ASSOCIATIONS BETWEEN WOMEN’S EMPOWERMENT, INFANT AND YOUNG
CHILD FEEDING, AND CHILD ANEMIA IN RURAL SENEGAL

By

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ABSTRACT OF THE THESIS

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Malnutrition in all its forms includes undernutrition, micronutrient deficiencies, and overweight/obesity. The determinants of malnutrition are inadequate dietary intake and disease, with underlying factors of food insecurity, poor health and household environments, and inadequate care practices. Children under 2 years are especially vulnerable to malnutrition because of rapid growth rates, and their nutritional status is directly affected by infant and young child feeding (IYCF) practices. Mothers are typically the primary caregivers who are responsible for IYCF. However, for women with low status and unequal access to resources, it is difficult to implement the best care practices. In rural Senegal, where gender inequalities and anemia are prevalent, appropriate complementary feeding practices are of most concern. The present study explores how women’s empowerment is related to IYCF practices and child anemia in the context of rural Senegal. This is a cross-sectional secondary data analysis of subsistence farming households, surveying mothers 15 to 49 years with children aged 0 to 23 months (n=521). Findings show that among children 6 to 23 months (n=484), 41.7% met minimum dietary diversity, 22.3% consumed a minimum acceptable diet, 51.4% had
any unhealthy food consumption, and 65.7% consumed zero vegetables and fruits.

Mother’s empowerment scores, measured on a scale from 0 to 9, were very low (mean 2.89±1.96). Binary logistic regression revealed few significant differences in IYCF with women’s empowerment as a predictor—having personal savings was the only significant determinant of meeting minimum dietary diversity in unadjusted analyses. The relationship between women’s status and IYCF practices could not be well-established in this study. However, our findings highlight the severity of suboptimal IYCF practices, child anemia, and low women’s status in rural Senegal.
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CHAPTER ONE: INTRODUCTION

Globally, populations suffer from malnutrition in the form of undernutrition, micronutrient deficiencies, and overweight/obesity. Stunting, indicated by low height-for-age, is the most prevalent indicator of malnutrition in children under 5 years of age at 21.3% worldwide. Regarding micronutrient deficiencies specifically, one of the most prevalent issues is iron deficiency. Iron deficiency leads to anemia, which is especially prevalent among children under 5 years of age at 41.7% worldwide. The immediate determinants of malnutrition include inadequate dietary intake and disease, which are affected by underlying factors of food insecurity, inadequate maternal and child care practices, and poor health environments such as unsanitary drinking water. Ultimately, the basic determinants of malnutrition are the political, economic, and environmental factors which determine a community’s quantity and quality of accessible resources. Therefore, the burden of malnutrition disproportionately affects low- and middle-income countries, especially in their poorest regions. Senegal is one such country, where anemia is most notably prevalent. In 2016, 68% of children under 5 years of age were anemic. Stunting is also prevalent in Senegal where 19% of children under 5 years of age were stunted in 2019.

Children under 2 years old are especially vulnerable to undernutrition and micronutrient deficiency because optimal growth and development are critical from birth to 2 years due to high growth rates. Poor nutrition during this critical period will negatively impact children’s physical and cognitive development, health outcomes, and survival. After 2 years of age, it is especially difficult to reverse adverse outcomes, such as stunting. One crucial step to improve child nutrition and health outcomes is to
improve infant and young child feeding (IYCF) practices. IYCF practices, namely appropriate breastfeeding and complementary feeding, directly affect the nutritional status of children under 2 years of age by influencing adequate dietary intake. In Senegal, breastfeeding is nearly universal, but appropriate complementary feeding practices are far behind and are of most concern.8,13

Women are the primary caregivers for young children in most societies, and therefore are typically responsible for infant and young child feeding practices.18 However, for when women with low status, it is more difficult to acquire the knowledge and skills to meet the best care practices.18 Women’s status can be linked to her autonomy, power, and wellbeing within her household and society.6,10 Power is the ability to make choices, and to define goals and pursue them even if opposed.18 Women’s empowerment is demonstrated through decision-making and is supported by control over resources, whether they be economic, human, social, or legal.19 Access to these resources allow for decisions on purchasing, healthcare, family planning, and more.20 A caregiver needs certain resources to provide proper care for her children, such as appropriate knowledge, autonomy, adequate time, and social support.18,21 The greater access to these resources, the more empowered she is to provide effective care for herself and her children. However, empowerment is multidimensional and context-specific and therefore is not easily measured.22 As a brief overview of our context in Senegal, gender inequality is prevalent throughout the country and within many individual households. Polygamy is legal in Senegal, and so men often take multiple wives.23-25 In addition, agriculture is the main livelihood and subsistence farming is common practice in rural regions.26
Appropriate IYCF practices directly contribute to better child nutrition outcomes, but there is not yet a clear relationship between women’s empowerment and specific IYCF practices, nor between women’s empowerment and children’s nutritional status. In Senegal, stunting and anemia are of great concern, with an even greater disparity when comparing rural and urban regions.\(^8\) The large-scale prevalence of child undernutrition and micronutrient deficiency drives the demand for further answers to address whether improving women’s status will improve IYCF practices, and therefore child nutrition outcomes. The present study aims to use the context of rural Senegal to explore this gap in knowledge.

**Research Questions and Hypotheses**

This study will investigate the relationship between women’s empowerment, IYCF practices, and child anemia in an environment of subsistence farming and polygamy in rural Senegal through the following research questions:

**RQ1**: How are various dimensions of women's empowerment related to IYCF and to child anemia in rural Senegal?

**RQ2**: Is there a difference in women’s empowerment and IYCF among marital status groups (i.e., monogamous, polygamous, etc.)?

**H1**: The greater the empowerment of the mother, the greater odds that their child will be fed according to appropriate IYCF practices and not be anemic.

**H2**: Monogamous wives will have greater women’s empowerment scores and will be more likely to meet appropriate IYCF practices than those in polygamous marriages.
CHAPTER TWO: LITERATURE REVIEW

THE BURDEN OF MALNUTRITION

Prevalence of Malnutrition

Multiple burdens of malnutrition are prevalent world-wide and disproportionately affect developing countries.\textsuperscript{1,2} Populations suffer threefold from undernutrition, micronutrient deficiencies, and overweight/obesity.\textsuperscript{1} Undernutrition includes stunting, indicated by low height-for-age, and wasting, indicated by low weight-for-height.\textsuperscript{3} In 2019, 8.9\% of the global population was undernourished, and have been increasing over the years.\textsuperscript{2} Undernourishment is most prevalent in Africa, where 19.1\% of the population are undernourished.\textsuperscript{2} Stunting is the most prevalent form of malnutrition in children under 5 years of age at 21.3\% worldwide, and 40\% in Africa.\textsuperscript{2} Micronutrient deficiency is caused by poor diet quality, but there is no single measurement for multiple dimensions of diet quality which cause commonly deficient micronutrients such as iron, vitamin A, iodine, and zinc.\textsuperscript{1,2} Iron deficiency leads to anemia, which is classified as a hemoglobin level under 11.0 g/dl, including mild anemia at 10.0-10.9 g/dl, moderate anemia at 7.0-9.9 g/dl, and severe anemia below 7.0 g/dl in children under 5 years.\textsuperscript{8} Anemia is a prevalent issue globally, especially among children under 5 years (41.7\%) and women aged 15-49 years (32.8\%).\textsuperscript{4}

Determinants of Malnutrition

Pregnant or lactating women and children under 2 years old are especially vulnerable to undernutrition and micronutrient deficiencies.\textsuperscript{10,11} The causes of malnutrition can be classified in to several levels: immediate factors at the individual level, underlying factors at the household level, and basic factors at the societal level.\textsuperscript{5}
The immediate causes include inadequate dietary intake and disease. Underlying causes at the household level are food insecurity, inadequate maternal and child care practices, and poor health environments regarding sanitary drinking water and toilet facilities. The basic determinants are the political, economic, and environmental factors which determine potential resources and the quantity/quality of actual accessible resources and how they are controlled. Each level has influence on other levels and are closely linked. For example, one’s resources could be limited by cultural, religious, and social systems, including women’s status. Widespread malnutrition then affects these underlying factors by exacerbating developmental problems in low labor productivity, reduced economic growth, and poverty.¹

**INFANT AND YOUNG CHILD FEEDING PRACTICES**

**Importance and Recommendations**

From birth to 2 years, optimal growth and development are critical for children. Poor nutrition during this period affects children’s health outcomes and survival, and after 2 years of age, it is especially difficult to reverse adverse outcomes such as stunting.¹²,¹⁷ This is especially important after 6 months of age, when breast milk no longer meets the complete nutrition needs of infants and complementary foods must be introduced.¹¹

Infant and young child feeding (IYCF) practices directly affect nutritional status of children under 2 years old, so improving IYCF practices is a crucial step to improving nutrition, health outcomes, and development.¹³ The World Health Organization’s (WHO) guiding principles recommend exclusive breastfeeding for the first 6 months of life, introducing complementary foods at 6 months of age, and continued breastfeeding to 2 years.¹¹ Meal frequency is also outlined in the guiding principles for specific age groups,
such as 2-3 complementary meals per day at 6-8 months of age, and 3-4 times per day at 9-24 months of age, all in addition to breastfeeding.\textsuperscript{11} To address micronutrient needs, it is recommended to provide a variety of food groups, or to provide fortified products or vitamin-mineral supplements.\textsuperscript{11}

**WHO and UNICEF Indicators**

Appropriate feeding is multi-dimensional and IYCF indicators can be used to reflect population-level progress towards optimal feeding practices.\textsuperscript{13,27} The WHO and United Nations Children’s Fund (UNICEF) indicators are mainly used for assessment of trends and targeting interventions and policies. The original indicators published in 2008 were recently updated in 2021 and include breastfeeding, complementary and other feeding indicators.\textsuperscript{27,28}

The breastfeeding indicators assess if the child was ever breastfed, early initiation of breastfeeding within one hour of birth, exclusively breastfed for the first two days after birth, exclusive breastfeeding under six months, mixed milk feeding under six months, and continued breastfeeding 12 to 23 months. The complementary feeding indicators are mainly for children 6 to 23 months: minimum dietary diversity, minimum meal frequency, minimum milk feeding frequency for non-breastfed children, minimum acceptable diet, egg and/or flesh food consumption, sweet beverage consumption, unhealthy food consumption, and zero vegetable or fruit consumption. The remaining complementary feeding indicator is introduction of solid, semi-solid, or soft foods 6 to 8 months. There are also miscellaneous indicators, which are bottle feeding 0 to 23 months and infant feeding area graphs. Caregivers, which are usually mothers, are the target respondents in IYCF practice surveys.\textsuperscript{28}
WOMEN’S STATUS AND EMPOWERMENT

Defining Women’s Status

Women’s status has no single definition, but is associated with women’s autonomy, power, authority, wellbeing, and position in society.\textsuperscript{6,10} Power is the ability to make choices, and to define goals and pursue them even when opposed.\textsuperscript{18} Women’s empowerment is demonstrated through decision-making and is supported by control over resources in several domains: economic, human, social, and legal.\textsuperscript{19} Assessment of women’s empowerment can be variable across studies, but there have been several frameworks that were conceptualized to develop the best methods for measurement.\textsuperscript{29-34} For example, a review by Malhotra et al.\textsuperscript{35} in 2002 was one of the first to compile variables of women’s empowerment, and includes four common domains as highlighted below.

Economic resources include income, time, productive inputs and labor, financial assets, and food. Human resources refer to education, skills, and knowledge or beliefs. Social capital is memberships in groups and access to social networks or social support. Legal empowerment may be entitlements over land and house. These resources allow for decisions on purchasing, healthcare, and family planning.\textsuperscript{20} Women’s status also incorporates access to health services and information, mental health, confidence, and self-esteem. Since women’s empowerment is multidimensional, it must be clearly defined when it is used.\textsuperscript{22} Women’s status can be defined in comparison to men’s status within their household, or in terms of their societal gender equality.\textsuperscript{3,18}
Caregiving

Women are the primary caregivers for young children and themselves in most societies. The greater control over household economic resources, the more effective women care for themselves and their children. However, for women with low status relative to men, it is more difficult to achieve adequate care for themselves and their children, and more difficult to go outside of their households to engage in social interaction. This leads to fewer chances of acquiring health and nutrition knowledge about the best care for women and their children. Less exposure to new information means they are less likely to question culturally based beliefs that are harmful to children’s nutritional status, such as inappropriate feeding practices for infant and young children, and the association of malnutrition with the influence of spirits rather than inadequate diet. The lower a woman’s status and physical autonomy, the more dependent she is on her husband. Additionally, women of low status are more likely to experience physical violence and to accept their lower status. All of these factors can lead to poor mental health, low self-esteem, lack of confidence, and lack of self-efficacy. A woman may be less willing to adopt new practices and less likely to respond to new information even if she does receive it under these circumstances.

PATHWAYS BETWEEN AGRICULTURE AND NUTRITION

Although there are many determinants of malnutrition, the agricultural sector plays an important role at the household level in the developing world, particularly among subsistence farming households. Agriculture is the main livelihood of the majority of the poor and nutritionally vulnerable households in the world. Agricultural production among subsistence farmers affects nutrition through multiple pathways: food
production, agricultural income, and women's empowerment. There are many interactions among these pathways and they are further influenced by the enabling environment, which includes natural resources, the food market, water and sanitation, policy/governance, and nutrition and health knowledge and norms.

**Household Food Production Pathway**

Household food production is important to diet and nutrition, especially in smallholder farms, because it can affect the type, quantity, and seasonality of food available for consumption. However, it is not typical to produce all the food a family needs, and most poor rural families are net purchasers of food. Therefore, a combination of food production, income, and local food availability and prices determines food security.

**Agricultural Income Pathway**

Agricultural income supports immediate or future household needs, including food and non-food purchases. Rural farm households balance their spending decisions between farm production, marketing investments, and purchases of food and health necessities. The effect of income on nutrition is influenced by what is available, affordable, and convenient to purchase, who decides what is purchased, and the factors that then drive those decisions.

**Women’s Empowerment Pathway**

Women's empowerment affects their decisions on income, caring practices (including IYCF), and time/energy expenditure. In 2012, the Women’s Empowerment in Agriculture Index (WEAI) was developed as a survey-based index to measure empowerment of women specifically in the agricultural sector. There are five
domains of empowerment that can be directly related to household agricultural activities: production (input and autonomy), resources (ownership of assets, rights to purchase/sell/transfer agricultural assets, control over credit), control over income use, leadership, and time use (workload versus leisure). The best way for women to control household income use is by earning their own income when possible. For women in rural areas, an agriculture-related livelihood is the most common way her family makes a living. The roles and status of women in agriculture and rural areas vary widely by region, age, ethnicity and social class. Women make up 43% of the agricultural labor force in developing countries and about 50% within sub-Saharan Africa, yet women in agriculture and rural areas generally have less access to productive resources and opportunities compared to men. The gender gap is found for many assets, inputs and services such as land, livestock, labor, education, financial services, and technology because women may face more severe social constraints than men. Rural women often manage complex households and pursue multiple livelihood strategies. That is, women face tight time constraints and may have little power over their time use. Their activities typically include producing agricultural crops, tending animals, preparing food, working for wages in the agricultural sector, collecting fuel and water, engaging in trade, caring for family members, and maintaining the home.

**WOMEN’S EMPOWERMENT AND CHILD NUTRITION OUTCOMES**

Improved children’s nutritional status is generally found to have a positive relationship with women’s higher status relative to her household. However, some studies have failed to show any significant relationship between women’s status and children’s nutritional outcomes, or have shown varied results.
When controlling for a variety of potential confounding factors, Smith et al.\textsuperscript{18} found a negative association between women’s relative decision making power and the three indicators of underweight, stunting, and wasting in sub-Saharan Africa. However, there was no significant association between societal gender equality and the three indicators.

According to a study by Ickes et al.\textsuperscript{37} in Uganda, women with a formal education and women who delivered in childbirth facilities had children with lower stunting and underweight probabilities. However, other typical indicators of women’s empowerment in the household—such as believing domestic violence to be unacceptable, freedom to travel, and involvement in household decisions—were not associated with reductions in stunting.\textsuperscript{37}

Cunningham et al.\textsuperscript{31} investigated specific indicators of women’s empowerment in Nepal and found that access to and decisions regarding credit, autonomy in production, and satisfaction with leisure time were positively associated with length-for-age Z scores for children under 2 years of age. However, no indicator of women's empowerment in agriculture regarding production, assess to resources, income, leadership, or time use was associated with weight-for-length Z scores in their child.\textsuperscript{31} Even so, another study by Heckert et al.\textsuperscript{20} in Burkina Faso found that improvements in women's empowerment in the domains of spousal communication, purchasing decisions, healthcare decisions, and family planning decisions contributed to reduced wasting. Spousal communication included discussing professional, agricultural, or domestic activities, expenses, community events, her child's health, her child's food intake, and her own health. On the other hand, the same improvements in women's empowerment did not contribute to the
increase in hemoglobin (indicator of iron status) and therefore was not associated with reduction in anemia. 

**WOMEN’S EMPOWERMENT AND IYCF PRACTICES**

The findings of studies examining the relationship between indicators of women’s empowerment and different IYCF practices in sub-Saharan Africa were more varied. Greater women’s empowerment was positively associated with minimum dietary diversity, minimum meal frequency, and minimum acceptable diet in sub-Saharan Africa, except in one study by Na et al. which found a consistent negative association specifically in Benin and Niger. The legal dimension of women’s empowerment did not show any associations with the three indicators in multiple countries. In 2018, Ickes et al. found that mothers with higher social support were more likely to feed children according to the three indicators of minimum meal frequency, minimum dietary diversity, and minimally acceptable diet, as well as iron-rich foods indicators. A positive association between women's decision-making power, particularly regarding economic resources, with meal frequency, dietary diversity, and appropriate complementary feeding suggests that women’s decision-making power is directly related to how much household income is allocated to food for children.

A mother’s education level and knowledge of recommended IYCF practices are typically associated with improved IYCF practices in sub-Saharan Africa. Multiple studies have found that a mother’s educational attainment is positively associated with the minimum dietary diversity practice and appropriate complementary feeding practices, and negatively associated with delayed initiation of breastfeeding. Similarly, mother’s IYCF knowledge was positively associated with early initiation of
breastfeeding, timely initiation of complementary feeding, and dietary diversity.\textsuperscript{36,44,46,47} One study found that a mother’s knowledge of breastfeeding recommendations and positive beliefs about breastfeeding were associated with significantly lower risks of early cessation of exclusive breastfeeding.\textsuperscript{48} Similarly, lack of knowledge about exclusive breastfeeding and having no formal education were negatively associated with exclusive breastfeeding practice.\textsuperscript{45,49} This could be related to the role of education and knowledge in resisting pressures of cultural traditions which favor inappropriate IYCF practices.\textsuperscript{36} However, this is contradicted in a study done by Mundagowa et al.\textsuperscript{50} which identified traditional family practices as a major barrier to exclusive breastfeeding. While a majority of mothers surveyed had knowledge about exclusive breastfeeding and expressed a positive attitude towards the practice, only 36% actually practiced exclusive breastfeeding.\textsuperscript{50}

Access to pre- and postnatal care is positively associated with better IYCF practices.\textsuperscript{43,45,47} Studies in Ethiopia showed that health education on IYCF practices during antenatal care visits as well as utilization of postnatal care were positively associated with appropriate complementary feeding practice.\textsuperscript{43,47} Similarly, mothers with fewer antenatal visits were significantly more likely to delay initiation of breastfeeding and less likely to exclusively breastfeed.\textsuperscript{45} Improved delivery conditions were also generally associated with improved IYCF practices in sub-Saharan Africa.\textsuperscript{46,49} Exclusive breastfeeding rates were higher among women who delivered while assisted by health professionals compared to those who were assisted by traditional or untrained birth attendants.\textsuperscript{49} Institutional delivery was also significantly associated with early initiation
of breastfeeding, but was negatively associated with complete exclusive breastfeeding until 6 months.\textsuperscript{37,46}

Although multiple aspects of women’s empowerment are generally associated with improved IYCF practices, improving women’s status can ultimately lead to reduced breastfeeding.\textsuperscript{6} For example, women’s relative decision-making power has a statistically significant and negative effect on the duration of breastfeeding.\textsuperscript{18} However, there was no association found between overall women's status and breastfeeding initiation nor exclusive breastfeeding in sub-Saharan Africa.\textsuperscript{18} Relative decision-making power is also associated with the likelihood of bottle-feed at some point, but bottle-feeding is generally uncommon in sub-Saharan Africa.\textsuperscript{18}

There are many other determinants that may influence the effect of women’s empowerment on IYCF practices. For example, studies show that higher wealth status was significantly associated with early initiation of breastfeeding and the odds of exclusive breastfeeding were higher in rich and middle income level households than poor households.\textsuperscript{46,49} However, Ickes et al.\textsuperscript{37} had found that mothers who were in the upper 60\% wealth percentile were less likely to exclusively breastfeed up until 6 months, although they were more likely to meet minimum meal frequency, diversity, and adequacy indicators. Interestingly, female infants were more likely to be exclusively breastfed than male infants, and there was a significantly lower exclusive breastfeeding rate for infants less than 6 months among mothers who lived in rural regions compared to those who lived in urban regions.\textsuperscript{49} As one might expect, the education and knowledge of fathers also had an effect on IYCF practices. Low fathers’ education was negatively associated with early initiation of breastfeeding.\textsuperscript{46} Fathers' specific knowledge of food
groups, child care activities, and “important things to keep the child healthy” was significantly associated with meeting minimum dietary diversity.\textsuperscript{51}

\textbf{SENEGAL}

\textbf{Hunger and Malnutrition}

Senegal is a lower middle-income country affected by the burden of malnutrition. In 2018, the Human Development Index (HDI) of Senegal was 0.541, ranking it 166 out of 189 countries.\textsuperscript{25} The index is a measure of long-term development using 3 dimensions: life expectancy, access to knowledge related to years of schooling, and standard of living related to gross national income per capita. While Senegal ranks low on the HDI, the mortality rate of children under 5 years of age and of infants have been decreasing steadily and reached 45 per 1000 live births and 33 per 1000 live births, respectively.\textsuperscript{4}

In 2019, Senegal ranked 67\textsuperscript{th} out of 117 countries for their Global Hunger Index (GHI) score, placing the country at a moderate level of hunger.\textsuperscript{3} The GHI score is comprised of 4 indicators: undernourishment, child wasting, child stunting, and child mortality.\textsuperscript{3} Senegal’s GHI score has been trending down since 2010, but hunger and malnutrition still remain prevalent. In 2018, the prevalence of moderate to severe food insecurity stood at 40.7\%, with regional disparities within the country.\textsuperscript{4,52} In 2019, prevalence of stunting, wasting, and overweight in children under 5 were 19\%, 8\%, and 3\%, respectively.\textsuperscript{9} There have been fluctuations in these numbers in the past 10 years, leading to minimal net change. Micronutrient deficiencies such as iron deficiency are also prevalent in Senegal, with 68\% of children under 5 years of age having anemia in 2019.\textsuperscript{4} The 2012-13 Demographic Health Surveys (DHS) found that 71\% of children aged 6-59 months were anemic, with a majority (42\%) being moderately anemic.\textsuperscript{8} The prevalence
of anemia is different among age groups, peaking at 83% in children aged 12-23 months and dropping to 54% by 48-59 months. There was also a difference between urban and rural areas of residence—75% of rural children versus 65% of urban children suffered from anemia. The prevalence of anemia in children under 5 has decreased slightly to 68% in 2016.

**IYCF Practices**

Breastfeeding is nearly universal in Senegal for children under 6 months (99.8%) and even up to 1 year, but exclusive breastfeeding is not nearly as prevalent. The 2012-2013 DHS found that only 38% of children under 6 months are exclusively breastfed, while a majority (46%) instead receive both breast milk and plain water. Bottle feeding was not common, with only 6% of children under 6 months using a bottle with a nipple. The 2010-2011 DHS found that only 48% were breastfed within the first hour after birth while 54% were given other food or liquids. In 2017, exclusive breastfeeding in children under 6 months had increased to 42%, but early initiation of breastfeeding within the first hour after birth had dropped to 34%. Current complementary feeding practices in Senegal are also not aligned with recommendations. The 2012-13 DHS found that introduction of complementary feeding in addition to breastfeeding was only found in 54% of children aged 6 to 7 months and 76% of children aged 8 to 9 months. In 2010, minimum dietary diversity was at 48%, minimum meal frequency was at 39%, and minimum acceptable diet was at 22% for breastfed children 6 to 23 months.

Caregivers weigh competing economic, social, cultural, and situational factors when making decisions about IYCF practices, particularly in the context of low- and middle-income countries where choices are limited. A study by Zobrist et al. explored
dimensions of food decision-making of mothers in rural and peri-urban communities of Senegal with children under 5 years. This includes mother’s perception of healthiness, convenience, child acceptance, appeal, and modernity in relation to local food items. Healthiness was the most valued dimension by far, and this was mainly interpreted by participants as cleanliness.\(^5^4\)

**Agricultural Practices**

Agriculture is a major sector in terms of employment and economy in Senegal. In 2013, agriculture was the primary livelihood for 69% of the workforce and accounted for 17.5% of the GDP.\(^2^6\) The rural population accounted for 52% of the total population in 2019.\(^4\) Farmers mainly grow sugarcane, groundnuts and cotton as primary cash crops, and the rest of the production is dominated by subsistence crops, especially rice, millet, sorghum and maize.\(^2^6\) The agricultural sector has been facing major challenges that have weakened its development. These include poor access to water, since only about 1.3% of agricultural land is equipped for irrigation, and vulnerability to climatic shocks such as drought.\(^2^6,5^2\)

**Women’s Status**

**Gender Inequality.** The Gender Inequality Index is a measure reflecting inequality between women and men in reproductive health (maternal mortality, adolescent birth rate), empowerment (at least some secondary education, share of seats in parliament), and participation in the labor market. In 2018, the Gender Inequality Index score in Senegal was 0.523, ranking at 125 out of 162 countries.\(^2^5\) Regarding women’s status within a household, the Senegalese Family Code grants parental authority to the father, and women are unable to take legal responsibility for their children. The father
handles administrative procedures, chooses the family’s place of residence, and receives family income.\textsuperscript{23} Women often do not participate in household decisions according to the 2011-2012 DHS data. Only 31% participated in decisions on their own healthcare, 26% participated in decisions about major household purchases, about 40% participated in decisions on visiting family or friends, and 51% of women reported not partaking in any of the listed decisions.\textsuperscript{53} In addition, 22% of women aged 15 years and older in 2018 experienced physical or sexual violence by their husband/partner.\textsuperscript{25} In 2017, MICS data showed that 46% of women aged 15-49 years considered a husband justified in hitting his wife for at least one specified reason (such as burning food, arguing, going out without telling, neglecting children, or refusing sex).\textsuperscript{9,55}

**Polygamy.** Polygamy, specifically polygyny, is legal in Senegal and is commonly practiced. The population of Senegal is predominately Muslim (94%), which may influence women’s status.\textsuperscript{8,24} If a wife consents to a polygamous marriage, the husband can marry up to four women without further consent, as is allowed by Islamic and legal rule.\textsuperscript{23,24} In addition, marriages are registered polygamous by default unless the husband chooses otherwise. DHS data from 2010-2011 showed that 35% of Senegalese women were married to a man with more than one wife, and polygamy was most commonly practiced in rural areas.\textsuperscript{53} In rural areas, co-wives live under the same residence, but each wife and her children have an autonomous space. Co-wives will maintain social interactions such as eating and doing chores together.\textsuperscript{24} However, co-wives may also live separately, such as one at a rural area or residence and another in an urban area of residence.\textsuperscript{56} There is a social hierarchy in the polygamous household. First wives traditionally have a higher social status than other wives, but also the number of children
a wife has may gain her more resources and raise her status. Children may be treated differently depending on if they are within a monogamous or polygamous union, and depending on their mother’s rank if in a polygamous household.

Interestingly, Cudeville et al. reported in 2017 that polygyny had a positive impact on women’s labor force participation, indicating an improvement in women’s empowerment. This may be explained as a self-protective strategy to increase their autonomy. However, this may also be a result of the sharing of domestic labor in polygamous households, leaving more time for participation in the labor force. This was supported by the finding that housework burden for first and second wives was 12.5 hours per week, while for wives in monogamous unions was 16.6 hours per week.

**Child Outcomes.** Lépine and Strobl showed that women’s empowerment in Senegal was related to improved child nutrition outcomes, specifically wasting as measured by mid-upper arm circumference (MUAC). They used “women’s bargaining power” which was measured by who makes decisions concerning the wife’s health, the children’s health, the schooling of the children, daily expenditures, large expenditures, food cooked, and visits to the wife’s relatives, and whether the wife can go out without the permission of her husband. They found that an increase in women’s bargaining power increases MUAC z-scores, but that women with high bargaining power in rural areas were more likely to have poor child nutrition outcomes. This could be because mothers with more power are associated with less attention from the husband, and therefore are provided fewer resources from the husband.
CONCLUSION

It is well-known that appropriate IYCF practices directly contribute to better child nutrition outcomes. Studies also generally show positive association between women’s empowerment in the household and improved child nutrition outcomes regarding underweight, stunting, and wasting, likely due to an increase in a mother’s caring capacity. However, there is not yet as clear a relationship between women’s empowerment and specific IYCF practices nor between women’s empowerment and children’s anemia status. The large-scale prevalence of child undernutrition and micronutrient deficiency drives the demand for further answers to address whether improving women’s status will improve IYCF practices, and therefore child nutrition outcomes. In Senegal specifically, undernutrition and anemia are widely prevalent with an even greater disparity when comparing rural and urban areas. The present study aims to investigate the influence of women’s empowerment on IYCF practices and children’s hemoglobin status in an environment of agricultural and polygamous households in Senegal.
CHAPTER THREE: METHODS

STUDY DESIGN

This is a secondary analysis of a cross-sectional study conducted with subsistence farmers in Senegal, West Africa. Household surveys and hemoglobin measurements were conducted with households in three regions (Thies, Diourbel, Fatick) of Senegal in February-March 2016. This study was approved by the Institutional Review Board at Rutgers University and participants gave written informed consent before participating. The study was also approved by the institutional review boards of Columbia University, George Washington University, and Johns Hopkins University, as well as the Comité National D'éthique pour la Recherche en Santé (National Ethics Committee for Health Research) of the Senegalese Ministry of Health.

PARTICIPANTS

Participants were recruited from 124 villages with active farming groups for the study. Within each of the selected villages, approximately 10 households were randomly selected to be included in the study. Households were randomly selected from a list of all households in the villages' farming group. The target participants were women in smallholder farming groups who had children under 5 years, and the total sample consisted of 1,268 households. Inclusion criteria for the present study were mothers 15 to 49 years of age with a child aged 0 to 23 months who had no missing data.

DATA COLLECTION

Household Survey

Enumerators conducted the household surveys in Wolof, the primary spoken language of participants. The survey was composed of sections relating to the household
roster (relationship to head of household, education, work, residence, ethnicity, religion),
agriculture, dietary intake for women and children, food consumption and expenditure,
food security, infant and young child feeding (IYCF) practices, child health/sanitation,
social capital, women's empowerment, and women's time use. In the present study, the
sections of interest answered by the mother of the child were concerning dietary intake,
household food security, IYCF practices, women’s empowerment and time use, maternal
education, and marital status (first, second, or third wife or other in the household).
Household food security was measured by the Food Insecurity Experience Scale, which
is assessed by an 8-question module on self-reported behaviors and experiences related to
eating and food access.\cite{footnote:57}

**Women’s Empowerment Variables.** Various aspects of women’s empowerment
were evaluated by adapting several instruments. The Demographic Health Surveys
Woman’s Questionnaire was adapted to evaluate the status of women in the household.\cite{footnote:58}
Survey questions assessed the participants’ decision-making power in the household and
if they had personal savings. Participants were asked who made decisions about spending
money, visiting family/relatives, and children’s education—response choices on these
items were self, husband/head of household, joint decision, or other. Regarding their
respective agricultural groups, participants were asked how actively they participate
(response choices were not active, somewhat active, or very active) and if they were a
board member. Time use was evaluated using a questionnaire adapted from the Living
Standards Measurements Study to examine women’s labor and workload.\cite{footnote:59}
Participants
were asked how many hours in the past day they spent on certain activities such as
fetching water or fuel, cooking, cleaning, child care, running errands, paid work, own business work, agricultural activities, social activities/leisure, and rest.

**Empowerment Domains.** Empowerment was categorized into domains modified from the Abbreviated Women’s Empowerment in Agriculture Index (A-WEAI) and from the work of Malhotra et al., 2002.²²,³⁵,³⁹–⁴¹ We examined five domains: resources, income, familial, leadership, and time use. Each domain was assessed using indicators which were assigned a score of 1 if the criteria was met, or a value of 0 otherwise (Table 1). Participants with missing data for any indicator were excluded. *

<table>
<thead>
<tr>
<th>Domain</th>
<th>Indicator Survey Item</th>
<th>Adequacy Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resources</strong></td>
<td>Do you have any personal savings?</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Control Over</strong></td>
<td>Who makes the decision on how to spend the money that you earn?</td>
<td>Self or Joint decision</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>Who makes the decision on how to spend money on health care for you?</td>
<td>Self or Joint decision</td>
</tr>
<tr>
<td></td>
<td>Who makes the decision on how to spend money on large household expenses (e.g., appliances, furniture etc.)?</td>
<td>Self or Joint decision</td>
</tr>
<tr>
<td><strong>Familial</strong></td>
<td>Who makes the decision on children’s education?</td>
<td>Self or Joint decision</td>
</tr>
<tr>
<td></td>
<td>Who makes the decision on visits to your family or relatives?</td>
<td>Self or Joint decision</td>
</tr>
<tr>
<td><strong>Leadership</strong></td>
<td>Are you a board member of [agricultural group]?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>How actively do you participate in this group’s decision making?</td>
<td>Very active</td>
</tr>
<tr>
<td><strong>Time Use</strong></td>
<td>24-hour recall</td>
<td>&lt; 10.5 hours worked in previous 24 hours</td>
</tr>
</tbody>
</table>

*Listwise deletion of cases with missing values used to simplify analyses and produce conservative results.
Resources were indicated by ownership of personal savings (1 item, possible score of 0 or 1). Control over income was indicated by who makes decisions on the use of income from personal earnings, and decisions on how to spend income on large household expenses and personal health care (3 items, possible score of 0-3); a response of self or joint decision was adequate to meet each indicator. The familial domain was indicated by who makes decisions on visiting family and children’s education (2 items, possible score of 0-2); a response of self or joint decision was assessed as meeting each indicator. The leadership domain was indicated by their agricultural group board membership and active participation (2 items, possible score of 0-2); a response of very active participation was adequate to meet the latter. The time use domain was indicated by workload (1 item, possible score of 0 or 1); reports of less than 10.5 hours worked per day (i.e., fetching water/fuel, cooking, cleaning, child care, running errands, paid work, own business work, agricultural activities) was adequate to meet this indicator.³⁹ This adequacy cut-off is used in the WEAI and is based on findings from a World Bank 2006 study in Guinea on time use allocation and constraints.⁹

Women’s empowerment domains and indicators were largely adapted from the A-WEAI, but several modifications were made: 1) the resources domain was indicated by personal savings rather than assets/credit, 2) the leadership domain was expanded to consider level of active participation, and 3) the production domain was replaced with the familial domain, adapted from Malhotra et al.³⁵ Substituting personal savings for the access to credit indicator was appropriate because even though women in Senegal are less frequently account holders at financial institutions compared to men, they do not experience direct discrimination in accessing credit once they are members of a financial
institution according to existing literature. The five domains of the modified index were then compiled into a composite score for a possible score range of 0-9. Cronbach’s alpha measuring internal consistency across the nine items was moderate at 0.65. Median split of the composite scores was then used to categorize each participants’ empowerment score as “low” or “high”.

**Child Feeding Variables.** IYCF indicators were assessed using the standard IYCF questions developed by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). The main indicators of interest were complementary feeding practices of children aged 6 to 23 months, evaluated using a 24-hour recall to obtain dietary intake from the previous day. Minimum acceptable diet (MAD) is measured by taking the proportion of children aged 6 to 23 months who met minimum meal frequency (MMF) that was standard for their age, who consumed foods from at least 5 of the 8 food groups identified by the minimum dietary diversity (MDD) indicator, and who were either breastfed or met minimum milk feeding frequency (MMFF). Their diets were also assessed by the specific indicators of egg and/or flesh food consumption (EFF), unhealthy food consumption (UFC), and zero vegetable or fruit consumption (ZVF). Assessment of egg, flesh food, vegetable, and fruit consumption are included within the 8 food groups of the MDD indicator. Unhealthy food consumption includes sweets (i.e., candies, chocolate, frozen treats, pastries) and fried foods (i.e., chips, crisps, fried dough) that are high in sugar, salt, and/or unhealthy fats.

Additional IYCF indicators of interest were exclusive breastfeeding under six months, continued breastfeeding at 12 to 23 months, child ever breastfed, and
introduction of solid, semi-solid, or soft foods for children age 6 to 8 months. Children were classified as breastfed if the child was breastfed the previous day.

**Hemoglobin Measurement**

Hemoglobin levels were measured by fingerstick using HemoCue machines, which were then used to determine anemia status in the children. The healthy hemoglobin level for children under 5 years of age is 11.0 g/dL according to WHO guidelines, and values below this level indicate anemia. Subjects were further classified as having mild (10.0-10.9 g/dL), moderate (7.0-9.9 g/dL), or severe (<7.0 g/dL) anemia.

**STATISTICAL ANALYSIS**

Demographic characteristics, women’s empowerment, and children’s outcome variables were summarized using descriptive statistics. To determine differences in the associations between women’s empowerment and IYCF practices among different marital status groups (i.e., monogamous, polygamous, or other), chi-squared tests were conducted. Analysis of Variance with Bonferroni post hoc tests were performed to assess child hemoglobin differences among and between marital status groups.

Multiple logistic regression models were used to examine associations between women’s empowerment factors and IYCF complementary feeding practices. Logistic regression analyses controlled for the following confounding variables: household food security, mother’s age and education level, and child age and sex. Data analysis was conducted using IBM SPSS Statistics 27 (IBM Corporation, Chicago, IL). For all analyses, statistical significance was set at p-value < 0.05.
CHAPTER FOUR: RESULTS

PARTICIPANT CHARACTERISTICS

The original sample included 1,268 households, but only 642 met inclusion criteria of the present study and 121 participants were removed due to missing data. Our final sample in this study was 521 mother and child dyads.

Child Characteristics

Mean age of the children was 13.22 (SD=5.12) months and ranged from 4 to 23 months. The 6-month age disaggregates are shown in Table 2. The sample was nearly half girls (46.4%) and half boys (53.6%). Most children were breastfed (86.2%) at the time of survey. Almost two thirds of children (66.4%) were anemic, one third (35.1%) of which were moderately to severely anemic. Child hemoglobin levels ranged from 6.30 to 14.60 g/dl with a mean of 10.32 g/dl (SD=1.32).

Table 2. Demographic and health characteristics among children 0 to 23 months (n=521)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percent (Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age of Child</strong></td>
<td></td>
</tr>
<tr>
<td>0-5 months</td>
<td>7.1 (37)</td>
</tr>
<tr>
<td>6-11 months</td>
<td>32.8 (171)</td>
</tr>
<tr>
<td>12-17 months</td>
<td>39.4 (200)</td>
</tr>
<tr>
<td>18-23 months</td>
<td>21.7 (113)</td>
</tr>
<tr>
<td><strong>Sex of Child</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>46.4 (242)</td>
</tr>
<tr>
<td>Male</td>
<td>53.6 (279)</td>
</tr>
<tr>
<td><strong>Currently Breastfed</strong></td>
<td>86.2 (449)</td>
</tr>
<tr>
<td><strong>Prevalence of Anemia</strong></td>
<td></td>
</tr>
<tr>
<td>Any Anemia</td>
<td>66.4 (346)</td>
</tr>
<tr>
<td>Moderate to Severe Anemia</td>
<td>35.1 (183)</td>
</tr>
</tbody>
</table>

*Mild anemia = 10.0-10.9 g/dL, Moderate anemia = 7.0-0.0 g/dL, Severe anemia = <7.0 g/dL.
Maternal Characteristics

Mean maternal age was 28.50 (SD=6.66) years and ranged from 16 to 47 years.

Table 3 describes the sociodemographic characteristics of the maternal counterparts. Almost all mothers were married (98.8%)—a majority were in monogamous marriages (75.6%), 23.3% were in polygamous marriages, and a small percentage was either single, widowed, or divorced (1.2%). Of those married, 82.3% were the first wife, and 17.7% were the second, third, or fourth. Only 24.6% of mothers attended any level of formal school. A majority (86.4%) reported knowing the appropriate recommended length of time to breastfeed, but only 35.5% correctly answered that breastfeeding up to 2 years is appropriate. A majority of participants reported no or mild food insecurity (61.4%), however, 29.9% were moderately food insecure, and 8.6% were severely food insecure.

Table 3. Sociodemographic characteristics among mothers of children 0 to 23 months (n=521)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percent (Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
</tr>
<tr>
<td>Monogamous</td>
<td>75.6 (394)</td>
</tr>
<tr>
<td>Polygamous</td>
<td>23.2 (121)</td>
</tr>
<tr>
<td>Other(^a)</td>
<td>1.2 (6)</td>
</tr>
<tr>
<td><strong>Wife Rank (n=515)</strong></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>82.3 (424)</td>
</tr>
<tr>
<td>Other(^b)</td>
<td>17.7 (91)</td>
</tr>
<tr>
<td><strong>Ever attended formal school</strong></td>
<td>24.6 (128)</td>
</tr>
<tr>
<td><strong>Household Food Insecurity(^c)</strong></td>
<td></td>
</tr>
<tr>
<td>Secure/Mild</td>
<td>61.4 (320)</td>
</tr>
<tr>
<td>Moderate</td>
<td>29.9 (156)</td>
</tr>
<tr>
<td>Severe</td>
<td>8.6 (45)</td>
</tr>
</tbody>
</table>

\(^a\)Single, divorced, or widowed  
\(^b\)Second, third, or fourth wife  
\(^c\)The Food Insecurity Experience Scale\(^{57}\) was used to assess severity of food insecurity.
Women’s Empowerment. All 521 mothers responded to all nine empowerment items. About one-fourth (25.9%) reported having personal savings. When applicable, 61.2% made the decisions on how to spend their personal income. However, only 22.8% contributed to decisions to use income on their personal health and only 22.5% contributed to decisions on large household expenses. Decision-making on familial decision was also low, with about one-fourth (24.6%) contributing to deciding family visits, and 21.7% contributing to decisions on their child’s education. About two-thirds (67.4%) reported working under 10.5 hours the previous day on fetching water/fuel, cooking, cleaning, childcare, running errands, paid work, own business work, or agricultural activities. Only 11.9% of participants were board members in their village farming group, but 37.0% reported being very active in group participation.

The empowerment composite score mean was 2.89 (SD=1.96) with a range of 0 to 9. The median split between low and high empowerment was a score of 0 to 2 (n=255, 48.9%) and 3 to 9 (n=266, 51.1%), respectively.

Feeding Practices

Table 4 reports the frequency of mothers meeting infant and young child feeding practices, including breastfeeding and complementary feeding indicators. Almost all children (96.0%) were breastfed at some point. For children 0 to 5 months (n=37), only 27% of mothers exclusively breastfed as appropriate, with 68% providing plain water in addition to breastmilk. However, a majority (78%) of children 12 to 23 months (n=313) continued to breastfeed. Continued breastfeeding disaggregated by age group was at 96.2% of children 12 to 15 months (n=130), 88.4% of children 16 to 19 months (n=112),
Table 4. Infant and young child feeding practices of study participants (n=521) using WHO/UNICEF indicators

<table>
<thead>
<tr>
<th>Breastfeeding Indicators</th>
<th>Percent (Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever breastfed (n=521)</td>
<td>96.0 (500)</td>
</tr>
<tr>
<td>Exclusive breastfeeding under 6 months (0 to 5 mo, n=37)</td>
<td>27.0 (10)</td>
</tr>
<tr>
<td>Continued breastfeeding 12-23 months (n=313)</td>
<td>78.0 (244)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complementary Feeding Indicators</th>
<th>Percent (Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of solid, semi-solid or soft foods 6 to 8 months (n=74)</td>
<td>70.3 (52)</td>
</tr>
<tr>
<td>Minimum dietary diversity (6 to 23 mo, n=484)</td>
<td>41.7 (202)</td>
</tr>
<tr>
<td>Minimum meal frequency (6 to 23 mo, n=484)</td>
<td>24.6 (128)</td>
</tr>
<tr>
<td>Minimum milk feeding frequency for non-breastfed children 6 to 23 months (n=71)</td>
<td>15.5 (11)</td>
</tr>
<tr>
<td>Minimum acceptable diet (6 to 23 mo, n=484)</td>
<td>22.3 (108)</td>
</tr>
<tr>
<td>Egg and/or flesh food consumption (6 to 23 mo, n=484)</td>
<td>59.5 (288)</td>
</tr>
<tr>
<td>Unhealthy food consumption (6 to 23 mo, n=484)</td>
<td>51.4 (249)</td>
</tr>
<tr>
<td>Zero vegetable or fruit consumption (6 to 23 mo, n=484)</td>
<td>65.7 (318)</td>
</tr>
</tbody>
</table>

and 28.2% of children 20 to 23 months (n=71). Of children 6 to 8 months (n=74), only 70.3% were fed solid, semi-solid, or soft foods.

The 7 remaining indicators pertain to children 6 to 23 months only (n=484). Less than half (41.7%) were fed the minimum dietary diversity (MDD) and only 24.6% met their indicator for minimum meal frequency (MMF). For non-breastfed children 6 to 23 months (n=71), only 15.5% of mothers provided the appropriate minimum milk feeding frequency (MMFF). Among all children 6 to 23 months, 22.3% consumed a minimum acceptable diet (MAD) and 59.5% had any egg and/or flesh food consumption (EFF). More than half (51.4%) had any unhealthy food consumption (UFC) and almost two-thirds had zero vegetable or fruit consumption (ZVF).
ASSOCIATIONS BETWEEN CHILD AND MATERNAL CHARACTERISTICS
AND CHILD OUTCOMES

Meeting Complementary Feeding Indicators

Table 5 reports the complementary feeding indicators for all children aged 6 to 23 months (n=484) including MDD, MMF, MAD, EFF, UFC, and ZVF stratified by 6-month age groups, child sex, food insecurity severity, and child anemia status. Among children 6 to 23 months, significantly fewer children 6 to 11 months met any of the six complementary feeding indicators compared to the two older age groups. Girls were significantly more likely to be fed egg and/or flesh foods than boys (65.3% vs. 54.4%, p=0.015), but there were no significant differences regarding MDD, MMF, MAD, UFC, nor ZVF. Child anemia of any severity was significantly associated with lower likelihood of meeting minimum dietary diversity and minimum acceptable diet, but there was no significant relationship with MMF, EFF, UFC, nor ZVF. Mothers with moderate to severe food insecurity were significantly less likely to feed their children the minimum dietary diversity and minimum acceptable diet compared to mothers with no to mild food insecurity; there were no significant differences regarding MMF, EFF, UFC, nor ZVF.

Binary logistic regression was performed to predict IYCF practices using empowerment score as a predictor. Table 6 reports results from unadjusted logistic regression. Table 7 reports results from logistic regression adjusted for child age and sex, maternal age and education, and food insecurity—besides the composite score, each sub-score is also adjusted for the other 4 sub-scores. The analyses revealed few significant differences in feeding practices for children 6 to 23 months with women’s empowerment scores as a predictor. Only an increase in the ‘resources’ domain score in unadjusted
Table 5. Complementary feeding practices of children 6 to 23 months (n=484) by age group disaggregates, child sex, child anemia status, and food insecurity severity.

<table>
<thead>
<tr>
<th>Child Age Group</th>
<th>Percent (Number)</th>
<th>χ²</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 11 mo (n=171)</td>
<td>12 to 17 mo (n=200)</td>
<td>18 to 23 mo (n=113)</td>
<td></td>
</tr>
<tr>
<td>MDD</td>
<td>23.4 (40)\textsuperscript{a}</td>
<td>51.0 (102)\textsuperscript{b}</td>
<td>53.1 (60)\textsuperscript{b}</td>
</tr>
<tr>
<td>MMF</td>
<td>33.9 (58)\textsuperscript{a}</td>
<td>50.0 (100)\textsuperscript{b}</td>
<td>55.8 (63)\textsuperscript{b}</td>
</tr>
<tr>
<td>MAD</td>
<td>13.5 (23)\textsuperscript{a}</td>
<td>30.5 (61)\textsuperscript{b}</td>
<td>21.2 (24)\textsuperscript{a,b}</td>
</tr>
<tr>
<td>EFF</td>
<td>31.0 (53)\textsuperscript{a}</td>
<td>70.5 (141)\textsuperscript{b}</td>
<td>83.2 (94)\textsuperscript{c}</td>
</tr>
<tr>
<td>UFC</td>
<td>44.4 (76)\textsuperscript{a}</td>
<td>52.5 (105)\textsuperscript{b}</td>
<td>60.2 (68)\textsuperscript{b}</td>
</tr>
<tr>
<td>ZVF</td>
<td>52.6 (171)\textsuperscript{a}</td>
<td>68.5 (137)\textsuperscript{b}</td>
<td>80.5 (91)\textsuperscript{b}</td>
</tr>
</tbody>
</table>

| Child Sex | | |
|-----------------|------------------|----|---------|
| Girl (n=225) | Boy (n=259) | |
| MDD | 44.0 (99) | 39.8 (103) | 0.887 | 0.346 |
| MMF | 47.6 (107) | 44.0 (114) | 0.608 | 0.435 |
| MAD | 24.0 (54) | 20.8 (54) | 0.689 | 0.406 |
| EFF | 65.3 (147) | 54.4 (141) | 5.929 | 0.015* |
| UFC | 51.5 (115) | 51.7 (134) | 0.019 | 0.891 |
| ZVF | 67.1 (151) | 64.5 (167) | 0.370 | 0.543 |

<table>
<thead>
<tr>
<th>Child Anemia Status</th>
<th>No Anemia (n=151)</th>
<th>Any Anemia (n=333)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MDD</td>
<td>48.3 (73)</td>
<td>38.7 (129)</td>
<td>3.942</td>
</tr>
<tr>
<td>MMF</td>
<td>51.7 (78)</td>
<td>42.9 (143)</td>
<td>3.179</td>
</tr>
<tr>
<td>MAD</td>
<td>29.1 (44)</td>
<td>19.2 (64)</td>
<td>5.897</td>
</tr>
<tr>
<td>EFF</td>
<td>64.9 (98)</td>
<td>57.1 (190)</td>
<td>2.652</td>
</tr>
<tr>
<td>UFC</td>
<td>47.7 (72)</td>
<td>53.2 (177)</td>
<td>1.245</td>
</tr>
<tr>
<td>ZVF</td>
<td>66.9 (101)</td>
<td>65.2 (217)</td>
<td>0.137</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food Insecurity</th>
<th>None or Mild (n=296)</th>
<th>Moderate to Severe (n=188)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MDD</td>
<td>45.9 (136)</td>
<td>35.1 (66)</td>
<td>5.555</td>
</tr>
<tr>
<td>MMF</td>
<td>48.3 (143)</td>
<td>41.5 (78)</td>
<td>2.156</td>
</tr>
<tr>
<td>MAD</td>
<td>26.0 (77)</td>
<td>16.5 (31)</td>
<td>6.016</td>
</tr>
<tr>
<td>EFF</td>
<td>59.8 (177)</td>
<td>59.0 (111)</td>
<td>0.027</td>
</tr>
<tr>
<td>UFC</td>
<td>53.4 (158)</td>
<td>48.4 (91)</td>
<td>1.139</td>
</tr>
<tr>
<td>ZVF</td>
<td>65.9 (195)</td>
<td>65.4 (123)</td>
<td>0.010</td>
</tr>
</tbody>
</table>

\textsuperscript{a,b,c} Chi-square analysis conducted for categorical variables  
\textsuperscript{a,b} In the same row, values with different superscripts indicate significant difference while those with common superscripts indicate no significant difference.  
\textsuperscript{*} Statistically significant at p-value<0.05  
MDD= minimum dietary diversity; MMF= minimum meal frequency; MAD= minimum acceptable diet; EFF= egg and/or flesh food consumption; UFC= unhealthy food consumption; ZVF= zero vegetable and fruit consumption
Table 6. Unadjusted logistic regression odds ratios (95% confidence interval) of complementary feeding practices for children 6 to 23 months (n=484) by women’s empowerment score as a predictor

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resources</strong></td>
<td>1.57* (1.04, 2.37)</td>
<td>1.11 (0.74, 1.67)</td>
<td>1.55 (0.97, 2.47)</td>
<td>1.16 (0.76, 1.76)</td>
<td>0.93 (0.62, 1.39)</td>
<td>1.31 (0.85, 2.04)</td>
</tr>
<tr>
<td><strong>Control of Income</strong></td>
<td>0.97 (0.81, 1.16)</td>
<td>1.09 (0.91, 1.30)</td>
<td>1.01 (0.82, 1.25)</td>
<td>1.06 (0.89, 1.27)</td>
<td>0.89 (0.75, 1.06)</td>
<td>1.07 (0.89, 1.29)</td>
</tr>
<tr>
<td><strong>Familial</strong></td>
<td>0.95 (0.74, 1.22)</td>
<td>1.06 (0.83, 1.36)</td>
<td>0.95 (0.70, 1.28)</td>
<td>1.13 (0.88, 1.46)</td>
<td>0.78 (0.61, 1.01)</td>
<td>1.21 (0.93, 1.58)</td>
</tr>
<tr>
<td><strong>Leadership</strong></td>
<td>1.28 (0.97, 1.67)</td>
<td>0.99 (0.76, 1.29)</td>
<td>1.15 (0.84, 1.58)</td>
<td>1.15 (0.87, 1.52)</td>
<td>0.94 (0.72, 1.23)</td>
<td>1.3 (0.97, 1.74)</td>
</tr>
<tr>
<td><strong>Time Use</strong></td>
<td>0.71 (0.45, 1.05)</td>
<td>0.84 (0.57, 1.23)</td>
<td>0.74 (0.47, 1.16)</td>
<td>0.95 (0.64, 1.40)</td>
<td>0.90 (0.61, 1.32)</td>
<td>0.93 (0.62, 1.39)</td>
</tr>
<tr>
<td><strong>Composite Score</strong></td>
<td>1.02 (0.93, 1.11)</td>
<td>1.02 (0.94, 1.12)</td>
<td>1.02 (0.92, 1.13)</td>
<td>1.05 (0.96, 1.15)</td>
<td>0.93 (0.85, 1.01)</td>
<td>1.08 (0.98, 1.19)</td>
</tr>
</tbody>
</table>

* p-value<0.05

MDD= minimum dietary diversity; MMF= minimum meal frequency; MAD= minimum acceptable diet; EFF= egg and/or flesh food consumption; UFC= unhealthy food consumption; ZVF= zero vegetable and fruit consumption
Table 7. Adjusted logistic regression odds ratios (95% confidence interval) of complementary feeding practices for children 6 to 23 months (n=484) by women’s empowerment score as a predictor

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources</td>
<td>1.39 (0.89, 2.18)</td>
<td>1.05 (0.68, 1.61)</td>
<td>1.36 (0.83, 2.23)</td>
<td>1.12 (0.69, 1.82)</td>
<td>0.98 (0.63, 1.51)</td>
<td>1.20 (0.75, 1.92)</td>
</tr>
<tr>
<td>Control of Income</td>
<td>1.04 (0.81, 1.34)</td>
<td>1.17 (0.92, 1.49)</td>
<td>1.08 (0.81, 1.44)</td>
<td>1.16 (0.89, 1.52)</td>
<td>1.05 (0.83, 1.34)</td>
<td>1.02 (0.78, 1.31)</td>
</tr>
<tr>
<td>Familial</td>
<td>0.88 (0.61, 1.25)</td>
<td>0.92 (0.66, 1.30)</td>
<td>0.87 (0.58, 1.31)</td>
<td>0.96 (0.65, 1.40)</td>
<td>0.74 (0.53, 1.04)</td>
<td>1.15 (0.80, 1.66)</td>
</tr>
<tr>
<td>Leadership</td>
<td>1.31 (0.97, 1.76)</td>
<td>0.98 (0.74, 1.30)</td>
<td>1.16 (0.83, 2.23)</td>
<td>1.17 (0.85, 1.62)</td>
<td>0.98 (0.74, 1.31)</td>
<td>1.30 (0.95, 1.78)</td>
</tr>
<tr>
<td>Time Use</td>
<td>0.68 (0.44, 1.04)</td>
<td>0.84 (0.56, 1.26)</td>
<td>0.72 (0.45, 1.17)</td>
<td>1.10 (0.69, 1.73)</td>
<td>0.92 (0.62, 1.39)</td>
<td>0.95 (0.61, 1.47)</td>
</tr>
<tr>
<td>Composite Score</td>
<td>1.02 (0.93, 1.12)</td>
<td>1.03 (0.94, 1.13)</td>
<td>1.02 (0.91, 1.14)</td>
<td>1.09 (0.98, 1.22)</td>
<td>0.93 (0.85, 1.02)</td>
<td>1.10 (0.99, 1.22)</td>
</tr>
</tbody>
</table>

Note: Separate regression analyses controlled for child age & sex, maternal age & education, food insecurity. Sub-scores controlled for the other 4 domain sub-scores
MDD= minimum dietary diversity; MMF= minimum meal frequency; MAD= minimum acceptable diet; EFF= egg and/or flesh food consumption; UFC= unhealthy food consumption; ZVF= zero vegetable and fruit consumption
regression (OR [95% CI] = 1.57 [1.04, 2.37]) was found to significantly increase likelihood of feeding their child a minimally diverse diet (Table 6).

Rather than domain sub-scores, there were several significant correlations found between specific items of women’s empowerment and IYCF indicators. There were weak negative correlations between decision-making on spending personal income and unhealthy food consumption ($r = -0.11, p = 0.016$), as well as between decision-making for their child’s education and unhealthy food consumption ($r = -0.14, p = 0.002$).

**Child Hemoglobin Levels**

Table 8 reports child hemoglobin levels stratified by either age group, sex, or mother’s empowerment score. Analysis of variance with Bonferroni post hoc tests revealed that older children (12 to 17 months and 18 to 23 months) had significantly lower hemoglobin than children 4 to 5 months—no significant differences were found between other age group comparisons. Girls had significantly higher mean hemoglobin at

**Table 8.** Child hemoglobin levels by age group disaggregates, sex, and mother’s empowerment (n=521)$^a$

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean (g/dL) ±SD</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Age Group</td>
<td>5.79</td>
<td></td>
<td>0.001*$^a$</td>
</tr>
<tr>
<td>0 to 5 months$^b$</td>
<td>11.05±1.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 to 11 months</td>
<td>10.43±1.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 to 17 months</td>
<td>10.21±1.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 to 23 months</td>
<td>10.11±1.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child Sex</td>
<td>7.38</td>
<td></td>
<td>0.007*$^a$</td>
</tr>
<tr>
<td>Girl</td>
<td>10.49±1.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>10.17±1.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Empowerment Score$^c$</td>
<td>0.97</td>
<td></td>
<td>0.325</td>
</tr>
<tr>
<td>Low empowerment</td>
<td>10.38±1.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High empowerment</td>
<td>10.26±1.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$ANOVA with Bonferroni post hoc test conducted when applicable

$^b$In this study sample, the 0 to 5 months standard age group only includes children 4 to 5 months.

$^c$Low=0-2, High=3-9

*Statistically significant at p-value<0.05
10.49 g/dL (SD=1.25) compared to boys at 10.17 g/dL (SD=1.36). There was no significant difference found in mean hemoglobin between children whose mothers had low (10.38 g/dL, SD=1.30) or high (10.26 g/dL, SD=1.33) empowerment scores.

ASSOCIATIONS AMONG MATERNAL MARITAL STATUS, WOMEN’S EMPOWERMENT, AND CHILD OUTCOMES

Raw empowerment scores were highest in the single, widowed or divorced group (5.00±2.68) compared to those in monogamous marriages (2.96±2.07) and those in polygamous marriages (2.82±1.67) (p=0.033). However, there were no statistically significant differences among marital groups in meeting complementary feeding indicators, in low/high empowerment scores, nor in child hemoglobin levels (Table 9).

Table 9. Complementary feeding practices, child hemoglobin level, and women’s empowerment score by marital status

<table>
<thead>
<tr>
<th>Complementary Feeding (n=484)</th>
<th>Percent (Number) or Mean ± SD</th>
<th>χ²</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monogamous (n=370)</td>
<td>Polygamous (n=108)</td>
<td>Other* (n=6)</td>
</tr>
<tr>
<td>MDD</td>
<td>43.2% (160)</td>
<td>37.0% (40)</td>
<td>33.3% (2)</td>
</tr>
<tr>
<td>MMF</td>
<td>45.4% (168)</td>
<td>46.3% (50)</td>
<td>50.0% (3)</td>
</tr>
<tr>
<td>MAD</td>
<td>22.7% (84)</td>
<td>22.2% (24)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>EFF</td>
<td>59.2% (219)</td>
<td>60.2% (65)</td>
<td>66.7% (4)</td>
</tr>
<tr>
<td>UFC</td>
<td>50.8% (188)</td>
<td>53.7% (58)</td>
<td>50.0% (3)</td>
</tr>
<tr>
<td>ZVF</td>
<td>67.6% (250)</td>
<td>61.1% (66)</td>
<td>33.3% (2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Monogamous (n=394)</th>
<th>Polygamous (n=121)</th>
<th>Other (n=6)</th>
<th>χ² or Fb</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Hemoglobin (n=521)</td>
<td>10.29±1.30</td>
<td>10.42±1.33</td>
<td>10.45±2.19</td>
<td>0.49</td>
<td>0.62</td>
</tr>
<tr>
<td>Low Empowerment Score* (n=521)</td>
<td>50.0% (197)</td>
<td>46.3% (56)</td>
<td>33.3% (2)</td>
<td>1.1</td>
<td>0.58</td>
</tr>
</tbody>
</table>

*Single, divorced, or widowed

†Chi-square analysis conducted for categorical variables, ANOVA for continuous variables

*Low=0-2, High=3-9
CHAPTER FIVE: DISCUSSION

The findings of the present study are discussed here in regard to the original research questions and their implications.

SUMMARY OF MAIN FINDINGS

**Prevalence of Appropriate Feeding Practices**

**Breastfeeding Practices.** The breastfeeding practices of participants in the present study were mostly consistent with national reports in Senegal at the time of data collection in 2017. Breastfeeding at any time was almost universal (96%) in this sample but only 86.2% were currently being breastfed. This was comparable to other studies that have found breastfeeding to be widely practiced in Senegal. However, exclusive breastfeeding under 6 months was only found in 27% in this sample, compared to 42.1% of a national sample and 40.5% in the rural setting in 2017. This sample had a drastically lower prevalence of exclusive breastfeeding even when considering the rural setting of this study. Very few infants in this study were under six months of age (n=37) and of those who were, they were either four or five months of age. This could help explain the large inconsistency in exclusive breastfeeding under 6 months in the current sample versus the national prevalence. Still, the large gap between any current breastfeeding and exclusive breastfeeding in this sample for children below 6 months is consistent with previous reports from Senegal in which a majority of mothers would provide both breastmilk and plain water.

Continued breastfeeding for children 12 to 23 months remained high (78%) which was similar to previous findings (70.3% in 2017) from the Senegal Continuous Demographic Health Survey (DHS). As expected, continued breastfeeding was high
among the younger children, then dropped off steeply among children 20 to 23 months (28.2%). Introduction of solid, semi-solid, or soft foods for children 6 to 8 months was also consistent with previous findings at 70.3% (compared to 66.9% in 2017).  

**Complementary Feeding Practices.** Several findings related to complementary feeding practice indicators differed from findings in national reports. The prevalence of infants who met the MDD indicator was twice as high (41.7%) as the prevalence found in the DHS (20.3% in 2017). While it is important to note that the indicator changed slightly since the DHS was conducted (e.g., change from 7 to 8 food groups), seasonal fluctuations in the food market are likely a contributing factor. Though subsistence agricultural production contributes to household diets, purchased foods typically play a much larger role in dietary diversity. Food availability and food prices are influenced by the time of year depending on the dry versus rainy season in Senegal. Data collection in the present study was conducted in February to March, compared to DHS data collection which lasts many months and includes the lean season when food harvests are depleted. The food market fluctuates year to year as well, which may be caused by poor harvests due to droughts or delays in rainy season. On the other hand, a 2021 study in Matam, Senegal found that even in January to February (during the harvest/post-harvest season), a majority of households had less than four foods available in the household though more than 50 foods were available in the markets. These variables merit further efforts into what other factors would maintain dietary diversity throughout the year in this population.

Meeting MMF remains consistently low at 24.6% in this sample compared to 29.9% in 2017, but meeting MAD was much higher in our study at 22.3% compared with
previous reports at 7.9%. Since dietary diversity is one criteria of a minimally acceptable diet, the increased prevalence of MAD is an expected reflection of the much-improved MDD. Egg and/or flesh food consumption was at 59.5%, notably higher than previous reports of 42.6%. This inconsistency agrees with the increase in MDD, and suggests that these foods may have been more plentiful at the time of survey.

**Unhealthy Feeding Practices.** Contrary to the increase in dietary diversity, prevalence of zero vegetable or fruit consumption was also higher in this sample (65.7%) than previously shown at 52.3% in 2017 national reports. However, this finding is more consistent when accounting for the exclusive rural setting of the present study—previous findings which show disparity among rural versus urban areas in Senegal regarding zero vegetable or fruit consumption (60.3% versus 38.6%, respectively). Existing data regarding the new 2021 unhealthy food consumption (UFC) indicator is limited, and the present study is one of the first to report on this standard indicator in this population. Unlike the other new or modified feeding practice indicators which can be re-assessed simply based on existing dietary recall data, unhealthy food consumption was not routinely assessed as it was not included in any previous indicators. The high prevalence of unhealthy food consumption at 51.4% in this study sample suggests that this is reflected in the population as well.

The high prevalence of UFC and ZVF found in the present study has serious implications on multiple burdens of malnutrition in rural Senegal, namely micronutrient deficiency and overweight/obesity. Fried foods, sweets, and ultra-processed foods are often energy-dense, nutrient-poor, and high in salt, added sugars, and saturated fats. Increased consumption of these foods among infants and young children may be due to
caregivers considering their children’s pleasure or satisfaction over nutritional value. However, these foods may displace more nutritious foods such as vegetables and fruits, limiting intake of essential vitamins and minerals. Behavior change communication programs should therefore focus on addressing misconceptions about the healthiness of foods that are energy-dense but nutrient-poor. This should be an important issue for policymakers, as such practices can increase the risk of children becoming overweight or obese yet deficient in essential micronutrients early in life. Further work should investigate specific drivers of unhealthy feeding practices in order to support future policies and interventions.

**Examining Additional Factors of Child Outcomes**

Child age was found to be a significant factor related to complementary feeding practices, likely because older children are likely eating more in general. This is reflected in the MDD and MMF indicators, for which children 6 to 11 months were significantly less likely to meet each indicator compared to children 12 to 17 months and 18 to 23 months. However, the greater overall intake among older children does not completely explain this difference as this is already accounted for in the MMF indicator, which has an increased the threshold to meet adequacy for older children. It is possible that mothers are unaware of the need for dietary diversity among younger children (who are more likely to be still breastfeeding), or they may prioritize food for older children. For MAD, children 6 to 11 months were less likely to consume an acceptable diet as compared to children 12 to 17 months, but not children 18 to 23 months, contrary to what would be expected. The very low breastfeeding rate among older children in this sample may help
to explain this deviation from the expected results, because the criteria for adequate milk feedings for a minimally acceptable diet is increased for non-breastfeeding children.

The EFF indicator is the only indicator in which there was a significant difference among all three age groups—increasing age was found to be related to higher likelihood of meeting adequacy. Tougher flesh foods such as beef, poultry, and goat are typically considered appropriate only for older children starting at about 18 months.\textsuperscript{73} However, a 2018 study in Senegal found that most mothers reported that it was still only appropriate to feed softer animal products such as eggs or fish at about 10 months at the earliest.\textsuperscript{74} Multiple studies have noted that there is a cultural belief among several Senegalese communities that egg consumption will lead to delayed speech if a child has not yet started speaking, which may explain why these foods are not introduced earlier.\textsuperscript{74,75}

Although older children tend to be fed the appropriate complementary feeding practices, the trend is similar regarding the unhealthy feeding practices in this sample. Contrary to previous reports, older children 12 to 17 months and 18 to 23 months were more likely to have zero vegetable or fruit consumption compared to children 6 to 11 months.\textsuperscript{71} Several studies have investigated IYCF practices in Senegal, and revealed that mothers would typically only feed fruits/fruit juice, pureed potatoes/vegetables, milk, and porridge to infants around 6 to 8 months of age.\textsuperscript{73,74} Thus, these findings suggest that mothers may be providing vegetables and fruits to children based on consistency, and not nutritional benefit. Complementary to this, unhealthy food consumption was significantly more likely among children 18 to 23 months compared to children 6 to 11 months. Again, this may be a result of mothers considering foods by consistency over nutrition. This
could also suggest that children’s food preferences (actual and/or perceived by caregiver) change as they age, preferring sweet/fried foods over vegetables and fruits.

An interesting and unexpected finding was that girls were significantly more likely to be fed egg and/or flesh foods compared to boys. This could suggest that mothers with girls prioritized these foods more, or somehow had more access to these foods. This difference was not previously seen between boys and girls in nation-wide reports from Senegal, but it is possible that this practice is specific to the rural population.⁶⁷

**Anemia and Hemoglobin.** Prevalence of child anemia in the present study (66.4%) was consistent with the reported national prevalence (68% in 2019), but among children under 5 years of age.⁴ The 2012-2013 Demographic Health Survey examined the prevalence of child anemia in Senegal by further age disaggregation and found that anemia in children 6 to 23 months is typically even more prevalent, at almost 81%.⁸ Considering the age range of children in the present study (4 to 23 months), the prevalence of anemia is lower than expected based on the previous findings. This is likely related again to an improvement in dietary diversity—children who were fed a minimally diverse diet and children who were fed a minimally acceptable diet were significantly less likely to have anemia.

Interestingly, there was no significant difference in child anemia status related to EFF, contrary to the expectation that consuming egg and/or flesh foods would be protective against anemia. However, it is important to note that the quantity of egg and/or flesh foods were not assessed, as any quantity consumed is adequate to meet the EFF indicator.²⁸ In addition, there are other etiologies of anemia not related to iron deficiency—malaria is a common cause of anemia in infants and young children,
although prevalence of malaria in children under 5 years is low in Senegal (<1% in 2017) but varies by region. Other potential causes of anemia are genetic blood disorders and obesity, though less likely in this population. Pre-term birth and the timing of umbilical cord clamping are also known to affect iron stores for up to 6 months post-birth.

Girls had significantly higher mean hemoglobin levels compared to boys, which is consistent with our findings that girls were more likely to be fed egg and/or flesh foods. Even so, mean hemoglobin for both groups still fell within the mild anemia category, again suggesting that meeting the EFF indicator is not protective against anemia. Young boys may be at greater risk of low hemoglobin due to a factor independent of egg and/or flesh food consumption, as previous assessments found that boy infants had consistently lower iron stores and higher rates of anemia than girl infants. Gender norms and cultural practices may also be contributing to differences in anemia in this sample, warranting further investigation.

Children younger than 6 months of age had significantly higher mean hemoglobin compared with any other age group, and mean hemoglobin levels trended down with increase in child age. This appears to contradict the greater prevalence of egg and/or flesh food consumption among older children, but is likely related to the depletion of iron stores. Around this age, body iron stores are depleted as iron demand is increased due to growth and expansion of blood volume.

Breastfeeding is protective against anemia before 6 months of age, but predominant breastfeeding beyond 6 months increases risk of iron deficiency anemia. Breastmilk has minimal iron that is highly bioavailable, but breastmilk alone is not enough to meet increased iron demands past 6 months, hence the need for complementary
Iron deficiency anemia could be further exacerbated by the addition of complementary foods which inhibit/compete with iron absorption.

The prevalence of household food insecurity (38.6%) was consistent with national reports (40.7% in 2018). As expected, children who were fed a minimally diverse diet and children who were fed a minimally acceptable diet were also significantly more likely to be food secure. Interestingly, there were no significant differences in EFF, UFC, nor ZVF among children from households with secure/mild insecurity and moderate/severe insecurity. Again, this suggests mothers may prioritize providing egg and/or flesh foods even if food insecure. This also implies that food insecurity does not deter unhealthy food consumption in this population. In addition, food security alone is likely not a driver of vegetable and fruit intake among subsistence households in rural Senegal. Subsistence farmers generally have access to some food security based on their livelihoods even in periods of less income or food availability at the community level—however, subsistence production is more important for staple foods such as cereals and tubers as opposed to vegetables, fruits, or flesh foods.

**Associations between Women’s Empowerment and IYCF Practices and Child Anemia**

Of the empowerment survey items taken directly from Demographic Health Survey Program (decisions on own healthcare, major household purchases, and visiting family/friends), the women in the present study reported lower frequency of participating in these decisions compared to reports from 2010-2011 DHS data. In a study investigating women’s empowerment in sub-Saharan Africa based on DHS data, Senegalese women more frequently reported being uninvolved in decision-making,
experiencing violence, and supporting violence compared to six out of eight other polygamous West African countries. Again, this data is intended to be nationally representative of Senegal—however, it has been shown that women in agriculture and rural areas generally have less access to productive resources and opportunities (education, financial services, etc.), so the lower empowerment of the participants in the present study is logical.

The results of both unadjusted and adjusted logistic regression analyses suggest that the selected women’s empowerment items were not predictors for meeting IYCF practice indicators, contrary to our hypotheses. The unadjusted analysis suggested that mothers having access to personal finances was a predictor for feeding their child a minimally diverse diet. However, this association was not statistically significant after controlling for confounders in the adjusted analysis. It is important to note that there was no income data available in this study and therefore we could not adjust for it in the regression analysis, even though it is known to affect child outcomes.

These analyses suggest that empowerment alone is not a driver of appropriate child feeding practices. An unclear relationship between women’s empowerment and child feeding practices is likely due to the ambiguous nature of how to measure empowerment. Previous findings on the relationship between women’s empowerment and feeding practices showed mixed results and each study, including the present study, rarely utilizes the exact set of items to assess an empowerment score. In addition, a recent 2021 study found that household survey assessments of women’s empowerment may not have as meaningful results as previously thought. Based on DHS data across 23 countries in sub-Saharan, nearly half of spouses in sub-Saharan Africa disagreed on
who made household decisions. The authors concluded that there is a difference between being delegated power versus “taking” power by declaring their own ability to make decisions, though the DHS is likely not sensitive to this difference.\textsuperscript{86}

However, there were some significant correlations between specific items of empowerment and feeding indicators. The more the mothers could control personal income or control their child’s education, the less likely they fed unhealthy foods to their children. This may suggest that providing unhealthy foods to their children is a product of being unable to make decisions on behalf of their children, and lack of better food options because of limited personal resources.

There was also no significant difference in child hemoglobin levels among mothers with low or high empowerment scores, with a surprising trend of higher mean hemoglobin in children of mothers with lower empowerment. This implies that although child anemia is a severely prevalent issue in this population, it is not closely linked to the empowerment domains explored in this study.

**Differences Among Martial Status Groups in Empowerment and IYCF Practices**

Less than a quarter of mothers in this sample were in polygamous marriages, compared to DHS data from 2010-2011 which reported 35\% of marriages being polygamous.\textsuperscript{51} The original hypothesis that women in polygamous marriages were more likely to have lower empowerment as well as poorer child outcomes was not supported in this study’s findings. Although there was no significant difference in empowerment among marital status groups, this could be related to overall low empowerment of women in this sample independent of marital status, reflective of what has been previously found in this population.\textsuperscript{23,25} These findings also suggest that although multiple wives/mothers
within a polygamous marriage may often need to share resources, this does not affect the likelihood of meeting IYCF practice indicators.24,56

**Strengths and Limitations**

The exploratory nature of this secondary data analysis study has several strengths and limitations. As a secondary data analysis, the research questions of this study were developed after data collection was complete—namely, this study was not designed to investigate the specific relationships of interest. While this circumvents researcher biases on the present research questions during data collection, it also did not allow for the opportunity to survey participants on every variable of interest such as income. Income is difficult to assess in household surveys because it can fluctuate by seasonal factors, particularly for subsistence farmers.87 The survey recall period is likely not extensive enough to be helpful in this context. Using retrospective data also necessitated a modified empowerment index rather than a previously validated instrument. Data was self-reported (except for hemoglobin measurements) and relied on 24-hour recall, leading to potential response bias or recall bias from participants.

The UNICEF and WHO recently updated their indicators for assessing infant and young child feeding practices, and therefore several indicators examined in the present study may differ from previous studies.28 Using the new 2021 IYCF indicators can be a potential limitation since the present study is not directly comparable to many existing studies. However, it is also a strength to be an early study investigating the new indicators and their implications, especially within a specific population. There are many other strengths within the present study. The large sample size, though not guaranteed to be reflective of the whole population, provides statistical strength and can ultimately
allow for stronger conclusions. However, it is important to note that it is not possible to investigate causal relations due to the cross-sectional design. Current national reports examine differences in feeding practices among rural versus urban populations and among child age groups, but this study pinpoints specific trends exclusively among the rural population. The disparity in child outcomes and women’s status between rural and urban populations is well-known and highlights the importance of the present study which contributes to the literature focusing on rural communities.38,64,71

**Directions for Further Research**

There are many directions for future research based on the present work. The concerning prevalence of the new UFC and ZVF indicators merit further research to investigate the determinants behind unhealthy feeding practices among infants and young children in this population. On the other hand, the increase in meeting MDD is also deserving of additional research on seasonal food availability and how it affects not only food security, but also the dietary diversity of what caregivers provide to children.

The relationship between women’s status and IYCF practices is complex and could not be well-established in this study, nor those before it. Empowerment ideally allows greater freedom of choice, but knowledge and resources may be a greater limiting factor to appropriate IYCF practices in many cases. In addition, empowerment is very context-specific, so perhaps the most useful direction would be following up with qualitative research such as focus groups to evaluate what interventions would most impact child nutrition in this population.
Conclusion

The present study contributes to the growing body of literature on the relationship between women’s empowerment, infant and young child feeding practices, and child anemia in the unique context of rural Senegal. Our findings further uncovered the severity of inappropriate IYCF practices, child anemia, and low women’s status in this population. The current research suggests that there are greater underlying determinants in the food and social environments which must be first addressed. Future work should focus on the development of IYCF interventions specific to rural and agricultural settings that ultimately confront both gender inequalities and poor child nutrition.
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