schooling. Maternal knowledge was specific to the knowledge on breastfeeding, complementary feeding, iron deficiency symptoms, vitamin A sources, iodine fortification, food diversity, and hand washing. One point was assigned for each correct response, and the sum was used as a measure of maternal knowledge (total possible scores: 22 for Bangladesh and 23 for Vietnam and Ethiopia).

Maternal height and BMI were used as the measures of physical health. Mental well-being was assessed by using the Self-Reporting Questionnaire-20 (SRQ-20) which is a valid and reliable tool to screen mental disorders in low- and middle-income countries (WHO, 1994). Mental well-being variable was developed by assigning one point for each item in which absence of symptoms was reported and adding the scores (total possible score of 20).

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Decision-making autonomy was developed by assigning one point for each item when mothers indicated that they were involved in the decision-making process alone or along with spouse/someone else (total possible score of 11). The household-decision making items were related to major purchases; cooking; visiting family, friends, or relatives; healthcare visit; family planning; and care of children including child-feeding. We did not use financial autonomy as a measure of autonomy because it was closely related to employment in our previous work. We used maternal employment status (employed vs not employed) of mothers to denote reasonable workload. Women are usually more engaged in household work than men regardless of the employment status; in the present study, being employed indicated higher workload (Fuwa, 2004; Lennon & Rosenfield, 1992).

Two measures of social support were used which were support in household chores and perceived instrumental support. Support in chores represented support received by mothers regarding household chores. A point was assigned if mothers reported receiving the support and then summed score was developed (total possible scores: 8 for Bangladesh and 9 for Ethiopia and Vietnam). Perceived social support indicated potential instrumental support when in need. A point was assigned when mothers indicated that they will get support if they need money, accommodation, or food. The sum of the scores was used as a measure of perceived instrumental support (total possible score of 3).

Covariates. The covariates used in this study were child's age, child's gender, and father's occupation. Total number of < 5 years children in the household and household

wealth index were also used as covariates. Household wealth index was constructed

using principal component analysis, followed by extracting the first component scores

(Vyas & Kumaranayake, 2006). Information used for constructing the household wealth

variable was related to house and land ownership, quality of house, access to services in

the household (for example, electricity, cooking fuel), and household assets.

Statistical analysis

The analyses were performed for each country separately using Stata 14. The

descriptive statistics were presented as mean and standard deviation (SD), or

percentage. Path analysis models using the Stata sem command were run to examine

the mechanisms through which resources for care were associated with HAZ, motor,

and language development. Separate models were run for each outcome variable. P-

value <0.05 was considered as significant.

Resources for care can be associated with HAZ, language, and motor

development directly or indirectly (Figures 4.5-4.6). The potential indirect paths through

which resources for care may be associated with HAZ are through dietary diversity,

cleanliness, immunization, psychosocial stimulation, and adequate care (Figure 4.5). The

potential indirect paths through which resources for care may be associated with child

development are through dietary diversity, cleanliness, immunization, psychosocial

stimulation, adequate care, HAZ, dietary diversity and HAZ, cleanliness and HAZ,

immunization and HAZ, psychosocial stimulation and HAZ, and adequate care and HAZ

(Figure 4.6). The effects were calculated by multiplying the unstandardized regression

coefficients of the paths. The models included all measures of resources for care, and

were adjusted for child's age and gender, father's occupation, total number of <5 years old in the household, and household wealth. The geographical clustering was also accounted.

For each care behavior domain (except family care behaviors), only one measure was used to reduce the possibility of the shared variation. We used two measures of family care behaviors (psychosocial stimulation and adequate care) because these two variables are theoretically distinct. Additionally, in our dataset, psychosocial stimulation and adequate care did not had a strong association.

RESULTS

Sample characteristics

Maternal education level was highest in Vietnam than Bangladesh and Ethiopia (Table 4.12). Mean maternal knowledge scores were 9.71 in Bangladesh, 9.09 in Vietnam, and 8.89 in Ethiopia. Maternal height was highest in Ethiopia than other two countries. Maternal BMI was about 20 kg/m^2 in all three countries. Mental well-being was highest in Vietnam (mean=15.0), followed by Ethiopia (mean=14.2) and then Bangladesh (mean=12.9). Decision-making autonomy was higher in Vietnam and Ethiopia than Bangladesh. Maternal employment was highest in Vietnam, followed by Ethiopia, and then Bangladesh. Support in chores had means of 4.60 in Bangladesh, 4.62 in Vietnam, and 2.99 in Ethiopia. Perceived instrumental support was higher in Bangladesh (mean=2.73) and Vietnam (mean=2.48) than Ethiopia (mean=1.10).

Mean age of children was about 18 months in all three countries. In Bangladesh and Ethiopia, about half of the children were females, whereas 45.7 % were females in

Vietnam. More than half of the households had only one <5 years old child in all three countries. Most of the fathers were engaged in manual or wage-based work in Bangladesh, and most of the fathers were farmers in other two countries.

Prevalence or mean of care behaviors and child outcomes

Children from Vietnam (mean=4.80) had highest dietary diversity, followed by Bangladesh (mean=3.32) and then Ethiopia (mean=1.96) (Table 4.13). Cleanliness was also higher in Bangladesh (mean=6.89) and Vietnam (mean=6.98) as compared to Ethiopia (mean=5.71). Child immunization was highest in Vietnam, followed by Bangladesh and then Ethiopia. Psychosocial stimulation was slightly higher in Bangladesh (mean=2.99) than Vietnam (mean=2.43). The prevalence of adequate care was higher in Bangladesh and Vietnam than Ethiopia.

The means of HAZ were -1.94, -1.03, and -1.97 in Bangladesh, Vietnam, and Ethiopia, respectively. Both motor and language scores had higher means in Vietnam than Bangladesh.

Paths between resources for care and child growth

Resources for care were associated with HAZ both directly and through care behaviors (Tables 4.14-4.16). The total effect of maternal height on HAZ was significant in all three countries. The total effects of BMI (Bangladesh and Vietnam) and mental well-being (Bangladesh) on HAZ were also significant. Maternal height was directly associated with HAZ in all three countries (Bangladesh: β=0.0544, Vietnam: β=0.0619, Ethiopia: β=0.0426). Additionally, BMI was directly associated with HAZ in Bangladesh (β=0.0326) and Vietnam (β=0.0477). About 98% of the total effects of maternal BMI on

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HAZ were attributable to the direct paths in both Bangladesh and Vietnam. Mental well-being had a direct positive association with HAZ in Bangladesh only (β=0.0240), and the direct path attributed to about 98% of the total effect of mental well-being. Knowledge (β=0.00375) and perceived instrumental support (β=0.0128) were associated HAZ through immunization in Bangladesh. Additionally, maternal height was associated with child HAZ through cleanliness in Vietnam (β=0.00211).

Paths between resources for care and motor development

Maternal resources for care were associated with motor development through both direct and indirect paths (Tables 4.17-4.22). The total effect of support in chores on motor development was significant in Bangladesh. In Vietnam, maternal decision-making was associated with motor development through the direct path (β=-0.133). Additionally, knowledge (β=0.0212) and perceived support (β=0.0649) were associated with motor development through dietary diversity in Vietnam. Mental well-being was associated with motor development through child immunization (β=0.0111) in Vietnam. Additionally, education (β=0.0329), knowledge (β=0.0283), employment (β=0.157), support in chores (β=0.0307), and perceived support (β=0.0832) were associated with motor development through stimulation in Vietnam. Height was associated with motor development through HAZ in Bangladesh (β=0.0342) and Vietnam (β=0.0485). Maternal BMI (Vietnam β=0.0373) and mental well-being (Bangladesh β=0.0153) were associated with motor development through HAZ. Height (β=0.00167) was associated with motor development through cleanliness and then HAZ in Vietnam. Knowledge (β=0.00240) and perceived support (β=0.00755) were associated with motor development through

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immunization and then HAZ in Bangladesh. In Bangladesh, maternal employment was negatively associated with adequate care, and adequate care was negatively associated with motor development. In Vietnam, education had a negative association with immunization, but immunization had a positive association with motor development.

Paths between resources for care and language development

The total effects of maternal mental well-being, and perceived support on child language development were significant in Vietnam, but the total effect of only decision-making on language development was significant in Bangladesh (Tables 4.23-4.28). Decision-making had a direct positive association with language development in Bangladesh (β=0.0855). Perceived support had a direct positive association with language development in Vietnam (β=0.333), but the association was negative in Bangladesh (β=-0.243).

Education was indirectly associated with language development through cleanliness (Bangladesh β=0.0112, about 91% of the total effect) and stimulation (Vietnam β=0.0253, about 34% of the total effect). Knowledge and perceived instrumental support were associated with language development through four indirect paths: through dietary diversity (Vietnam), cleanliness (Bangladesh), stimulation (Vietnam), and immunization and then HAZ (Bangladesh). In Vietnam, mental well-being and employment were associated with language development through immunization (β=0.00757) and stimulation (β=0.120), respectively. Additionally, support in chores was associated with language development through stimulation in Vietnam (β=0.0236). In both countries, height (Bangladesh β=0.0159, Vietnam β=0.0349) and BMI (Bangladesh

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β=0.00935, Vietnam β=0.0271) were associated with language development through HAZ. Mental well-being was associated with language development through HAZ in Bangladesh (β=0.00695). Height was associated with language development through cleanliness and then HAZ in Vietnam (β=0.00121). Education had a negative association with immunization, but immunization had positive association with language development in Vietnam.

DISCUSSION

Resources for care were associated with HAZ directly or indirectly through cleanliness and immunization. Resources for care were associated with children's motor and language development directly or through indirect paths. The indirect paths through which resources for care were associated with motor development were through dietary diversity, immunization, stimulation, adequate care, HAZ, cleanliness and then HAZ, and immunization and then HAZ. Resources for care were associated with language development indirectly through dietary diversity, cleanliness, immunization, stimulation, HAZ, cleanliness and then HAZ, and immunization and then HAZ.

The total effects of maternal height, BMI, and mental well-being on child growth were significant. Maternal height, BMI, and mental well-being had direct associations with HAZ. Additionally, maternal height was associated with child HAZ through cleanliness. Associations between maternal physical health and children's nutritional status have been found in previous studies as well. A study from India found that children of mothers with higher height had decreased risk of stunting, underweight, and wasting (Subramanian, Ackerson, Smith, & John, 2009). Positive association of maternal

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height with linear growth of offspring can be attributed to genetic and non-genetic factors (Addo et al., 2013). Short stature and low BMI during pregnancy may lead to adverse pregnancy outcomes such as obstructed labor, small-for-gestational age, and preterm births which may predispose to poor growth and development (Black et al., 2008; Kozuki et al., 2015). Maternal short stature indicates poor and constrained environment of mothers (Addo et al., 2013). Short stature may have negative impact on health, and economic and educational achievement, which may in turn negatively influence child outcomes (Addo et al., 2013; Dewey & Begum, 2011; Hernandez-Diaz et al., 1999). Undernourished mothers are more likely to have co-morbidities and lack energy which may negatively impact children (Kulasekaran, 2012). Mental well-being was also directly associated with children's HAZ. A meta-analysis that included studies from the low- and middle-income countries also found that children of mothers with depression or depressive symptoms were more likely to be have a poor nutritional status (Surkan, Kennedy, Hurley, & Black, 2011). Poor mental health may compromise parenting and care received by children like breastfeeding, however, future studies are needed to better understand the effects of maternal mental health on children's growth (Santos, Santos, Silva, Hasselmann, & Barreto, 2011; Surkan et al., 2011).

Maternal knowledge and perceived instrumental support were associated with children's HAZ through immunization. Knowledge learned outside a classroom may also play a crucial role in improving children's nutritional status (Glewwe, 1999). Researchers have suggested that improving knowledge of caregivers in the communities with low educational status may have potential to improve care behaviors and child outcomes

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(Christiaensen & Alderman, 2004). Mothers with higher knowledge and perceived support may have awareness regarding immunization and may be able to mobilize material resources, which may facilitate immunizing children (Glewwe, 1999; Umberson & Karas Montez, 2010). Consistent with our finding, a study from Kenya found protective effect of immunization against stunting (Bloss, Wainaina, & Bailey, 2004). Immunization helps to prevent infectious disease which may result in improved growth (Doherty et al., 2016).

The total effects of mental well-being, decision-making, support in chores and perceived support on child development were significant. Knowledge, height, BMI, mental well-being, employment, and support in chores were positively associated with child development through direct or indirect paths. Education, decision-making autonomy and perceived support had both positive and negative associations with child development. Maternal education had negative associations with child immunization, but child immunization was positively associated with child development. Previous studies, especially from high-income countries, have demonstrated negative attitude of highly educated parents toward childhood immunizations, which may have negative impact child growth and development (Hak, Schönbeck, De Melker, Van Essen, & Sanders, 2005). Maternal autonomy was negatively associated with motor development in Vietnam but was positively associated with language development in Bangladesh. Higher autonomy among mothers may increase spending of household resources in favor of children (Thomas, 1990). Additionally, mothers are more likely to allocate for health and nutrition-related expenses if they have control over household resources as

compared to fathers (Quisumbing & Maluccio, 2000). On the other hand, increased autonomy may increase mothers' ability to travel and be engaged in activities outside house which may have negative influence on children, especially if mothers lack support system to care for children.

In Vietnam, perceived social support had a direct positive association with language development, but the association was in a negative direction in Bangladesh. The total effect of support in chores on motor development was in a positive direction in Bangladesh. Previous studies have also found mixed effects of social support. Harpham and colleagues found that high levels of cognitive social capital and social support were positively associated with health of infants; however, maternal membership in community groups was not much beneficial (Harpham, De Silva, & Tuan, 2006). Social support may have unintended negative effects by increasing demand to care for people in social ties, and increasing stress levels, peer pressure, and risky behaviors (Umberson & Karas Montez, 2010).

Knowledge and perceived instrumental support were associated with motor and language development through dietary diversity. Receiving diverse diet may help to meet the requirements of micronutrients like iron, zinc, iodine, and vitamin B12 which are important for neurological function (Black, 2003a; Black 2003b). A study from Bangladesh found that intensive IYCF intervention had positive effects on children's motor and language development, and improved complementary feeding partially explained the effects (Frongillo et al., 2016). Cleanliness was another path through which resources for care (education, knowledge, and perceived support) were

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associated with language development. Cleanliness may improve child development by preventing infections and gut-inflammation, however, further studies are needed to understand the role of cleanliness in child development (Ngure et al., 2014; Piper et al., 2017). Additionally, mental well-being was associated with motor and language development through immunization. Poor mental health among mothers may negatively influence care behaviors including uptake of child immunizations which may have negative effects on child health and well-being (Rahman, Harrington, & Bunn, 2002; Tough et al., 2008). As expected, stimulation was an important path through which resources for care were associated with child development. Education, knowledge, employment, support in chores, and perceived support were associated with motor and language development through stimulation. Maternal education and knowledge improve quality of mother-child relationship and quality of home environment (Benasich & Brooks-Gunn, 1996; Brody & Flor, 1998). Educated mothers are also more likely to understand cues of children and be responsive to their needs (Engle et al., 1999). In a study by Rubio-Codina and colleagues, nurturing home environment partially mediated the effect of maternal education on children (Rubio-Codina, Attanasio, & Grantham-McGregor, 2016). Maternal employment may improve ability to invest in children (Engle et al., 1999). Huston and Aronson found that employment reduced time duration spent by mothers with their children; nevertheless, when mothers were at home, they decreased other activities to provide more time to children to compensate for work-time. The study also found that mothers who had spent longer time at work had higher Home Observation Measurement of the

Environment scores (Huston & Aronson, 2005). Additionally, social support and cognitive social capital may also help in the provision of a more nurturing environment, which may positively impact children's well-being (Engle et al., 1999; Harpham et al., 2006).

Children's physical growth was a significant mechanism through which resources for care were associated with child development. Height, BMI, and mental well-being of mothers had associations with child development through children's HAZ. Additionally, knowledge and perceived instrumental support were associated with motor and language development through immunization and then HAZ. Height was associated with motor and language development through cleanliness and then HAZ. Immunization and cleanliness may prevent infectious disease and may support linear growth of children. Linear growth represents chronic nutritional status of children. Chronic exposure to poor nutrients may damage structure of the brain (Prado & Dewey, 2014). Additionally, malnourished children may lack energy to interact with the environment and poor nutrition may pose risk to infections (Brown & Pollitt, 1996). Furthermore, caregivers are less likely to be engaged in stimulating activities with the children if they appear smaller (Larson et al., 2018). Significant associations of linear growth with child development was found in children from India (Larson et al., 2018) and Tanzania (Olney et al., 2009) as well. A recent study that included multiple African countries also found associations of linear growth with child development (Prado et al., 2017). Despite the associations between linear growth and child development, promoting linear growth

may not be the most efficient strategy to promote child development (Leroy & Frongillo, 2019).

Maternal employment was negatively associated with adequate care, and adequate care was negatively associated with motor development. Employed mothers may not have qualified child care substitute and may leave children alone or with children (Engle et al., 1999). Our findings also suggest that not leaving children alone or with minors may not be enough to improve children's growth and development. A study which included 36–59 months old children from 26 low- and middle-income countries also found no significant associations of inadequate care with literacy-numeracy and learning development (Frongillo et al., 2017).

The magnitudes of associations between resources for care measures and child growth were modest. For example, a ten centimeters difference in maternal height was associated with a 0.426-0.619 difference in child HAZ through the direct path. The magnitude of associations of some resources for care with motor development were modest to strong. For example, a ten centimeters difference in maternal height was associated with a 0.342 and 0.485 points differences in motor development through HAZ in Bangladesh and Vietnam, respectively. On the other hand, the magnitude of associations of some resources for care with motor development were weaker. For example, in Bangladesh, a three-point difference in the perceived support was associated with a difference of 0.0227 point in motor development through the path of immunization and then HAZ. The magnitude of associations between resources for care and child development also differed by the types of resources for care and paths

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involved. For example, in Bangladesh, a ten-unit difference in maternal education and knowledge was associated with 0.112 and 0.203 point differences, respectively, in language development through cleanliness, but a ten-unit difference in maternal knowledge was associated with only 0.0113 point difference in language development through immunization and then HAZ. We also found modest association of maternal knowledge with language development in Vietnam, but dietary diversity and stimulation mediated the associations.

We also found additional variations in the associations of resources for care with child outcomes across study settings. For example, in Ethiopia, only maternal height was directly associated with child HAZ, but other measures also had direct associations with HAZ in two other countries. Additionally, decision-making autonomy was positively associated with language development only in Bangladesh. Furthermore, perceived social support had a direct negative effect on language development in Bangladesh but the association was positive Vietnam. We also found a few differences in the mechanisms through which resources for care were associated with child outcomes by study settings. Previous studies have also suggested that the role of maternal attributes and the mechanisms through which they are associated with child outcomes may differ by study settings (Engle et al., 1999; Prado et al., 2017). Maternal attributes and household conditions are crucial for optimal growth and development, however, other factors such as communities, socio-political contexts, and culture may also influence (Britto et al., 2017). In addition to the causation, there may be a possibility of joint effects of selection and causation (Miech, Caspi, Moffitt, Wright, & Silva, 1999). For

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example, poor mental well-being among mothers may negatively influence child development and poor child development may further deteriorate maternal mental health.

The strengths of the present study are inclusion of three socio-culturally distinct countries and use of the reliable and validated tools (for example, SRQ-20). Additionally, this study allowed us to examine the mechanisms through which maternal resources for care were associated with children's growth and development. Limitations of this study are cross-sectional data, limited generalizability for high-income countries, use of self-reporting data for some measures, and use of maternal employment status as a proxy for workload. Additionally, the associations of resources for care on children's growth and development may occur through other paths than those included in our study (for example, prenatal conditions and childhood illnesses). There may be also be a possibility of reporting biases of child development, especially by the mothers who are aware about the timing of milestone achievement. For example, a mother may report that her child has achieved a milestone appropriate for the age even if it was not achieved.

Early childhood is a critical period for growth and development. The study findings highlight that maternal resources for care are important for children's growth and development. Resources for care were associated with child outcomes directly or indirectly through improved care behaviors. Dietary diversity, cleanliness, immunization, psychosocial stimulation, and adequate care partially explained the associations of maternal resources for care with children's growth and development. Additionally, children's physical growth mediated the association between resources for care and

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children's development. Interventions to promote resources among mothers have potential to impact children's growth and development. Integration of interventions that intend to improve children's growth and development could be effective. Improving multiple resources for care among mothers has potential to improve health and well-being of their children. Programs and policies that are holistic with aims to improve overall status of women are warranted. Future studies are needed to examine potential paths beside those included in our study (for example, childhood illnesses, prenatal conditions) through which maternal resources for care may be associated with children's growth and development. Research is warranted to understand the mechanisms through which resources for care may be associated with other child outcomes like socio-emotional development.

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Table 4.12. Selected sample characteristics of 12-23.9 months old in Bangladesh, Vietnam, and Ethiopia.

	Bangladesh (n= 803)	Vietnam (n=635)	Ethiopia (n= 546)
	Percent or mean ± SD		
Maternal characteristics			
Years of schooling	4.79 ± 3.71	9.21 ± 3.34	1.58 ± 2.60
Knowledge (Range: B=0-22, V and E=0-23)	9.71 ± 2.25	9.09 ± 3.01	8.89 ± 3.01
Height, centimeters	151 ± 5.37	153 ± 5.30	157 ± 6.03
Body mass index	19.9 ± 2.99	19.9 ± 2.45	19.6 ± 2.10
Mental well-being (Range: 0-20)	12.9 ± 5.16	15.0 ± 4.27	14.2 ± 4.86
Decision-making (Range:0-11)	8.28 ± 2.68	9.02 ± 2.00	9.14 ± 2.55
Employed, %	6.23	88.8	48.0
Support in chores (Range: B=0-8, V and E= 0-9)	4.60 ± 3.02	4.62 ± 3.09	2.99 ± 3.48
Perceived support (Range: 0-3)	2.73 ± 0.760	2.48 ± 0.849	1.10 ± 1.24
Child characteristics			
Age, months	18.0 ± 3.24	18.0 ± 3.43	17.6 ± 3.69
Female, %	49.9	45.7	50.0
Household characteristic			
Number of <5 years children, %			
1 child	79.3	84.9	52.9
≥ 2 children	20.7	15.1	47.1
Father's characteristic			
Occupation, %			
Unemployed/no husband	2.62	1.40	5.13
Farmer	20.1	44.9	88.1
Manual or wage-based work	35.2	13.2	3.66
Service or salaried work	14.6	12.3	-
Business, trade or self-employed	23.3	28.2	3.11
Others	4.18	-	-

Note: B=Bangladesh, V=Vietnam, E=Ethiopia.

Table 4.13. Prevalence or mean of care behaviors and child outcomes of 12-23.9 months old in Bangladesh, Vietnam, and Ethiopia.

	Bangladesh (n= 803)	Vietnam (n=635)	Ethiopia (n= 546)
	Percent or mean ± SD		
Care behaviors			
Dietary diversity score (Range: 0-7)	3.32 ± 1.46	4.80 ± 1.38	1.96 ± 1.03
Cleanliness (Range: 0-10)	6.89 ± 3.16	6.98 ± 2.32	5.71 ± 3.14
Immunization, %	81.8	87.5	58.2
Psychosocial stimulation (Range: 0-6)	2.99 ± 1.63	2.43 ± 1.67	-
Adequate care, %	96.4	95.6	68.2
Child outcomes			
Height-for-age z scores	-1.94 ± 1.30	-1.03 ± 1.23	-1.97 ± 1.49
Motor development (Range: 0-29)	19.6 ± 3.94	22.1 ± 4.72	-
Language development (Range: B=0-21, V=0-20)	9.78 ± 3.38	10.9 ± 3.83	-

Note: B=Bangladesh, V=Vietnam.

Table 4.14. Associations of maternal resources for care with height-for-age z scores of 12-23.9 months old children in Bangladesh.

Resources for care	Direct effect	Indirect effect						Total effect
		Dietary diversity	Cleanliness	Immunization	Stimulation	Adequate care	Total indirect effect	
Education	0.0198	0.00158	0.000533	0.000724	-0.000123	0.000144	0.00286	0.0227
Knowledge	-0.0200	0.00225	0.00104	*0.00375*	0.000185	0.000234	0.00746	-0.0125
Height	*0.0544*	0.000218	0.0000819	0.0000563	-0.0000763	0.000170	0.000450	*0.0548*
Body mass index	*0.0326*	-0.000459	0.000491	0.000772	-0.0000787	-0.000204	0.000521	*0.0331*
Mental well-being	*0.0240*	0.0000883	0.000187	0.000177	-0.0000424	0.0000528	0.000463	*0.0245*
Decision-making	0.00106	-0.000192	-0.000140	-0.000130	-0.000127	-0.000370	-0.000959	0.000101
Employment	0.128	-0.00301	-0.00483	0.0101	0.000239	-0.0102	-0.00770	0.120
Support in chores	0.00501	0.00119	0.000180	-0.000531	-0.000200	-0.0000926	0.000546	0.00556
Perceived support	0.0120	0.000690	0.00470	*0.0128*	-0.000980	0.00148	0.0187	0.0307

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05 (indirect effect).

Italicized regression coefficients indicate p<0.05 (direct and total effect).

Table 4.15. Associations of maternal resources for care with height-for-age z scores of 12-23.9 months old children in Vietnam.

Resources for care	Direct effect	Height-for-age z scores (β)						Total effect
		Indirect effect						
		Dietary diversity	Cleanliness	Immunization	Stimulation	Adequate care	Total indirect effect	
Education	0.0159	0.00227	0.000486	-0.00264	-0.000665	-0.00132	-0.00187	0.0140
Knowledge	0.00992	0.00382	0.000837	0.000832	-0.000565	0.000623	0.00555	0.0155
Height	*0.0619*	-0.0000924	*0.00211*	-0.000404	0.0000437	-0.000171	0.00149	*0.0634*
Body mass index	*0.0477*	-0.000520	0.00149	-0.000309	0.000190	0.000412	0.00126	*0.0490*
Mental well-being	0.0115	0.00109	0.000385	0.00188	-0.0000546	-0.000355	0.00295	0.0145
Decision-making	-0.0147	0.00213	0.00338	0.00199	-0.0000972	0.000509	0.00791	-0.00679
Employment	-0.00382	-0.00320	-0.0170	-0.00269	-0.00291	-0.000286	-0.0261	-0.0299
Support in chores	-0.0168	-0.000331	0.00203	-0.000255	-0.000599	0.000518	0.00136	-0.0154
Perceived support	-0.0351	0.0120	0.00997	-0.00293	-0.00168	0.000103	0.0175	-0.0176

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05 (indirect effect).

Italicized regression coefficients indicate p<0.05 (direct and total effect).

Table 4.16. Associations of maternal resources for care with height-for-age z scores of 12-23.9 months old children in Ethiopia.

	Height-for-age z scores (β)						
		Indirect effect					
Resources for care	Direct effect	Dietary diversity	Cleanliness	Immunization	Adequate care	Total indirect effect	Total effect
Education	0.0153	-0.000359	0.000851	0.0000387	-0.000350	0.000181	0.0155
Knowledge	0.00744	-0.00200	0.000464	0.0000478	-0.000377	-0.00187	0.00557
Height	*0.0426*	-0.000299	0.000137	0.00000792	-0.0000357	-0.000190	*0.0424*
Body mass index	0.0523	0.0000385	-0.000159	-0.0000000500	0.000415	0.000294	0.0526
Mental well-being	-0.00625	-0.0000938	0.000332	-0.0000635	-0.000176	-0.00000130	-0.00625
Decision-making	0.0385	-0.000612	0.000122	-0.0000443	0.000247	-0.000287	0.0382
Employment	-0.0644	-0.00128	0.00235	0.000281	0.00126	0.00261	-0.0618
Support in chores	0.0323	-0.000448	0.000105	0.0000422	0.000211	-0.0000898	0.0322
Perceived support	-0.0382	-0.00163	0.000534	0.000271	-0.000305	-0.00113	-0.0393

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05 (indirect effect).

Italicized regression coefficients indicate p<0.05 (direct and total effect).

Table 4.17. Indirect associations of maternal resources for care with motor development of 12-23.9 months old children through care behaviors and HAZ in Bangladesh.

	Motor development (β)					
Resources for care	Dietary diversity	Cleanliness	Immunization	Stimulation	Adequate care	HAZ
Education	0.00440	0.000571	0.00107	0.00370	-0.00145	0.0127
Knowledge	0.00605	0.00103	0.00599	-0.00444	-0.00257	-0.0126
Height	0.000508	0.0000784	-0.000207	0.00192	-0.00181	*0.0342*
Body mass index	-0.00108	0.000483	0.000918	0.00203	0.00222	0.0197
Mental well-being	0.000277	0.000196	-0.0000737	0.00104	-0.000618	*0.0153*
Decision-making	-0.000634	-0.0000503	0.000201	0.00338	0.00407	0.00102
Employment	-0.00673	-0.00471	0.00479	-0.00607	*0.107*	0.0879
Support in chores	0.00312	0.000197	-0.000535	0.00550	0.00123	0.00365
Perceived support	0.00208	0.00445	0.0188	0.0231	-0.0160	0.00561

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05

HAZ= height-for-age z scores.

Table 4.18. Indirect associations of maternal resources for care with motor development of 12-23.9 months old children via the path of care behaviors through HAZ in Bangladesh.

	Motor development (β)				
Resources for care	Dietary diversity through HAZ	Cleanliness through HAZ	Immunization through HAZ	Stimulation through HAZ	Adequate care through HAZ
Education	0.00120	0.000414	0.000430	-0.0000997	0.0000797
Knowledge	0.00165	0.000749	*0.00240*	0.000120	0.000141
Height	0.000139	0.0000569	-0.0000828	-0.0000517	0.0000996
Body mass index	-0.000294	0.000350	0.000368	-0.0000548	-0.000122
Mental well-being	0.0000756	0.000142	-0.0000295	-0.0000280	0.0000340
Decision-making	-0.000173	-0.0000365	0.0000804	-0.0000911	-0.000224
Employment	-0.00184	-0.00342	0.00192	0.000164	-0.00586
Support in chores	0.000851	0.000143	-0.000214	-0.000148	-0.0000677
Perceived support	0.000568	0.00323	*0.00755*	-0.000622	0.000882

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had $p<0.05$.

HAZ= height-for-age z scores.

Table 4.19. Associations of maternal resources for care with motor development of 12-23.9 months old children in Bangladesh.

Resources for care	Motor development (β)		
	Direct	Total indirect	Total
Education	0.00869	0.0230	0.0317
Knowledge	-0.0421	-0.00148	-0.0436
Height	-0.0121	0.0349	0.0228
Body mass index	-0.0340	0.0245	-0.00950
Mental well-being	-0.0251	0.0163	-0.00880
Decision-making	0.00346	0.00754	0.0110
Employment	0.116	0.173	0.289
Support in chores	0.0779	0.0137	*0.0916*
Perceived support	-0.156	0.0496	-0.106

Notes: Regression coefficients depicted in the table are unstandardized.
Italicized regression coefficients indicate p<0.05.

Table 4.20. Indirect associations of maternal resources for care with motor development of 12-23.9 months old children through care behaviors and HAZ in Vietnam.

Resources for care	Motor development (β)					
	Dietary diversity	Cleanliness	Immunization	Stimulation	Adequate care	HAZ
Education	0.0124	0.000463	*-0.0157*	*0.0329*	-0.00411	0.0125
Knowledge	*0.0212*	0.000700	0.00505	*0.0283*	0.00194	0.00777
Height	-0.000820	0.00178	-0.00226	-0.00261	-0.000530	*0.0485*
Body mass index	-0.00196	0.00138	-0.00211	-0.00882	0.00130	*0.0373*
Mental well-being	0.00666	0.000377	*0.0111*	0.00329	-0.00110	0.00897
Decision-making	0.0128	0.00296	0.0117	0.00564	0.00158	-0.0115
Employment	-0.00596	-0.0131	-0.0204	*0.157*	-0.000843	-0.00288
Support in chores	-0.00116	0.00174	-0.00176	*0.0307*	0.00161	-0.0132
Perceived support	*0.0649*	0.00808	-0.0174	*0.0832*	0.000307	-0.0276

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05.

HAZ= height-for-age z scores.

Table 4.21. Indirect associations of maternal resources for care with motor development of 12-23.9 months old children via the path of care behaviors through HAZ in Vietnam.

	Motor development (β)				
Resources for care	Dietary diversity through HAZ	Cleanliness through HAZ	Immunization through HAZ	Stimulation through HAZ	Adequate care through HAZ
Education	0.00175	0.000433	-0.00205	-0.000520	-0.00104
Knowledge	0.00298	0.000654	0.000658	-0.000446	0.000490
Height	-0.000115	*0.00167*	-0.000295	0.0000412	-0.000134
Body mass index	-0.000276	0.00129	-0.000275	0.000139	0.000327
Mental well-being	0.000937	0.000353	0.00144	-0.0000519	-0.000278
Decision-making	0.00179	0.00276	0.00153	-0.0000891	0.000399
Employment	-0.000839	-0.0122	-0.00266	-0.00247	-0.000213
Support in chores	-0.000163	0.00162	-0.000230	-0.000485	0.000407
Perceived support	0.00914	0.00755	-0.00227	-0.00131	0.0000774

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05.

HAZ= height-for-age z scores.

Table 4.22. Associations of maternal resources for care with motor development of 12-23.9 months old children in Vietnam.

Resources for care	Motor development (β)		
	Direct	Total indirect	Total
Education	0.0272	0.0370	0.0642
Knowledge	-0.0344	0.0692	0.0348
Height	-0.0110	0.0452	0.0342
Body mass index	0.0902	0.0283	0.119
Mental well-being	-0.00105	0.0317	0.0306
Decision-making	*-0.133*	0.0296	-0.103
Employment	0.717	0.0954	0.812
Support in chores	0.0306	0.0191	0.0497
Perceived support	-0.0344	0.125	0.0906

Notes: Regression coefficients depicted in the table are unstandardized.
Italicized regression coefficients indicate p<0.05.

Table 4.23. Indirect associations of maternal resources for care with language development of 12-23.9 months old children through care behaviors and HAZ in Bangladesh.

	Language development (β)					
Resources for care	Dietary diversity	Cleanliness	Immunization	Stimulation	Adequate care	HAZ
Education	0.00646	*0.0112*	0.0000444	0.00288	0.000765	0.00590
Knowledge	0.00890	*0.0203*	0.000247	-0.00345	0.00136	-0.00581
Height	0.000748	0.00154	-0.00000854	0.00149	0.000956	*0.0159*
Body mass index	-0.00159	0.00950	0.0000380	0.00158	-0.00117	*0.00935*
Mental well-being	0.000407	0.00385	-0.00000304	0.000808	0.000326	*0.00695*
Decision-making	-0.000932	-0.000990	0.00000830	0.00263	-0.00215	0.000338
Employment	-0.00990	-0.0928	0.000198	-0.00473	-0.0562	0.0397
Support in chores	0.00459	0.00388	-0.0000221	0.00428	-0.000650	0.00157
Perceived support	0.00306	*0.0875*	0.000779	0.0179	0.00847	0.00327

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had $p<0.05$.

HAZ= height-for-age z scores.

Table 4.24. Indirect associations of maternal resources for care with language development of 12-23.9 months old children via the path of care behaviors through HAZ in Bangladesh.

	Language development (β)				
Resources for care	Dietary diversity through HAZ	Cleanliness through HAZ	Immunization through HAZ	Stimulation through HAZ	Adequate care through HAZ
Education	0.000500	0.000172	0.000202	-0.0000360	0.0000379
Knowledge	0.000688	0.000311	*0.00113*	0.0000432	0.0000673
Height	0.0000578	0.0000236	-0.0000390	-0.0000187	0.0000474
Body mass index	-0.000123	0.000146	0.000173	-0.0000198	-0.0000581
Mental well-being	0.0000315	0.0000590	-0.0000139	-0.0000101	0.0000162
Decision-making	-0.0000721	-0.0000152	0.0000378	-0.0000329	-0.000106
Employment	-0.000765	-0.00142	0.000902	0.0000592	-0.00279
Support in chores	0.000355	0.0000595	-0.000101	-0.0000536	-0.0000322
Perceived support	0.000237	0.00134	*0.00355*	-0.000225	0.000420

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05.

HAZ= height-for-age z scores.

Table 4.25. Associations of maternal resources for care with language development of 12-23.9 months old children in Bangladesh.

Resources for care	Language development (β)		
	Direct	Total indirect	Total
Education	-0.0158	0.0281	0.0123
Knowledge	0.0568	0.0238	0.0806
Height	-0.0114	0.0206	0.00920
Body mass index	-0.0291	0.0178	-0.0113
Mental well-being	-0.00936	0.0124	0.00304
Decision-making	*0.0855*	-0.00128	*0.0842*
Employment	-0.358	-0.128	-0.486
Support in chores	0.0530	0.0139	0.0669
Perceived support	*-0.243*	0.126	-0.117

Notes: Regression coefficients depicted in the table are unstandardized.
Italicized regression coefficients indicate p<0.05.

Table 4.26. Indirect associations of maternal resources for care with language development of 12-23.9 months old children through care behaviors and HAZ in Vietnam.

Resources for care	Language development (β)					
	Dietary diversity	Cleanliness	Immunization	Stimulation	Adequate care	HAZ
Education	0.00920	0.000693	*-0.0107*	*0.0253*	0.00219	0.00884
Knowledge	*0.0157*	0.00105	0.00345	*0.0217*	-0.00103	0.00555
Height	-0.000608	0.00267	-0.00154	-0.00201	0.000287	*0.0349*
Body mass index	-0.00144	0.00207	-0.00147	-0.00677	-0.000679	*0.0271*
Mental well-being	0.00494	0.000565	*0.00757*	0.00253	0.000581	0.00658
Decision-making	0.00945	0.00443	0.00800	0.00434	-0.000841	-0.00819
Employment	-0.00441	-0.0196	-0.0137	*0.120*	0.000416	-0.0000516
Support in chores	-0.000859	0.00260	-0.00120	*0.0236*	-0.000855	-0.00935
Perceived support	*0.0481*	0.0121	-0.0118	*0.0639*	-0.000167	-0.0202

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had p<0.05.

HAZ= height-for-age z scores.

Table 4.27. Indirect associations of maternal resources for care with language development of 12-23.9 months old children via the path of care behaviors through HAZ in Vietnam.

	Language development (β)				
Resources for care	Dietary diversity through HAZ	Cleanliness through HAZ	Immunization through HAZ	Stimulation through HAZ	Adequate care through HAZ
Education	0.00128	0.000313	-0.00147	-0.000353	-0.000750
Knowledge	0.00218	0.000473	0.000473	-0.000303	0.000353
Height	-0.0000846	*0.00121*	-0.000211	0.0000279	-0.0000982
Body mass index	-0.000201	0.000932	-0.000202	0.0000943	0.000233
Mental well-being	0.000687	0.000255	0.00104	-0.0000352	-0.000199
Decision-making	0.00132	0.00200	0.00110	-0.0000604	0.000288
Employment	-0.000615	-0.00885	-0.00188	-0.00168	-0.000142
Support in chores	-0.000120	0.00117	-0.000164	-0.000329	0.000293
Perceived support	0.00670	0.00546	-0.00162	-0.000891	0.0000571

Notes: Regression coefficients depicted in the table are unstandardized.

Italicized regression coefficients indicate that all legs in the paths had $p<0.05$.

HAZ= height-for-age z scores.

Table 4.28. Associations of maternal resources for care with language development of 12-23.9 months old children in Vietnam.

Resources for care	Language development (β)		
	Direct	Total indirect	Total
Education	0.0402	0.0345	0.0747
Knowledge	0.0321	0.0496	0.0817
Height	-0.0478	0.0345	-0.0133
Body mass index	0.0181	0.0197	0.0378
Mental well-being	0.0459	0.0245	*0.0704*
Decision-making	-0.0603	0.0218	-0.0385
Employment	0.354	0.0695	0.424
Support in chores	-0.0787	0.0148	-0.0639
Perceived support	*0.333*	0.102	*0.435*

Notes: Regression coefficients depicted in the table are unstandardized.
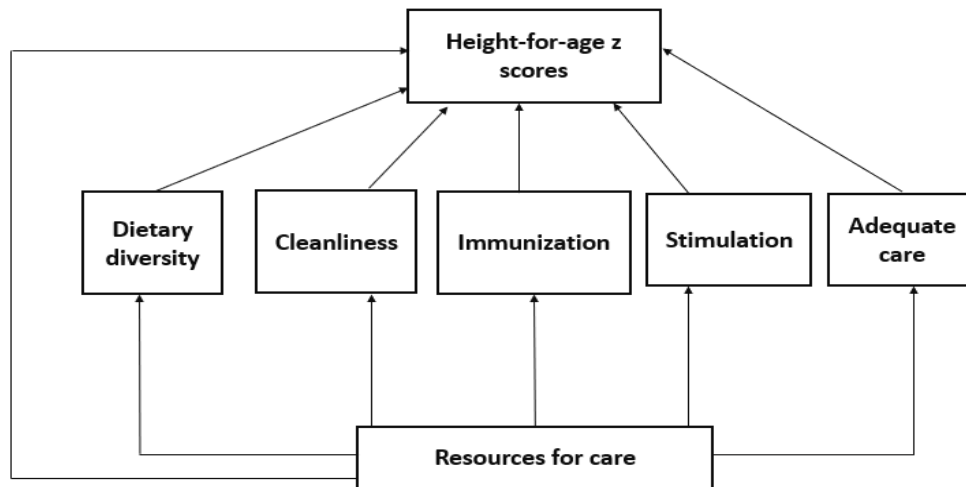Italicized regression coefficients indicate p<0.05.

Figure 4.5. Graphical presentation of the hypothesized paths through which resources for care are associated with height-for-age z scores.
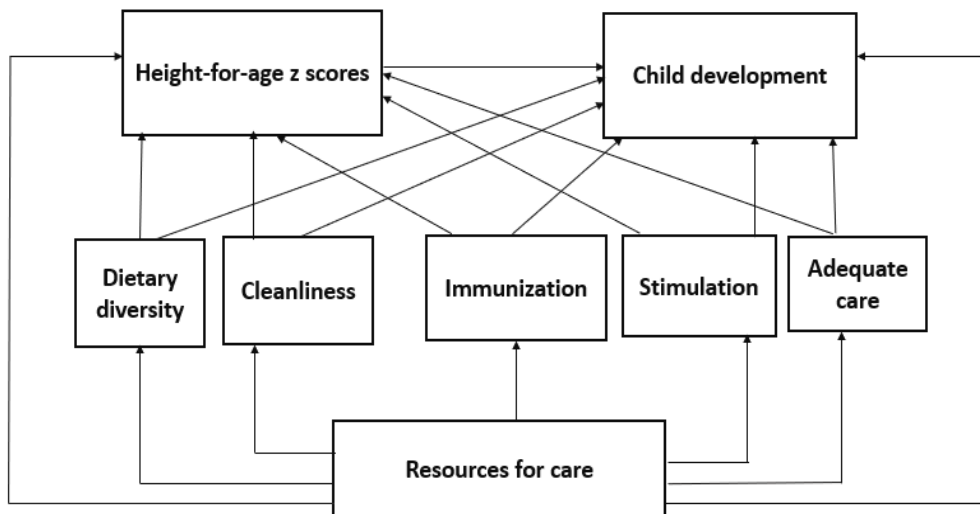

Figure 4.6. Graphical presentation of the hypothesized paths through which resources for care are associated with child development.

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CHAPTER 5

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

5.1 Summary of Major Findings

Suboptimal child growth and development are major problems in low- and middle-income countries (Black et al., 2013; Black et al., 2017; McCoy et al., 2016). Maternal resources for care such as education, knowledge, physical and mental health, autonomy, reasonable workload and availability of time, and social support may improve children's well-being (Engle et al., 1999). Resources for care can help mothers to meet needs of children by improving caregiving which may result in optimal growth and development (Britto et al., 2017; Doherty et al., 2016; Engle, 1999; Frongillo et al., 2017).

We used the Alive & Thrive baseline data that were collected in Bangladesh, Vietnam, and Ethiopia in 2010. Mothers and their < 5 years old children were included in the surveys. In the first manuscript, we examined the structure of resources for care measures which were maternal education, knowledge, height, BMI, mental well-being, decision-making autonomy, financial autonomy, reasonable workload, support in household chores, and perceived instrumental support. We also measured equivalence across contexts for the measures that were scale.

In Bangladesh, a three-factor solution best explained the structure of resources for care. In Vietnam and Ethiopia, a two-factor solution best explained the structure. First factor was associated with financial autonomy and employment in Bangladesh and Vietnam. In Bangladesh, second factor was associated with education, knowledge, BMI, mental well-being, and perceived support, and the third factor was associated with decision-making and receiving support in household chores. In Vietnam, the second factor was associated with education, knowledge, mental well-being, and perceived support. In Ethiopia, first factor had associations with decision-making autonomy, financial autonomy, and employment, and second factor had associations with education and knowledge. In general, we found that the structure of resources for care were similar across countries. Additionally, the order of the percentage of affirmative responses for the items were similar across countries. Therefore, the findings support that the measures can be used to measure and compare resources for care in low- and middle-income countries. In contrast, we also found a few differences in structure and equivalence of resources for care measures across countries. Previous research has also found contextual differences related to resources for care (Hindin, 2005; Jejeebhoy & Sathar, 2001). The differences across countries may also be due to distal factors such as socio-cultural characteristics of the geographical region and policies. For example, women's involvement in household decision-making may be influenced by ethnic identities, social relations, and patriarchal relations (Hindin, 2005; Jejeebhoy & Sathar, 2001).

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The second manuscript examined the associations of resources for care with EBF, minimum meal frequency, dietary diversity, improved drinking water source, improved sanitation, cleanliness, child immunization, psychosocial stimulation, and adequate care. All measures of resources for care were positively associated with care behaviors, but in a few cases, the associations were in the negative direction. Our findings support that improving education, knowledge, health, autonomy, availability of time, and social support among mothers would improve care received by children. In some instances, we found that the associations between resources for care and care behaviors differed across the countries. The differences could be due to the attributes other than those of mothers and families (for example, government policies, health system, and the private sector) (Britto et al., 2017; Maggi et al., 2010; Nguyen et al., 2014b). Despite some contextual variations, resources available to mothers improve the provision of time, attention, and support to children (Engle et al., 1999). Previous studies have also demonstrated that resources available to mothers are important determinants of care behaviors such as IYCF (Senarath et al., 2012), hygiene (Semba et al., 2008), heath-seeking (Abuya et al., 2011), and family care (Peter & Kumar, 2014).

The third manuscript examined the mechanisms through which resources for care had associations with child HAZ, language, and motor development. The study found that maternal resources for care are important for children's physical growth and development. Resources for care were associated with child HAZ directly, through cleanliness, and through immunization. Resources for care had associations with motor development directly and indirectly; the indirect paths were through dietary diversity,

immunization, stimulation, adequate care, HAZ, cleanliness and then HAZ, and immunization and then HAZ. We also found associations between maternal resources for care and language development through direct and indirect paths; the indirect paths were through dietary diversity, cleanliness, immunization, stimulation, HAZ, cleanliness and then HAZ, and immunization and then HAZ. The findings highlight that the interventions which promote resources among mothers have potential to impact children's growth and development. Consistent with our findings, previous research found that the improved care mediated the associations between maternal resources for care and child outcomes (Rubio-Codina et al., 2016). Provision of care to meet physical and psychosocial needs of children is considered important for ensuring optimal growth and development (Britto et al., 2017; Engle, 1999). Previous studies have also found associations between linear growth and child development (Larson et al., 2018; Olney et al., 2009). Exposure to undernutrition during early period of life may impair brain structure and neurological function (Prado & Dewey, 2014). Malnourished children are also prone to infections and lack energy which may negatively influence interactions with the environment (Brown & Pollitt, 1996). Additionally, caregivers may be less engaged with children who appear to be smaller (Larson et al., 2018).

Resources for care may influence care behaviors and child outcomes due to several reasons. Education and knowledge help mothers in better processing information, acquisition of skills, understanding their roles as a caregiver, and developing positive attitude towards modern healthcare (Engle et al., 1999; Glewwe, 1999; Wachs, 2008). Improved physical and mental health facilitate in transforming

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acquired understanding or knowledge into practice (Engle et al., 1999). Mothers with

poor health may lack energy and motivation to be involved in the caregiving

(Kulasekaran, 2012; Walker, 1997). Additionally, poor health during pregnancy can lead

to adverse pregnancy outcomes that may negatively influence growth and development

(Black et al., 2008; Kozuki et al., 2015). Autonomy among mothers helps them to make

decisions that may favor their children (Quisumbing & Maluccio, 2000; Thomas, 1990).

Additionally, women with autonomy are more likely to spend in health and nutrition as

compared to men (Carlson et al., 2015; Engle et al., 1999; Quisumbing & Maluccio,

2000). Employment may improve economic capacity among mothers, however, it may

also reduce the time for caregiving (Engle et al., 1999). Social support may enhance

caregiver's ability to provide care (Engle et al., 1999). Social support improves

information and mobilization of material resources, decreases stress, and gives a sense

of purpose in life (Evans et al., 2008; Turney, 2013; Umberson & Karas Montez, 2010).

Our research findings also suggest that provision of resources to mothers are important

for care behaviors and children's growth and development. Additionally, our findings

support that resources for care and care behaviors may vary by society and culture

(Engle et al., 1999), but all children around the world requires nurturing care to reach

their full potential of growth and development (Britto et al., 2017; Engle et al., 1999).

5.2 Limitations

The study may not be generalizable to high-income countries as the contexts of

high-income countries may be different than our study settings. For example,

governmental policies, child-care services, and preschool programs may be different in

high-income countries than low- and middle-income countries. Some of our data were collected by reporting from mothers; measures were taken to reduce the chances of biases (for example, training to the data collectors, use of reliable and valid instruments). We lacked data on time spent by mothers on work and leisure; therefore, we used maternal employment as a proxy for workload. Additionally, we used cross-sectional data which may not allow us to draw causal inferences. Although we accounted for the potential conditions that may influence care behaviors, child growth, and development, other conditions can influence care behaviors and child outcomes (for example, father's knowledge). Additionally, there may be joint influence of causation and selection (Miech et al., 1999). Furthermore, the associations between resources for care and child outcomes may be explained by other paths than those included in our research (for example, childhood illnesses).

5.3 Conclusion, Implications, and Recommendations

Suboptimal growth and development are global health problems with higher prevalence in low- and middle-income countries. Appropriate care behaviors can help to achieve optimum growth and development, however, lack of resources for care may hinder the provision of care.

In general, the structures of resources for care were similar across countries. We also found that the order of the percentage of affirmative responses for the items were similar across countries, but a few differences also existed. The scales used to measure resources for care also had a high internal consistency. Our findings support that the

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scales can be used to measure and compare resources for care in low- and middle-income countries.

Our research also found associations between resources for care with feeding, hygiene, health-seeking, and family care practices. Our findings show that strengthening resources among mothers are important for ensuring appropriate care behaviors. We also found associations between resources for care and children's growth and development through direct and indirect paths. Care behaviors mediated the associations of maternal resources for care with children's growth and development. Physical growth of children also partially explained the associations of resources for care with children's development. Our findings highlight that interventions to strengthen resources among mothers may have positive impact on children's growth and development.

Future studies that examine the structure and equivalence of resources for care in other settings are warranted. This may help to develop the contextually sensitive and robust instruments to measure and compare resources for care. Research that examine the association of other types of resources for care like emotional support, with care behaviors and child outcomes, may increase our understanding about the role of resources for care in improving care and child outcomes. Future research to understand other potential mechanisms (for example, childhood illnesses, prenatal conditions, and receiving minimum number of meals) through which maternal resources for care may be associated with children's growth and development is recommended. Additionally, further research is needed to examine the effects of maternal resources for care on

other child outcomes like socioemotional development. Qualitative studies may provide deeper understanding on the differences in the findings across countries. Furthermore, longitudinal studies may provide evidence on causal associations of resources for care with care behaviors and child outcomes.

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