# Examination of the associations between indices of caregiver capabilities on infant and young child feeding practices and nutrition status

Courtney Davis

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Scott Ickes

Michelle Averill

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## Abstract

Examination of the associations between indices of caregiver capabilities on infant and young child feeding practices and nutrition status

Courtney Davis

Chair of the Supervisory Committee:
Scott Ickes
Nutritional Sciences Department

**Background:**

Undernutrition in children is a leading underlying cause of child death globally. Previous research has shown that inappropriate or suboptimal infant and young child feeding practices (IYCF) play an essential role in the development of undernutrition. Implementing the IYCF correctly significantly decreases the likelihood of a child being malnourished. However, many low and middle-income countries fall short in implementing these nutrition recommendations. One theory as to why IYCF practices are not being implemented appropriately is related to caregiver capabilities. The purpose of this study is to investigate the relationship between

caregiver capabilities and IYCF practices and nutrition outcomes in children across the East and Southern Africa region. We hypothesize that greater presence of caregiver capabilities—measured as a decision-making domain, bodily integrity domain, and overall capability index—will be associated with a decreased stunting and wasting incidence and will be positively associated with mother's IYCF practices.

**Methods:**

We used cross-sectional data from the 13 nationally-representative Demographic and Health Surveys (DHS) from the East and Southern regions of Africa that met inclusion criteria. Nutrition status was assessed by indicators of stunting (length-for-age Z-score < -2) and wasting (weight-for-length Z-score < -2) using the 2006 WHO Multicentre Growth References Study values. IYCF dependent indicators included exclusive breastfeeding (EBF), minimum meal frequency (MMF), minimum diet diversity (MDD), and minimum acceptable diet (MAD). Two domain-specific scales, bodily integrity and decision-making, as well as an overall caregiver capabilities scale were developed by a multi-step approach. We explored the country-specific association between each independent variable (bodily integrity, decision making, and overall capability scales) and each dependent variable (IYCF and nutrition outcomes) using separate adjusted logistic regression models. After obtaining disaggregated estimates for each country, and each domain, the beta coefficients were entered into separate meta-analyses to obtain odds ratios pooled across countries for the associations between bodily integrity, decision making, and overall capability scales and IYCF and nutrition outcomes.

**Results:**

Among individual countries, decision-making was found to be the domain with the most significant associations with IYCF practices. When all countries were combined, we discovered

a positive association between the bodily integrity domain, decision-making domain, and overall caregiver capabilities index with all measured indices of IYCF. Greater presence of caregiver capabilities was also negatively associated with stunting incidence between all countries.

**Conclusion:**

Based upon our results, greater presence of caregiver capabilities positively influences child health. Efforts to strengthen capabilities among mothers may result in the implementation of recommended IYCF practices and reduction in undernutrition. Our findings contribute to the understanding of previously under measured social variables identified as influencers of caregiver capabilities. The continued enrichment of this particular field of maternal health provides opportunities for further research, programs, policies, and other intervention strategies.

## Introduction

Undernutrition in children is a leading underlying cause of child death globally, responsible for approximately 3 million deaths among children under five years annually.[1,2] Undernutrition may cause irreversible physiological damage that results in alterations of physical growth and brain development. The lasting effects of these alterations include increased susceptibility to infections, decreased learning capacity, and loss of productivity.[3] Undernutrition presents as low height for age (stunting), low weight for height (wasting), low weight for age (underweight), or micronutrient deficiencies.[4] Approximately 1,171 million children are stunted (height-for-age Z score < -2), with the vast proportion in low or middle-income countries.[5] Despite a global reduction from 32.7% to 22.9% over 26 years, the stunting prevalence in East and Southern Africa remains high at 34.5%, translating to 56.8 million stunted children.[2,6]

Inappropriate or suboptimal infant and young child feeding practices (IYCF) play an essential role in undernutrition.[7] As part of a global strategy for improving child nutrition through improved feeding, the WHO defines eight primary indicators to provide an assessment at the population level for dietary adequacy, and to serve as a yardstick for monitoring nutritional behaviors over time at a population level.[8] Implementing the IYCF correctly significantly decreases the likelihood of a child being malnourished.[9] Many low and middle-income countries fall short in implementing these nutrition recommendations.[10] One theory as to why IYCF practices are not being implemented appropriately is related to caregiver capabilities.

Caregiver capabilities have been previously defined by Martin et al., as the factors that modify a caregiver's ability to care for a child in a way that produces positive nutrition, health, and development outcomes.[11] A caregiver can be any person who provides basic needs such as food, and responsive care to a child. Females historically and currently are the predominate

caregivers worldwide.[12] Martin et al. developed a framework which identifies caregiver capabilities as a pathway through which interventions can work or the avenue by which caregivers leverage interventions to change caregiving behaviors. In this capacity, mothers with strong capabilities can convert meager material or conceptual resources into relatively high child health outcomes. Whereas, mothers that have access to the same resources but lack strong capabilities will be unable to yield the same health outcomes.[11]

Martin et al. proposed five primary constructs of capabilities that are relevant to child health and nutrition; 1) social support, 2) decision-making ability, 3) positive mental health, 4) adequate time sufficiency, and 5) positive bodily integrity.[11] These constructs can indirectly alter the implementation of child feeding practices.[11] Social support is considered the information or presence of relationships that lead a mother to feel that she is cared for, esteemed, and a valued member of her community.[14] When a mother feels supported, she is more likely to provide her child a diverse diet.[15] Decision-making is directly related to a woman's level of empowerment. Women's empowerment refers to the ability to influence economic, socio-cultural, familial, interpersonal, and legal decision making. Mothers who lack empowerment have been found to be less likely to implement appropriate breastfeeding and complementary feeding practices.[9,15] This may be related to an inability to express their wishes and opinions on child rearing. Psychological distress may lessen a mother's ability to react to the physical or emotional needs of her child. In relation to feeding practices, this blunted connection may result in decreased incidence of breastfeeding or complementary foods intake.[16,17] Time sufficiency refers to the minimal amount of time required to complete a task. Many mothers are not only charged with child rearing but must also focus on provisioning the household. As the list of daily tasks a caregiver must complete increases, the amount of time that a caregiver can dedicate towards

feeding their child diminishes.[18] Bodily integrity refers to a woman's personal autonomy and ability to make decisions for her own body. This sense of bodily integrity is threatened when a woman experiences physical, emotional, or sexual intimate partner violence (IPV). Women who have experienced IPV have been found to initiate inappropriate complementary feeding practices and are less likely to exclusively breastfeed.[17,19] However, when a mother does exhibit all five of the constructs of capabilities, she is more responsive to her child. This mother is then more likely to meet multiple IYCF indicators[15] and have a child who is well-nourished.

The purpose of this study is to investigate the relationship between caregiver capabilities and IYCF practices and nutrition outcomes in children across the East and Southern Africa region. We hypothesize that greater presence of caregiver capabilities—measured as a decision-making domain, bodily integrity domain, and overall capability index— will be associated with a decreased stunting and wasting incidence. We also hypothesize that evidence of enabled capabilities will be positively associated with mother's IYCF practices.

## Methods

### *Data Source and Sampling*

We used cross-sectional data from the 13 nationally-representative Demographic and Health Surveys (DHS) from the East and Southern regions of Africa that met inclusion criteria. We defined the East and Southern Africa region according to the UNICEF regional definition.[20] Inclusion criteria was 1) having a survey fielded between August 2010 and February 2016, and 2) having data on indices of maternal capabilities, child nutrition status, and IYCF practices. Based on these inclusion criteria, our analysis contained 13 countries: Burundi, Comoros, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe. Analyses included all women of reproductive age (ages 15-49) who had at least

one child between ages 0-24 months. To be included in the analysis, children were required to be residing in the household; if mothers had more than one child, the youngest child in the household was the child included in the analyses.

***Primary Dependent Variables***

Nutrition status was assessed by indicators of stunting (length-for-age Z-score < -2) and wasting (weight-for-length Z-score < -2) using the 2006 WHO Multicentre Growth References Study values.[21]

Four of the seven IYCF indicators were chosen for this study based on previous studies showing that the four indicators have substantial influence on child nutrition status.[9,15,18,22,23] IYCF dependent indicators included exclusive breastfeeding (EBF), minimum meal frequency (MMF), minimum diet diversity (MDD), and minimum acceptable diet (MAD). These variables were created using data from the 24-hour recall of foods/food groups available in DHS. EBF, a binary variable, was defined as the proportion of infants 0-5 months of age who were fed exclusively with breast milk.[24] MFF, a binary variable, was defined as the proportion of breastfed and non-breastfed children aged 6-23 months who received solid, semi-solid, or soft foods the minimum number of times or more the previous day. The minimum number of times is classified as 2 times for breastfed infants aged 6-8 months, 3 times for breastfed children aged 9-23 months, and 4 times for non-breastfed children aged 6-23 months.[24] MDD, a binary variable, was defined as the proportion of children 6-23 months of age who received 4 or more of the following food groups: grains, roots, and tubers; legumes and nuts; dairy products (milk, yogurt, cheese); flesh foods (meat, fish, poultry, liver/organ meats); eggs; vitamin-A rich fruits and vegetables; and other fruits and vegetables. MAD, a binary variable, was defined as the proportion of children aged 6-23 months who received a minimum acceptable diet. For breastfed

children, MAD was defined as those who received MDD and MMF. For non-breastfed children, MAD was defined as those who received at least 2 milk feedings, MDD not including milk feeds, and MMF.[24]

***Primary Independent Variables***

Initially, we chose to evaluate four of the five constructs of caregiver capabilities that previous studies have shown to influence child nutrition status and IYCF practices: bodily integrity, decision making, time sufficiency, and social support. First, each response variable was categorized into a dichotomous variable with 1 indicating higher empowerment and 0 indicating lower empowerment. Second, related response variables were summed to develop a continuous scale for each domain (further described below). To develop the continuous scales, we employed a multi-step approach. Items were first selected for the domain-specific scales through the sequential elimination of the least reliable items by way of a principal components analysis (PCA). We then utilized scree plots to identify the number of substantially important factors in the subscale. Next, we used an eigen value plot to identify the primary items involved with the most important factors for each scale. Finally, we calculated Cronbach's alpha to examine the impact of eliminating the least reliable items on the internal consistency of the scale.

*Bodily Integrity.* Two of the 9 items (respondent is afraid of husband, respondent forced to perform sexual acts) were removed from the bodily integrity scale to create a 7-item scale. Items included in the scale examined the respondent's opinion of: 1) beating or hitting justification by husband if she goes out without obtaining husband's permission 2) beating or hitting justification by husband if she neglects the children 3) beating or hitting justification by husband if she argues with him 4) beating or hitting justification by husband if she burns food when cooking 5) beating or hitting justification by husband if she refuses to have sex 6) sex

refusal justification if husband is involved with other women 7) asking husband to use a condom if he has a sexually transmitted infection (STI). We then divided the scale (ranging from 0 – 7) into quintiles and bodily integrity was modeled as a 5-category variable to ensure equal distribution of respondents for analysis.

*Decision Making.* Two of 8 items (primary decision maker for respondent's earnings and contraception use) were removed from the decision-making scale to create a 6-item scale. Items included in the scale examined the respondent's ability to make the final decision regarding 1) her own health care 2) visits to family or relatives 3) use of husband's earnings 4) large household purchases 5) timing of pregnancy; and 6) if respondent needed to obtain permission from husband to seek healthcare. We then divided the scale (ranging from 0 – 6) into quintiles and decision making was modeled as a 5-category variable to ensure equal distribution of respondents for analysis.

*Caregiver Capabilities.* After conducting the PCA for the time sufficiency and social support domains, we determined that there were an insufficient number of variables to generate reliable individual scales. Therefore, we developed an overall capabilities index that combined variables from all four domains identified a priori to generate a robust 18-item scale of caregiver capabilities. The overall capabilities index included the following domains: 1) bodily integrity, 2) decision-making, 2) respondent's marital status 3) if respondent is residing with her husband or partner 4) number of children residing at home 5) time it takes to obtain water; and 6) employment status. We then divided the scale (ranging from 0-18) into quartiles and caregiver capabilities index was modeled as a 4-category variable to ensure equal distribution of respondents for analysis.

***Confounders***

Confounding factors were identified a priori using a directed acyclic graph (DAG). The DAG was used to identify variables based on both theorized and documented relationships between study's primary independent (maternal agency) and dependent variables (child nutrition outcomes). In all models, confounders included maternal education (< primary school, ≥primary school), maternal age at first pregnancy (first birth ≤ 17 years of age, first birth ≥ 18 years of age), wealth status, and child morbidity (presence of diarrhea or fever in the last two weeks).

***Statistical Analysis***

*Within Country Analysis*. First, we explored the country-specific association between each independent variable (bodily integrity, decision making, and overall capability scales) and each dependent variable (IYCF and nutrition outcomes) using separate adjusted logistic regression models.

*Between Country Analysis.* After obtaining disaggregated estimates for each country, and each domain, the beta coefficients were entered into separate meta-analyses to obtain odds ratios pooled across countries for the associations between bodily integrity, decision making, and overall capability scales and IYCF and nutrition outcomes.

Tanzania did not have a domestic violence module so was excluded from the within- and between-country analyses examining the bodily integrity domain and overall capabilities index.

In all models, sample weights were used to account for the cluster sampling design of the DHS data. Alpha was set to 0.05. Analyses were performed using Stata 12.1 (StataCorp LP, College Station, Texas). No institutional review board review was obtained as all analyses used secondary data.

## Results

Overall, average child age was 11.3 months (standard deviation [SD]=6.7) (Table 1). Among children 0-24 months of age, 19.7% of children were stunted and 6.1% were wasted. Among children ages 0-6 months of age, 47.0% were exclusively breastfed. Among children ages 6-23 months of age, 38.7% met requirements for MMF, 17.1% met requirements for MDD, and 6.9% achieved MAD (Table 1). The sample size of models varied based upon the number of children that met criteria for predetermined IYCF indices and mothers with complete DHS questionnaires (Table 2).

***Within-Country Analyses***

*Stunting among children ages 0-24 months of age*

In the majority of countries, caregiver capabilities were not significantly associated with stunting among children aged 0-24 months. However, the associations in Zimbabwe deviated from this general trend. As detailed in Table 3, in Zimbabwe, bodily integrity was associated with lower odds of stunting (OR = 0.91 95% CI: 0.82,1.00). Similarly, in Zimbabwe, decision-making (OR = 0.86, 95% CI =0.75, 0.98) and the overall capabilities index (OR = 0.85, 95% CI =0.73, 0.99) was associated with significantly lower odds of stunting (Tables 4 and 5).

*Wasting among children 0-24 months of age*

Similarly to stunting, caregiver capabilities were not significantly associated with wasting among children aged 0-24 months. However, the associations in Zambia not only deviated from the general trend but had conflicting associations between domains. In Zambia, bodily integrity (OR=0.91, 95% CI=0.93, 0.99) and the overall capabilities index (OR=1.02, 95% CI=0.89, 1.18) was associated with lower odds of wasting. On the contrary, higher levels of decision-making were associated with significantly higher odds of wasting (OR= 1.23, 95% CI= 1.10, 1.37) in

Zambia (Table 4). Higher levels of caregiver capabilities were associated with lower odds of wasting in Uganda (OR =0.67; 95% CI= 0.48, 0.94) (Table 5).

*Exclusive breastfeeding among children 0-5 months of age*

Higher levels of decision-making were associated with lower odds of EBF in both Kenya (OR=0.86, CI=0.75, 0.99) and Namibia (OR=0.71, 95% CI=0.54, 0.93) (Table 4). In Uganda, higher levels of bodily integrity were also associated with lower odds of EBF (OR=0.86; 95% CI=0.74, 0.99).

In Comoros, higher levels of bodily integrity (OR=1.69; 95%CI= 1.08, 2.63) and overall caregiver capabilities index (OR=1.56, 95% CI=1.03, 2.36) was significantly associated with higher odds of EBF. Higher levels of the caregiver capabilities index were also associated with higher odds of EBF in Rwanda (OR=1.27; 95% CI=1.00, 1.62).

*Minimum meal frequency among children 6 to 23 months of age*

Overall, caregiver capabilities were associated with higher odds of MMF among children aged 6-23 months. Bodily integrity had the most significant associations among the tested domains. Higher levels of bodily integrity were associated with higher odds of MMF in Namibia (OR=1.20; 95% CI=1.04, 1.39) and Uganda (OR=1.09; 95% CI=1.00, 1.20). In Mozambique (OR=1.16, 95%CI=1.06, 1.27) and Zambia (OR=1.09; 95%CI=1.03, 1.16) higher levels of bodily integrity were significantly associated with increased odds of MMF. On the contrary, higher levels of bodily integrity were associated with lower odds of MMF in Burundi (OR=0.90; 95% CI=0.84, 0.97). In Rwanda, increased decision-making capability (OR=1.14; 95% CI=1.05, 1.23) and increased levels of the caregiver capabilities index (OR=1.14; 95% CI=1.04, 1.25) was associated with higher odds of MMF. In Zambia, increased levels of the caregiver capabilities index were also associated with higher odds of MMF (OR=1.09; 95% CI=1.00, 1.19).

*Minimum diet diversity among children 6-23 months of age*

In the majority of countries, caregiver capabilities were associated with higher odds of MDD in children aged 6-23 months. However, Burundi and Comoros deviated from this general trend. In Burundi, higher levels of bodily integrity (OR=0.88; 95% CI=0.77, 0.99) was associated with lower odds of MDD while in Comoros (OR=0.83; 95% CI=0.70, 0.99) was associated with lower odds of MDD. However, higher levels of decision-making were associated with higher odds of MDD in Mozambique (OR=1.15; 95% CI=1.06, 1.26), Namibia (OR=1.27; 95% CI=1.05, 1.53), and Zimbabwe (OR=1.18; 95% CI=1.03, 1.36). There were no significant associations between the caregiver capabilities index and MDD.

*Minimum acceptable diet among children 6-23 months of age*

In the majority of countries, caregiver capabilities were associated with higher odds of MAD among children aged 6-23 months. In Namibia, higher levels of decision-making were associated with higher odds of MAD (OR=1.47; 95% CI=1.05, 2.07). Additionally, higher decision-making capability had highly significant higher odds of MAD in Mozambique (OR=1.18; 95%CI=1.06, 1.32) and Tanzania (OR=1.17; 95% CI=1.05, 1.31).

***Between-Country Analyses***

*Stunting among children ages 0-24 months of age*

Between all countries, the bodily integrity domain (OR=0.99, 95% CI=0.96, 1.91), decision making domain (OR=0.99; 95%CI= 0.97, 1.02), and overall maternal capabilities index (OR=0.98; 95% CI=0.94, 1.01) showed a non-significant negative association with stunting prevalence. (Table 6)

*Wasting among children ages 0-24 months of age*

As described in Table 6, neither bodily integrity (OR=0.97; 95% CI=0.92, 1.01) nor overall capabilities (OR=0.99; 95% CI=0.93, 1.05) were associated with odds of wasting. Higher decision-making capabilities were associated with non-significantly higher odds of wasting (OR=1.01, 95%CI=0.95, 1.07). (Table 6)

*Exclusive breastfeeding among children 0-5 months of age*

Neither bodily integrity (OR =1.01; 95% CI=0.96, 1.07), decision making (OR=1.01; 95% CI = 0.96, 1.07), nor overall maternal capabilities (OR = 1.02; 95% CI = 0.94, 1.11) were significantly associated with higher odds of EBF in any country. (Table 6)

*Minimum meal frequency among children 6-23 months of age*

Among all countries, caregiver capabilities were associated with higher odds of MMF among children aged 6-23 months. Higher bodily integrity capabilities were associated with higher odds of MMF among children aged 6-23 months (OR = 1.05; 95% CI = 1.01, 1.10). Higher decision-making capabilities were associated with higher odds of MMF (OR= 1.04; 95% CI = 1.01, 1.07). Higher overall maternal capabilities were associated with higher odds of MMF (OR = 1.05; 95% CI = 1.02, 1.09). (Table 6)

*Minimum diet diversity among children 6-23 months of age*

Neither bodily integrity (OR =1.01; 95% CI =0.98, 1.04), decision making (OR =1.04; 95% CI =0.99, 1.08), and overall maternal capabilities (OR =1.01; 95% CI = 0.97, 1.05) were significantly associated with higher odds of MDD. (Table 6)

*Minimum acceptable diet among children 6-23 months of age*

Bodily integrity (OR=1.04; 95%CI= 0.99, 1.08) and maternal capabilities (OR=1.03; 95% CI= 0.98, 1.09) were non-significantly associated with higher odds of MAD. However,

higher decision-making capability was highly significantly associated with higher odds of minimum acceptable diet (OR =1 1.05, 1.14) (Table 6).

## Discussion

The capabilities approach applied to child growth and feeding provides a novel framework for identifying areas where resources for mothers can be strengthened to enable healthier child diets and caregiver practices to support health growth.[11,13] Caregiver capabilities have the potential to modify IYCF practices and ultimately child nutrition status in both beneficial and negative ways. When all countries were combined, we discovered a positive association between bodily integrity domain, decision-making domain, and overall caregiver capabilities with all measured indices of IYCF. However, the domains only held significance for MMF and MAD. For each step increase in the bodily scale domain and caregiver capabilities index, mothers were 1.05 times more likely to feed their children the minimum number of recommended meals daily. Mothers with increased decision-making capability were 1.04 times more likely to meet MMF standards and 1.09 times more likely to meet MAD.

Decision-making was found to be the domain with the most significant associations with IYCF in individual countries. Women in Mozambique and Tanzania were over 1.1 times more likely to meet MAD standards whereas women in Namibia were 1.5 times more likely to meet MDD with each step increase in the decision-making scale. The women of Mozambique and Namibia were also found to be over 1.1 times more likely to meet MDD. Women in Zimbabwe and Rwanda with greater decision-making abilities were more likely to meet MDD and MMF respectively. These results were consistent with previous findings that empowered women are more likely to implement appropriate complementary feeding practices.[9,15] However, our results were not consistent with previous implications that increased decision-making capacity is

associated with improved rates of exclusive breastfeeding.[9,15] We discovered that women in Kenya and Namibia were 14% and 29%, respectively, less likely to exclusively breastfeed with each increase in the decision-making scale. There are several possibilities as to why women with higher empowerment many not choose to follow breastfeeding recommendations. For one, empowerment could be associated with increased wealth index. In some societies, formula feeding is seen as a symbol of surpassing poverty. Therefore, women of middle or upper income may choose to formula feed over breastfeed. Additionally, women are taught cultural or social beliefs regarding breastfeeding practices by their families and members of the community. Mothers have noted influence by prominent members in their community to be a significant determinant as to why they terminated breastfeeding early and introduced children to solid foods at a younger age.[10]

We had mixed findings regarding bodily integrity's influence on IYCF among individual countries. Women in Mozambique, Namibia, Uganda, and Zambia with higher bodily integrity provided their children the recommended number of minimum meals daily. However, women in Burundi with higher bodily integrity were 10% less likely to meet MMF. Higher bodily integrity was also associated with decreased likelihood of EBF and MDD in Uganda and Namibia, respectively. Although, with each step increase in bodily integrity women in Comoros were 1.7 times more likely to exclusively breastfeed. The mixed results may be related to the role of intimate partner violence's effects on a woman's psychological welfare. It is thought that IPV could result in negative or positive coping behaviors. For example, a woman that has experienced sexual IPV may have negative connotations with her breasts and therefore be less likely to breastfeed.[17] On the other hand, victims of IPV may be more cognizant of their child's needs and practice optimal feeding behaviors.[17,19]

Among individual countries, the overall caregiver capabilities index had the least amount of significant findings with IYCF practices. Women in Rwanda and Zambia both showed an increased likelihood of MMF with each step increase in caregiver capabilities. Women in Rwanda were also 1.3 times more likely to exclusively breastfeed while women in Comoros were 1.6 times more likely with each step increase in caregiver capabilities. The decreased amount of significant results may be attributable to the large number of variables included in the index. Not only were the variables that comprised the decision-making and bodily integrity domains included in the composite index, variables examining social support and time sufficiency were added as well. Social support and time sufficiency have been found to be significant influences on the implementation of appropriate child feeding practices. In Western Kenya, mothers with spousal or familial support were twice as likely to provide minimum diet diversity and adequate diet to their children.[25] Additionally, women with strong social support are less likely to initiate inappropriate complementary feeding practices.[10] Other tasks such as procuring water and caring for other children have also been noted as burdens towards appropriate nutrition practices.

We hypothesized that strong caregiver capabilities would be associated with decreased incidence of stunting and wasting. We found a small, though non-significant, protective effect among the decision-making domain, bodily integrity domain, and overall caregiver capabilities index on stunting prevalence between all countries. Among individual countries, Zimbabwe was the only country that showed a significant reduction in stunting prevalence among all 3 independent variables. However, this pattern was not observed with wasting incidence. Within the bodily integrity domain and overall capabilities index, only half of the individual countries showed a protective effect against wasting incidence. In fact, women in Zambia were 1.23 more

likely to have a child who was wasted if they expressed higher decision-making ability. On the other hand, the same population of women were 9% less likely to have a child who was wasted if they expressed increased bodily integrity. Uganda showed the largest decrease in wasting prevalence with a 33% decrease in wasting prevalence for each step increase in the caregiver capabilities index. At first, the variation in findings seems surprising as we anticipated that empowered women have the authority to use resources and make healthcare related decisions, such as child feeding practices, that would result in a reduction in stunting and wasting. Yet the variation may be an indication that in some areas empowered women may not have the means to access these resources. If a woman experiences financial or transportation constraints, no amount of self-efficacy will be enough to change their situation.

To our knowledge, this is the only study that examines the relationship between a composite scale of decision-making ability, bodily integrity, and an in-depth caregiver capability index on child nutrition outcomes and IYCF practices. We used a large and nationally-representative sample that strengthened our results. However, we were limited by the type of data we used in this study. Firstly, the cross-sectional study design does not allow us to draw conclusions about cause and effect. While we did find positive outcomes with increased caregiver capabilities, we cannot conclude that these domains have a direct influence on our primary outcomes. Additionally, the IYCF outcome indicators were based upon a 24-hour dietary recall. This form of measurement allows for potential errors. For example, a mother may over-report consumption of "appropriate" foods and under-report consumption of "inappropriate" foods. Further, a mother may not recall everything her child consumed the day before. Combined, this introduces the possibility that our results could be positively skewed. Furthermore, we were limited in our domain scale creation due to the type of questionnaires used

in the DHS survey. The variables that comprised our primary outcomes were based on a selection of standardized questions. Although we generated reliable scales for the decision-making and bodily integrity domains, there were not enough variables from the DHS survey to create individual domains for time sufficiency and social support. While it would have been preferable to generate a new survey, our results remain valid as these domains were reflected in our overall caregiver capabilities index.

## Future Implications

Our study supports previous research that has shown improved nutrition status and child feeding practices with increased caregiver capabilities. Martin et al. postulated that caregiver capabilities may be the means by which mothers leverage resources to produce optimal child health outcomes. We must then take this concept to develop interventions that enhance a mother's capabilities. Based on our findings, interventions should focus on improving women's decision-making abilities and positive bodily integrity. The primary focus of these interventions should be on promotion of maternal education. It is well documented that advances in maternal education are related to improved IYCF and nutrition outcomes. Further, maternal education is positively associated with empowerment and increased decision-making capability. Therefore, it is reasonable to assume that improvements in maternal education will lead to increased decision-making ability. All proposed interventions should include a component designed to promote emotional and physical support for mothers. It has been found that when mothers have a strong support system, they are more likely to implement appropriate child feeding practices.[23,25] When a mother has physical support for daily tasks, such as fetching water or conducting household chores, she is provided with more freedom. Physical support then grants the mother additional time that can be used towards the care of her child. Emotional support has been found to

decrease the occurrence of maternal psychological stress.[16] If a mother is experiencing mental distress, it is unlikely she will be able to focus her attention solely on her child. The ability to confide in another or to seek emotional comfort may improve the mother's well-being allowing her to be more sensitive to her child's needs.

In the future, it would be beneficial to conduct qualitative studies to identify additional barriers and factors that influence caregiver capabilities. These qualitative analyses should include individualized questions that expand upon the variables we included in our decision-making, bodily integrity, and caregiver capabilities index. For example, we did not differentiate between different forms of intimate partner violence in our study. Instead, we combined all answers related to violence from the DHS questionnaire into one bodily integrity scale. Therefore, questions could explore how sexual, emotional, and physical violence individually influence IYCF and nutrition outcomes.

## Conclusions

Caregiver capabilities influence child health and well-being. Efforts to strengthen capabilities among mothers may result in the reduction of undernutrition and implementation of recommended IYCF practices. Our findings contribute to the understanding of previously under measured social variables identified as influencers of caregiver capabilities. The continued enrichment of this particular field of maternal health provides opportunities for further research, programs, policies, and other intervention strategies.

## Tables

Table 1- Demographic factors, Infant and Young Child Feeding Practices, and Nutritional Status of the study population

| **Child age** | Number | Percent |
|---|---|---|
| 0 to 5 months | 11,619 | 25.07% |
| 6 to 11 months | 12,186 | 26.30% |
| 12 to 17 months | 12,170 | 26.26% |
| 18 to 24 months | 10,365 | 22.37% |
| Mean child age (months) +/- SE | 11.3 +/- 6.7 | (4.59, 17.95) |
| | | |
| **Nutrition Status among children 0 to 24 months** | | |
| Prevalence of underweight (Weight-for-age Z-score <-2) | 4,559 | 9.84% |
| Prevalence of stunting (Length-for-age Z-score <-2) | 9,112 | 19.66% |
| Prevalence of wasting (Weight-for-length Z-score <-2) | 2,809 | 6.06% |
| | | |
| **Socio-demographic Factors** | | |
| Adolescent Mother (age at first birth was 17 or younger) | 14,461 | 31.21% |
| Husband of respondent has multiple wives | 4,561 | 34.91% |
| Married/Living together with partner | 38,768 | 83.67% |
| Caring for 5 or more children | 8,186 | 17.67% |
| Number of children cared for by mother (mean (SE)) | 2.79 +/- 1.79 | (1.01, 4.58) |
| Number of biological children per mother-living (mean (SE)) | 3.14 +/- 2.03 | (1.10, 5.17) |
| Greater than 1 hour to reach water source | 14,774 | 31.88% |
| Access to media | 25,480 | 56.37% |
| | | |
| **Maternal Education** | | |
| None | 10,712 | 23.12% |
| Some primary/Complete primary | 23,423 | 50.54% |
| Some secondary and above | 12,195 | 26.31% |
| | | |
| **Feeding Practices** | | |
| Exclusive Breastfeeding to 6 months (0 to 6 months,) | 6,842 | 47.04% |
| Continued Breastfeeding at One Year (12-18 months) | 10,984 | 77.97% |
| Timely Introduction of Complementary Foods (6-8 months) | 4,071 | 75.36% |
| Fed Minimum Dietary Diversity (6-23 months) | 7,252 | 17.14% |
| Fed Minimum Meal Frequency (6-23 months, n=163) | 11,937 | 38.70% |
| Fed Minimally Adequate Diet (6-23 months, n=163) | 2,914 | 6.93% |

Table 2-Final Sample Size by Domain and Outcome

| Domain | Stunting | Wasting | EBF | MAD | MMF | MDD |
|---|---|---|---|---|---|---|
| Bodily Integrity | 23,827 | 24,133 | 8,955 | 26,583 | 25,057 | 26,604 |
| Decision Making | 24,780 | 25,059 | 8,908 | 25,912 | 25,375 | 25,936 |
| Maternal Capabilities Index | 19,866 | 20,120 | 7,500 | 21,869 | 21,431 | 21,884 |

[1]EBF=exclusive breastfeeding. MAD= minimum acceptable diet MMF=minimum meal frequency MDD=minimum diet diversity

Table 3- Individual Country Regression Analysis Results-Bodily Integrity

| | Stunting (HAZ < -2) | Wasting (WLZ < -2) | Exclusive Breastfeeding (0 to < 6 months) | Minimum Meal Frequency (6 to < 24 months) | Minimum Dietary Diversity (6 to < 24 months) | Minimum Adequate Diet (6 to <24 months) |
|---|---|---|---|---|---|---|
| **Burundi** | 0.95 (0.87, 1.03) | 0.93 (0.78, 1.11) | 0.99 (0.86, 1.13) | 0.90 (0.84, 0.97)** | 1.06 (0.96, 1.16) | 1.03 (0.91, 1.16) |
| **Comoros** | 0.95 (0.80, 1.11) | 1.08 (0.895, 1.29) | 1.69 (1.08, 2.63)* | 0.92 (0.78, 1.08) | 1.09 (0.93, 1.28) | 0.78 (0.56, 1.098) |
| **Ethiopia** | 0.98 (0.91, 1.06) | 0.92 (0.83, 1.02) | 1.04 (0.91, 1.19) | 1.05 (0.96, 1.16) | 1.07 (0.88, 1.297) | 1.07 (0.86, 1.33) |
| **Kenya** | 0.96 (0.88, 1.05) | 0.99 (0.86, 1.13) | 0.93 (0.799, 1.09) | 1.05 (0.97, 1.13) | 1.00 (0.92, 1.09) | 1.02 (0.92, 1.13) |
| **Lesotho** | 0.94 (0.77, 1.14) | 1.18 (0.85, 1.65) | 1.18 (0.92, 1.52) | 1.10 (0.94, 1.27) | 0.91 (0.77, 1.08) | 0.99 (0.77, 1.27) |
| **Malawi** | 0.97 (0.86, 1.09) | 1.08 (0.82, 1.43) | 1.04 (0.92, 1.18) | 1.5 (0.97, 1.13) | 1.00 (0.92, 1.09) | 1.06 (0.93, 1.21) |
| **Mozambique** | 1.02 (0.94, 1.10) | 0.899 (0.79, 1.02) | 1.03 (0.87, 1.21) | 1.16 (1.06, 1.27)** | 0.96 (0.87, 1.05) | 1.03 (0.90, 1.17) |
| **Namibia** | 1.12 (0.94, 1.32) | 1.03 (0.82, 1.29) | 0.91 (0.75, 1.11) | 1.20 (1.04, 1.39)* | 0.88 (0.77, 0.99)* | 0.96 (0.74, 1.24) |
| **Rwanda** | 0.97 (0.88, 1.06) | 1.20 (0.92, 1.58) | 1.02 (0.85, 1.22) | 1.06 (0.99, 1.13) | 1.03 (0.95, 1.11) | 1.07 (0.97, 1.17) |
| **Tanzania** | *No observations* | *No observations* | *No observations* | *No observations* | *No observations* | *No observations* |
| **Uganda** | 0.94 (0.82, 1.06) | 0.90 (0.71, 1.14) | 0.86 (0.74, 0.99)* | 1.09 (1.00, 1.195)* | 1.02 (0.92, 1.14) | 1.04 (0.87, 1.25) |
| **Zambia** | 1.03 (0.98, 1.09) | 0.91 (0.93, 0.999)* | 1.02 (0.91, 1.14) | 1.09 (1.03, 1.16)** | 1.03 (0.95, 1.11) | 1.05 (0.94, 1.17) |
| **Zimbabwe** | 0.91 (0.82, 1.00)* | 1.06 (0.91, 1.22) | 1.09 (0.93, 1.29) | 1.03 (0.93, 1.14) | 0.99 (0.88, 1.11) | 1.03 (0.83, 1.29) |

Table 4- Individual Country Regression Analysis Results-Decision-Making

| | Stunting (HAZ < -2) | Wasting (WLZ < -2) | Exclusive Breastfeeding (0 to < 6 months) | Minimum Adequate Diet (6 to <24 months) | Minimum Meal Frequency (6 to < 24 months) | Minimum Dietary Diversity (6 to < 24 months) |
|---|---|---|---|---|---|---|
| **Burundi** | 0.96 (0.87, 1.06) | 0.94 (0.79, 1.11) | 0.99 (0.86, 1.14) | 1.08 (0.96, 1.23) | 1.09 (0.999, 1.18) | 1.00 (0.92, 1.09) |
| **Comoros** | 1.05 (0.92, 1.198) | 0.97 (0.82, 1.14) | 1.18 (0.89, 1.57) | 1.17 (0.83, 1.65) | 1.11 (0.97, 1.28) | 0.83 (0.70, 0.99) * |
| **Ethiopia** | 1.05 (0.96, 1.16) | 1.05 (0.95, 1.15) | 1.12 (0.98, 1.27) | 1.17 (0.89, 1.54) | 1.07 (0.98, 1.16) | 1.14 (0.897, 1.46) |
| **Kenya** | 1.01 (0.92, 1.10) | 1.09 (0.91, 1.297) | 0.86 (0.75, 0.996)* | 1.09 (0.98, 1.21) | 1.05 (0.97, 1.13) | 1.05 (0.97, 1.15) |
| **Lesotho** | 1.05 (0.82, 1.33) | 0.98 (0.64, 1.52) | 1.14 (0.88, 1.48) | 1.15 (0.89, 1.49) | 0.99 (0.83, 1.18) | 0.92 (0.77, 1.095) |
| **Malawi** | 1.03 (0.94, 1.12) | 0.99 (0.82, 1.196) | 0.93 (0.84, 1.03) | 1.00 (0.90, 1.11) | 1.06 (0.999, 1.12) | 1.05 (0.98, 1.12) |
| **Mozambique** | 0.97 (0.91, 1.03) | 1.01 (0.92, 1.12) | 0.97 (0.85, 1.099) | 1.18 (1.06, 1.32)** | 0.96 (0.898, 1.02) | 1.16 (1.06, 1.26)*** |
| **Namibia** | 0.89 (0.69, 1.16) | 0.88 (0.64, 1.20) | 0.71 (0.54, 0.93)* | 1.47 (1.05, 2.07)* | 1.05 (0.87, 1.28) | 1.27 (1.05, 1.53)* |
| **Rwanda** | 0.96 (0.87, 1.08) | 0.86 (0.66, 1.11) | 1.16 (0.95, 1.41) | 1.02 (0.91, 1.14) | 1.14 (1.05, 1.23)** | 0.96 (0.87, 1.06) |
| **Tanzania** | 1.00 (0.93, 1.08) | 0.91 (0.79, 1.06) | 0.99 (0.87, 1.13) | 1.17 (1.05, 1.31)** | 0.999 (0.93, 1.07) | 1.03 (0.95, 1.12) |
| **Uganda** | 0.99 (0.85, 1.14) | 0.95 (0.77, 1.18) | 1.04 (0.92, 1.17) | 1.01 (0.82, 1.24) | 0.98 (0.91, 1.06) | 0.97 (0.86, 1.097) |
| **Zambia** | 1.00 (0.95, 1.06) | 1.23 (1.10, 1.37)*** | 1.04 (0.92, 1.18) | 1.05 (0.93, 1.19) | 1.03 (0.97, 1.09) | 1.01 (0.93, 1.09) |
| **Zimbabwe** | 0.86 (0.75, 0.98)* | 0.93 (0.76, 1.14) | 1.13 (0.93, 1.37) | 1.18 (0.92, 1.52) | 1.09 (0.95, 1.25) | 1.18 (1.03, 1.36)* |

Table 5- Individual Country Regression Analysis Results- Maternal Capabilities Index

| | Stunting (HAZ < -2) 4 CAT | Wasting (WLZ < -2) 4 CAT | Exclusive Breastfeeding (0 to < 6 months) | Minimum Adequate Diet (6 to <24 months) | Minimum Meal Frequency (6 to < 24 months) | Minimum Dietary Diversity (6 to < 24 months) |
|---|---|---|---|---|---|---|
| **Burundi** | 0.97 (0.86, 1.09) | 0.88 (0.70, 1.097) | 0.93 (0.78, 1.11) | 1.03 (0.86, 1.23) | 0.97 (0.87, 1.08) | 1.04 (0.92, 1.18) |
| **Comoros** | 0.96 (0.77, 1.19) | 1.10 (0.87, 1.39) | 1.56 (1.03, 2.36)* | 0.92 (0.57, 1.496) | 1.05 (0.85, 1.28) | 0.799 (0.63, 1.01) |
| **Ethiopia** | 0.98 (0.88, 1.10) | 0.96 (0.83, 1.11) | 1.09 (0.91, 1.31) | 1.28 (0.95, 1.72) | 1.04 (0.898, 1.2) | 1.22 (0.94, 1.596) |
| **Kenya** | 0.92 (0.81, 1.04) | 1.12 (0.92, 1.37) | 0.897 (0.70, 1.15) | 1.07 (0.92, 1.23) | 1.04 (0.94, 1.16) | 1.06 (0.94, 1.19) |
| **Lesotho** | 0.98 (0.71, 1.35) | 1.03 (0.69, 1.54) | 1.34 (0.895, 2.01) | 1.15 (0.796, 1.67) | 1.15 (0.91, 1.45) | 0.85 (0.67, 1.09) |
| **Malawi** | 1.04 (0.91, 1.19) | 0.97 (0.74, 1.27) | 0.90 (0.77, 1.06) | 0.96 (0.81, 1.13) | 1.06 (0.97, 1.16) | 1.00 (0.91, 1.11) |
| **Mozambique** | 0.997 (0.91, 1.09) | 0.97 (0.84, 1.12) | 0.98 (0.81, 1.18) | 1.09 (0.93, 1.28) | 0.98 (0.88, 1.08) | 1.07 (0.95, 1.21) |
| **Namibia** | 0.97 (0.64, 1.48) | 0.90 (0.61, 1.34) | 0.89 (0.599, 1.31) | 1.03 (0.63, 1.67) | 1.11 (0.84, 1.46) | 0.93 (0.72, 1.19) |
| **Rwanda** | 0.95 (0.83, 1.09) | 1.00 (0.71, 1.41) | 1.27 (1.00, 1.62)* | 1.02 (0.89, 1.18) | 1.14 (1.04, 1.25)** | 0.995 (0.89, 1.12) |
| **Tanzania** | *cannot calculate* | *cannot calculate* | *cannot calculate* | *cannot calculate* | *cannot calculate* | *cannot calculate* |
| **Uganda** | 0.95 (0.78, 1.15) | 0.67(0.48, 0.94)* | 0.85 (0.71, 1.03) | 0.94 (0.73, 1.22) | 1.07 (0.96, 1.19) | 1.01 (0.87, 1.18) |
| **Zambia** | 1.01 (0.94, 1.08) | 1.02 (0.89, 1.18) | 1.02 (0.88, 1.19) | 1.02 (0.87, 1.199) | 1.09 (1.00, 1.19)* | 0.96 (0.86, 1.08) |
| **Zimbabwe** | 0.85 (0.73, 0.997)* | 1.14 (0.39, 1.46) | 1.21 (0.95, 1.54) | 0.94 (0.71, 1.24) | 0.99 (0.85, 1.15) | 0.99 (0.85, 1.16) |

Table 6- Pooled Country Regression Analysis Results

| Primary Variable and Outcome | OR (CI) |
|---|---|
| **BI STUNT** | 0.99 (0.96, 1.01) |
| **BI WAST** | 0.97 (0.92, 1.01) |
| **BI EBF** | 1.01 (0.96, 1.07) |
| **BI MIN FEED FREQUENCY** | 1.05 (1.01, 1.10)* |
| **BI MDD** | 1.01 (0.98, 1.04) |
| **BI MIN ADQ DIET** | 1.04 (0.99, 1.08) |
| **DM STUNT** | 0.99 (0.97, 1.02) |
| **DM WAST** | 1.01 (0.95, 1.07) |
| **DM EBF** | 1.01 (0.96, 1.07) |
| **DM MIN FEED FREQUENCY** | 1.04 (1.01, 1.07) ** |
| **DM MDD** | 1.04 (0.99, 1.08) |
| **DM MIN ADQ DIET** | 1.09 (1.05, 1.14)*** |
| **CCAPS STUNT** | 0.98 (0.94, 1.01) |
| **CCAPS WAST** | 0.99 (0.93, 1.05) |
| **CCAPS EBF** | 1.02 (0.94, 1.11) |
| **CCAPS MIN FEED FREQUENCY** | 1.05 (1.02, 1.09) ** |
| **CCAPS MDD** | 1.01 (0.97, 1.05) |
| **CCAPS MIN ADQ DIET** | 1.03 (0.98, 1.09) |

***BI= bodily integrity, STUNT= stunting, WAST= wasting, EBF= exclusive breastfeeding, MMF= minimum meal frequency**
**MDD= minimum diet diversity, MAD= minimum adequate diet, DM= decision making, CCAPS= maternal capabilities index**

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