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Exploring Dietary Diversity and Its Associated Factors within Household and Child Populations in Bihar, India

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Exploring Dietary Diversity and Its Associated Factors within Household and Child Populations in Bihar, India

By

Erica Dawn Lee
B. S., Howard University, 2011

Thesis Committee Chair: Melissa Young, PhD.

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Health
2016

Abstract

Exploring Dietary Diversity and Its Associated Factors within Household and Child Populations in Bihar, India

By Erica Lee

The prevalence of child malnutrition in Bihar, India is amongst the highest in the country. [39] Poor child feeding practices and food insecurity are common causes of malnutrition in India. Consuming a diverse diet and micronutrient rich foods are critical to meeting high nutrient demand for young children. The household dietary diversity scale, HDDS, and child dietary diversity scale, CDDS, are a proxy for dietary nutrient adequacy and potential determinants for proper child nutrition. Data collected in West Champaran, Bihar, India on the household and child level were used to explore the dietary diversity and its associated factors.. Food group consumption patterns were also examined. Chi-square and multivariate logistic regression were used to examine the correlations and associations. Meat, eggs, and fruits and vegetables high in Vitamin A were consumed in low quantities (< 15.6%) on both the house and child level. Sweets (74.9%) and dairy (99.5%) were consumed more frequently among children; while other fruits and vegetables (85.6%), oils (90.1%), and legumes (54.63%) were consumed at higher rates in the households. Only 45.6% of HH and 19.6% of children meet the criteria for minimum dietary diversity. Children in households with adequate dietary diversity were 3.4 more likely to be meeting the dietary requirements. CDD was positively associated with socioeconomic status, the age of the child 2.6 (2.2,3.2), maternal nutrition knowledge 2.2 (1.2,3.1), caste, and Anganwadi home visits 1.5 (1.2, 1.8). To induce positive change on child intake, nutrition education should be the focus of health education by Anganwadi workers. Education should be centered on feeding young children all family foods and feeding children a diverse diet, 4+ food groups a day, once complementary feeding has initiated. Targeted programming is necessary to improve the nutrition status of child living in Bihar.

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Acknowledgments

I would like to thank my family for their encouragement and support. You have supported me through all my academic endeavors. This paper was no exception. I would also like to thank my thesis advisor, Melissa Young, for guidance through the entire thesis process. Lastly, I would like to thank the friends that I have made at Emory University, Without your endurance, support, and jokes I would not have been able to write one page, so thank you for simply being there.

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Introduction

Childhood malnutrition can have profound detrimental effects on the long-term health of a child. The inadequacy in sustenance leads the body to reserve stores, capitalizing the nutrients needed for proper growth and development. [5] Studies show that chronic lack of adequate food intake can lead to a reduction in IQ, linear growth, and reduced fat and muscle.[25] The significance of malnutrition is most pertinent within the first 1000 days of a child's life. Growth failure within the first 1000 days has permanent consequences on the height and mental cognition of the child, which ultimately can impact productivity and health during adolescence and as an adult. [5, 25]

In areas wherein malnutrition is heavily present, its effects can be seen in the prevalence of low literacy, high levels of poverty, and poor maternal and infant health outcomes. Individuals whom are chronically malnourished as children are more likely to learn less in school and live in poverty as an adult.[5] In addition to impeding growth on an individual level, malnourishment during childhood affects the macro-economic level of a society. [44] Human development is highly correlated with economic growth. [12, 34] In a study exploring the interconnectedness of human development and economic development areas where poverty is omnipresent displayed stagnate growth in GDP.[34] The lack monetary resources influence individual's spending making them less likely expend the money they do have on local businesses.[34] The lack of economic growth can inhibit human development through low secondary school enrollment and low health advocacy.[34]

In India, Bihar has some of the highest rates malnutrition and lowest economic growth. Bihar has the third highest population in India at 95.8 million with the lowest GDP per person countrywide at $1,019 per year.[39] Simultaneously, Bihar has a maternal mortality rate of 219 per 100,000 live births as compared to the country average of 178. [39] The rate of infants born under 2.5g is 21.9%. [39] The regional rate of stunting and wasting among children under the age of 5 are 55.6% and 27.1%. [39] The statistics suggest an inadequacy in health care and nutrition. To improve the health outcomes and potentially the economic status within Bihar, steps need to be taken to address malnutrition levels.

Increasing the nutrition status of the population is an intervention that could raise population mental cognition and physical growth. Assessing dietary diversity is a method of predicting nutrition status. [37] Dietary diversity, DD, is the measure of food consumption that can act as a proxy for nutritional adequacy in the diet of individuals and also be a reflection of adequate food access within a household. [22, 37] DD is pinpointed by recalling foods eaten in the previous 24-hours. The foods in the questionnaire are categorized in to food groups. Dietary diversity is calculated through the dietary diversity score, DDS. The DDS is the tool used to measure the level to which an individual or household has a diverse array of foods in their diet. [22, 37]

Purpose of Study

The goal of this paper is to explore dietary diversity, DD, on the household and child level in Bihar, India. Understanding DD on a household level predicts the level of food access and nutrients consumed by the family. The child level examines the quantity of nutrients given to the child and the beliefs of the caregivers in terms of what should be fed to a child. Knowledge of

the DDS on the HH level can assist in informing stakeholders on the nutrients consumed and not consumed in their communities, level to which certain foods are available in their communities, and lead to knowing where the prevalence of the most and least food diversity exists. On the child level, it could lead to implications on the content needed to be taught to mothers. Additionally, making a comparison between the child dietary diversity and household dietary diversity can lead to understanding the effects of HDD on CDD. Making these determinations could give way to creating focused and effective nutrition interventions that reduce nutrient deficiencies and potentially increase regional human development.

Research Gap

In India, there has been extensive research on food security related issues. Food security at the national level is continually monitored by international organizations, i.e. the International Food and Nutrition Policy Research Institute. [16] Household food security has also been explored. [6] However, there has been limited research on the food access portion of food security and its relationship to child dietary diversity and complementary food practices in Bihar. Studies have been conducted exploring individual nutritional status and the household food security. [1, 29] Yet, little has been done to explore the similarities and differences consumption patterns of two different entities within the same household in Bihar, India. This paper aims to fulfill this gap through analyzing food intake of households and child 6-18 months; comparing and contrasting and examining the determinants of dietary diversity.

Research Question

What are the key determinants of dietary diversity for the household and for the child in Bihar, India?

Objectives

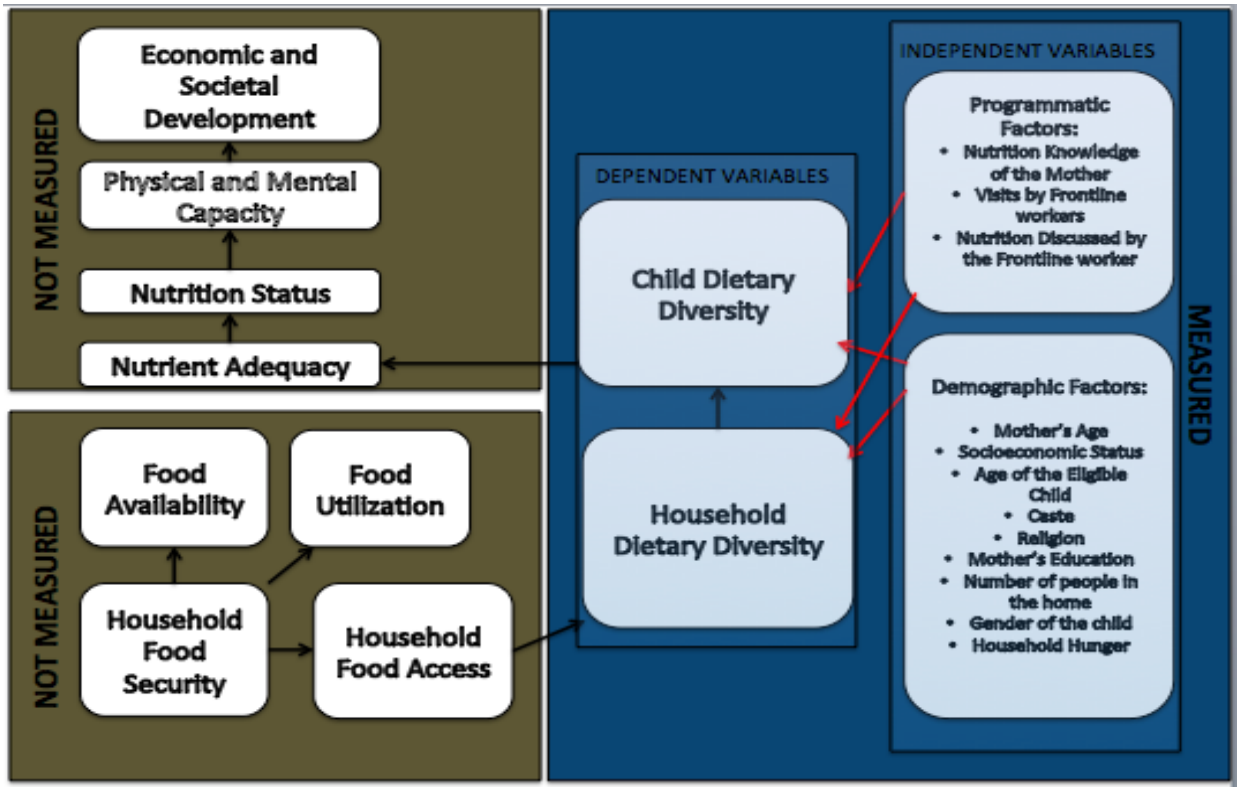
1. To explore the diversity of foods consumed at the household and child level in Bihar, India in an effort to understand the spectrum of consumption in households and for children.
2. To describe DDSs at the household and child level in Bihar, India.
3. To determine what factors area associated with household DDS and child DDS.

Literature Review:

Conceptual Framework

The conceptual framework, Figure 1, is an illustration of the major concepts examined in this paper. The framework was created with influence from previous models by Unicef, WHO, and IFPHI. Unicef and WHO noted strong links between child malnutrition and household food security; while IFPHI, illustrated the pathway between nutrient adequacy and economic and societal development. [7, 9, 40] Food security, nutrient adequacy, nutrient status, physical and mental capacity and economic societal development were not directly analyzed in this paper; yet, they are interconnected with both measures of dietary diversity.

Figure 1: Conceptual Framework



Food Security

Food security "is achieved when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and foods preferences for an active and healthy life. **"[45]**Attaining food security in any setting requires that its three pillars are satisfied, resulting in sufficient food in quantity and quality.[3] The 3 pillars include food access, food availability, and food utilization. Food access is when a population can physically obtain food that is culturally appropriate, safe to consume, and is economically accessible. [20] Food availability refers to when a population has food physically available. [20] Food utilization is in reference to how the food is being prepared and when it is consumed if it is properly being absorbed by the body.

Measuring food security can occur at the global and national level, macro, or the community, household, or individual levels, micro. [9] It was previously believed that if food security was attained at the macro level then communities and households would reap similar benefits. [3] This presumed tickle down effect has shown to be non-existent in developed and developing countries alike. Take the United States for instance. According to the Economist, as a nation the United States ranks in number 1 in food security yet 48 million people, 14% of the population, in 2013 qualified as food insecure. [41, 43]

Differing food security statuses is an indication of external factors, such as class and gender, impacting food accessibility, availability, and utilization. [6] Accounting for associations between influences, such as class and gender, and food security gives a comprehensive interpretation of food secure or insecure environments. Understanding this permits policy makers

to 1) avoid making assumptions about a populations status and 2) target the factors potentially preventing adequate food consumption. [3]

Amid its complexity, proper evaluation of food security at the macro and micro levels involve tools that are sensitive to access, availability, and utilization. [19, 20] The toolkit is constantly evolving in an effort to produce methods that are highly sensitive to the targeted concepts. [20] 17 tools are presently used in the field. [20] The metrics span from food balance sheets, necessary for national data acquisition, and the household hunger scale. [20] Full evaluations of food security require multiple tools used in concert. For instance in Uganda, the food security index and household dietary data together grasped the three pillars. [4] A study in Bangladesh, Ethiopia, and Vietnam employed the Household Food Insecurity Access Scale and anthropometrics. [1]

Food Security in an Indian Context

India has experienced booming economic growth since the 1990's. [30] Unfortunately, population level nutrition related issues have not undergone the same positive expansion. India is presently experiencing a triple burden of malnutrition characterized by the coexistence of micronutrient deficiencies and inadequate caloric intake in large sections of the population, with obesity and the pervasiveness of chronic disease within other sections of the populous. [30] Additionally, 25% of the world's population of hungry people are located in India and it was estimated that 43% of Indian children 5 years or younger are malnourished.[18] Various factors have been attributed ubiquitous malnutrition, with food security being credited as one of the main contributors. [30]

Food security within India is in a contradictory state as a large portion of the population are seemingly not ingesting adequate food, as evidenced by 43% of Indian children 5 years or younger are malnourished, yet growth rates of grains have expanded exponentially in recent years. [15, 18] The paradoxical existence in India has been suggested to be attributable to three main causes, 1) stagnate implementation of the National Food Security Act by government officials coupled with improper maintenance current food distribution programs, 2) poor purchasing power, caused by rises in food prices, and low food availability, and 3) socio-demographics which includes education, unemployment, and gender bias. [28, 30, 42] Limited food access is at the crux of India's lack of success in universal food security. [30, 42]

The inhibitors of food access are especially evident in the rural areas of India. Rural India, generally, has seen slowed economic growth as compared to urban areas. [42] In an area heavily dependent on agrarian practices for sustenance, a combination of low grain output, little improvement agricultural technologies and facilities, climate change, lack of education, and supplemental job opportunities has left the population vulnerable . [42]

Evaluation of food security in India is continuously monitored on the national scale, as in the case of the International Food Policy Research Institute food portal, and in some instances regionally. [18] Regionally, through utilization of the Household Food Insecurity Assess Scale, a study found that in a north Indian population (n=250)77% were food insecure[6] The same was true for a study conducted in Tamil Nadu were 61.5% of the 130 surveyed households were food insecure. [10]

Fighting Food Insecurity in Bihar

Creating a food secure India that effectively targets food access involves addressing the causal factors of insecurity. The public distribution scheme, providing mid-day meals, and a national food security mission are amongst the past tactics by the Indian government. [28] In the state of Bihar, the government has made efforts to address food security through partnering with the Bill and Melinda Gates Foundation to implement the Ananaya project. [17] Ananaya is a 5-year multi-organizational project aimed at increasing the overall health and access to health services for the Bihar people. [17] Within Anaya, improving child nutrition and complementary feeding practices is being headed by CARE international in partnership with Emory University. [17] CARE developed a program to provide enhanced training, job aids and improve the counseling skills of local health front line workers, FLW's.. In fact, the success of the program is largely dependent on the work of the FLW's. [17] The collaborative efforts of Emory, CARE and the Government of Bihar are aimed at improving stunting and wasting throughout the Bihar region. [17]

Food Access and Household Dietary Diversity

One focal point of this thesis is targeted at interpreting one pillar of food security in Bihar, India, food access. Additionally, this paper only seeks to assess food access on the household level. Household dietary diversity, "the number of food groups consumed at a given reference period ", is an apparatus sensitive to the food quality component of food access, and was one of the primary tools used in this paper's methods.[14, 33] The narrow capacity of the household dietary diversity scale lends itself to both strong validity and an inability to encompass the whole of food access. The tool is not able to adequately identify if the foods eaten are safe to consume or

culturally appropriate.[23] To this effect, the implications of the thesis results can only be interpreted within the measurement scope of household dietary diversity.

Household Dietary Diversity Scale

The household dietary diversity scale, HDDS, is an easy to use and malleable index developed by USAID. [37] The easy to use nature of HDDS supplements complex data collection tools, i.e. food frequency questionnaires. [14] The 12 item questionnaire allows for use in low resource areas where alternative methods can be time consuming and expensive. [14] Being that diversified diets are, independently, an important outcome, associated with improved child and adult anthropometric measures, and correlated nutrition adequacy and household income, HDDS's simplicity still allows for it act as a proxy indicator for food access. [37]

HDDS is comprised of 12 standard food groups. The groups serve as a foundation for adaption of the scale to various contexts and countries. This adaption is critical to HDDS's validity. [37] Prior to HDDS usage, researchers must conduct formative research to understand the cultural specific words used for each of the 12 food groups. [37] For instance, the data used for this paper includes dal in the legumes/pulses/nuts food group..

Child Dietary Diversity Scale

Household food access is not a given representative of the food consumption patterns of all a home's inhabitants. The individual dietary diversity scale is alternative tool that is sensitive to individual food intake. Contrary to HDDS, IDDS serves as a proxy indicator for nutrient

adequacy.[22, 36, 37] IDDS can be specified in to women's IDD or child's IDD. This thesis centers on child dietary diversity, CDD.

Like the straightforwardness of the HDDS, the CDDS is comprised of 7 food groups.[46] The CDDS is a component of a larger set of tools created by the WHO.[46] The collective purpose of the mechanisms were to accurately measure breastfeeding and complementary feeding practices of children aged 0-23 months.[46] Prior to the guidebooks creation there was not a standard tool used to account for complementary feeding practices. [46] WHO's aim was to establish tools that could gauge complementary feeding practices across different contexts.[46]

Determinants of HDDS and CDDS

Similar to food security, HDDS and CDDS are partial to external determinants. The consumption of a diverse diet is interconnected with the surrounding environment. Demographics such as household income, mother's education, socioeconomic status, property ownership, and to some extent religion, family-size, and women's decision making power are permanent fixtures in past studies exploring outside factors influencing dietary intake in middle – low income countries, including India. [6, 13, 26, 31, 38] Program-oriented determinants, i.e. nutrition education and visits by frontline workers, also influence the uptake of a diverse diet.[13, 31]

Socioeconomic status, property ownership and income of the household have been shown to be positively linearly correlated with diverse food intake.[6, 13, 31, 38] The more monetary and capital resources available the higher the odds for diverse food access. Mother's education has had mixed results as to its effects on food intake. Mother's education has been shown to have no profound effect on dietary diversity.[31, 35]Yet, contradictory studies note the when mother's

education is grouped into illiterate and literate there is a significant positive association between increased literacy and increased dietary diversity.[13]

Religion, maternal knowledge of food diversity, number of people living in the household, age of the mother were determinants Religion, measured by comparing Hindi and Muslim, in a rural Bangladeshi population was not significantly associated with dietary diversity. .[13] In a study comparing maternal dietary diversity and child dietary diversity in Bangladesh, Vietnam, and Ethiopia, maternal knowledge of food diversity had no significant effect. [31] Number of people living in the home and female decision making power both had a null association with household dietary diversity. [13, 26, 35, 38]

Programmatic determinants of food security, such as maternal nutrition knowledge, had overall null results across multiple studies. Maternal nutrition knowledge of food dietary diversity was shown to be null.[31] Moreover maternal knowledge of general under-nutrition prevention strategies and general nutrition had no associations with elements of food security.[13, 31]

Household Hunger Scale

Household Hunger Scale is not a factor traditionally assessed in previous studies. Yet, its addition to this paper was appropriate for comparing HDDS and CDDS with extreme cases of food insecurity. The Household Hunger Scale was a tool created by the Food and Nutrition Technical Assistance Project. [2] The purpose of the instrument was to measure cases of extreme food security in a developing nation context.[2]

Methods:

A quantitative approach was used to assess the dietary diversity of households and children living in Bihar, India. Data source was a 2014 baseline data questionnaire conducted by CARE India and Emory University in a study exploring the use of micronutrient powders in 4360 children age 6-18 months.

Quantitative

Baseline data was collected from West Champaran district in Bihar. Demographics, socioeconomic status, and child feeding practices were the foci of the questions in the instrument. The 24 hour-recall contained 12 questions pertaining specifically to household DD and 19 questions pertaining specifically to the child DD.

Sampling

The baseline questionnaire was part of a larger cross-sectional cluster-randomized study in West Champaran Bihar that was aimed at evaluating the program effectiveness of multiple micronutrient powders in Bihar among children 6-18 months of age. The ages of the children were the inclusion criteria utilized. For the reminder of the paper the children included in the study will be identified as eligible children.

The four blocks chosen in West Champaran were randomly sampled. Within the four blocks, 70 health sub-center clusters were randomly sampled. For reference, health sub-centers, HSC, are community hubs in mostly rural areas of India where community members can receive vaccines, health information, etc. From each HSC, 62 households with eligible children were randomly sampled. Only one child per household could be included in the study. The children were

stratified by age, resulting in 31 of the households had children between the ages of 6 and 12 months and 31 of the households with children between the ages of 12 to 18 months.

Dietary Diversity Score

The dietary diversity score (DDS) is the measure used calculate the variety of foods eaten in a given individual and/or population. Household dietary diversity score (HDDS) and child dietary diversity score (CDDS) were two types of measurements utilized. HDDS measures the household food access. The standard number of food groups for HDDS are 12. CDDS measures the estimated amount of nutrients consumed by a child. The CDDS contains 7 standard food groups.

Both the HDDS and CDDS were calculated separately through adding the number of foods groups reported to be eaten in the household or by the child in a 24hr period. To obtain the appropriate DDS, the food groups from the baseline questionnaire were reformatted. For the HDDS the food groups were as follows: cereals, foods high in vitamin A (orange, yellow, and dark green colored vegetables), white colored tubers and roots, dal and legumes, fruits high in vitamin A (orange, yellow, and dark green colored fruits), other fruits and vegetables (fruits and vegetables which do not classify as being high in vitamin A or white tubers and roots), organ meats, flesh meats, eggs, nuts and seeds, milk, and oils. HDDS scores ranged from 0-12. The food groups for the CDDS were: Grains/Roots/Tubers, Vitamin A Rich Foods, Other Vegetables/Fruits, Meat/Poultry/ Fish/Seafood, Eggs, Pulses/Legumes/Nuts, and Milk/Milk Products. CDDS scores ranged from 0-7.

Asking about the consumption of the household and individual in the same questionnaire can be confusing for a participant. Therefore, it is key to word the questions in a clear and

concise manner. In this study's instrument the questions were worded as such: "I would like to ask you about the types of foods that you or anyone else in your household ate yesterday during the day and at night?" and "Yesterday during the day or night, did (NAME) drink/eat any (FOOD GROUP ITEMS)?"

Being that dietary diversity is an index measurement, there is no defined "good" score of DDS.[22] A good DDS is dependent on the average score given in the group of people being examined.[22] Although no "good" measure exists, it is standard practice that and dietary diversity score of 4 is representative of a diet that has the adequate amount of nutrients**.[21, 46]** For the purpose of the analysis of the data in Bihar, the same standards were used. Through using SAS, the minimum for children and households DDS were pinpointed.

A limitation with DDS is that the score does not specify what foods are being predominately eaten in each score. For instance, a household could be said to have a low DDS but the foods they are eating are legumes, vegetables, and milk. While another family could score a minimum DDS and be consuming fruits, bread, fat, and vitamin A foods.

Data Analysis

SAS was the quantitative platform used for all quantitative data analysis. The basic descriptive statistics for the population were obtained using a combination of univariate analysis and frequency. Using basic frequency commands in SAS, the individual foods eaten by the household and by the child 24 – hours prior to the survey being taken were identified. The foods which were included in the frequency analysis for the household were: Cereals, Roots and Tubers/Vegetables/Fruits high in Vitamin A, other Roots and Tubers/Vegetables/Fruits,

Meat/Poultry/Fish/Seafood, Eggs, Pulses/Legumes/Nuts, Milk/Milk Products, Oils/Fats, Sugar/Honey, and Spices. Amid the foods eaten by children 24 hours prior, the foods which were included were: grains, nuts, dairy, eggs, meat (includes fish, chicken, and goat; beef was excluded due to cultural practices), foods high in vitamin A (orange, yellow, and dark green colored fruits and vegetables), sweets, oil, and condiments. The percentage of foods consumed was recorded for the household and child consumption.

To obtain the dietary diversity scores, the foods recorded were summed separately by household and child. For each participant, the foods consumed in the household were combined to create the HDDS. For the child, the food consumed by the eligible child in each home were combined together to create the CDDS. Achieving minimum dietary diversity, as defined as a dietary diversity score of greater than or equal to 4, was the primary outcome for the data analysis. As mentioned, a dietary diversity score of 4 has shown to be least number of foods needed to be consumed in order to obtain the nutrients necessary for proper growth and maintenance of life. Both the HDDS and CDDS used 4 as the threshold for reaching the minimum dietary diversity.

HDDS and CDDS were compared against selected variables. Multivariate logistic regression analysis was used in the comparison of the outcome of interest against the selected variables. The variables chosen were based on two factors. The first was if the variable was related to the CARE study's programming sector. At the time the survey was administered each of the mothers was the recipient of Infant and Young Child Feeding practices education from Ashas and Anganwadi workers whom periodically visited the communities. The programming variables were related to the education being given by the health workers. They included: the number of

times the Ashas visited the home, the number of times the Anganwadi workers visited the home, the specific topics the Ashas and Anganwadi workers spoke about, and the knowledge that the mothers had regarding the foods that they perceived where appropriate for their child to eat. Mother's nutrition knowledge was measured by the number of foods that the mother indicated should be eaten by the child. The question in the survey was worded as such "What should (type of food) be given to a child?" The answer options were yes, no, spontaneous, and don't know. The foods that were asked about included: dal, roti, green vegetables, fruits, animal foods, dairy, egg, oil, biscuits, and sugar. A new variable was created which measured the number of foods that they believed their child should eat. A score of 1 was given food if the mother responded yes or spontaneous to the question, while a 0 was given if the mother responded No or Don't Know to the question. Missing answers were counted as missing. The answers were summed together to create a new variable. The new variable was as follows: for every mother who answered yes to 3 or less of the foods the number 0 was assigned, for mother who answered yes 4 or more to the foods they were given the number 1. The number 4 was given to correlate with the child dietary diversity scores. The objective for choosing the specific variables was to measure if the programming being given was having a positive, neutral, or negative effect on child dietary diversity.

The second factor considered in the selection criteria for the variables were factors that were a part of the household's demographics. These variables were chosen to see if certain elements that were relatively stable in the household could be predictors of the quality of foods that household members consumed. The specific variables used were the following: socioeconomic status, the number of people in the home, the mother's literacy, dad literacy, the age of the child, the

eligible child's gender, age of the mother, family's religion, family's caste, and the household hunger scale.

The SES is a composite variable comprised of a combination of household amenities (toilet, wash room, etc.) and assets (possession of animals). The literacy of the father and mother were created through separating the education of mother and dad to those who are illiterate and those who had attended some school. The household hunger scale was the compilation of three survey questions. The scale using a scoring system to determine if a household is food secure, moderately food insecure, and severely food insecure. The system is as follows: 0-1 indicates that a household food secure, 2-3 indicates that a household is minimally food insecure, 4-5 indicates that a household is severely food insecure**. [2]**

Prior to comparison of the variables to dietary diversity, basic statistics were explored. The basic statistics for the categorical variables were retrieved using frequency analysis. The frequency in percentage was recorded. Dad literacy, mother literacy, the gender of the child, socioeconomic status, religion, and caste were all categorical variables. The basic statistics for the continuous variables were retrieved using univariate analysis. The mean was recorded, as well as skewness. In addition to the two measurements mentioned, the continuous variables normality was also studied. The age of the mother, the age of the child, and the number of people within the family, were the continuous variables. In addition to obtaining the descriptive statistics, the SES was compared to the specific foods consumed in the population. The tertiles of the SES were compared to each food group eaten by the household and the child.

All of the factors listed were compared against the minimum dietary diversity. For the categorical variables, the chi-square measure was noted to determine if a correlation existed. The Pearson's correlation was used to determine if a correlation existed between the dietary diversity and the continuous variables. P-values < 0.05 were considered significant.

Four types of models were created using multivariate logistic regression. The initial model was a looking at the minimum dietary diversity compared to the socioeconomic status score. Comparing the programming variables with the minimum dietary diversity was the next model constructed. The third model was comprised of the demographic variables. The final model was a combination of the SES the programming variables, and the demographic variables. No selection for any of the models was utilized. The odds ratio and p-values were recorded. A p-value of <0.05 was considered significant.

Limitations

The methods used were privy to limitations. One limitation was that the data was collected through a questionnaire, the information that was record was completely based upon the recall of the participant. Therefore, the information given was perhaps prone to recall bias. Another limitation was length of the survey. Those taking the surveys were mothers, thus they may have been busy and needed to tend to children and other concerns.

Results:

The basic characteristics of the population are described in Table 1. The mean age of the mothers interviewed was 25.2 years old. The average age of the children was 11.3 months old. 49.7% of the eligible children were female, as compared to 50.3% whom were male. Hinduism and Muslims were the prominent religions, accounting for 78.1% and 21.2%. The reminder of the religions included Christian, Buddhist and others, which collective totaled 0.09% of the surveyed population and thus were not included in final model due to small sample size.. Scheduled Caste, Scheduled Tribe, OBC, and others were the castes asked in the survey. Scheduled Caste comprised of 25.2% of the population, Scheduled Tribe was 8.3%, OBC was 50.5%, and 16.0% were other none specified castes. The illiteracy rate amongst the mothers was 60.1%. The fathers had an illiteracy rate of 36.1%.

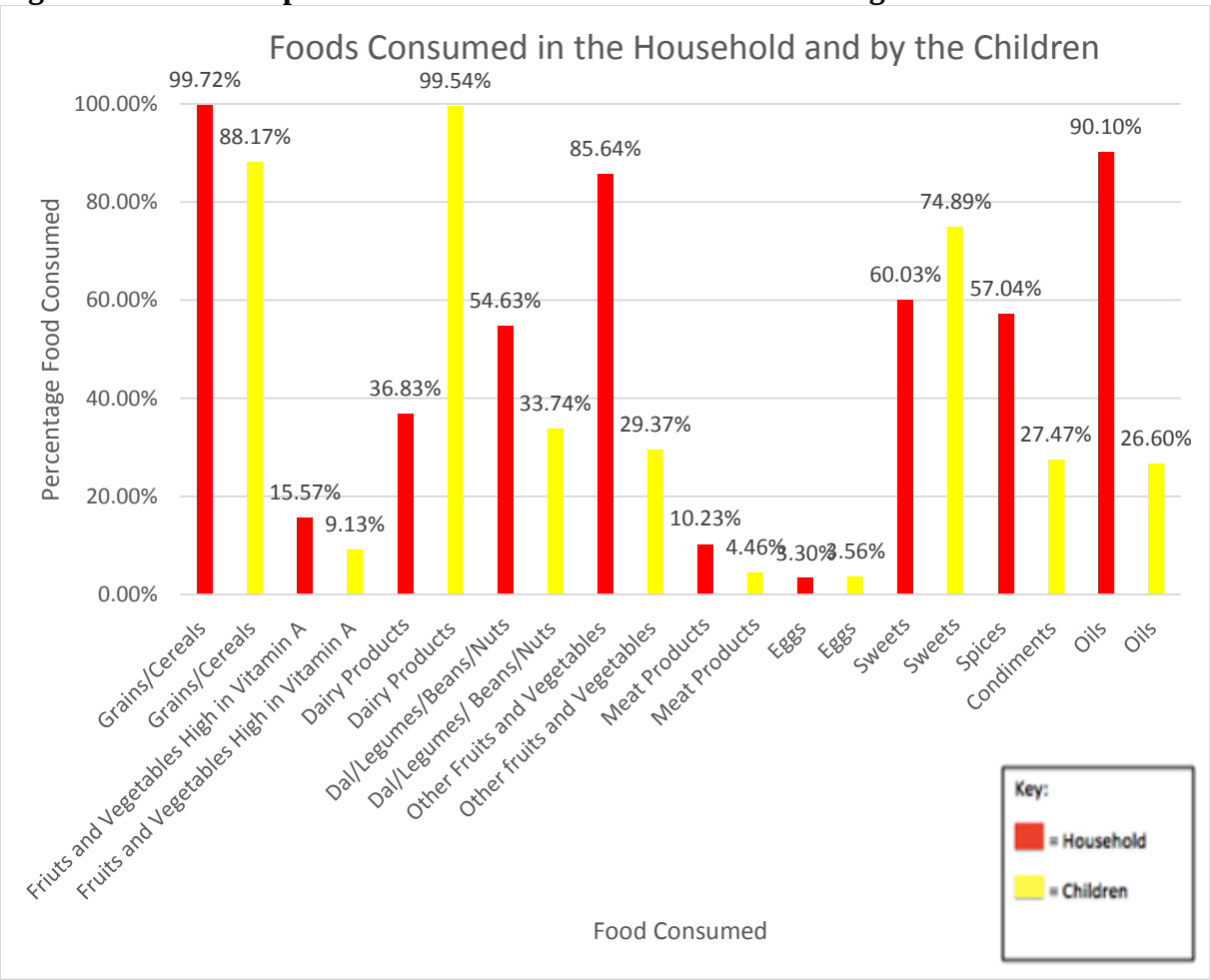
Table 1: Descriptive Characteristics

Characteristics	Statistics (mean; %)
Maternal Age	25.2 years
Age of Eligible Child	11.3 months
Literacy of Mother	60.1%
Literacy of Father	36.1%
Gender of Eligible Child	Male: 50.3 % Female: 49.7%
Number of People in the Home	6.4 people/home
Caste	Scheduled Caste: 25.2% Scheduled Tribe: 8.3% OBC: 50.3% Other Castes: 15.7%
Religion	Hindu: 78.7% Muslim: 21.2% Christian: 0.02% Buddhist: 0.02% Other: 0.1%
Socioeconomic Status	Low SES: 33.3% Moderate SES : 33.4% High SES: 33.3%

Aim 1: To explore the diversity of foods consumed at the household and child level in Bihar, India in an effort to understand the spectrum of consumption in households and for children.

To reach aim 1 the foods eaten in the previous 24-hours were recorded. For the households and children the food consumed at the highest frequency were grains and cereals. The consumption was similar in the households and amongst the children for the other foods as well, with the expectation of other fruits and vegetables, spices and condiments, and oils. Additionally, sweets and dairy were consumed at a greater percentage by children then by the household.(Fig. 1)

Figure 1: Food Groups Consumed in the Households and Among the Children



The foods eaten in households and by children were compared to socioeconomic status. Socioeconomic status was divided in to tertiles. The tertiles were categorized into low SES, moderate SES, and high SES using a standard scale.

Overall the diversity of foods consumed increased for both households and children as SES increased. In particular fruits and vegetables high in vitamin A, legumes/nuts/dal, meats, eggs, milk sweets, and spices increased with increasing diversity for HH and fruits and vegetables high in vitamin A, other fruits and vegetables, legumes/nuts/dal, meats, eggs, sweets, condiments, and oils foods increased for children, while consumption of other foods remained stable regardless of income. In the low SES households' cereals were the most frequent food consumed at 99.7% percent. Oils followed with a consumption percentage of 90.4%. (Fig. 2) The child intake within the Low SES category differed slightly from the household intake. The most frequently consumed food was dairy at 99.3%. Grains were the next most widely consumed food at 87.8%. The 5 remaining food groups, sweets, fruits and vegetables high in vitamin A, other fruits and vegetables, legumes/nuts/dal, meats, eggs, milk, and spices were consumed at a lower frequency as compared to grains and sweets. (Fig. 3)

At the moderate SES the household intake of the some foods varied significantly from those in the lower SES status. Grains were the highest consumed food product at 99.7%. (Fig. 2) Among the children living in the moderate SES homes, 99.6% ate dairy and 88.5% ate grains, a slight increase from children living in homes with low SES, yet not significant. (Fig. 3)

The high SES displayed the most variability in food consumption as compared to moderate and low SES. This was true within the household and for the individual child. In the household the most frequently eaten items were grains at 99.7%. Oils and other fruits and vegetables were the next most commonly consumed food groups at 89.9% and 87.1%. (Fig. 2) Amid the foods eaten by children whom were living in high SES homes, the two most commonly consumed foods were dairy and grains 99.6% and 88.8% (Fig. 3)

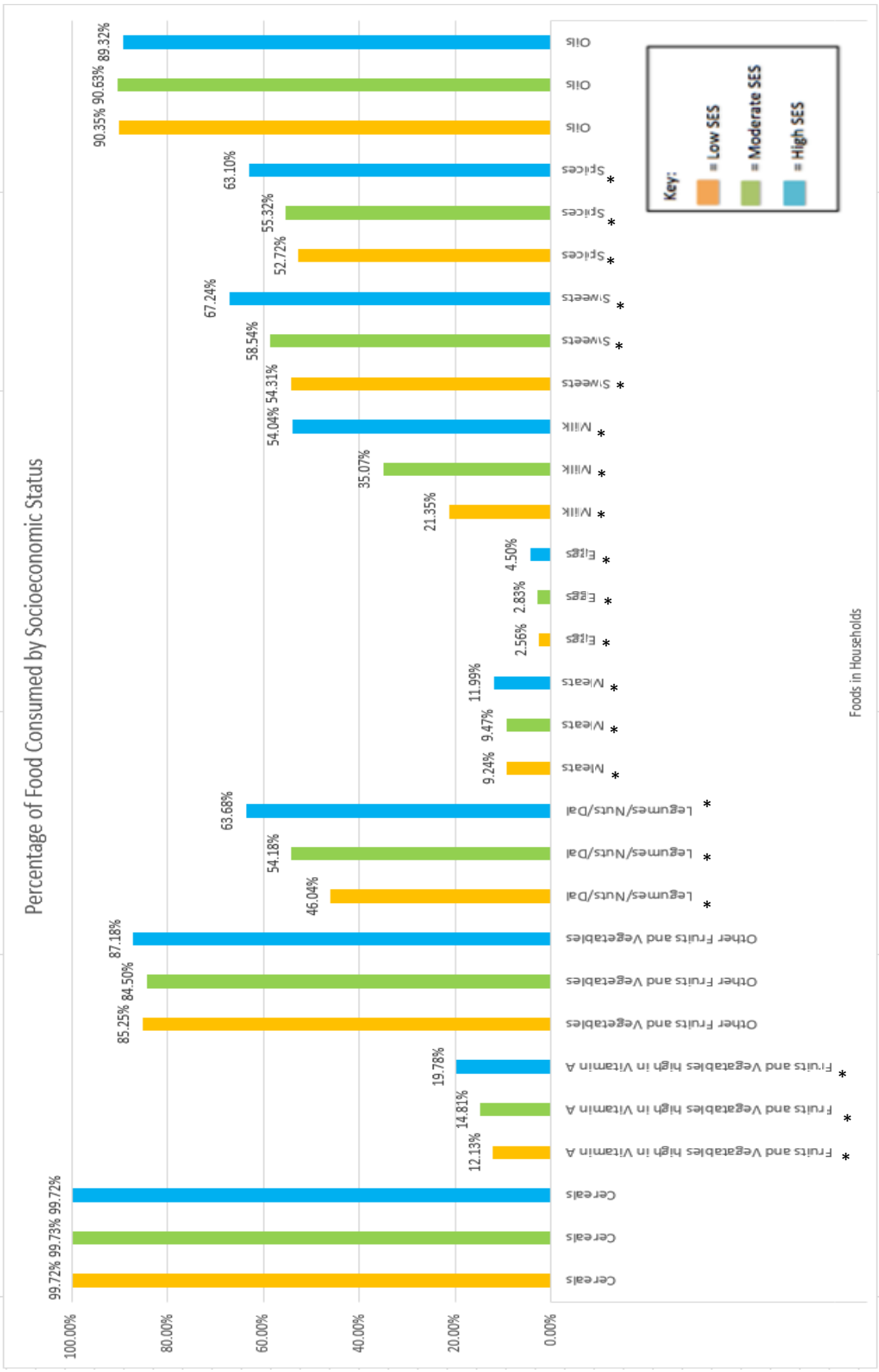


Figure 2: Food Groups Consumed in Households by Socioeconomic Status *Indicates p-value <0.05

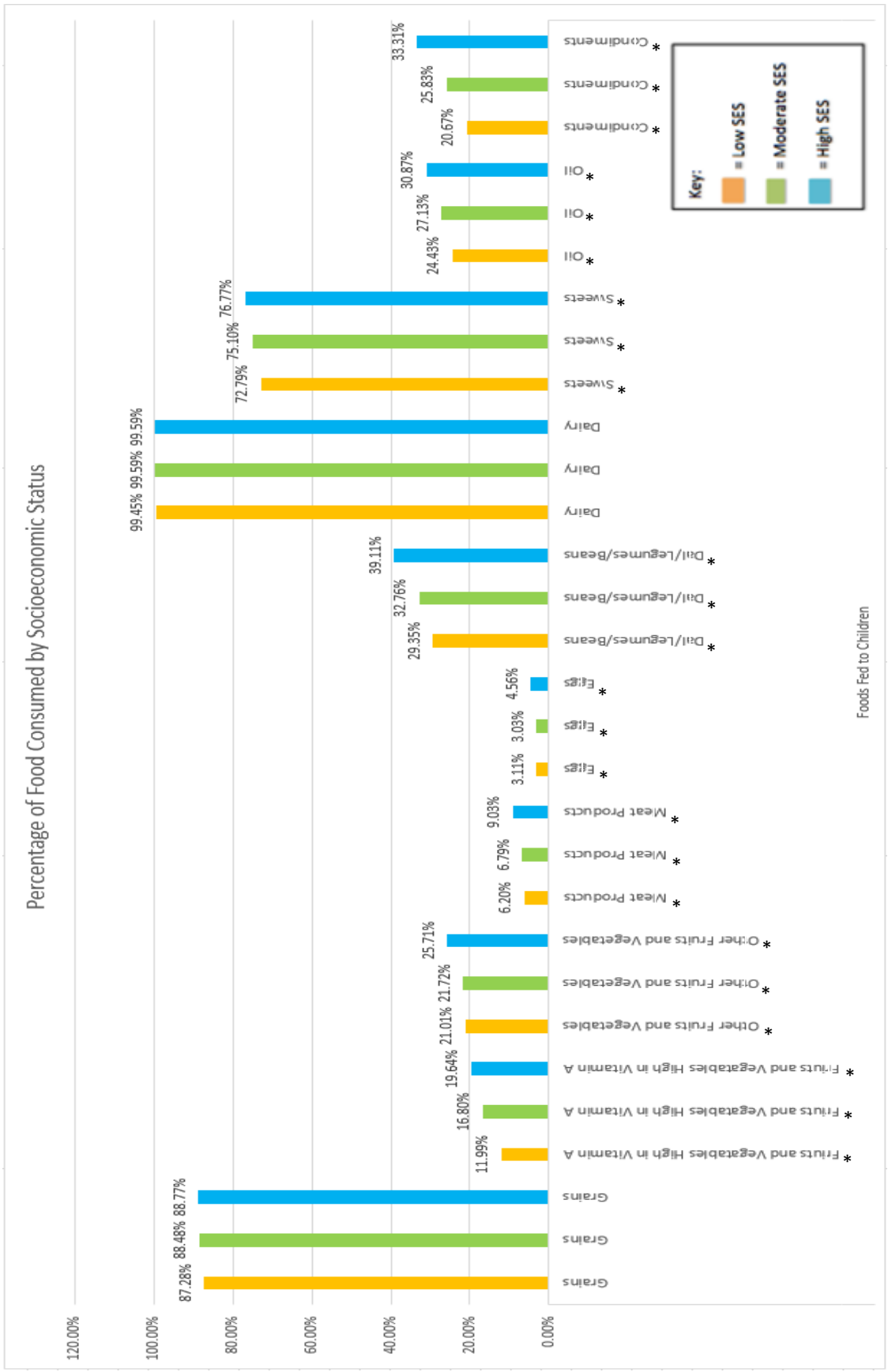


Figure 3: Food Groups Consumed by Children aged 6-18 months by Socioeconomic Status *Indicates p-value <0.05

Key Messages:

Household Consumption:

- Consumption of fruits and vegetables high in vitamin A, meats, legumes/nuts/dal, eggs, milk, sweets, and spices significantly increase as socioeconomic status increases.

Child Consumption:

- Consumption of fruits and vegetables high in vitamin A, other fruits and vegetables, meats, legumes/nuts/dal, eggs, sweets, oils, and condiments significantly increase as socioeconomic status increases.

Across all Socioeconomic Brackets:

- Both the household and children consumed low amounts of animal based products; with the exception of children's consumption of dairy.
- Oils and fruits and vegetables low in vitamin A are eaten more frequently at the household level.
- Children are fed sweets more frequently than the household consumes sweets.
- Legumes, Dal, and Nuts are eaten in greater qualities by the household as a whole.
- Fruits and vegetables high in Vitamin A are eaten in lower qualities by both households and children.

Aim 2: To describe DDSs at the household and child level in Bihar, India.

For the household dietary diversity the highest dietary diversity score achieved was 9. Although, there were 12 food groups, none of the participants were reported to have eaten between 10 and 12 food groups the previous day. The food groups were chosen in accordance with the FANTA guidelines for measuring household dietary diversity.**[37]**

In the household, the average dietary diversity score was 3.49. Amongst the children in the households the average dietary diversity score was 2.71. 8.8 % of children and 23.7 % households were reported to consume only 0 or 1 of the listed food groups. (Fig. 4) This is compared to only 0.1% and 1.5% of the household that consumed 0 or 1 food groups. (Fig. 5)

Figure 4: Percentage Dietary Diversity Score of Children

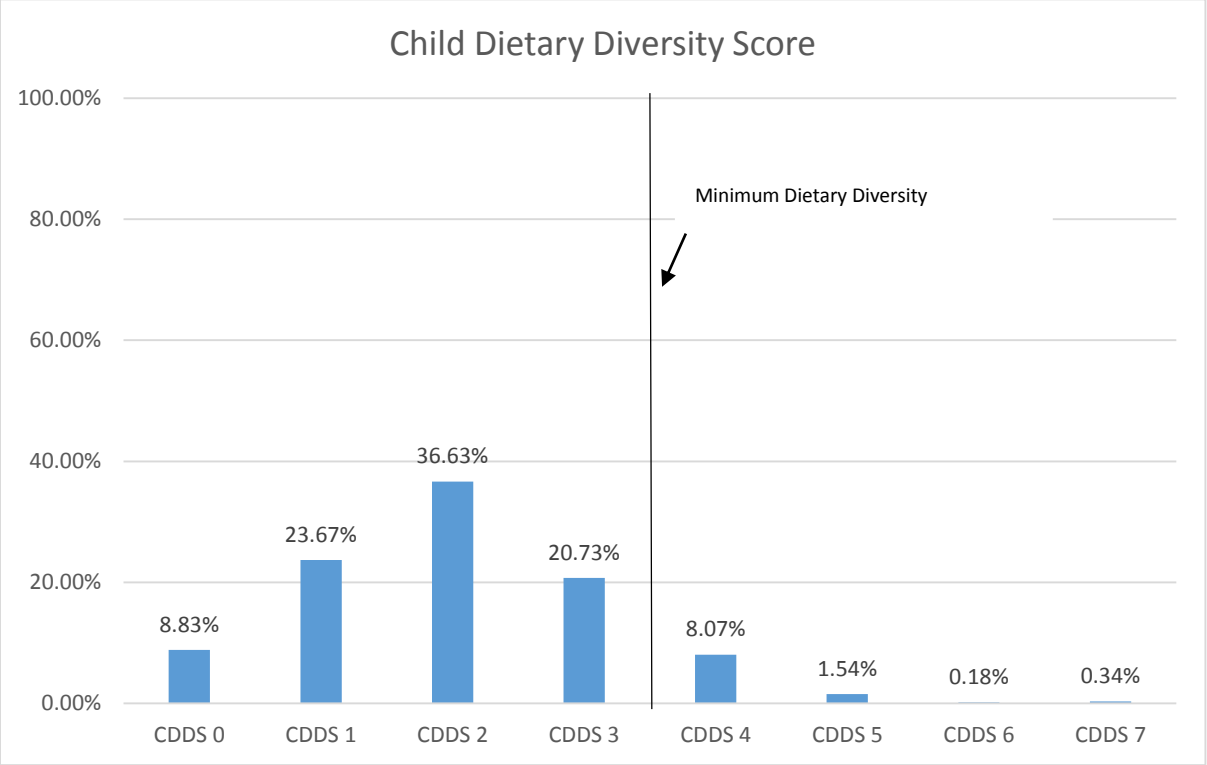
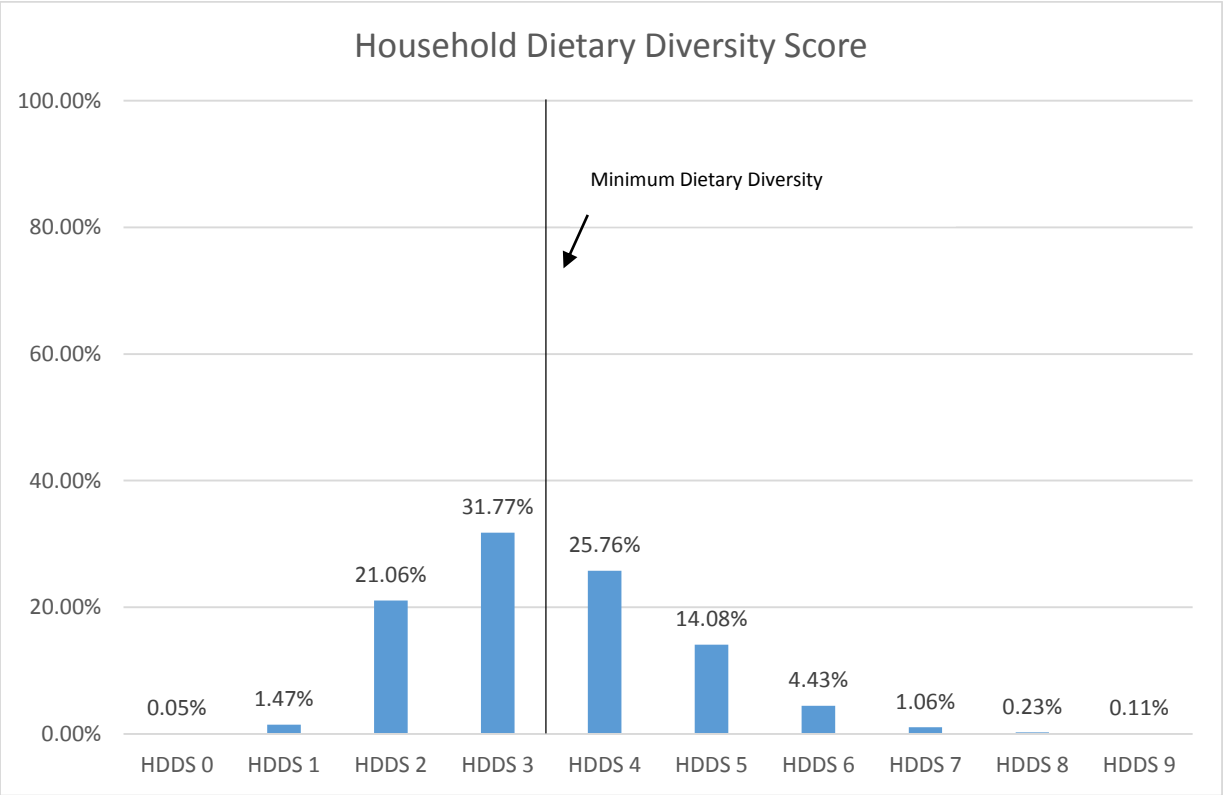


Figure 5: Percentage Dietary Diversity Score of Households



The household and child dietary diversity were both grouped in to the minimum dietary diversity score. The minimum intake was defined as eating equal to or above 4 food groups in the previous 24-hours. At the household level, 45.6% of the population had a household dietary diversity score of equal to or greater than 4. While only 19.6% of children of meet the criteria for minimum dietary diversity. The difference in prevalence of minimum dietary diversity in the household as compared to the children, indicated that some children within the minimum DDS households were not receiving the minimum dietary diversity. Of the 80.3% of children who are not meeting the minimum dietary diversity, 49.2% are living in homes that are consuming 4+

food groups. This is significant at a chi-square of <0.0001. This difference in consumption could be linked to multiple sources. Examining the programming and demographic variables could assist with uncovering associations.

The child dietary diversity and the household dietary diversity were compared against the household hunger scale. Approximately 9.5% of the homes surveyed reported a moderate to severe form of food security. Of the homes whom were said to be food insecure, 8.3% had children who were not meeting the DD while the remaining 1.2% of homes had child who were meeting the DD. Amongst the household, approximately 6.6% of the 9.5% who displayed food insecurity were also not meeting the DD requirement. The remaining 2.85% were meeting the requirement. Both the CDD and the HDD had significant associations with chi-squares of 0.0001 and <0.0001.

Aim 3: To determine what factors are associated with household and child DDS.

Simple and multiple logistic regression were used to assess the factors that have a significant influence on dietary diversity at the household and child level. Four models were tested to assess the potential factors. The dependent variables used in the models were either child dietary diversity (CDD) or household dietary diversity (HDD).

In order to establish an association between the child dietary diversity and the household dietary diversity, the variables were run through simple logistic regression. Children living in a household that was meeting minimum dietary diversity were 4.45 times more likely to also be

consuming at least 4 food groups. The model also had a ROC of 0.67, signifying average strength.

Role of SES on dietary diversity

Child dietary diversity and household dietary diversity were separately compared against low, moderate, and high socioeconomic status using simple logistic regression. (Table 4) Overall the higher the SES the more likely households and children will consume 4+ food groups.

Table 3: Simple Logistic Regression of Household and Child Dietary Diversity against Socioeconomic Status**

Dietary Diversity	Low SES (OR, Confidence Interval)*	Moderate SES (OR, Confidence Interval)*	High SES (OR, Confidence Interval)*
Household	0.407 (0.356, 0.464)	0.880 (0.775, 0.998)	2.75 (2.411, 3.127)
Child	0.579(0.488, 0.688)	0.947 (0.808, 1.111	1.72 (1.473, 2.001)

*****Dummy variables were created for low SES, moderate SES, and high SES.
** Model is predicting the odds ratio of dietary diversity.

Role of Program Factors on Dietary Diversity

The next model, programming variables against the child dietary diversity, was run through multiple logistic regression.. Household dietary diversity was not compared to the programming variables as the programming was directed towards the mother and child rather than the entire household. The programming variables were the number of times that the ASHAS and Anganwadi workers went to households, if the ASHA's and/or Anganwadi workers discussed nutrition, and the maternal nutrition knowledge, measured by the number of food groups the mother reported should be consumed by the eligible child. The model containing only the

number of times that the ASHAS and Anganwadi workers went to the households and the knowledge given to the household by the ASHAS and Anganwadi's was compared against the CDD. The model had a ROC of 0.58 indicating weakness. The odds ratios further supported the weakness of the model. Each estimate was between 1.3 and 0.8. Additionally, none of the variables were significant, with the exception of if the ASHA gave information about nutrition. If an ASHA did give nutrition education on their visit the odds of the child meeting the minimum dietary diversity was 1.3 times higher (1.1, 1.6) .

Mother's knowledge of nutrition appeared to have an effect on if the child was meeting the dietary diversity (2.81-95% CI). This signifies that if a mother believed that her child should receive greater than 4 foods, the child was 2.8 times more likely to be meeting minimum dietary diversity.

Role of demographic factors

The third model incorporated the demographics of the population. The models differed for the HDD and the CDD. For the CDD, the demographics included if a mother was literate or illiterate, the number of people in the home, the caste of the household, the household religion, the age of the child, the age of the mother, and the gender of the child. For reference purposes, the religions considered were Muslim and Hindu, while the castes were Scheduled Castes, Scheduled Tribes, OBC and other. In regards to the HDD, the demographics included were the literacy of the father, the number of people in the home, the caste of the household, and the household religion.

The child dietary diversity demographics model revealed notable effects. Children with literate mothers were 1.4 times more likely to be meeting the minimum dietary diversity. This output was significant at a p-value of <0.0001. Children whom were between the ages of 12-18 months were 2.1 more likely to have a dietary diversity that was adequate as compared to a child who was between the ages of 6-11months. This difference in ratio could be attributed to breastfeeding patterns however; there was no confounding when breastfeeding was entered in to the model. Additionally, only 5% of the population was not breastfeeding. The remaining variables were not significant.

For the HDD all the inputted variables were significant. The odds ratios, however, revealed that the effect on household dietary diversity was strong for some variables and weak for others. Father's education and religion displayed the strongest odds ratios. Father's education had an odds ratio of 1.6, indicating that for households with a illiterate father had a 1.6 times higher chance of consuming 4+ food groups. As for the religion, the data suggested that for homes that practiced Islam they were 25% times less likely to adequate dietary diversity as compared to Hindus. Although the p-values of the remaining variables were significant, the odds ratios displayed minimal predictive value. The number of the people in the home had an odds ratio of 1.1(1.04,1.10). The caste had an odds ratio of 1.2 (1.08,1.23).

The final models constructed were a collection of all the variables utilized above against child dietary diversity and household dietary diversity. The inputs for the model included the following: household dietary diversity score (exclusive to the child dietary diversity model), child dietary diversity score (exclusive to the household dietary diversity model), the

socioeconomic status, mother's education, the household religion, the household caste, the age range of the child, the number of people in the home, the gender of the child, the age of the mother, the household hunger scale, and maternal nutrition knowledge. When all of these factors were taken into consideration the model demonstrated that household dietary diversity, socioeconomic status, the age range of the child, Anganwadi visiting at least once every three months, and the nutrition knowledge of the mother were all significant at a p-value of 0.05. Table 5 below depicts the full model.

When controlling for all other factors, a child living in a home that is meeting the minimum dietary diversity is 3.4(2.77, 4.08) times more likely to be meeting the dietary diversity as well (Table 5). . Children in high SES homes were 1.6 times more likely to meet the minimum dietary diversity as compared to children in low SES households. Moderate SES was also significant with an odds ratio of 1.3 (1.0, 1.64) and a p-value of 0.04. If a child was between the ages of 12-18 months they were 2.6 (2.17, 3.21) times more likely to be meeting the CDD than a child who was 6-11months. Two programming variables were also relevant in the final model. Anganwadi's visits and maternal nutrition knowledge had p-values of 0.0003 and <0.0001. Children who meet the minimum DD were 1.5 (1.20, 1.81) times more likely to have an Anganwadi worker visit their home at least once in the previous three months and 2.15 (1.47, 3.12) times more likely to have if the mother was knowledgeable about dietary diversity.

A subsequent model was run which included all the variables mentioned above with the expectation of household dietary diversity. The logic behind this model was to identify if HDD had an effect on the other variables in the final model. While the significance of all of the

variables did not change, the relationship with SES and child dietary diversity was strengthened (10% change). This is consistent with previous studies, as HDD has shown to be a proxy for SES and may confound the relationships. (Note there was no evidence of muliticolinearity in models, VIF <).

In the multivariate analyses, household dietary diversity was significantly associated with socioeconomic status, Anganwadi worker visits, child dietary diversity score, number of people living in the home, food security, caste, and Anganwadi workers discussing nutrition knowledge during a visit. The strongest association was with child dietary diversity with a odds ratio of 4.33 (3.51, 5.35); signifying that the home who was eating 4+ food groups a day was 4.3 times more likely to have an eligible child living within the home that was also consuming 4+ food groups a day. (Table 7)

A subsequent model was run which excluded child dietary diversity..(Table 8) The significance of all key variables remained the same with the exception of maternal knowledge which became significant after excluding child DD. Relationships with SES were likewise strengthen in the final model.

Table 4: Key Determinants of Child Dietary Diversity (including HDD)

Final Model			
Child Dietary Diversity by Key Factors			
Key Factor	P-Value	Odds Ratio	95% Wald Confidence Limits
Household Dietary Diversity	**<. 0001**	**3.36***	**2.77, 4.08**
Socioeconomic Status: **Moderate SES vs Low SES** **High SES vs Low SES**	 **0.0474** **0.0003**	 **1.28*** **1.63***	 **1.0, 1.64** **1.25, 2.13**
Mother's Literacy: Literate Mother vs Literate Mother	0.2451	1.13	0.95, 1.61
Religion: Hindu vs Muslims	0.1072	1.24	0.95, 1.62
Ashas did discuss nutrition during visits	0.0770	1.21	0.98, 1.48
Anganwadi Workers did discuss nutrition during visits	0.5802	1.07	0.85, 1.34
Castes: Scheduled Caste vs OBC **Scheduled Tribe vs OBC** Other Castes vs OBC	 0.4886 **0.0003** 0.6059	 0.93 **1.71*** 0.93	 0.70, 1.17 **1.28, 2.30** 0.70, 1.23
Eligible Child Age: **12-18 months vs 6-11 months**	 **<0.0001**	 **2.64***	 **2.17, 3.21**
Number of People in the Home	0.1063	0.97	0.93, 1.01
Gender of Eligible Child: Female vs Male	 0.7370	 1.03	 0.86, 1.25
Mother's Age	0.2503	1.01	0.99, 1.04
Nutrition Knowledge: **Mother knows that a child should eat at least 4 foods vs does not know that the child should not eat 4 foods**	 **<0.0001**	 **2.15***	 **1.47, 3.12**
Asha visited home at least once times in the previous 3 months	0.6520	1.080	0.77, 1.51
Anganwadi Worker visited home at least once in the previous 3 months	**0.0003**	**1.47***	**1.20, 1.81**
Food Security	0.5689	1.110	0.78,1.59

*Indicates p-value <0.05

Table 6: Key determinants of Child Dietary Diversity (Excluding Household Dietary Diversity)

Final Model			
Child Dietary Diversity by Key Factors			
Key Factor	P-Value	Odds Ratio	95% Wald Confidence Limits
Socioeconomic Status: **Moderate SES vs Low SES** **High SES vs Low SES**	 **0.0015** **<0.0001**	 **1.48*** **2.13***	 **1.16, 1.87** **1.65, 2.75**
Mother's Literacy: Literate Mother vs Literate Mother	0.2282	1.13	0.93, 1.39
Religion: Hindu vs Muslims	0.0677	1.27	0.98, 1.64
Ashas did discuss nutrition during visits	0.0739	1.20	0.98, 1.47
Anganwadi Workers did discuss nutrition during visits	0.3979	1.10	0.88, 1.37
Castes: Scheduled Caste vs OBC **Scheduled Tribe vs OBC** Other Castes vs OBC	 0.6446 **0.0024** 0.7047	 0.95 **1.56**** 1.06	 0.75, 1.20 **1.17, 2.06** 0.80, 1.39
Eligible Child Age: **12-18 months vs 6-11 months**	 **<0.0001**	 **2.71****	 **2.25, 3.28**
Number of People in the Home	0.1755	0.98	0.94, 1.01
Gender of Eligible Child: Female vs Male	 0.6400	 1.04	 0.87, 1.25
Mother's Age	0.5586	1.01	0.99, 1.03
Nutrition Knowledge: **Mother knows that a child should eat at least 4 foods vs does not know that the child should not eat 4 foods**	**<0.0001**	**2.22****	**1.54, 3.19**
Asha visited home at least once in the previous 3 months	0.2897	1.19	0.86, 1.66
Anganwadi Worker visited home at least once in the previous 3 months	**0.0009**	**1.41****	**1.15, 1.71**
Food Security	0.1576	1.29	0.91, 1.83

**Indicates p-value <0.05

*Indicates p-value <0.05 and confounding as evident by <10% change

Table 7: Key Determinants of Household Dietary Diversity (including CDD)

Final Model			
Household Dietary Diversity by Key Factors			
Key Factor	P-Value	Odds Ratio	95% Wald Confidence Limits
Child Dietary Diversity	**<. 0001**	**4.33***	**3.51, 5.35**
Socioeconomic Status: **Moderate SES vs Low SES** **High SES vs Low SES**	 **<.0001** **<. 0001**	 **1.64*** **2.99***	 **1.37, 1.98** **2.42, 3.69**
Mother's Literacy: Literate Mother vs Literate Mother	0.5399	0.95	0.80, 1.13
Religion: **Hindu vs Muslims**	 **0.0083**	 **1.31***	 **1.07, 1.62**
Ashas did discuss nutrition during visits	0.2387	1.11	0.93, 1.32
Anganwadi Workers did discuss nutrition during visits	**0.0181**	**1.26***	**1.04, 1.53**
Castes: Scheduled Caste vs OBC Scheduled Tribe vs OBC **Other Castes vs OBC**	 0.9995 0.2477 **0.0008**	 1.00 1.17 **1.48***	 0.90, 1.54 0.90, 1.54 **1.18, 1.87**
Eligible Child Age: 12-18 months vs 6-11 months	 0.1843	 1.11	 0.95, 1.30
Number of People in the Home	**0.0053**	**1.04***	**1.01, 1.08**
Gender of Eligible Child: Female vs Male	 0.7399	 1.03	 0.88, 1.19
Mother's Age	0.0917	0.99	0.97, 1.00
Nutrition Knowledge: Mother knows that a child should eat at least 4 foods vs does not know that the child should not eat 4 foods	 0.0810	 1.23	 0.98, 1.56
Asha visited home at least once times in the previous 3 months	 0.6060	 1.07	 0.83, 1.37
Anganwadi Worker visited home at least once in the previous 3 months	**0.0009**	**0.76***	**0.64, 0.89**
Food Security	**0.0039**	**1.49***	**1.14,1.96**

*Indicates p-value <0.05

Table 8: Key Determinants of Household Dietary Diversity (excluding HDD)

Final Model			
Household Dietary Diversity by Key Factors			
Key Factor	P-Value	Odds Ratio	95% Wald Confidence Limits
Socioeconomic Status: **Moderate SES vs Low SES** **High SES vs Low SES**	 **<.0001** **<. 0001**	 **1.72**** **3.23***	 **1.44, 2.06** **2.64, 3.96**
Mother's Literacy: Literate Mother vs Literate Mother	 0.8200	 0.98	 0.83, 1.16
Religion: **Hindu vs Muslims**	 **0.0083**	 **1.36****	 **1.12, 1.66**
Ashas did discuss nutrition during visits	0.1235	1.11	0.97, 1.34
Anganwadi Workers did discuss nutrition during visits	**0.0123**	**1.26****	**1.05, 1.52**
Castes: Scheduled Caste vs OBC Scheduled Tribe vs OBC **Other Castes vs OBC**	 0.8916 0.0547 **0.0009**	 0.98 1.29 **1.47****	 0.82, 1.18 0.99, 1.67 **1.17, 1.84**
Eligible Child Age: **12-18 months vs 6-11 months**	 **<.0001**	 **1.35***	 **1.17, 1.84**
Number of People in the Home	0.0213	1.04	1.01, 1.07
Gender of Eligible Child: Female vs Male	 0.6773	 1.03	 0.89, 1.20
Mother's Age	0.1434	0.99	0.97, 1.00
Nutrition Knowledge: **Mother knows that a child should eat at least 4 foods vs does not know that the child should not eat 4 foods**	**0.0055**	**1.38***	**1.1, 1.74**
Asha visited home at least once times in the previous 3 months	0.4132	1.10	0.87, 1.41
Anganwadi Worker visited home at least once in the previous 3 months	**0.0168**	**0.82****	**0.70, 0.97**
Food Security	**0.0016**	**1.53****	**1.17,1.99**

**Indicates p-value <0.05

*Indicates p-value <0.05 and confounding as evident by <10% change

Key Messages:	
Key determinants to Increasing Child Dietary Diversity	**Key determinants to Increasing Household Dietary Diversity**
• Household Dietary Diversity consuming 4+ food groups • Increased Socioeconomic Status • Household is part of a Scheduled Tribe • Increase Age of Child • Increase Maternal Nutrition Knowledge • Increase visits by Anganwadis workers	• Child Dietary Diversity consuming 4+ food groups • Increased Socioeconomic Status • Household practices Hinduism • Increase in the number of people in the home • Household is part of Other Castes • Anganwadis discuss nutrition during home visit • Increase in HHS

Discussion:

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This study provided an overview of food consumptions patterns and determinants of household and child dietary diversity in Bihar, India. Results of the study have important implications for developing and targeting programs to improve the nutritional status of children.

Individual Food Groups

A key CARE program message in Bihar is for families to feed their young child a diverse variety of foods consumed in the home. . Yet, this paper indicates that children do not receive the same level of dietary diversity as other household members. Households consume greater quantities of fruits and vegetables, oils, and legumes. Households consumed more of each food group across all socioeconomic brackets. This indicates that the foods are present at every socioeconomic level, yet the significant difference between the household and child consumption implies that regionally these foods are not given to the child. Fruits and vegetables, oils, and legumes contain fat, protein, fiber, and vitamins that are critical to child development. Evenly distributing these foods among the whole of a household, including the young children, could improve child nutritional status.

In the surveyed population, children did show significantly higher intakes of sweets and dairy as compared to the household. This was true across all socioeconomic brackets; indicating that this pattern is not influenced by monetary resources. Sweets are energy dense but low in nutritional value while, dairy is energy dense as well as high in protein. The intake of these foods could have potential unintended consequences. Being that both foods are energy dense, they could deter the intake of other vitamin rich foods, such as legumes. Elevated intake of sweets and dairy

compared to low intakes of some vitamin rich foods, indicates presence of nutrition transition. Nutrition transition is characterized by low and middle income countries decreased consumption in traditional vitamin rich foods and an increased consumption of foods high in fat and sugar.[27] The factors contributed to this change are influx of a westernized diet accompanied with an increased in monetary resources. [27] The consequences of the nutrition transition are elevated levels of metabolic diseases and obesity. [27] India has recently been documented as a country who is experiencing a nutrition transition. [27]Evidence from this paper suggests the transition is present in the West Champaran region.

In addition to the nutrition transition, future research will be needed to understand how the consumption of dairy products could impact breastfeeding practices as mothers may perceive dairy as a breast milk substitute.

In contrast to profound differences in the data, meat, fruits and vegetables high in Vitamin A and eggs were consumed sparingly in both the household and child populations. This suggests that these foods are inaccessible in the surveyed population. This was true across all socioeconomic brackets. Inaccessibility of the food groups could be due to a range of factors; religion being one. The majority of the surveyed population practiced Hinduism. Hinduism is characterized by its non-violent approach towards animals, lending most Hindis to consumption of lactovegetarian diet. Thus, the low consumption of meat may be a result of religious belief rather than inaccessibility.

Key Associated Factors

Household dietary diversity and child dietary diversity were highly associated (3.4; 2.77, 4.08).This implies that if a home has access to foods then the child is more likely to have access to a diversity of foods, however, as previously explained above, the composition of the foods consumed may not be identical.

In addition to the diversity of the household diet, socioeconomic status of the home, the caste, the age of the eligible child, maternal nutrition knowledge, and visits by the Anganwadi workers were determinants that contributed young child dietary diversity. Similar to previous studies, there was a positive linear correlation between socioeconomic status and young child dietary diversity[31].Older children, 12 – 18 months, were 2.64 times more likely to eat 4+ food groups within a 24-hour period, while mothers who knew that a child should eat at least four groups a day were more likely to have children who consumed a diverse diet. Both the age and knowledge factor imply that potential nutrition education surrounding the appropriate amount of foods to feed a young children and at what age should be a standard lesson.

Involvement of frontline workers in the household had mixed results in this paper. When the model only included the number of times that the ASHAS and Anganwadi workers went to households, if the ASHA's and/or Anganwadi workers discussed nutrition, and the maternal nutrition knowledge, ASHA's discussing nutrition was significant. However, when the final model was run, ASHA's discussing nutrition was confounded by the demographic factors in the model making its significance null. Contrastingly, Anganwadi workers visits became significant in the final model. In previous studies, Anganwadi workers have a positive association with

improved overall nutrition practices of mothers living in India. [24] This paper's findings provide further support that involvement of Anganwadi workers lead to increased adaption of appropriate nutrition practices.

While there were many overlapping predictors of child and HH diversity, there were some key differences. Socioeconomic status, Anganwadi worker visits, child dietary diversity score, number of people living in the home, food security, caste, and Anganwadi workers discussing nutrition knowledge were all significantly associated with HH dietary diversity. Number of people living in the home, food security, Anganwadi workers discussing nutrition knowledge during a visit, were factors unique to HDD. It is unclear why AWW household visits were positively associated with child DD, but negatively associated with household DD. In both the child DD and household DD confounding by demographic factors of is a major contributor to the determining the direction of the AWW household visits**.** Previous studies have found associations between HDD and the number of people living within the home. [11] As HDD is a proxy for food access, the association to food security is expected.[8] Anganwadi workers providing nutrition knowledge and the inverse relationship with Anganwadi visits has been studied in a limited capacity. Thus further research should be conducted.

Prior studies had mixed data considering the effect of caste. Caste was said to have no association in one study, yet a conflicting study states that scheduled tribes and scheduled castes tend to have lower dietary diversity scores then other castes. [6, 32] Limited research exists discussing caste relations in West Champaran. Further research needs to be conducted to understand the role of caste on dietary diversity in this context.

Recommendations

Using this paper's findings, in order to create positive change in child malnutrition in the West Champaran community it is recommended that change occur on the government, community, and research level. The government of Bihar should create an apparatus, i.e. policy or programming, wherein local agricultural and livestock production is facilitated. The production of livestock and agricultural has been on the rise in urban areas of India. [8] Thus, the consumption of meat-based products has also increased.[8] Although West Champaran is a mostly rural Hindi population and therefore possibly majority lactovegetarians, supplying populations with the means to increase livestock production could induce positive results on the egg consumption and overall socioeconomic status. [8]

As a community, it is suggested that behavior change should be the focus of nutrition education by Anganwadi workers. Anganwadi workers should encourage caregivers to feed young children family foods. If spices or the amount of oils in the foods cause issues for the child, then prior to addition of the spices or possibly cooking a separate plate for the child may help with intake. In addition to providing family foods, feeding young children at least 4 food groups a day once complementary feeding has begun and emphasizing that sweets be consumed in minimal amounts should be the included in the instruction.

Lastly, further research should be conducted to understand the source of the agreement and disagreement between child and household consumption of certain food groups and the actual amount of foods consumed by the household members and children. The potential research

should consider the external economic environment. This could include the accessibility to markets, the economic climate of the community, and food prices in the area as compared to the average income. Comprehending if the external factors could assist with creating targeted programming in the region.

Strengths and Limitations

This paper's strength was that it provided further evidence as to the impact food access has on the intake of children living within the household. Another strength of this paper lies large sample size (4360). The location of the study was an additional strength. Little research has been done in the West Champaran region of Bihar, and even less has been conducted looking at the dietary diversity.

This paper was also limited in a number of ways. One way in which it was limited was that the dietary diversity scale does not measure portion sizes. As a result, it was not possible to gauge if the foods given to children were given as a meal, snack, or as a bite. Portion sizes are also relevant in the context of the household. 45.6% of the surveyed homes reported consuming 4+ food groups yet, the portion size of each food is beyond the capabilities of the tool.

Another limitation of the paper was that the tools were not able to be compared to the outside factors that determine food availability. The factors could include a corresponding assessment of the economic climate in the community. Surveys of market contents and prices, an analysis of the foods being grown and the rate to which they are being grown and consumed, and an analysis of the traditional foods eaten could provide a more comprehensive picture.

Public Health Implications

Child malnutrition has profound effects on long-term human productivity. [25] Preventing child malnutrition involves understanding the mechanisms that contribute to increasing and/or decreasing its prevalence. This paper's findings provide evidence that household food access, nutrition education, and socioeconomic status are associated with child nutrient adequacy. The public health implications of the findings are the following:

1) Maternal nutrition education, within a developing context, is key to ensuring the health of children ages 6-18 months.
2) Ensuring food access of all its citizens should the focus of governing bodies. Food affordability, food locations, and
3) Improvement of socioeconomic status through providing more opportunities for income generation.

Conclusions:

Food security and nutrition are complex issues that require various tools in order to gain a complete understanding in developed and developing nations alike. Dietary diversity is apparatus that can be utilized to address food access and nutrient adequacy. Using this tool, this paper does shed some light on the food consumption patterns of children aged 6-18 months and the households they live in in Bihar, India. This paper also opens up opportunity for understanding the determinants of adequate nutrition for children 6-18 months. The implications garnered from the data informs stakeholders in Bihar, India of the mechanisms that could be influence food security and nutrition within their communities.

Although this paper provides insights, further research should be conducted to understand the significance of the identified determinants and differences and similarities in food consumption. This is especially true for socioeconomic status and food access. The other determinants can be addressed to some extent with health education. However, food access and socioeconomic status are complex issues that may need interference by larger outside entities, i.e. the government,. Targeted programs are needed to improve food access and socioeconomic status in order to impact child dietary diversity, and ultimately reduce child stunting and wasting.

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