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Circular migration and child nutrition: a study among families who seasonally migrate to the brick kilns of Bihar, India

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Doctor of Philosophy

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Circular migration and child nutrition: a study among families who seasonally migrate to the brick kilns of Bihar, India

By

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B.A., Rutgers University, 2003
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Advisor: Usha Ramakrishnan, Ph.D.

An abstract of
A dissertation submitted to the Faculty of
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2021

Circular migration and child nutrition: a study among families who seasonally migrate to the brick kilns of Bihar, India

Abstract

By
Reshma P. Roshania

Background: Poverty and systemic inequities are basic causes of undernutrition that also drive households to engage in circular migration for livelihood. An estimated 100 million people circularly migrate in India, including women and young children. Yet, the nutritional implications of repeated shifts in food and health environments between home and destination has not been studied.

Methods: Using a mixed-methods approach, we collected primary data among circular migrants working in the brick industry throughout the state of Bihar, India. Using a stratified cluster sampling design, we conducted a cross-sectional survey across 1156 randomly selected brick kilns in 37 districts in June 2018 and January 2019. We collected anthropometric data and migration histories on 2564 migrant children under three. We utilized qualitative methods to explore migrant parents' perceived changes in key dimensions of the food environment between home and destination spaces. Lastly, to compare the nutrition status of circular migrant children with children in male migrant and non-migrant households, we pooled our survey data with data from a parallel study conducted in ten districts of Bihar; we statistically created comparable groups using multinomial covariate balancing propensity scores.

Results: Our results suggest there are nutritional advantages during migration for children, namely concerning food security and affordability of nutritious foods; there are also nutritional risks during migration, namely loss of access to essential public health services such as growth monitoring and immunization. We found that among circular migrant children who first migrate in early life, those who migrate multiple times have a higher likelihood of stunting compared to those who migrate once. Overall, circular migrant children are less than half as likely to be stunted, but twice as likely to be wasted compared to children in comparable male and non-migrant households.

Conclusions: Policy efforts should address the structural causes of undernutrition and enable safe, dignified migration by upholding workers' rights to fair wages, children's education/child care, and social entitlements. Households in rural India that experience similar class, education and caste vulnerabilities as circular migrant households but do not engage in migration must also be prioritized for nutrition and food security programs.

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Table of Contents

List of Tables

List of Figures

Abbreviations

ANH FEWG	Agriculture Nutrition and Health Food Environment Working Group
ARI	Acute respiratory infections
BMLE	Block Monitoring, Learning and Evaluation Officers
BTSP	Bihar Technical Support Program
CBPS	Covariate balance propensity scores
CMLE	Concurrent Monitoring, Learning and Evaluation
ESS	Effective sample size
FAO	Food and Agriculture Organization
FIES	Food Insecurity Experiences Scale
GDP	Gross domestic product
HAZ	Height-for-age z-score
ICDS	Integrated Child Development Scheme
IDI	In-depth interviews
KII	Key informant interviews
LMIC	Low- and middle-income countries
MDMS	Mid-Day Meal Scheme
NELM	New Economics of Labor Migration
NFHS	National Family Health Survey
NFSA	National Food Security Act of 2013
NRC	Nutritional Rehabilitation Center
NREGA	National Rural Employment Guarantee Act
NRHM	National Rural Health Mission
NSS	National Sample Survey
OBC	Other Backward Class
PDS	Public Distribution System
RSBY	Rashtriya Swasthya Bima Yojana
SAM	Severe acute malnutrition
SC	Scheduled Caste
SD	Standard deviation

SECC	Socio Economic Caste Census
SMD	Standardized mean difference
SNP	Supplementary Nutrition Program
ST	Scheduled Tribe
UPR	Usual place of residence
WHZ	Weight-for-height z-score

Chapter 1. Introduction

Nearly one third of the global burden of stunting is in India; India has the world's highest numbers of both stunted (45.5 million) and wasted (25.5 million) children under five years of age (1). Improving maternal, infant and child nutrition in India is critical to making progress towards reducing the global burden of undernutrition.

The effects of chronic undernutrition, or stunting defined as low height-for-age, are substantial and largely irreversible after two years of age (2). Long-term consequences of chronic undernutrition can include reduction in educational attainment, cognitive ability, and economic productivity, its effects potentially extending into adulthood and intergenerationally (3). Although the prevalence of acute undernutrition, or wasting defined as low weight-for-height, is lower than stunting, the risk of mortality is higher (4). Furthermore, wasting is predictive of later stunting in children (5), highlighting the importance of addressing both stunting and wasting within the same programmatic context.

The basic causes of undernutrition consist of the societal structures that perpetuate poverty and limit or deny the realization of rights and the access of essential resources to vulnerable populations. Addressing inequity is the domain of policy and social transformative change, and there is little evidence on what initiatives work to reduce undernutrition at this level. Income growth, however, has been demonstrated to be an important driver of nutrition status (6). Although India experienced a period of great economic growth due to reforms in the 1990's and observed overall declines in stunting during the following years, this growth was not equitable – disparities in nutrition status by household wealth widened over time (7). Indeed, as the pro-poor welfare state diminished during this period, the importance of household level income became increasingly important in determining child nutrition outcomes (8).

In this context, migration is an important livelihood strategy undertaken by many poor households as a route out of poverty. In India, the majority of movement is internal (9, 10), and the dominant form of internal migration among the poor is circular (11). Circular migration is defined as temporary, repetitive movement for the purposes of employment, followed by a return to the normal place of residence. Circular migration furthermore lacks the intention of permanent change in residence (12, 13), brought about by smallholdings, family ties to home, high costs of living in urban destinations, and the informal, precarious nature of occupations that employ labor migrants. It is the poorer, less educated groups, Scheduled Castes and Scheduled Tribes, those without access to credit and located in drought prone areas that are most likely to engage in circular migration (11). It is therefore important to draw the connection that those inequities that drive disparities in nutrition status are the same inequities that drive circular migration.

Theoretically, the relationship between migration and child nutrition is indeterminate. For children who remain in the origin, remittances sent from migrating family members can increase dietary quality and intake, thereby reducing childhood underweight. The second channel through which migration can affect child nutrition is time allocation. Remaining household members may be required to assume the responsibilities of those who have migrated (e.g. agricultural production and household tasks), potentially resulting in less time for child care and feeding (14).

Some streams of circular migration, especially those in agriculture or the brick industry, involve migration of the whole family, including young children. These movements tend to be over shorter distances, and are often rural-to-rural; temporary migration to rural destinations is inadequately captured in official migration statistics, and is less regulated with respect to compliance of safety and welfare laws.

The potential impacts of nutrition of children who accompany their families are presumably multidirectional. Increased income may improve food security and dietary quality and intake, thereby improving child nutrition. However, poor hygiene and working conditions of common labor destinations of circular migrants may compromise nutrition. Depending on occupations and household composition in the origin, time allocation for child care may improve or worsen at the destination. Additionally, children who cyclically migrate with their families experience repeated shifts in their food environments – the context in which food acquisition and consumption occurs within the larger food system (15). Food environments can potentially shift from consisting of own production, formal and informal markets, and domicile food transfers in the origin, to consisting of only the markets in the destination. Lastly children who move become disconnected from community-based essential health services such as growth monitoring and immunization.

The objective of this dissertation is to contribute to the understanding of how circular migration patterns can influence migrant children's health and nutrition environment, with importance to programmatic and policy implications.

1.1 Research Aim 1

Estimate the association of early life and repeated migration with stunting and wasting among children under three of circular migrant families.

To address this aim, we conducted a cross-sectional survey of 2564 randomly selected migrant children under three residing on 1156 randomly sampled brick kilns in 37 of 38 districts in Bihar. We implemented two waves of the survey, in June 2018 and January 2019 to capture seasonality. To explore the association of nutrition with circular patterns of movement, we conducted

multilevel modelling with the interaction of age at first migration and number of migration episodes as the exposure, and stunting and wasting as the outcomes. We also present descriptive statistics on the underlying and immediate determinants of nutrition status, including access to the community-based health system, food security, hygiene, illness, and feeding practices. Results are described in *Chapter 4: Early life migration and undernutrition among circular migrant children: an observational study in the brick kilns of Bihar, India.*

1.2 Research Aim 2

Explore perceived changes in food environments between home and destination among circular migrants.

This was a mixed methods analysis, which utilized the survey data described in Aim 1 and qualitative interviews conducted with migrant parents working and residing in twelve purposively selected brick kilns across Patna, Gopalganj, and Rohtas districts. We explored differences between home and destination in key aspects of the food environment including market and non-market sources of food, affordability, accessibility, availability and convenience. We also analyzed food security and household food availability, and present validation findings of the Food Insecurity Experiences Scale (FIES) developed by the Food and Agriculture Organization (FAO). Results are described in *Chapter 5: Food environments, food security and household food availability of circular migrant families: a mixed methods study among brick kiln laborers in Bihar, India.*

1.3 Research Aim 3

Compare stunting, wasting and determinants of nutrition status among circular migrant children, children in male migrant households, and children in non-migrant households in Bihar.

In this analysis, we pooled a subset of data from the survey of brick kilns described in Aim 1 with data from a longitudinal cohort study implemented in ten districts of Bihar during the same time period, which also captured information on household migration histories. We used propensity score weighting methods to create covariate balance among three groups of children: those engaging in circular migration, those in households with male migrant members, and those in households that do not engage in migration. We compared stunting, wasting, and the underlying and immediate determinants of nutrition status among the three balanced groups. Results are presented in *Chapter 6: Circular migration and child nutrition: a comparison of children from family circular migrant, male migrant, and non-migrant households in Bihar, India.*

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Chapter 2. Background

2.1 Migration and development: theoretical foundations[1]

Migration is inextricably linked to the processes of development. The theoretical foundations of the migration-development nexus are heterogenous. Early neo-classical theorists beginning with Ravenstein in the 1880s (1) conceptualized development as an equilibrium between rural and urban wages and labor availability; rural-to-urban migration thus is a necessary step in the process of development, as is transition from rural-based agriculture to urbanized industry. In this line of thought, migrants make individual, rational decisions to move out of free will, based on wage differentials between rural and urban areas until wages and labor availability are equalized. Later articulations that expanded neo-classical migration theory included the 'Harris and Todaro model' (2), which explains that rural-to-urban migration persists despite unemployment based on 'expected' income differentials. Lee rationalized the selectivity of migration (3); migrants are different from those who don't migrate in the source areas because of differences in human capital and labor markets.

Historical-structuralist migration theory is radically divergent from neo-classical thought, and is based on Marxist political economy. In Frank's 'dependency theory' (4), as result of capitalist processes, peasant societies are disrupted and displaced from their traditional livelihoods; migration is viewed as a consequence of the inequalities that capitalist economies

[1] This section is based on Hein de Haas' analysis of migration theory in Migration and Development: a theoretical perspective. International Migration Institute (2008).

engender and importantly, migration perpetuates underdevelopment and inequality. Individuals who migrate do not have agency and are forced to move to survive due to structural forces.

Both of these broad families of thought conceptualize migration as an outcome of development, rather than recognizing the reciprocal nature of migration and development. The new economics of labor migration (NELM) and network theories were important advancements, and together, they provide theoretical foundations that this dissertation draws upon. The NELM, developed in 1985 by Stark (5), views neither the individual nor macro-level socio-economic structures as the sole decision-making unit in migration. Rather, the family or the household considers migration of one or more members as a livelihood strategy that diversifies risk and income for the entire household unit. NELM thus acknowledges that migration is not individualistic as theorized by neo-classicalists, but rather migration occurs within a larger familial and social context. Similarly, for proponents of structuralist thinking, NELM represents a more pluralist view that allows for human agency.

Network theory and the closely related migration systems theory founded by Mabogunje (6) emphasize the importance of migration flows facilitating further migration flows because of social bonds and networks, thus resulting in observable patterns from origins to destinations. Very importantly, by making explicit the linkages migrants have with their homes, both NELM and migration systems theory recognize the reciprocal and feedback effects of migration on development in source areas. Analysis of remittances, for example, represents much of the literature on the economic impacts of migration on poverty in rural origins.

2.2 Migration in India

While population mobility has been a feature of Indian societies for centuries, migration

increased substantially in the 1990s in response to economic liberalization. According to Census estimates, the number of migrants in India doubled from 1991 to 2011 (7). However, as further described, below, the Census is designed to capture permanent migration. Among the poor in India, and in many other Asian and African countries, migration streams are often seasonal and temporary (8).

The pace of urbanization in India has been relatively slow; while on average, 75 percent of populations in high income countries reside in urban areas (9), only 35 percent of the Indian population does (10). The majority of urban growth that was observed between the 2001 and 2011 Censuses was from a natural increase in the population (births minus deaths) and reclassification of rural jurisdictions to urban jurisdictions, rather than net rural-to-urban migration (9).

Despite low urbanization rates, population mobility in India is substantial. This is because circularity is the dominant pattern of migration. De Haan articulates five underlying factors for this phenomenon (11) – cheap transport and communications, lack of adequate living conditions in cities which are not conducive to permanent resettlement of the family, agricultural ties to the village – specifically smallholdings, informality of employment opportunities in urban areas, and preservation of the family structure.

2.2.1 Circular migration

Zelinsky developed the mobility transition model, which linked population movement patterns to the broader demographic transition (12). Circular migration is a key feature of the early transition stage, characterized by declines in mortality and substantial population growth, and the late transition stage, marked by fertility decline. Circular migration is defined as temporary, repetitive movement for the purposes of employment, followed by a return to the normal place of

residence. Furthermore, circular migration lacks the intention of permanent change in residence (12, 13).

In the Indian context, there are two forms of circular migration that have been characterized by Deshingkar and Farrington (13). Accumulative migration, which can result in increased wealth, tends to be undertaken by those who have some education and skills with strong social networks. This form of circular migration is often rural-to-urban, undertaken by one or more male members of the household to larger cities such as Delhi and Mumbai for work in the industrial, manufacturing and service sectors. Therefore, this stream of circular migration implies relatively long distances for long periods, with earnings sent to the origin in the form of remittances.

Coping migration is undertaken by the very poor and lesser educated and is often for the purpose of survival. Coping migration involves short distances, and work tends to be in low-paid manual jobs, such as agriculture and the brick industry. Employment is informal, often through labor contractors, thereby potentially resulting in exploitation with respect to pay, working conditions, and labor bondage. These jobs also tend to involve migration of the entire family, including children (13).

2.2.2 Invisibility of circular migration

National sources of data used to estimate the magnitude of internal migration are limited in measuring circular migration. The National Census, for example, classifies an individual as a migrant if they have ever changed their place of residence in the past from one village or town to another village or town, thereby capturing permanent migration streams (14). Circular migrants do not officially reside in their places of work, despite often living there for several months of the year. Since they do not meet the definition of a migrant, circular migrants are not included in

Census migration estimates. The National Sample Survey (NSS), the second source of national data used to measure migration, included short-term migration in its 64th round (2007-2008) and defined a short-term migrant as someone who has been away from their usual place of residence for more than one month and less than six months (15). However, several streams of circular migration are seasonal, such as farm work and construction, and migrants can be away for up to ten months of the year (16); circular migration is therefore also inadequately captured in the NSS. While the temporary labor migration figure according to NSS data is 13.6 million people (17), based on labor data from occupations that employ circular migrants, it is estimated that approximately 100 million people engage in circular migration within the country (13).

Partially as a result of the underestimation of the magnitude of circular migration, and partially because of a generally pessimistic policy stance on internal migration borne from the lens of urban decay (18), migrants have been left out of the social protection policy framework. In its Constitution, India recognizes the right to move freely within the territory, yet two of the most fundamental privileges of citizenship, voting and the right to social entitlements, are based on domicile registration, assuming a sedentary population. Roy argues this loss of citizenship, coupled with informality of work and low wages, leads to the 'immobile foundations of labor mobility' (19).

2.2.3 Food security and nutrition policy framework

Food security and nutrition entitlements are important social protections which migrants lose upon moving. In its recognition of the 'right to food', India implements the world's largest food safety net program, targeting to reach 75 percent of the rural population and half of the urban population (20). India's food security policy is outlined in the National Food Security Act of 2013 (NFSA) (21), which is universal for all citizens of India irrespective of residence. The three

foundational components of India's food security policy are:

(1) Public Distribution System (PDS), under which subsidized food products including rice, wheat, sugar and kerosene are available through fair price shops. PDS has generally focused on hunger reduction and provision of staple grains. PDS beneficiaries are identified based on locality of residence, and benefits are therefore not portable.

(2) The Supplementary Nutrition Program (SNP) of the Integrated Child Development Scheme (ICDS) was established to provide food supplements to pregnant and lactating women and children from six months to six years of age. This includes micronutrient fortified and/or energy dense take home rations for children aged six months to three years and pregnant and lactating women, and morning snacks and a hot cooked meal for children three to six years of age who attend the local anganwadi (child care and development) center. SNP services are provided by ICDS Anganwadi workers and helpers. Benefits are provided based on the jurisdiction of the anganwadi center (i.e. not the residence of the beneficiary).

(3) The Mid-Day Meal Scheme (MDMS) provides cooked meals to school-going children aged 6 to 14 to reduce classroom hunger.

There are several bureaucratic barriers for migrants that restrict their physical access to these programs, as well as social barriers that place them at a political disadvantage in negotiation for program access (22). Although previous research has demonstrated that duration of stay in destination locations is associated with greater food security policy access (23), this is likely not the case for circular migrants who cannot establish eligibility in their place of work despite often living in their destinations for six to eight months of the year.

2.3 Circular migration and nutrition

Evidence on the associations of migration, food security and child nutrition in India has been largely limited to studies among long-term, rural-to-urban migrants. These studies have found that migrant children are more likely to be undernourished and experience higher mortality compared to urban non-migrant children (24, 25). Food insecurity also increases at urban destinations. In their study of long-term migrant families in urban Gujarat, Rai and Selvaraj (26) found that migrants experienced worse access to nutritious foods in their destination compared to their homes in rural Bihar and Uttar Pradesh, due to high food prices, the loss of food entitlements, the need to purchase water and fuel, and the high costs of rent and children's education.

There is a growing body of global work that demonstrates migration improves food security of family members who remain in rural origins, mainly through remittances from migrant members (predominantly male), within the context of both internal and international migration (27-29). In one study from India, households with male migrant members reported a yearly income from remittances alone that was virtually equal to the total yearly income of non-migrant households (30). Furthermore, almost all households with a migrant member reported using remittances for food, noting more frequent consumption of nutrient-rich animal source foods. Indicators of food insecurity such as eating only one meal a day, eating meals without vegetables, and borrowing money to buy food were lower among households that had a migrant member compared to households without a migrant member. Remittances were often also used for investment into agriculture and landholdings, illustrating the interdependence of farm and non-farm livelihoods for rural households.

The effects of migration on food security through the pathway of agriculture is also important to consider. One study from neighboring Nepal, where remittances account for almost 30 percent of the nation's gross domestic product (GDP), demonstrated both positive and negative effects of male migration on household food security at the origin. Remittances relieved women's experiences of worry about having enough food to eat, but the loss of labor resulted in a decline in agricultural productivity, and increased reliance on market purchases for food (31).

There is a gap in the literature on nutrition and food security among families that migrate circularly as a unit, and furthermore compares migrant children to non-migrant children in the origin. As de Haas notes, it is critical to "include *nonmigrants* in any migration impact analysis, as migration tends to affect sending societies *as a whole*" (32). Through this dissertation, we aim to begin filling these gaps by studying the associations of child nutrition with repetitive and short-term movement, characteristic of circular patterns, by exploring perceived changes in food security between home and destination, and by comparing nutrition among children in circular migrant, male migrant, and non-migrant households.

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Chapter 3. Methodology

3.1 Conceptual framework

To guide our overarching approach to the dissertation research aims, we adapted the UNICEF Conceptual Framework of the Determinants of Child Undernutrition (1), which commonly serves as the theoretical basis for global nutrition intervention design and implementation. The framework outlines the primary pathways among the basic, underlying, and immediate determinants of child nutrition status. We recognize that circular migration is a response to the structural level inequities that drive disparities in the underlying and direct causes of nutrition, and ultimately nutrition status and its consequences. Moreover, in some instances, circular migration can cause further vulnerabilities through exploitative processes and a loss of entitlements and political voice while migrants are away from home. Drivers of circular migration are numerous and include poverty, landlessness or low agricultural productivity, and ruralness; these factors and the change in location brought about by circular migration affect the food environment, which includes food entitlements. These basic factors influence the determinants of undernutrition at the underlying and immediate levels. The outlined causal pathways are not static; this is particularly the case for circular migrant families, for whom household food security, access to health care, feeding practices, and dietary intake can vary periodically over time *and* geographies. Children who engage in circular migration may be at a differential risk of undernutrition compared to their non-migrant counterparts because the causal pathways among the basic, underlying and direct determinants of nutrition status may potentially operate differently. We thus utilized the adapted framework shown in Figure 3.1 to identify important variables to analyze across all research aims.

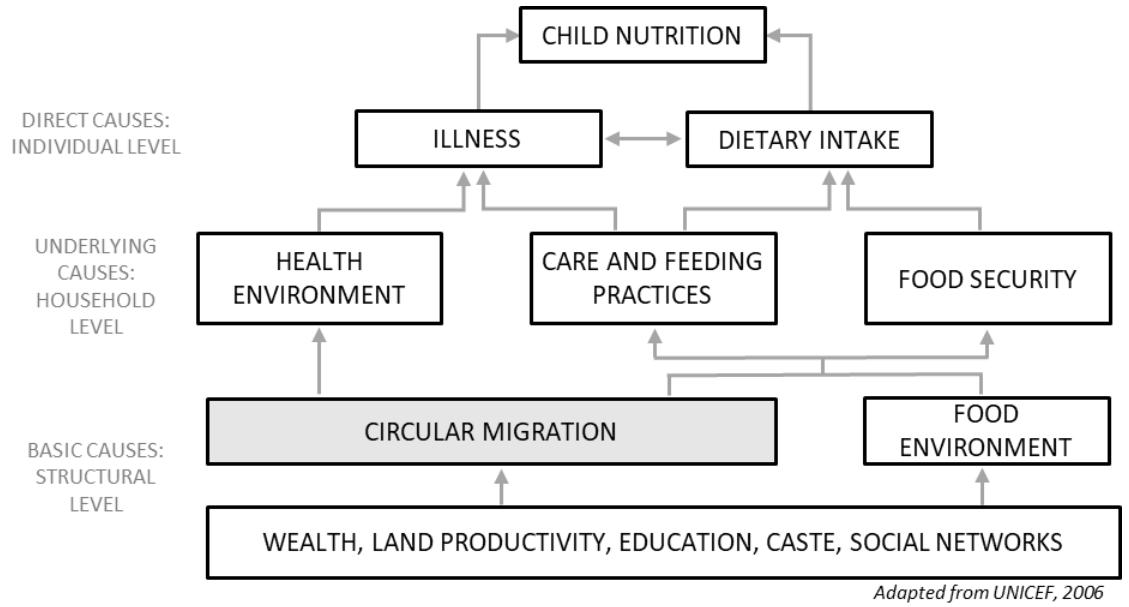

Figure 3.1 Conceptual framework of circular migration and the determinants of child nutrition

3.2 Defining and identifying the study population

There is no standardized definition of who qualifies as a circular migrant with respect to distance travelled and length of time away from home in the context of internal migration in India. In the 55th round of the NSS (1999-2000), temporary labor migration was defined as staying away from the usual place of residence (UPR), if the UPR was the place of enumeration, for 60 days or more in the prior one year in search of employment (2). For the 64th round of the survey (2007-2008), the definition was modified to better capture short-term movement; a temporary labor migrant was one who was away from the UPR between 30 days and six months in the previous one year in search of employment (3). Circular migrants in several migration streams can be away from their home for up to nine to ten months of the year. Therefore, for the purposes of our study, we defined a circular migrant as one who was away from their UPR for at least two

months in total, with at least one return home (for any length of time) in the previous one year; the latter part of the definition was included to capture the cyclical aspect of circular migration. We also included in our definition of circular migrants those who, if were migrating for the first time, had an intention to return home within the year.

To understand the shifts that migrant children experience in determinants of nutrition status, such as food environments, feeding practices, and access to health care, the ideal design would have been to survey the same migrant families both in their home and destination places. However, identifying circular migrant households in the place of origin would have needed to have occurred during a period when migrants had returned home, which can vary based on industry and distance. Furthermore, although we had a sense of villages with high family circular outmigration based on data missingness from CARE India's Severe Acute Malnutrition (SAM) longitudinal cohort study (further described below in Aim 3), from any given high outmigration village, circular family migrant households would have innumerable destinations across several states, some very far. Such a design within a reasonable time frame and financial resources was not feasible. Rather than identifying migrant families in the source village and following them to their destination, it was more practical to identify migrant families at destination sites, namely brick kilns, which represent a major circular family migration stream, further described below. We thus utilized a cross-sectional design to examine the nutritional picture of circular migrant children in their destinations (Aim 1), a mixed-methods design to explore how circular migrant families experience shifts in their food environments (Aim 2), and a pooled dataset to compare how nutrition status differs between migrant and non-migrant children (Aim 3).

3.3 Study context

3.3.1 State of Bihar

Within India, there is considerable variability among states with respect to the prevalence of undernutrition indicators. All 38 districts in Bihar, India's third most populous state, have either a very high prevalence (≥40%) or a high prevalence (30% to <40%) of stunting (4). Bihar also ranks among the poorest states in India with respect to socioeconomic indicators such as wealth, women's literacy and access to improved sanitation; health care access indicators such as antenatal care and institutional delivery; and feeding practices indicators such as timely introduction of complementary foods (5). Almost 90 percent of the state's population is rural, relying on agriculture or agricultural labor for livelihood; however, the majority of land holdings, over 80 percent, are marginal (less than one hectare). Furthermore, being the most flood-prone state in the country, Bihar's agricultural productivity is volatile (6). It is therefore no surprise that Bihar experiences the highest temporary labor movement both in terms of rate and absolute numbers (7).

3.3.2 Emory University and CARE India research partnership

The research for this dissertation was implemented in collaboration with CARE India in Bihar. Since 2011, CARE India has been providing support to the state's Department of Health and Family Welfare in improving maternal and child health outcomes and strengthening delivery of health services. Emory University is a technical partner to CARE India under the Bihar Technical Support Program (BTSP), funded by the Bill and Melinda Gates Foundation. As a part of CARE India's ongoing monitoring and evaluation activities, the Concurrent Monitoring, Learning and Evaluation (CMLE) implements state-wide annual household surveys, facility-

based surveys, and discrete research studies to inform programmatic decision-making.

3.3.3 The brick industry

To collect data on circular migrant families, we focused our research in the brick manufacturing industry. Bihar is a major brick producing state due to its location in the Gangetic plains, rich with alluvial soil (8). Brick making in India still largely utilizes traditional, manual processes, in some areas depending almost entirely on migrant labor (9). The season generally operates from November (following the Kharif harvest season) to June (preceding the monsoon season), varying based on the specific agro-climatic zone. During these months, migrant families reside in rudimentary housing on the kiln premises. Kilns are generally located in rural and peri-urban areas; thus migrants who work in brick kilns mostly classify as rural-to-rural migrants (10). Due to the informality of the sector, estimates of the number of people working in brick kilns vary greatly. The International Labour Organization estimates there are over 140,000 kilns in India, each employing on average 50 to 100 laborers (11). Women make up close to half of this workforce as a result of the industry's practice of recruiting male-female pairs. This also results in the migration of children who accompany their parents seasonally and are consequently out of school. Young children are often cared for by older siblings while their parents are working; some older children and adolescents contribute to family earnings by working with their parents despite child labor laws prohibiting such work.

Exploitation is frequent in India's brick industry, partially due to the advance system of payment (12). Lump sum payments are given to workers before the operating season, thus indebting families to the kiln owner. These advances, in addition to other costs accrued such as emergency health care and weekly payments for food expenses, are paid off throughout the

season. Payment at the end of the season forces workers to stay on the kiln. Low wages, financial illiteracy, and dishonest kiln owners can leave families bonded to return the following season.

3.4 Formative research

In February 2018, we conducted formative research in Gaya district, which has a large number of operational brick kilns. We visited two kilns to observe the general environment, housing structures, proximity to markets, and the presence and scale of families and young children; this latter point helped inform the sampling strategy. We also spoke with migrants to gain a preliminary understanding of migration patterns, including migration histories, length of time on kilns, origins, family and social relations on the kiln, and daily schedules. These formative findings informed our operational definition of circular family migration described above, as well as survey and qualitative tool development, described below.

3.5 Research Aim 1 Methods

3.5.1 Study objective, design and population

The objective of this aim was to estimate the association of early life and repeated migration with stunting and wasting among children under three of circular migrant families. To achieve this, we conducted two waves (June 2018 and January 2019) of cross-sectional data collection among migrant families residing on brick kilns with accompanying children under three. We focused on early life, as growth faltering primarily occurs in the first 1000 days (13); we also included children two to three years of age due to sample size considerations – it was unknown prior to the study how many children under two migrate with their families to brick kilns. Eligibility criteria for the study included:

(1) Self-identification as a circular migrant household, defined as living away from the home block for employment purposes for a total of at least 60 days in the previous one year, with at least one return home in the previous one year; and
(2) Presence of at least one child under three years of age in the household.

3.5.2 Sampling strategy

We utilized a multi-stage stratified cluster sampling approach, with districts as strata and brick kilns as clusters.

Sampling frame. Our sampling frame was obtained from the Government of Bihar Department of Mines and Geology. At the state level, the department maintains a publicly available aggregated number of operational brick kilns per district, which is updated annually (14). To acquire the names and locations of operational kilns per district, with permission from the state level, we visited each of the 38 district level offices for the list of individual kilns. CARE India Block Monitoring, Learning and Evaluation Officers (BMLE) did an initial survey of kilns listed in their blocks (administrative sub-division of district) to document kilns that were not operational (i.e. had shut down either permanently or for the season) or that were operational but did not have migrant families (i.e. employed only local labor or unaccompanied male migrant labor). These kilns were removed from the sampling frame before selection. Kilns that had not paid taxes or did not pass environmental safety standards were ordered to shut down and were not included in the government list of operational brick kilns. However, it is likely that some of these kilns continued to operate illegally; these would have been excluded from our original sampling frame.

Sample size calculations. For this aim, we calculated sample size using the formula:

$$n = \frac{1.96^2\, p(1-p)\ (DEFF)}{d^2}$$

p = the estimated proportion of stunting (0.50)

$DEFF$ = the design effect based on clustering (2)

d = desired precision = (0.05)

$$n = \frac{1.96^2\ 0.5(0.5)\ (2)}{0.05^2}$$

The calculated sample size was thus 769 children under three, and with a conservative estimate of 30 percent non-response, the sample size was increased to 1000. To perform sub-group analyses on males versus females, and by younger versus older children, this estimate was multiplied by two for a final sample size of 2000 children under three.

Based on the formative research described above, the team concluded that there would likely be around five to ten children under three on a given kiln; thus, a cluster size of three was conservatively appropriate. Dividing 2000 by 37 districts (Banka district did not have operational kilns during the first wave), and three children per kiln, 18 kilns per district needed be sampled.

Sample selection. Eighteen clusters (brick kilns) were randomly selected from each stratum (district). Within each randomly selected eligible kiln, a census was conducted to register circular migrant families meeting the eligibility criteria for the study and record individual child details per household. From the listing thus generated, three eligible households per kiln were randomly selected using a random number table, one with a child in the zero to eleven month age group and two with a child in the 12 to 35 month age group. Children zero to eleven months of age were oversampled to ensure an adequate sample size for performing subgroup analyses. Only one child per household was selected.

3.5.3 Tool development

For the main survey instrument administered to mothers, we developed a migration module to collect data on families' migration histories and ascertain when index children first experienced migration (including birth during migration), and how many times they migrated since their birth. We included details on household composition, previous destination sites, and occupations. Remaining modules covering feeding practices, immunization history, contact with front-line health workers, micronutrient supplementation, and illness were identical to those used by CARE India in their household surveys; we did not change these items so as to ensure comparability to pool these data with non-migrant child data from the SAM cohort study (Aim 3). To measure food security, we used the FAO Food Insecurity Experience Scale (FIES), an eight-item scale measuring the latent factor of continuous access to adequate food, which was calibrated using data from over 150 countries, including India (15).

We also developed a short tool that was administered to kiln managers to collect cluster level information such as the production capacity of the kiln, types of fuel used, how labor is recruited, and where laborers are referred to in the case of illness.

We pretested the instruments at a kiln in Patna district prior to the study and improved the tool according to findings. The final instrument was digitized with in-built skip patterns and logic checks using SurveyCTO software for use on tablets used by enumerators.

3.5.4 Training

We held a four-day training in May 2018, prior to the first wave of data collection, and a one-day refresher training in January 2019, prior to the second wave of data collection. CARE India district level CMLE staff, who were experienced in survey enumeration, were trained on the

study objectives, the individual modules, and anthropometric data collection. Each of the district teams then trained BMLE, who were the study enumerators, on the same content in a cascade approach.

3.5.5 Challenges

The first wave of the survey was implemented in June 2018, towards the end of the brick production season; by this time, many kilns had ended operations and migrants had returned home. Due to the timing, we could not achieve the desired sample size; additionally, it was possible that migrants who remained through the end of the season were from different origins and castes compared to migrants who returned home earlier. We decided to implement a second wave of the survey in January 2019, a few months into the following migration season, to provide a more accurate representation of origin distribution. The inclusion of a second wave also allowed us to examine seasonality. Our final sample size included 2564 children 0 to 35 months of age from both waves of data (1094 from the June 2018 wave and 1470 from the January 2019 wave) after excluding observations with missing or implausible outcome values (n=178). 519 and 637 brick kilns were surveyed in the first and second wave, respectively.

3.6 Research Aim 2 Methods

3.6.1 Study objective, design and population

The objective of the second aim was to explore perceived changes in food environments between home and destination among circular migrants. We utilized a mixed-methods approach, combining survey data described in Aim 1, with qualitative data gathered in June 2018. We conducted in-depth interviews (IDI) with circular migrant mothers and fathers of young children,

and key informant interviews (KII) with brick kiln owners, kiln managers, and labor contractors.

3.6.2 Conceptual framework

This aim was guided by the Agriculture, Nutrition and Health Food Environment Working Group Food Environment Conceptual Framework (ANH FEWG) (16), which illustrates the external and personal domains of the food environment. For example, in the external domain, availability is defined as the physical presence of foods within one's food environment, whereas accessibility, a dimension of the personal domain, is determined by one's ability to procure those foods based on distance and transport. Similarly, while food prices are established externally, affordability of food is a personal dimension based on purchasing power.

3.6.3 Qualitative sampling strategy

We chose three districts – Patna, Rohtas, and Gopalganj, based on agro-climatic zone, rural/urban status, and information from CARE India field staff regarding areas where kilns were still operational in mid-June. We then chose four kilns that were not included in the first wave of survey data to avoid user fatigue. Per selected kiln, we chose participants based on convenience sampling. We intended to interview one migrant mother per kiln, and either one father or one key informant per kiln visited. Our final sample included eleven migrant mothers, six migrant fathers, two labor contractors, two brick kiln owners, and four brick kiln managers.

3.6.4 Qualitative tool development

Semi-structured guides for IDI and KII were developed based on the ANH FEWG conceptual framework described above to understand how migrants experience differences in key dimensions of their food environments. These included food sources (with particular attention to

PDS and ICDS food security entitlements), availability, accessibility, affordability, prices and convenience. We also sought to understand drivers of family migration, migration histories, illness and care seeking, child care, and experienced and aspired outcomes of engaging in migration.

3.6.5 Qualitative team

The qualitative team included the doctoral researcher who is trained and experienced in qualitative methods, a female consultant who is Bihari and was experienced in qualitative interviewing, and a male CARE India employee who is Bihari and was minimally experienced in qualitative research. Prior to data collection, the team worked together to practice establishing rapport and probing techniques. During data collection, the team debriefed daily to discuss challenges and brainstorm solutions.

3.6.6 Challenges

As described in Aim 1, due to the timing of data collection coinciding with end of the work season, it was difficult to recruit participants from varying origins and castes. As a result, almost all of the migrant parents who participated were from Jharkhand and were from Scheduled Tribe communities. While generalizability is not an intention of qualitative research, our findings may have been more heterogenous had we been able to include a variety of regional and caste communities. Secondly, the analysis was conducted by only the doctoral researcher. This was due to the fact that the transcripts were written in Hindi, and because the analysis was done in MAXQDA, a proprietary software. While it is considered best practice have multiple coders to reduce research bias and expand insights, we decided including coders unfamiliar with the distinct context would undesirably result in superficial rather than rich analyses.

3.7 Research Aim 3 Methods

3.7.1 Study objective, design and population

The objective of this aim was to compare stunting, wasting and the determinants of nutrition status among circular migrant children, children in male migrant households, and children in non-migrant households in Bihar. We pooled data from the survey of circular migrant families residing on brick kilns described in Aim 1 with a subset of data from a separate longitudinal cohort study implemented by CARE India; the latter dataset comprised our sample of children from non-migrant and male migrant households.

3.7.2 SAM longitudinal cohort study

From August 2017 to July 2018, CARE India implemented a longitudinal cohort study with the objective of determining the incidence of severe acute malnutrition. Ten districts were chosen, one from each of the ten CARE programmatic regions. Within the ten districts, three villages were purposively selected based on accessibility to the district capital. All children under five years of age from the selected 30 villages were enrolled into the open cohort. A household survey was administered to the caregiver once during the study period. Weight data and information on illness in the previous month for each child was collected monthly, and height/recumbent length data was collected once every three months. Weight data for the two interval months was interpolated based on the preceding and subsequent weight measures.

We integrated a migration module in the SAM household survey administered to the caregiver. The module collected data on members of the household who migrated for work for at least two months in the previous one year. We were thus able to identify children who lived in households whose fathers migrated for work and children who lived in households that did not

engage in any form of migration. There were very few households that reported engaging in family migration, which was expected, as those households would have likely been away from home during the time of survey implementation.

3.7.3 Sample selection for analysis

A total of 6554 children under five were included in the SAM cohort study. For this analysis, we restricted the data to children under three years of age for whom weight and height (measured or interpolated) were available for June 2018. We further subset the analysis to children who were from households that engaged in male only migration (n=925) and households that did not engage in any migration during the previous one year (n=1257).

Of the 2564 circular migrant children included in the survey described in Aim 1, we restricted the dataset to the June 2018 wave to maintain temporal consistency for anthropometric comparisons with non-migrant children. We further subset the data to migrants whose origins were within Bihar, so that we could compare Bihari non-migrant children to Bihari migrant children. Our final circular migrant child sample size was 540.

3.7.4 Propensity score weighting

Circular family migration is selective, in that families who circularly migrate are different from families who do not engage in migration in many important aspects that also impact child nutrition, such as wealth, land ownership, parental education, and caste. Controlling for variables in a regression analysis without addressing covariate imbalance can lead to model dependence and imprecise estimates (17). Thus, in the context of observational research where a random assignment to circular migration is impossible, matching and weighting are methods often used to pre-process data and create balanced groups prior to effect estimation.

Most available covariate balancing tools are designed for binary treatment groups. However, due to the importance of male migration to the livelihood strategy of many households in Bihar, we decided to include children in households with male migrants as a distinct third group rather than combining them with non-migrant households. Guidance on control for imbalance across multiple groups is limited (18), and was not available for methods we initially explored, including coarsened exact matching and propensity score matching. We thus used propensity score weighting, for which there are tools available for multinomial groups. We used the covariate balance propensity scores (CBPS) method (19), which optimizes both covariate balance and prediction of treatment assignment using generalized method of moments for propensity score estimation. CBPS performs well when covariates are binary and categorical (20). Propensity scores are calculated to estimate the likelihood of 'treatment', in this case engaging in circular migration, conditional on specified covariates. Based on the estimand of interest, the average treatment effect on the treated (ATT), weights were generated and applied to observations from non-migrant and male migrant households, so that children from these groups looked similar to circular migrant children on the specified covariates; weights for circular migrant children were one. Weighting yielded effective sample sizes (ESS) of 123 non-migrant children and 121 children from male migrant households.

Covariate selection. Guidance on selection of covariates to estimate propensity scores is limited (19, 21); we chose covariates that predict both the exposure – circular migration, and the outcome – nutrition status (20). Specifically, our covariates were wealth quintile, paternal education (any versus none), land ownership (yes/no), child age (in months) and child sex. Household level caste information was not available for all respondents in the SAM dataset, nor could we weight on district of origin as there was low overlap between the ten districts included

in the SAM cohort study and the districts of origin represented among intrastate circular migrants. We thus included as a covariate a variable that indicated the district proportion of the population that is SC or ST. We used data from the Socio Economic Caste Census (SECC) (22), and classified districts as high SC and ST (combined proportion of SC and ST greater than 20 percent) or low SC and ST (combined proportion of SC and ST less than or equal to 20 percent). This variable advantageously allowed us to capture the social network aspect of outmigration, which aligns with caste. That is, circular migrants are disproportionately SC and ST; therefore, districts with a high SC and ST population are also likely to be high outmigration districts due to migration networks.

3.7.5 Challenges

Propensity scoring is traditionally utilized as a causal inference methodology; however, it is important to note that as our data are cross-sectional, we cannot make any causal inferences. Furthermore, the conclusions we draw from this aim are generalizable to children who engage in circular migration to the brick industry, and children in the 30 villages selected for the SAM cohort study who are similar with respect to socioeconomic status but do not migrate. As a result of applying weights to the sample of children from non-migrant and male migrant households to resemble circular migrant children, we lost substantial power.

About two-thirds of the anthropometric data from the June 2018 measurement in the SAM cohort study was interpolated based on previous and subsequent measures. This was by design to reduce the burden of data collection on both the enumerator and the children and their caregivers. Because quarterly height measurements were staggered by district for logistical purposes, using only the subset of observed measures would have resulted in not only a smaller non-migrant sample size, but also a regionally skewed dataset.

Lastly, we did not adjust for sampling design in this aim because different sampling approaches were used for the two datasets that were pooled. Sampling error thus may not have been adequately accounted for, and as a result standard errors may have been underestimated.

3.8 Ethics

We applied for ethical approval for the study of circular migrant children as a sub-study of the SAM longitudinal cohort study; approval was granted by Emory University Institutional Review Board and Ashirwad Ethics Committee in India. Verbal informed consent was obtained from the mother of each selected child before the interviews and anthropometric measurements. No incentives were provided to the participants in either study.

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Chapter 4. Early life migration and undernutrition among circular migrant children: an observational study in the brick kilns of Bihar, India

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Abstract

Objective: India holds the world's largest burden of chronic and acute child undernutrition. Poverty and systemic inequities are basic causes of undernutrition that also drive households to engage in circular migration for livelihood. Among the most precarious streams of circular migration, movement of the whole family, including young children, is common. Yet, the nutritional implications of recurrent movements beginning in early life has not been studied. Our research examines the association of recurrent movement beginning in early life in Bihar, India, which experiences the highest movement in the country.

Design: We focused our study in the brick industry setting; traditional brick kilns operate seasonally during the dry months and rely on migrant laborers, who often live with their families on-site. We used descriptive statistics to explore the determinants of nutrition status, including diet, illness, food security and the health environment. We conducted multilevel modeling to estimate the association of circular migration patterns with stunting and wasting among 2564 children under three temporarily residing on 1156 sampled brick kilns throughout the state.

Results: Among children who were either born during migration or first migrated before six months of

age, those who have experienced multiple episodes of migration are more likely to be stunted compared to those who migrated once. Our results demonstrate substantial gaps in delivery of essential public health and nutrition programs for circular migrant women and children. Diet and feeding practices may be positively influenced during migration.

Conclusions: Policy efforts should ensure continuity of social protection and welfare entitlements between home and destinations for circular migrant families, with an explicit focus on rural-to-rural movement.

Keywords: circular migration; internal migration; child nutrition; brick kilns; India

4.1 Introduction

India has 45.5 million children who are stunted, nearly one third of the global burden (1). Indicative of linear growth faltering, stunting is a marker of chronic undernourishment and illness resulting from a deficient food and health environment, and is associated with long-term cognitive deficits and reduced earning potential (2). Of the 50 million children worldwide who are wasted, or acutely undernourished, over one half live in India (1). Wasting indicates thinness, due to weight loss or failure to gain weight, often as a result of disease or food shortage; children with acute malnutrition have an increased risk of mortality (3). As outlined in the UNICEF Conceptual Framework of the Determinants of Child Undernutrition (4), the basic causes of child stunting and wasting relate to the sociopolitical and economic contexts that limit or deny the realization of rights and access to essential resources among vulnerable populations, perpetuating poverty and inequity. Indeed, countries that have experienced economic growth have also achieved overall national declines in stunting (5, 6).

India's rapid economic growth in recent decades has been inequitable and, in fact, disparities in child nutrition have widened during this period; while overall, the prevalence of severe stunting reduced from 31% in 1992 to 22% in 2005, the prevalence ratio of severe stunting among the poorest compared to the richest increased from 1.8 to 2.8 during this same time period (7).

4.1.1 Circular migration

To cope with poverty and build wealth, many poor households engage in internal migration for income. For these households, migration is a critical element of a diversified livelihood strategy. Ten percent of rural households in India receive remittances from a member who has internally migrated, and among these households, remittances account for up to 30% of household expenditures (8).

The dominant form of labor migration undertaken by the chronically poor is circular in nature (9), defined as temporary, repetitive movement, followed by a return to the normal place of residence (10, 11). National sources of data used to estimate the magnitude of internal migration are limited in measuring circular migration. The National Census, for example, classifies an individual as a migrant if they have ever changed their place of residence in the past from one village or town to another village or town, thereby capturing permanent migration streams (12). Circular migrants do not officially reside in their places of work, despite often living there for several months of the year, and are therefore not included in Census estimates of migration. The National Sample Survey (NSS), the second source of national data used to measure migration, included short-term migration in its 64th round (2007-2008) and defined a short-term migrant as someone who has been away from their usual place of residence for more than one month and less than six months (13). However, several streams of circular migration are

seasonal, such as farm work and construction, and migrants can be away for up to ten months of the year (14); circular migration is therefore also inadequately captured in the NSS. While the temporary labor migration figure according to NSS data is 13.6 million people (15), based on labor data from occupations that employ circular migrants, it is estimated that approximately 100 million people engage in circular migration within the country (10).

Circular migration streams, though heterogenous, are theorized to fall under one of two broad classifications – coping migration undertaken for survival, and accumulative migration intended to increase wealth. Those who engage in coping migration are very poor, less educated, and belong to marginalized groups such as tribal and low-caste communities. Circular migration for survival generally involves short-distance travel, and work is manual and low-paid. Employment is informal, often through labor contractors; as a result, circular migrants can face additional vulnerabilities with respect to pay and working and living conditions (10). We focus on this type of circular migration, drawing the connection that the inequities driving coping migration are common to the inequities driving disparities in nutrition status.

Within India, there is considerable variability among states with respect to the prevalence of undernutrition, poverty, and engagement in circular migration. The state of Bihar has the highest prevalence of stunting among children under five in the country (16), with all 38 of Bihar's districts classifying as very high (≥40%) or high (30% to <40%) stunting (17). Over one in five children under five years of age in the state are wasted (16), surpassing the World Health Organization (WHO) critical public health significance threshold of 15 percent (18). Bihar ranks the lowest in the country in wealth (16), and has both the highest absolute and rate of temporary labor migration in the country (15).

4.1.2 Circular migration and the brick industry

We focus our research in the brick manufacturing industry of India, the second largest in the world after China (19), and growing in scale due to demand for construction following the country's economic growth. Brick making in India still largely utilizes traditional, manual processes, in some areas depending almost entirely on migrant labor (20). Brick kilns are operational during the dry months and are located in rural and peri-urban areas; thus migrants who work in brick kilns mostly classify as rural-to-rural migrants (21). Bihar, located in the Gangetic plains rich with alluvial soil, is a major brick producing state (22). Due to the informality of the sector, estimates of the number of people working in brick kilns vary greatly. The International Labour Organization estimates there are over 140,000 kilns in India, each employing on average 50 to 100 laborers (23). Women make up close to half of this workforce as a result of the industry's practice of recruiting male-female pairs. This also results in the migration of children who accompany their parents seasonally and are consequently out of school. The season generally operates from November (following the Kharif harvest season) to June (preceding the monsoon season), varying based on the specific agro-climatic zone. During these months, migrant families reside in rudimentary housing on the kiln premises. Young children are often cared for by older siblings while their parents are working; some older children and adolescents contribute to family earnings by working with their parents despite child labor laws prohibiting such work.

4.1.3 Migration and nutrition

The majority of research on health and nutrition of children who internally migrate to accompany their parents in India has focused on permanent, rural-to-urban migration streams; these studies

have found that migrant children are more likely to be undernourished and experience higher mortality compared to urban non-migrant children (24, 25). The literature also suggests that, in urban India, compared to recent migrants, those who have spent more time at their destination are more likely to access health care (26), water and sanitation services, and food security programs (27), the underlying causes of nutrition status in the UNICEF Conceptual Framework.

Circular migrants, however, are likely at a disadvantage compared to permanent internal migrants who can eventually establish official residence and exercise political voice. Circular migrants lose access to domicile entitlements upon leaving their home locality, such as subsidized food rations through the Public Distribution System (PDS), and are ineligible for those entitlements in their place of work. Besides administrative barriers, stigma and discrimination against migrants prevent access to entitlements that legally should be provided irrespective of residence (28), for example, participation in the Integrated Child Development Services (ICDS) programming, which delivers health and nutrition support for children and pregnant and lactating women.

The potential effects of family circular migration on child nutrition are theoretically multidirectional. Increased income may improve food security and dietary quality and intake, thereby improving child nutrition. Conversely, interruption of critical health services such as immunization and maternal care due to cyclical movement, and unhygienic living conditions in many work sites may leave circular migrant families, especially young children, vulnerable to illness and malnutrition. Brick kilns in particular are hazardous environments given the high level of air pollutants and widespread lack of sanitation infrastructure. Two studies examining nutrition among migrant children living in brick kilns in the states of Maharashtra and West Bengal found a high prevalence of undernutrition, including stunting, wasting, and underweight;

and high morbidity, including acute respiratory infections (ARI) and diarrhea (29, 30). However, existing published research does not consider the potential effects of repetitive and short-term movement that circular migrant children experience. Nor does the literature include research on the effects of first experiencing circular migration in early childhood, when nutritional insults can have long-lasting impacts on growth.

4.1.4 Current study

We conducted a study that allowed us to explore how first migration at an early age interacts with recurrent shifts in environment, potentially affecting nutrition outcomes among circular child migrants. Specifically, we conducted a representative survey of circular migrants working in brick kilns throughout Bihar who migrated with their children, and used these data to examine the determinants of nutrition status and the association of child age at first migration and number of migration episodes since birth with stunting and wasting.

4.2 Methods

This study was part of an ongoing collaboration between Emory University and CARE India under the Bihar Technical Support Program (BTSP) partnership funded by the Bill and Melinda Gates Foundation. Ethical approval was obtained from Emory University Institutional Review Board (IRB00090920) and the local review board, Ashirwad Ethics Committee.

4.2.1 Study design and sampling strategy

A multi-stage sampling strategy was employed to obtain a representative sample of children under three years of age who migrate with their families. We stratified by district (administrative subdivision of the state), and within each district we randomly sampled 18 brick kilns (based on

a priori sample size calculations), which were used as clusters. Our sampling frame was obtained from the Department of Mines and Geology, which maintains a yearly updated list of operational brick kilns in the state. The study was conducted in the 37 districts in Bihar that had listed operating kilns during the time of the study.

Selected kilns that did not have migrant families present (in other words, only employed local labor or unaccompanied male migrants), or were closed, either for the season or permanently, were excluded. Within each randomly selected eligible kiln, a census was conducted to identify circular migrant families meeting the inclusion criteria for the study:

(1) Self-identification as a circular migrant household, defined as living away from their home block (sub-district) for employment purposes for a total of at least 60 days in the previous year, with at least one return home during that year; and
(2) Presence of at least one child under three years of age at the kiln.

From the sampling frame thus generated, three eligible families per kiln were selected, one with a child in the zero to eleven month age group and two with a child in the 12 to 35 month age group. Children zero to eleven months of age were oversampled to ensure an adequate sample size for performing subgroup analyses. Verbal informed consent was obtained from the mother of each selected child before the interview and anthropometric measurement. No incentives were provided to the participants. We collected two waves of cross-sectional data in June 2018 (summer) and January 2019 (winter). The summer wave of data was collected towards the end of the migration season, and therefore reflected a longer average length of time since arrival to the kiln of enumeration compared to the winter wave of data collection, which occurred approximately two months into the migration season. For the January 2019 wave, we repeated

random sampling of clusters, resulting in a different list of selected brick kilns for data collection.

4.2.2 Data collection

Data collection was conducted by block level team members of CARE India. Trainings were held before each wave of data collection on the administration of the survey instrument and anthropometric methods using standard procedures (31). After orienting the kiln owner or manager to the purposes of our study, trained block level staff administered a household survey to the selected child's mother and collected anthropometric data on all selected children. Height was collected using stadiometers for children two years and older, and infantometers were used to measure recumbent length for children under two years of age. Digital scales (SECA 874) were used to measure weight. Height/length and weight measurements were conducted twice successively per child; we used the average of the two measurements for analysis. Enumerators recorded anthropometric and survey data digitally on Android tablets using a custom interface developed with SurveyCTO software, which included in-built logic checks and data validation. Supervisory staff additionally conducted back-checks with a random subsample of respondents to ensure data quality.

4.2.3 Variables

Our key exposures of interest were child age at first migration (in months) and number of migration episodes since the index child's birth (including the migration at the time of the survey), derived from detailed questions on the family's migration history. Primary outcomes were height-for-age (HAZ) and weight-for-height (WHZ) z-scores, both calculated using WHO reference data (32). HAZ and WHZ scores of less than negative two standard deviations (SD)

classify as stunting and wasting, respectively; HAZ and WHZ scores of less than negative three SD classify as severe stunting and severe wasting, respectively.

Additional variables of interest included the basic, underlying and immediate determinants of nutrition: caste[1], wealth, level of education completed by mother of selected child, state of origin, parity, interaction with front-line health workers[2] since arrival to the kiln, sanitation on the kiln, household food insecurity, immunization, illness in the previous one month (acute respiratory infection (ARI) and diarrhea), and age appropriate feeding. Wealth index was derived by conducting principal component analysis of household asset ownership data and creating quintiles based on the resulting factor scores (33). Household food insecurity was measured using the Food and Agriculture Organization Food Insecurity Experience Scale (FIES) (34), with reference to the previous one year and was dichotomized into any versus no food insecurity. A fully immunized child is one who, by 12 to 23 months of age, has received one dose of tuberculosis vaccine, three doses of pentavalent or diphtheria pertussis tetanus vaccine, three doses of oral polio vaccine and one dose of measles containing vaccine. ARI was

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[1] Scheduled Castes, or Dalits, are marginalized Hindu communities that are outside of the traditional caste hierarchy. Scheduled Tribes are marginalized communities due to geographic isolation. Other Backward Classes (OBC) are marginalized communities that are economically, socially or educationally disadvantaged and do not fall into the Scheduled Caste or Scheduled Tribe classifications.

[2] Front-line health workers include Anganwadi Workers, Accredited Social Health Activists, and Auxiliary Nurse Midwives; these cadres of community-based health workers deliver essential health and nutrition services such as immunization, food supplements, institutional delivery promotion, and education about recommended feeding practices.

presumed if any one of the following symptoms were reported by the mother: cough with fast breathing, difficulty in breathing, chest indrawing, or wheezing/grunting Age appropriate feeding was a dichotomous variable constructed based on age-specific WHO infant and young child feeding indicators (35).

Dietary intakes for children under two years of age was assessed by asking the mother to report foods that were consumed in the previous 24 hours using a predefined list of common food items developed by CARE India for its monitoring and evaluation activities. For children 24 to 35 months, a single day, multiple-pass interactive 24-hour dietary recall method was used (36). For children zero to five months, age appropriate feeding was defined as exclusive breastfeeding. Exclusive breastfeeding was only included in the January 2019 wave of data collection; as a result, children zero to five months from the June 2018 wave were excluded from analyses using the age appropriate feeding indicator (n=111). For children 6 to 23 months, age appropriate feeding was defined as minimum acceptable diet, a composite indicator of minimum dietary diversity and minimum meal frequency constructed using the food item consumption tool described above. For children 24 to 35 months, age appropriate feeding was defined as dietary diversity (greater than or equal to four food groups) using 24-hour recall data.

4.2.4 Statistical analysis

We first conducted descriptive analyses of sociodemographic characteristics and migration exposures of our sample, followed by bivariate associations between the determinants of nutrition status and season, using Rao-Scott chi-square tests.

To examine the adjusted association of migration exposures with nutrition status, we ran multiple variable logistic regression models with dichotomous stunting and wasting as separate outcomes. We tested statistical interaction between child age at first migration (categorized into

birth during migration or first migration at less than six months, and first migration at greater than or equal to six months) and number of migration episodes (categorized into one, two and greater than or equal to three episodes) for both nutrition outcomes. For each outcome, we ran models controlling for age in months, sex, state of origin (categorized into Bihar, Jharkhand, and Other states), caste (Scheduled Caste, Scheduled Tribe, Other Backward Class, and General Caste), parity (< 3 and ≥ 4), mother's education (any and none), wealth quintile and season (summer and winter).

Collinearity of predictor variables were assessed for all models. All analyses accounted for the stratified cluster survey design. We did not include survey weights as the true population distribution of migrant children is unknown. Alpha was set at 0.05, and analyses were conducted in SAS 9.4. Maps and figures were generated using R 4.0.2.

4.3 Results

The study had a final sample size of 2564 children 0 to 35 months of age from both waves of data (1094 from the June 2018 wave and 1470 from the January 2019 wave) after excluding observations with missing or implausible outcome values (n=178). 519 and 637 brick kilns were surveyed in the first and second waves, respectively. Reasons for not surveying a selected eligible kiln included refusal by the kiln owner or manager to enter the premises, or inability to locate the kiln.

4.3.1 Population characteristics

The majority of migrants were from Bihar (53.4%), followed by the neighboring state of Jharkhand (33.2%). Figure 4.1 displays the distribution of migrant origins by district, showing the high presence of migrants on selected kilns from Gaya, Nawada and Nalanda districts in

Bihar, Ranchi and Gumla districts in Jharkhand and Cooch Behar district in West Bengal represented in our study.

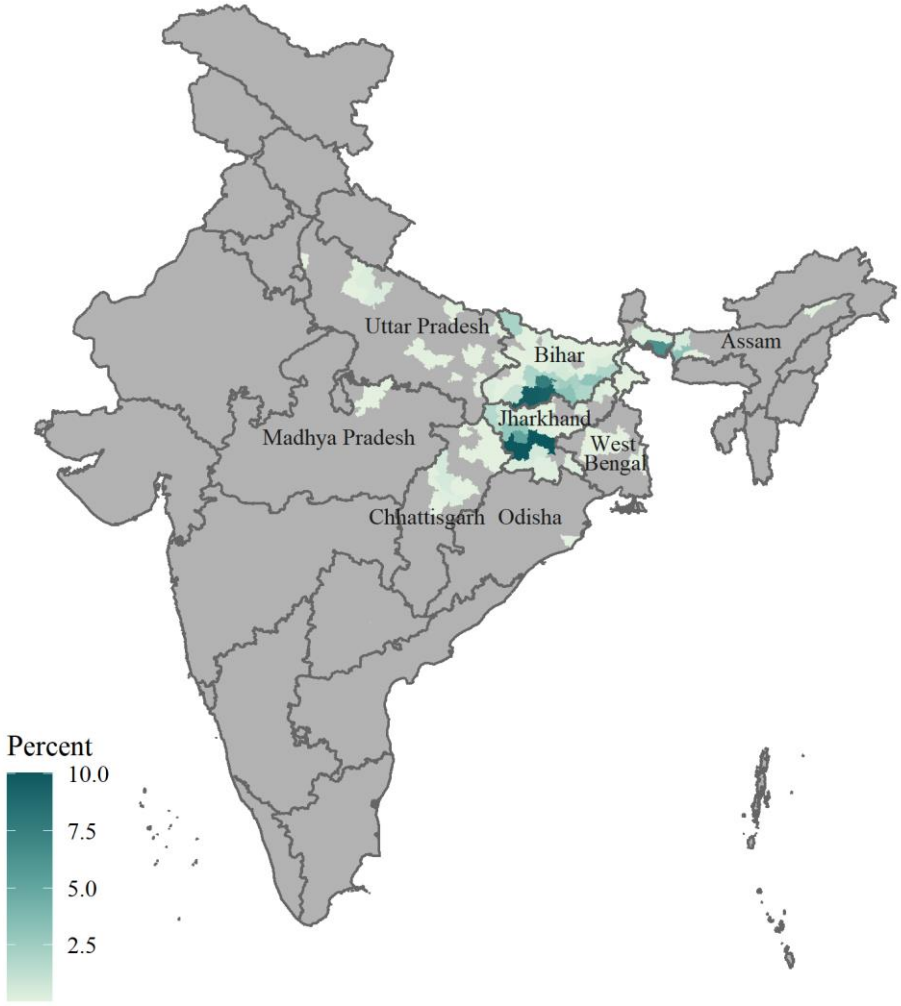

Figure 4.1 District origin distribution of circular migrant families residing at study site brick kilns in Bihar, June 2018 and January 2019

Table 4.1 demonstrates differences in sociodemographic characteristics by state of origin. Interstate migrants had greater representation in higher wealth quintiles compared to those who migrated within Bihar. On average, intrastate migrants had larger households, migrated with a greater number of household members and have engaged in circular migration for a greater number of years, compared to migrants from other states. Among respondents who migrated for

Table 4.1 Sociodemographic characteristics of circular migrant families in Bihar by state of origin, June 2018 and January 2019

	Bihar	Jharkhand	Other	Total
All, n (%)	1370 (53.4)	851 (33.2)	343 (13.4)	2564 (100.0)
Child age category, n (%)				
0 to 5 months	239 (17.4)	86 (10.1)	50 (14.6)	375 (14.6)
6 to 11 months	231 (16.9)	160 (18.8)	63 (18.4)	454 (17.7)
12 to 23 months	616 (45.0)	389 (45.7)	126 (36.7)	1131 (44.1)
24 to 35 months	284 (20.7)	216 (25.4)	104 (30.3)	604 (23.6)
Child sex, n (%)				
Male	686 (50.1)	426 (50.1)	187 (54.5)	1299 (50.7)
Female	684 (49.9)	425 (49.9)	156 (45.5)	1265 (49.3)
Caste, n (%)				
Scheduled Caste	944 (68.9)	189 (22.2)	26 (7.6)	1159 (45.2)
Scheduled Tribe	93 (6.8)	533 (62.6)	22 (6.4)	648 (25.3)
Other Backward Class	321 (23.4)	119 (14)	160 (46.6)	600 (23.4)
General Caste	12 (0.9)	10 (1.2)	135 (39.4)	157 (6.1)
Religion, n (%)				
Hindu	1358 (99.1)	788 (92.6)	101 (29.4)	2247 (87.6)
Muslim	12 (0.9)	21 (2.5)	241 (70.3)	274 (10.7)
Other	0 (0.0)	42 (4.9)	1 (0.3)	43 (1.7)
Mother's age (years), mean (SD) *(n=2268)*	25.8 (5.3)	24.3 (4.7)	24.2 (5.3)	25.0 (4.9)
Mother's age at marriage (years), mean (SD) *(n=2550)*	15.9 (3.0)	16.7 (3.2)	15.8 (3.6)	16.4 (3.3)
Parity of mother, mean (SD)	3.4 (1.9)	2.6 (1.6)	2.5 (1.5)	2.6 (1.5)
Mother's education, n (%)				
No formal education	1308 (95.5)	640 (75.2)	229 (66.8)	2177 (84.9)
Up to 8th standard	52 (3.8)	131 (15.4)	90 (26.2)	273 (10.6)
Above 8th standard	10 (0.7)	80 (9.4)	24 (7.0)	114 (4.4)
Father's education, n (%) *(n=2430)*				
No formal education	1128 (85.6)	439 (56.4)	229 (68.6)	1796 (73.9)
Up to 8th standard	158 (12.0)	201 (25.8)	96 (28.7)	455 (18.7)
Above 8th standard	32 (2.4)	138 (17.7)	9 (2.7)	179 (7.4)
Primary occupation of father, n (%) *(n=1458)*				
Agriculture/agricultural labor	371 (44.9)	229 (65.1)	106 (38.0)	706 (48.4)
Non-agricultural labor	369 (44.6)	84 (23.9)	123 (44.1)	576 (39.5)
Unemployed	63 (7.6)	25 (7.1)	23 (8.2)	111 (7.6)
Other	24 (2.9)	14 (4.0)	27 (9.7)	65 (4.5)
Wealth quintile, n (%)				
Lowest	402 (29.3)	86 (10.1)	29 (8.5)	517 (20.2)
Second	349 (25.5)	121 (14.2)	38 (11.1)	508 (19.8)
Middle	303 (22.1)	153 (18.0)	57 (16.6)	513 (20.0)
Fourth	223 (16.3)	196 (23.0)	94 (27.4)	513 (20.0)
Highest	93 (6.8)	295 (34.7)	125 (36.4)	513 (20.0)
Household size at origin, mean (SD)	6.4 (2.6)	6.5 (2.9)	5.7 (2.3)	6.3 (2.7)
Household size at kiln, mean (SD)	5.3 (1.8)	4.2 (1.4)	4.5 (1.5)	4.8 (1.7)
Number of years migrating, mean (SD)	6.1 (4.6)	5.2 (4.5)	4.3 (3.7)	5.6 (4.5)

work for more than one year (n=2143), 77 percent worked only in the brick kiln setting during previous migrations, followed by six percent of circular migrants who reported also migrating for work in agriculture.

4.3.2 Migration exposures

About half of the children (45.5%) sampled in our study experienced more than one migration episode; 12.6% experienced three or more migration cycles. Over half of children sampled were early life migrants; that is, they were either born during migration (16.4%) or first experienced migration between zero and five months of age (39.1%).

Reflecting the seasonality of migration, the average number of months spent at the destination kiln during the current migration episode was 6.0 (SD: 2.0) months in the summer wave of data collection, and 2.8 (SD: 1.5) months in the winter wave of data collection.

4.3.3 Underlying and immediate determinants of nutrition status at the destination

Overall, access to health services in the study sample was low; 42.5% of children 12 to 23 months were fully immunized, and 5.3% of respondents reported interactions with front-line health workers at the migration destination. 37.2% of households experienced any food insecurity in the previous year. Most children were in environments without any sanitation facilities; 84.6% of respondents reported open defecation at the kiln. Only 18.3% of children had a diet that met age appropriate feeding guidelines. This was primarily driven by feeding practices for children over six months of age: 81.1% of children zero to five months were exclusively breastfed; 15.3% of children 6 to 23 months received a minimum acceptable diet, and 4.3% of children 24 to 35 months consumed greater than or equal to four food groups in the previous 24 hours.

We observed significant differences in the determinants of nutrition status by season. In the summer, there was a lower proportion of children who met age-appropriate feeding recommendations, a higher prevalence of reported open defecation[3], and a higher prevalence of diarrhea compared to the winter (Figure 4.2). Significantly higher food insecurity was reported in the winter compared to the summer. There were no differences by season in ARI prevalence, full immunization, or contact with front-line health workers.

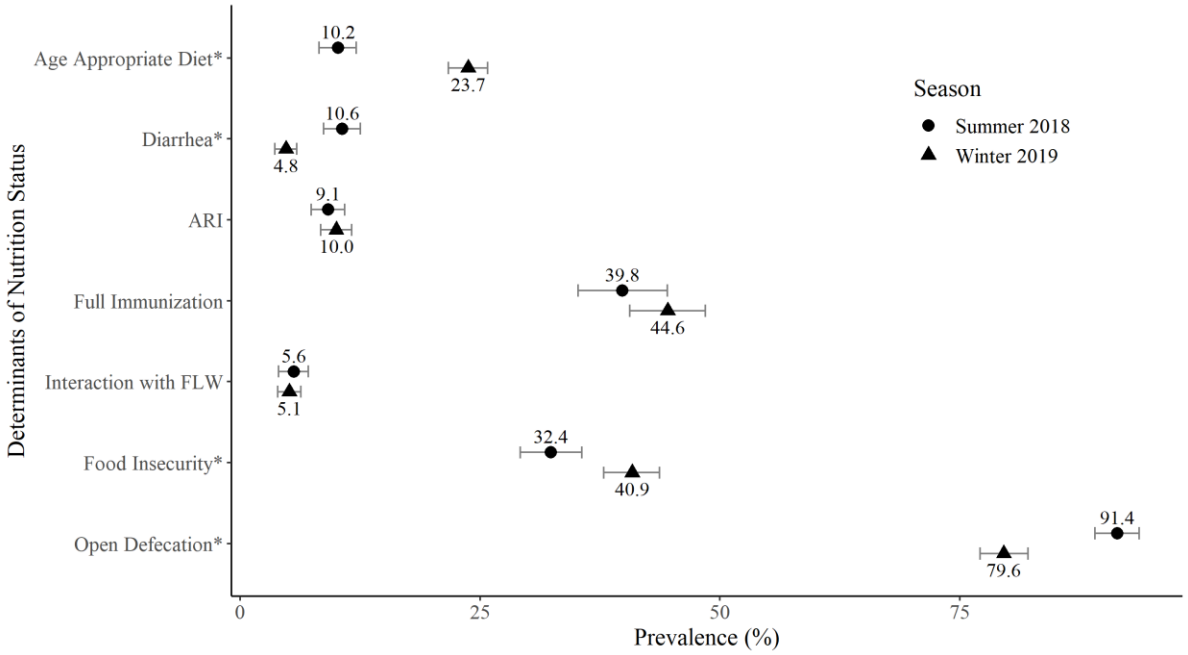

Figure 4.2 Prevalence of the determinants of nutrition status[1] by season among circular migrant children 0-35 months old, June 2018 and January 2019, Bihar

[3] The reduction in reported open defecation between 2018 and 2019 may have been a result of Phase I Swachh Bharat Abhiyan efforts, a national sanitation campaign aimed at open defecation elimination and solid waste management.

4.3.4 Stunting and wasting

The overall unadjusted prevalence of stunting was 51.6%; among children who were stunted, half were severely stunted (25.9%). Stunting prevalence significantly increased with age category ($p < 0.0001$) (Figure 4.3a). Males were more likely to be stunted compared to females ($p=0.021$); there were no differences in stunting prevalence by season of data collection.

Overall, wasting and severe wasting among the sampled children was 25.7% and 6.7%, respectively. The highest prevalence of wasting was in the six to eleven and 12 to 23 months age categories for males and females, and in both seasons. (Figure 4.3b). Males were more likely to be wasted compared to females ($p=0.025$). There were significant differences by season in wasting prevalence: 38.8% of children overall were wasted in the summer compared to 16.0% during the winter ($p<0.0001$).

We found evidence of statistically significant interaction between child age at first migration and number of migration episodes. Among children who first migrated early in life (i.e. were either born during a migration episode or who first migrated within the first six months of life), those who migrated multiple times had higher odds of stunting compared to children who migrated once. (Table 4.2). Among children who first migrated after six months of age, there is no association of number of migrations with stunting.

We did not find any evidence of interaction between child age at first migration and number of migration episodes for wasting. Neither age at first migration nor number of migration episodes were associated with the odds of wasting (Table 4.3). The strongest driver of wasting was the summer season; children from the summer wave of data were over three times as likely to be wasted compared to the winter.

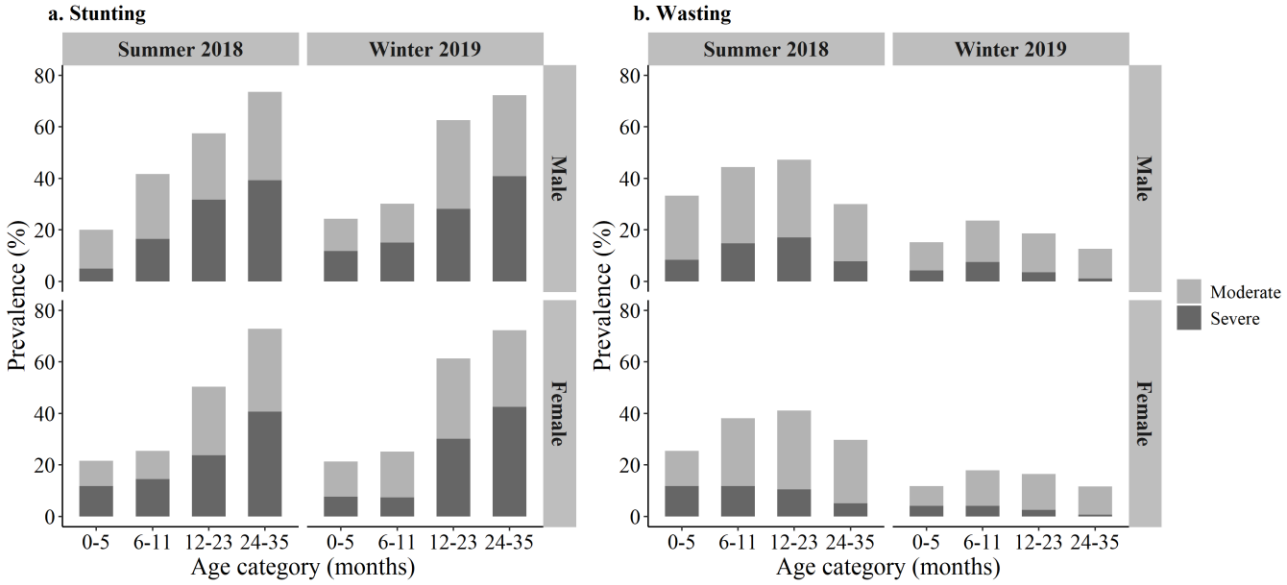

Figure 4.3 Stunting(a) and wasting(b) prevalence among circular migrant children 0-35 months old by age category, sex, and season, June 2018 and January 2019, Bihar

Table 4.2 Adjusted estimates of stunting among circular migrant children 0-35 months old, June 2018 and January 2019, Bihar

	OR (95% CI)
Number of migration episodes * child age at first migration	
2nd vs. 1st migration, age at first migration < 6 mos.	1.60 (1.17-2.19)
≥ 3rd vs. 1st migration, age at first migration < 6 mos.	2.10 (1.30-3.41)
2nd vs. 1st migration, age at first migration ≥ 6 mos.	0.93 (0.69-1.26)
≥ 3rd vs. 1st migration, age at first migration ≥ 6 mos.	1.01 (0.61-1.70)
Child age (months)	1.08 (1.06-1.10)
Child sex	
Female	0.80 (0.68-0.96)
Male	Reference
Origin	
Bihar	Reference
Jharkhand	0.77 (0.60-0.99)
Other	0.58 (0.41-0.82)
Caste	
Scheduled Caste	1.64 (1.30-2.06)
Scheduled Tribe	1.27 (0.95-1.68)
General Caste	1.09 (0.69-1.73)
OBC	Reference
Parity of mother	
≥ 4	1.05 (0.87-1.26)
≤ 3	Reference
Mother's education	
Any education	0.86 (0.67-1.11)
No education	Reference
Wealth quintile	
Lowest	1.19 (0.87-1.63)
Second	1.10 (0.81-1.49)
Middle	0.99 (0.75-1.32)
Fourth	0.91 (0.69-1.20)
Highest	Reference
Season	
Summer 2018	0.83 (0.69-0.99)
Winter 2019	Reference

Table 4.3 Adjusted estimates of wasting among circular migrant children 0-35 months old, June 2018 and January 2019, Bihar

	OR (95% CI)
Number of migration episodes	
1	Reference
2	0.95 (0.74-1.22)
≥ 3	0.73 (0.49-1.09)
Child age at first migration	
< 6 mos.	0.99 (0.77-1.28)
≥ 6 mos.	Reference
Child age (months)	0.99 (0.98-1.01)
Child sex	
Female	0.81 (0.68-0.97)
Male	Reference
Origin	
Bihar	Reference
Jharkhand	1.46 (1.13-1.88)
Other	1.17 (0.79-1.76)
Caste	
Scheduled Caste	1.24 (0.95-1.61)
Scheduled Tribe	1.14 (0.85-1.54)
General Caste	1.48 (0.91-2.42)
OBC	Reference
Parity of mother	
≥ 4	1.18 (0.96-1.46)
≤ 3	Reference
Mother's education	
Any education	1.01 (0.76-1.34)
No education	Reference
Wealth quintile	
Lowest	1.12 (0.80-1.55)
Second	1.28 (0.92-1.76)
Middle	1.32 (0.97-1.80)
Fourth	1.11 (0.82-1.49)
Highest	Reference
Season	
Summer 2018	3.28 (2.68-4.01)
Winter 2019	Reference

4.4 Discussion

The objective of our research was to explore the determinants of nutrition status and the association of early and repeat migration with the risks of stunting and wasting among circular migrant children under three who accompany their parents during migration to the brick kilns in Bihar. Among children who were born during migration or first migrated in the early months of life, experiencing multiple episodes of migration was associated with a greater likelihood of stunting compared to children who were experiencing their first migration at the time of the study, suggesting a cumulative association of migration with stunting. These results can potentially be explained by shifts in the underlying and immediate conditions that determine nutrition status as outlined in the UNICEF Conceptual Framework (4).

Indeed, we found only 42% of circular migrant children 12 to 23 months of age received full immunization, an important indicator of regular access to the health system, compared to 62% of children nationally in the same age group who are fully immunized (16). Families engaged in circular migration live away from their residence for much of the year, often during pregnancy and delivery, disrupted from their home sources of health care and information. At the destination, circular migrants can be disconnected from health services due to long work hours, unfamiliarity with the local health system, language barriers, and discrimination against migrants. In our study, only five percent of respondents reported any contact with front-line health workers since arriving to the kiln of enumeration. From research conducted in Bhojpur district, Bihar, 35% of households with children under two years of age reported receiving services from front-line health workers within the previous three months, so coverage overall remains suboptimal (37); however, this study also found that households were more likely to receive immunization services in villages where front-line health workers reported receiving

timely monetary incentives for providing immunization, which presents a potential strategy for service provision among migrant families.

Age appropriate feeding substantially varied by age. For example, over 80 percent of infants under six months were exclusively breastfed, whereas only 15 percent of children 6 to 23 months received a diet considered acceptable in terms of frequency of meals and diversity of foods. This gap may be due to the financial and time challenges of meeting the complementary feeding guidelines of frequent, diverse meals. Notably, age appropriate feeding in both age groups were higher than in national estimates: 55 percent of infants are exclusively breastfed and under ten percent of children 6 to 23 months of age receive a minimum acceptable diet nationally (16). This pattern suggests that some migrant families may have a better ability to implement recommended infant feeding practices compared to the overall population. One study conducted in informal settlements in Mumbai comprising of mainly migrants found that social support and self-efficacy for decision making are important factors in determining mothers' feeding behaviors (38); it is possible that for some women, these constructs can improve during migration, as they are removed from traditional, sometimes oppressive, family structures. Additionally, migration can influence children's diets (positively or negatively) through increased household income as well as exposure to new health and nutrition practices (39).

We found an alarmingly high prevalence of wasting among child migrants in the summer season, which coincides with the end of the brick production season. Overall wasting in this period neared 40%, compared to 16% in the winter season. Literature on the effects of seasonality on nutrition status in the region finds wasting is more prevalent during the rainy season compared to the dry season (40, 41); the proposed pathways include higher incidence of infectious disease and pre-harvest food unavailability during the monsoon. In the context of

seasonal migration for work in the brick industry, migrants often return home before the onset of monsoon as traditional brick production does not operate during the rainy months, and for those migrants who do engage in agriculture (approximately half of our sample), to cultivate land. However, the same pathways are relevant for this population. We observed higher diarrhea prevalence in the summer wave of data collection. Diarrheal pathogen counts increase in the warmer summer months compared to the winter (42), as do densities of flies, vectors of enteric disease (43); these factors compounded with the widespread absence of sanitation facilities for migrants on kilns increase the risk of diarrhea in the summer. We also observed lower age appropriate feeding in the summer compared to the winter, potentially due to less availability of diverse foods and higher food prices in the summer compared to the winter. Since weight is sensitive to short-term changes in food intake and illness, the accumulative effects of lack of sanitation on the kiln and changes in the food environment over the six to eight month migration season may contribute to a higher prevalence of wasting towards the end of the migration cycle.

Migration experts have long articulated recommendations for the explicit inclusion of internal migrants in the country's social protection and nutrition policy framework, beginning with accurate enumeration of temporary migrants and women who migrate for work. Additionally, recommendations include portability of entitlements, namely subsidized food rations through the PDS, expanded coverage of front-line health workers in the ICDS program to include women and children who move, and implementation of existing legislation for safe housing on construction sites inclusive of adequate sanitation facilities (10, 21, 44). These recommendations have largely focused on addressing the systematic exclusion of migrants from urban spaces. Our findings illustrate the gaps in entitlements and delivery of services among families who engage in rural-to-rural migration; policy efforts must also consider the

enumeration and needs of migrants in rural destination environments, which often are less regulated and more disconnected from the health system.

There are some limitations to this study. Due to the nature of the cross-sectional design of the study, we are unable to conclude that early life and repeat migration causes poor height-for-age outcomes; additionally, we cannot estimate the extent to which growth trajectories falter or accelerate over the course of a migration episode, or the influence on growth trajectories of the determinants of nutrition status, such as illness and food security, which also seasonally fluctuate. These questions can be answered by a longitudinal study design. Secondly, our results could be upward biased by residual confounding from covariates we did not include in our analysis, for example maternal nutrition. Lastly, these findings are not generalizable beyond the population studied of circular migrant children who temporarily reside at mostly rural brick kilns in Bihar. Brick kilns present a unique nutritional risk environment with respect to pollution and sanitation; conducting similar research in alternative contexts of family circular migration will be useful.

There are several strengths to this research. We had a large, state-wide sample with a comprehensive sampling frame of all legally operating kilns in the state. By collecting detailed migration history, we were able to explore the association of nutrition with early life and repeat migration, characteristic of circular patterns of temporary movement; this is the first study to our knowledge to examine the association of these patterns with nutrition. Additionally, we conducted our research in Bihar, which experiences the greatest circular migration in the country. Given the high occurrence of family movement, and the poor coverage of health services in general, multi-sectoral and coordinated targeting by government health, rural development, and labor ministries is a necessary strategy to improve the health and nutrition

status of women and children in the state overall. Our work contributes to the migration and nutrition literature by examining circular, rural-to-rural, and family migration – streams that have been less addressed in existing research.

In conclusion, circular child migrants who have migrated multiple times beginning early in life are especially vulnerable to chronic undernutrition. A high percentage of circular child migrants temporarily residing on brick kilns are acutely malnourished, and are therefore are at an increased risk of mortality, especially as the migration season progresses into summer. However, it is important to recognize that engaging in migration may also be advantageous for children in some nutritional aspects such as dietary diversity and feeding practices. Further research is required to understand the complex and multidimensional pathways of circular migration and child nutrition. Policy efforts should enable households to exercise livelihood choice safely, and ensure continuity of entitlements between home and destinations for those households that engage in circular migration.

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Chapter 5. Food environments, food security and household food availability of circular migrant families: a mixed methods study among brick kiln laborers in Bihar, India

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Abstract

Objective: Over one in five households in India experiences moderate food insecurity. Circular migration of one or more household members is a means that many rural households utilize to cope with food insecurity and poverty. We aim to explore how circular migrant families experience episodic shifts between their home and destination food environments, and how migration may influence food security and household food availability.

Design: We conducted our study among circular migrant families working and living on brick kilns throughout the state of Bihar. We utilized a mixed-methods approach, including 17 qualitative in-depth interviews with migrant parents and eight key informant interviews with brick kiln owners, managers, and labor contractors; the quantitative component included two waves of a household survey among 2564 circular migrant families, using a stratified cluster sampling design. Qualitative data were thematically analyzed using predefined and emergent codes. We conducted descriptive analyses of the quantitative data and a Rasch model analysis of the Food Insecurity Experiences Scale (FIES).

Results: Sources of food were diverse in home food environments, including agriculture, food transfers, wild foods, and the private market, whereas during migration they were limited to only the private

market. Although food prices were higher at destinations, affordability of foods was improved during migration. Rasch model assumptions were met, validating the use of the FIES in our study population.

Conclusions: Circular migration is an important strategy used by many poor households to improve food security and to some extent dietary diversity by enhancing affordability of foods. Explicit inclusion of migrants in food security policy frameworks is necessary; in the context of migration within exploitative industries, upholding fundamental labor rights such as fair wages and safe housing is paramount in addressing some of the root vulnerabilities underlying chronic food insecurity.

Keywords: circular migration; food environments; food security; brick kilns; India

5.1 Introduction

The world's highest burden of food insecurity is in South Asia; close to 692 million people in the region experience food insecurity, and prevalence trends demonstrate that food insecurity is increasing in South Asian countries (1). In India, 22.5 percent of households experience at least moderate food insecurity, characterized as a reduction in the quality, variety or quantity of food consumed due to a lack of money or resources, and 12.5 percent of households experience severe food insecurity, defined as hunger or going without food due to a lack of money or resources (2, 3).

In the context of widening economic disparities, inadequate livelihood opportunity in rural areas, and rising agricultural uncertainty, migration of one or more household members is a means that many rural households utilize to cope with poverty and food insecurity (4). Indeed, in a global analysis across 94 low- and middle-income countries (LMIC) including India, the severity of food insecurity predicted the desire to migrate internationally (5). The vast majority of global movement however is internal (6, 7); within India, the largest migration streams are

circular in nature (8), repeatedly undertaken for short periods of time for the purposes of employment, with the intention of returning to the usual place of residence (9, 10). Circular migration is a strategy to diversify income-generating activities in more than one geographic space, often in addition to smallholding; movement is therefore according to the agrarian calendar as well as seasonal labor requirements (4). Official numbers grossly underestimate the number of circular migrants due to the data challenges of capturing temporary, short-term movement using national level survey methods. However, calculations derived from labor statistics estimate 100 million people engage in circular migration within the country (9). The poor, lesser educated, and those from socially marginalized groups such as Scheduled Castes and Scheduled Tribes are the most likely to engage in circular migration in India (4).

Research on the linkages between circular migration and food security has primarily focused on the food security impacts of remittances from male migrants on household members remaining in the place of origin. One such study in India found a positive relationship between migration and food security at the source village (11); households with male migrant members reported a yearly income from remittances alone that was virtually equal to the total yearly income of non-migrant households. Almost all households with a migrant member reported using remittances for food, noting more frequent consumption of nutrient-rich animal source foods. Indicators of food insecurity such as eating only one meal a day, eating meals without vegetables, and borrowing money to buy food were lower among households that had a migrant member compared to households without a migrant member. Remittances were often also used for investment into agriculture and landholdings, reinforcing the interdependence of farm and non-farm livelihoods for rural households.

In addition to unaccompanied male migration, an important stream of circular migration is the movement of family units. The agriculture and construction sectors in particular, employ migrant women in high numbers (12), and therefore represent sites where accompanying young children also live. For circular migrant women and children, the food environment – that is, the interface where the broader food system encompassing policy and production links with individual diets (13, 14) – shifts episodically between home and destination spaces. The availability of foods, time and distance to markets, and food prices can vary between home and destination as a result of differences in location and urbanicity; the ability to afford foods and time allocation for preparing foods can also alter depending on livelihood. Moreover, irrespective of geography, the very status of being a migrant denies families access to state-led food security entitlements. The Public Distribution System (PDS) provides subsidized staple grains to households, but eligibility is based on domicile and is not portable. While migrant women and children remain eligible for nutrition supplementation through the Integrated Child Development Services (ICDS), they are rarely included as ICDS beneficiaries during migration.

The three ways of securing food with dignity – own production, purchase through livelihood income, and state provisions (15), are thus all affected by migration, differentially at home and destination. This study aims to understand how circular migrant families experience these changes, and the multidirectional ways in which repeated shifts in their food environments influence household food security and food availability. Findings can inform efforts directed at realizing the right to food for those engaging in migration, both at home and destination.

5.2 Methods

5.2.1 Conceptual framework

Our conceptual framework for the study was developed by the Agriculture Nutrition and Health Food Environment Working Group (ANH FEWG) (13); this framework distinguishes between the external and personal domains of the food environment. For example, in the external domain, availability is defined as the physical presence of foods within one's food environment, whereas accessibility, a dimension of the personal domain, is determined by one's ability to procure those foods based on distance and transport. Similarly, while food prices are established externally, affordability of food is a personal dimension based on purchasing power. We hypothesize that circular migrants experience shifts in both external and personal domains through changes in geography and livelihood as they move between home and destination.

5.2.2 Study setting and design

We conducted our study among circular migrant families working and living on brick kilns throughout the state of Bihar. Among Indian states, Bihar has the lowest per capita income and the lowest worker population ratio, coupled with fragmented landholdings, inadequate agricultural inputs and climate volatility (16); it is no surprise, therefore, that Bihar experiences the highest circular migration in the country (4). Brick kilns are major seasonal labor destination sites for circular migrant families. Labor is arranged through contractors, who often recruit male-female pairs for many types of kiln occupations, thus resulting in the accompanying migration of young children. Brick kilns are mostly located in rural and peri-urban areas; migrant families reside on-site in rudimentary housing for the duration of the work season (during the dry months of October to June with some variation based on agro-climactic zone). The industry is known for

exploiting labor through unfair pay, hazardous living and working conditions, and bondage.

We utilized a mixed-methods approach to our study. We used quantitative survey data to examine sociodemographic and seasonal trends in food sources, food insecurity, and dietary patterns during migration among circular migrant families. Additionally, in the same study population, we used qualitative methods to explore how migrant families perceive and experience changes between home and destination food environments, and how these perceived changes in food environment potentially translate to changes in food security and dietary patterns.

The study was collaboratively implemented by CARE India and Emory University under the Bihar Technical Support Program partnership. Ethical approval was obtained from Emory University Institutional Review Board and Ashirwad Ethics Committee.

5.2.3 Data collection

Quantitative data. We conducted two waves of cross-sectional surveys in summer (June 2018) and winter (January 2019). Eligibility criteria for the study included 1.) Self-identification as a circular migrant household, defined as living away from the home block (administrative sub-unit of the district) for employment purposes for a total of at least 60 days in the previous one year, with at least one return home in the previous one year; and 2.) presence of at least one child under three years of age.

We utilized a stratified cluster sampling design, wherein we randomly selected 18 brick kilns (cluster) from each district (stratum). Clusters were sampled from a district-wise list of operational brick kilns provided by the Bihar State Department of Mines and Geology. Based on

a priori sample size calculations, per cluster, three households with children under three were randomly selected. Our final sample size was 2564 households from 1068 brick kilns.

After orienting the kiln owner or manager to the purposes of our study, a household survey was administered to the selected child's mother. Data collection was conducted by CARE India Continuous Monitoring Learning and Evaluation (CMLE) team members. Enumerator trainings were held before each wave of data collection. Surveys were administered in Hindi, and were pretested before the start of the study. Household food security was measured using the Food and Agriculture Organization (FAO) Food Insecurity Experiences Scale (FIES), using the previous one year as the reference period (2). Household food availability was quantitively assessed among households with children zero to 23 months (n=1960) using a predefined list of 31 common cooked and packaged food items; the food list was developed by CARE India as a part of its monitoring and evaluation activities. Enumerators asked mothers to report the number of days (zero to seven) in the previous one week that each food was present and/or cooked in the household. Household food availability data were not collected among children over two years of age since a 24-hour dietary recall was used to assess dietary diversity for this age group. Enumerators collected all survey data digitally on tablets using the SurveyCTO software, a mobile data collection platform with in-built logic checks to minimize data entry error. CARE India supervisory staff also conducted back-checks with a random subsample of research participants to ensure data quality.

Qualitative data. For the qualitative component of the study we purposively selected three districts – Patna, Rohtas and Gopalganj, based on agro-climatic zone and rural/urban status. Within each district, we visited four kilns that were not included as a survey site for the quantitative study to avoid respondent fatigue. We recruited participants from each kiln using

convenience sampling, while ensuring selection allowed for heterogeneity with respect to community of origin, caste, family size and migration histories. Interviews were conducted in the late morning and early afternoon, which is a rest period of the work day in the summer due to intense sun and heat.

An interview team of two female researchers and one male researcher conducted in-depth interviews using semi-structured interview guides with circular migrant mothers (n=11), circular migrant fathers (n=6), and key informants including labor contractors (n=2), brick kiln owners (n=2), and brick kiln managers (n=4). None of the selected migrant mothers and fathers were from the same household. We intended to interview one migrant mother per kiln, and either one father or one key informant per kiln visited. Interviews with fathers were conducted by the male member of the team, interviews with mothers were conducted by the female members of the team; interviews with contractors, managers and owners were conducted by both male and female members of the team. All interviews were conducted in Hindi and were tape recorded after obtaining informed oral consent from the participant. Recordings were transcribed verbatim in Devanagari script. All interviews were conducted in June 2018, towards the end of the migration season.

5.2.4 Analysis

Quantitative. We conducted descriptive and bivariate analyses to explore sociodemographic characteristics, food sources, and household food availability. Wealth quintiles were created based on factor scores derived from principal components analysis of asset ownership. For household food availability, we categorized the 31 food items from the list into the following 12

food groups: rice, wheat, roots and tubers, pulses, green leafy vegetables, other vegetables, fruits, dairy, egg, meat/fish, snack foods, and sweets.

We validated the FIES data by checking the Rasch model assumptions using the RM.weights R package (17). The food insecurity raw score is calculated by adding the number of affirmative responses to each of the eight items in the scale. Based on the clustering of item severity parameters obtained from the Rasch analysis, we categorized the raw score into none (0), mild (1-3), moderate (4-5), and severe (6-8) food insecurity. We then tested bivariate associations between food insecurity level and sociodemographic and food source variables. Analyses were conducted in SAS 9.4; population characteristics and food security estimates considered the clustered sampling design, and therefore all bivariate analyses used the Rao-Scott chi square test. Alpha was set at 0.05.

Qualitative. The first author, who is fluent in Hindi, analyzed the written transcripts using a priori English codes based on the in-depth interview guides and the conceptual framework. Broadly, codes corresponded to food acquisition, food environment dimensions (availability, accessibility, prices, affordability and convenience), food security experiences, and diet. Emergent codes were also identified through the process of transcript review and memo writing. Descriptive thematic analysis was conducted using MAXQDA 2018 software. Quotes presented in the manuscript were translated into English by the first author.

5.3 Results

5.3.1 Population characteristics

Survey sample description. The majority of circular migrants in the survey sample were intrastate migrants, followed by migrants from neighboring Jharkhand (Table 5.1). Scheduled Castes, almost half of the sample, were disproportionately less likely to own land compared to other caste groups. General caste migrants were the most likely to utilize PDS at home. Both land ownership and PDS utilization was positively associated with education. The poorest circular migrants were least likely to own land for home production of food, and were also the least likely to obtain PDS rations.

Qualitative sample description. All migrant mothers and fathers except one (intrastate migrant mother) were from Jharkhand, the majority of whom were from tribal communities. Migrant mothers and fathers had a range from one to five children. Of the 17 parents interviewed, seven had migrated without one or more of their children; these children remained in the home village with other relatives to attend school, although not all school going aged children remained at home. On average, families interviewed had two accompanying children with them. The youngest accompanying child was six weeks of age, and the oldest accompanying child was 13 years of age; the average age was 4.3 years. Most households on the kiln were nuclear family units; four migrant interviewees also migrated with parents, parents-in-law, or elder relatives to the kiln.

Table 5.1 Population characteristics of circular migrant households by land ownership and PDS utilization at home, June 2018 and January 2019, n = 2564

	Own Land* **n (%)**	**Utilizes PDS at home*** **n (%)**	**Total** **n (%)**
Origin			
Bihar	259 (18.9)	590 (43.1)	1370 (53.4)
Jharkhand	657 (77.2)	413 (48.5)	851 (33.2)
Assam	36 (36.4)	43 (43.4)	99 (3.9)
West Bengal	43 (24.0)	143 (79.9)	179 (7.0)
Other	22 (33.8)	31 (47.7)	65 (2.5)
Caste			
Scheduled Caste	269 (23.2)	532 (45.9)	1159 (45.2)
Scheduled Tribe	476 (73.5)	310 (47.8)	648 (25.3)
OBC	225 (37.5)	282 (47.0)	600 (23.4)
General	47 (29.9)	96 (61.1)	157 (6.1)
Religion			
Hindu	900 (40.1)	1039 (46.2)	2247 (87.6)
Muslim	78 (28.5)	160 (58.4)	274 (10.7)
Other	39 (90.7)	21 (48.8)	43 (1.7)
Respondent's Education			
No formal education	780 (35.8)	1008 (46.3)	2177 (84.9)
Up to 8th standard	156 (57.1)	149 (54.6)	273 (10.6)
Above 8th standard	81 (71.1)	63 (55.3)	114 (4.4)
Wealth Index			
Lower	49 (9.6)	191 (37.5)	509 (19.9)
Second	136 (26.4)	209 (40.5)	516 (20.1)
Middle	185 (36.1)	223 (43.5)	513 (20.0)
Fourth	270 (52.5)	282 (54.9)	514 (20.0)
Higher	377 (73.6)	315 (61.5)	512 (20.0)
Total	1017 (39.7)	1220 (47.6)	2564 (100.0)

**p < 0.05 for all variables*

Four out of eleven women interviewed were pregnant at the time of the interview. Among the 17 migrant parents interviewed, three participants began engaging in circular migration during their childhood, accompanying their parents or elder relatives to brick kilns, eventually beginning to work themselves. For three other participants, the time of interview was during their first time migrating for work. Just over half of migrant women interviewed (six of eleven) began migrating for employment on the kilns after marriage, whereas the other half (five of eleven) began migrating before marriage. Both of the labor contractors interviewed were

women from Jharkhand; one contractor also worked on kilns as a laborer. All of the owners and managers interviewed were men from Bihar.

5.3.2 Food environment

Food sources. Seventy percent of circular migrants from our survey sample utilized at least one non-market source of food while living in their place of origin (Figure 5.1). Around half of respondents produced food for consumption, either by growing crops or raising livestock, or a combination of both. Around half of respondents reported obtaining rations from PDS shops, and one quarter reported both home production (crops and/or livestock) and PDS utilization as sources of food at home.

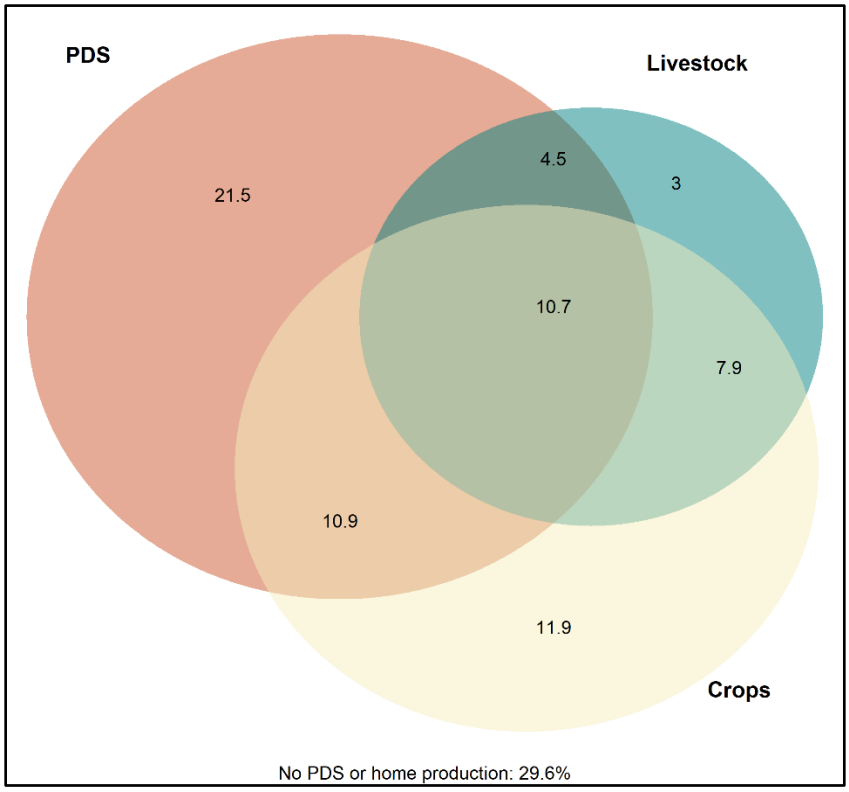

Figure 5.1 Percentage of respondents who utilize non-market sources of food in place of origin, June 2018 and January 2019, n=2564

Our qualitative findings demonstrate that sources of food differ considerably between home and destination. Most migrants (ten out of 17) included in the qualitative study owned some land that they used for farming and as a source of food while at home, reflecting survey findings described above. Lack of irrigation infrastructure was often discussed as a reason for engaging in circular migration during the dry months as reliance on rainfed irrigation means land can only be farmed during the Kharif agricultural season. One respondent, who owns eight acres of land said:

> Where we live, all summer long, there is no irrigation. So, during the rains we farm, and during the summer we leave to earn. This is the only reason [we leave]. If there's no irrigation what will we do all summer long? 'Go somewhere and earn two paisa for savings', we say and leave from home. *Jharkhandi father of four, Gopalganj*

During the months when migrants are home, most households who farm rely on grains and vegetables that are produced for the majority of dietary needs.

> When we stay in the village, we only have to buy salt. Everything else is there at home… Anything, green vegetables, garlic, onion. Even for oil we trade, we don't buy. *Jharkhandi mother of one, nine months pregnant, Patna*

At the destination, however, sources of food are limited only to the private market for the several months families reside in the brick kilns.

> We get food from the market near the village. If we run short during the week, we buy from the store just across [the kiln]. Rice, daal, vegetables. Besides water, totally everything has to be bought. *Jharkhandi mother of three, Rohtas*

PDS rations are widely availed of at home as supplemental sources of food; though, four of eleven migrant mothers and fathers interviewed did not avail of PDS rations at home – among these non-users, one had been attempting unsuccessfully to apply for a ration card, and one participant had a Below Poverty Line card, but rations in her village were only given to Antyodaya Anna Yojana card holders (issued to the poorest of the poor). Those who availed of PDS rations reported receiving mainly rice, wheat, kerosene and sugar.

Overwhelmingly, migrants noted they are ineligible for PDS while migrating, many referring to themselves as pardesi (foreigners).

> Here, nobody gets [government rations]. It would be nice if I received them, if everyone received them. We've come from a foreign land, what can we do? *Jharkhandi mother of one, nine months pregnant, Patna*

One kiln owner from Rohtas explained that laborers working on his kiln who are from the neighboring districts of Gaya and Aurangabad returned home once monthly to collect rations.

> These people, one day of the month they go, the Biharis will definitely go home one day a month and release their rations from the quota shop. Rice, rations, whatever, they go and bring it back. It's convenient because they go by train and the train fare is low. It seems to me they don't even have to pay fare. *Bihari brick kiln owner, Rohtas*

Wild foods, harvested from the jungle and common land, was another important source of food, especially indigenous leafy greens, mentioned by three migrants from Jharkhand. The sense of being an outsider at the destination, however, restricted this food source.

> In our land, in our village, we can go to other fields and just take greens. Here where will we go? We've come to another land, what if someone says something? *Jharkhandi mother of four, Rohtas*

Food availability and accessibility. In qualitative findings on food availability, almost all migrant mothers and fathers expressed that the availability of foods in the market was largely similar between home and destination environments in terms of grains, vegetables, fruits and animal source foods. There were however some exceptions, namely specific varieties of rice (parboiled versus raw), alcohol (although Bihar is a dry state, two male respondents and one contractor alluded to drinking liquor on the kiln), and regional fruits such as lychees, grown in Bihar.

While there is very little difference in the types of foods available between home and destination, some migrants expressed there is a greater *choice* to consume a diversity of foods in the destination. Households that produce food at home are largely restricted to consuming those foods which are grown. During migration however, all food must be purchased from the market. Some migrants discussed their ability to choose to purchase foods that are not grown at home, such as wheat, while they are migrating for work.

> When we stay at home, we eat more rice and when we come here, we eat more roti. Here we buy and eat wheat. At home we don't grow wheat nor do we buy it. If there isn't money at home, how will we buy it? *Jharkhandi mother of one (newborn), Patna*

Food accessibility for circular migrants is shaped by the work schedule on the brick kilns; the weekly day off and disbursement of allowances was usually planned to coincide with the day of the haat (open air vegetable market). Distance and transport to market were also important

aspects of food accessibility, and varied from site to site; sometimes transport to the market was provided by kiln managers on tractors, whereas sometimes migrants walked to the market. Accessibility to the market was a key factor in migrants' experiences of working at a particular kiln, as demonstrated by the following quotes from two different women:

> Laborers go wherever it is nice, where there is a bazaar, where there is a good market. Here the market is good. There are close to ten stores for vegetables, two to three stores for daal and rice. I don't need to say anything. One laborer will go back home and tell others 'that place was nice.' *Jharkhandi labor contractor, Gopalganj*

> This place is the worst. The bazaar, haat, everything is far. And the bricks are heavier too. *Jharkhandi mother of one (newborn), Patna*

Accessibility to markets is gendered; most migrant women reported their husbands go to the market on the weekly day off while they stay on the kiln, implying that gender norms around mobility and financial transactions persist across home and destination environments.

Food prices and affordability. While some migrants reported that food prices were the same at home and destination, others noted that prices of staples were considerably higher at the destination compared to prices at home.

> There is a lot of difference. Here it is expensive. There it is cheap. Like potatoes. Here, [potato] is 18 rupees a kilo. There, in our place, it's ten rupees. Ten rupees for two kilos. There is also a difference in rice. Here rice is 29 rupees, 30 rupees. There it is 17, 18 rupees. *Jharkhandi father of three, Gopalganj*

However, many migrants indicated that despite higher prices in the destination, the affordability of foods is higher during migration. This is because of the regular weekly allowances that migrants receive during the season for the purposes of buying provisions. Although these allowances are deducted from a family's final earnings at the end of the season, the weekly sum of money enabled food affordability, especially for expensive, desired items such as animal source foods.

> Here, working, we can eat whatever we desire, meat, fish, eggs, kheer, roti, daal, puri, anyone can make and eat these things. If we want to eat chicken twice in a week, we can. Here, in a week, if we work or don't work, even if we only work two days, we'll still get 300 or 400 rupees, so you can eat however much you desire. *Jharkhandi mother of three, Rohtas*

The ability to purchase desired foods during the migration season was also expressed by one of the labor contractors:

> They eat less in the village. Here, they eat chicken, fish, eggs every day, these people. Here they earn, no? In the village they don't earn, no? If someone wants to eat something, they'll request 200 rupees from us. 'Give us 200 rupees, we feel like eating chicken.' They're earning here so we give it. 'Go and eat'. In the village they won't get [money] immediately. In the village it's tough. *Jharkhandi labor contractor, Patna*

While the perspective of most interviewees was that the weekly allowances provide a means to purchase sufficient and desirable foods during the migration season, two migrant mothers expressed that food is less affordable during migration, resulting in less dietary diversity. One mother made the distinction between receiving a weekly allowance versus the families' full earnings:

> We get more food at home. At home, we buy milk to feed the kids. Here, we can't save enough, how will we buy? In vegetables, we only eat potato. Here, we aren't able to buy. We get eight days' allowance – 800, 900 rupees. Rations for five people, every eight days, doesn't last the week. How will we get green vegetables? [At home] we earn and take the money. [Here] they give us allowances, we don't get our earnings. Now when the kiln closes, then will we get earnings. *Bihari mother of four, Patna*

Convenience. Similar to accessibility of foods, the convenience of preparing and consuming food was shaped by the work schedule on the brick kiln. In the summer months (when the qualitative interviews were conducted), the workday usually began at six o'clock in the morning to avoid labor in the afternoon heat and sun. Some mothers woke up at four o'clock to cook food for the day, while others consumed food from the previous night for breakfast. In some instances, non-working family members who also migrated to the kiln (often elderly women, pregnant women, or adolescent girls) prepared meals, washed clothes, and cared for young children.

Several migrants suggested that preparation of food was easier while working on the brick kilns as the owner provides cooking fuel (coal used to fire bricks), whereas at home, wood fires, which are more time consuming, were often used.

5.3.3 Food Security

Findings from survey data demonstrate that almost 40 percent of respondents experienced some food insecurity in the previous one year (Table 5.2). Intrastate migrants were more likely to experience food insecurity compared to migrants from other origins. Food insecurity was negatively associated with education and wealth, and positively associated with household size. Reported food insecurity in the previous 12 months was also higher in the winter wave of data

collection compared to the summer wave. Circular migrants who reported utilizing non-market sources of food including home production of crops and animal source foods were less likely to experience food insecurity. There was no significant association between PDS utilization and food insecurity.

The validation exercise of the FIES data from our survey confirmed that the assumptions of the Rasch model were met. All item infit statistics were between 0.85 and 1.23, and outfit statistics were between 0.74 and 1.79. The Rasch reliability score was 0.72.

Results from the relative item severity parameters are shown in Figure 5.2. On the continuum of food insecurity severity, the experience of consuming fewer types of food was the least severe among circular migrants, whereas anxiety or worry about running out of food occurred farther along the spectrum. The most severe experience of food insecurity was going a whole day without eating due to lack of money or resources. The item severity parameters clustered into mild, moderate, and severe food insecurity categories as indicated by color.

Table 5.2 Bivariate associations of food insecurity and sociodemographic variables, June 2018 and January 2019, n=2,560

	Food Insecurity Severity				
	None	**Mild**	**Moderate**	**Severe**	***p-value***
	% (95% CI)	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**	
Origin					
Bihar	56.8 (53.8-59.8)	27.1 (24.5-29.7)	6.8 (5.5-8.1)	9.3 (7.7-10.9)	
Jharkhand	71.2 (67.7-74.7)	18.6 (15.8-21.3)	4.8 (3.3-6.4)	5.4 (3.6-7.2)	
Assam	69.1 (57.3-80.8)	20.6 (12.1-29.2)	5.2 (0.9-9.5)	5.2 (0.0-10.3)	
West Bengal	65.2 (57.4-72.9)	20.2 (14.3-26.2)	7.3 (3.6-11.0)	7.3 (3.0-11.6)	
Other	61.5 (48.9-74.2)	24.6 (14.0-35.2)	6.2 (0.5-11.8)	7.7 (0.4-15.0)	*<0.0001*
Caste					
Scheduled Caste	59.2 (56.0-62.5)	24.8 (22.0-27.6)	6.7 (5.3-8.2)	9.2 (7.5-11.0)	
Scheduled Tribe	69.9 (66.0-73.9)	20.5 (17.2-23.9)	4.8 (3.0-6.5)	4.8 (3.0-6.5)	
OBC	62.5 (58.4-66.6)	24.2 (20.7-27.7)	5.7 (3.9-7.5)	7.7 (5.4-9.9)	
General	60.4 (51.4-69.4)	23.4 (16.0-30.8)	8.4 (4.4-12.5)	7.8 (2.7-12.9)	*0.006*
Respondent's Education					
No formal education	61.1 (58.8-63.5)	24.3 (22.4-26.3)	6.3 (5.3-7.3)	8.2 (7.0-9.5)	
Up to 8th standard	68.4 (62.7-74.1)	21 (16.1-25.8)	6.3 (3.3-9.2)	4.4 (2.0-6.9)	
Above 8th standard	80.7 (73.3-88.1)	13.2 (6.9-19.4)	1.8 (0.0-4.1)	4.4 (0.6-8.2)	*0.0004*
Wealth Index					
Lower	53.4 (48.8-58.1)	23 (19.2-26.8)	9.2 (6.8-11.6)	14.3 (11.3-17.4)	
Second	60.5 (56.0-64.9)	24.6 (20.9-28.3)	6.4 (4.3-8.5)	8.5 (6.1-11.0)	
Middle	60.0 (55.4-64.5)	27 (22.9-31.0)	6.3 (4.1-8.4)	6.8 (4.7-9.0)	
Fourth	65.2 (61.1-69.4)	23.4 (19.7-27.1)	5.7 (3.7-7.6)	5.7 (3.7-7.7)	
Higher	74.8 (70.9-78.7)	19.4 (15.8-22.9)	2.9 (1.5-4.4)	2.9 (1.5-4.4)	*<0.0001*
HH size at kiln					
≤ 4	67.8 (64.9-70.7)	20.8 (18.4-23.3)	5.7 (4.4-7.0)	5.7 (4.4-7.1)	
> 5	58.0 (55.0-60.9)	26.0 (23.5-28.5)	6.5 (5.1-7.9)	9.5 (7.8-11.2)	*<0.0001*
Season					
Summer 2018	67.6 (64.4-70.8)	21.5 (18.8-24.2)	4.8 (3.5-6.0)	6.1 (4.6-7.7)	*0.0003*
Winter 2019	59.1 (56.2-62.0)	25.0 (22.6-27.3)	7.1 (5.8-8.4)	8.8 (7.2-10.4)	
Crop Production					
No	60.0 (57.1-62.8)	24.0 (21.6-26.4)	7.2 (5.9-8.5)	8.9 (7.3-10.4)	
Yes	66.8 (63.7-69.8)	22.8 (20.2-25.4)	4.5 (3.2-5.8)	5.9 (4.5-7.4)	*0.0005*
Livestock for ASF					
No	59.1 (56.5-61.6)	25.7 (23.6-27.8)	6.7 (5.5-7.8)	8.6 (7.2-9.9)	
Yes	73.2 (69.7-76.7)	17.2 (14.3-20.2)	4.5 (2.9-6.1)	5.1 (3.3-6.9)	*<0.0001*
PDS Utilization					
No	62.6 (59.7-65.5)	24.4 (22.0-26.9)	5.7 (4.5-7.0)	7.2 (5.8-8.7)	
Yes	62.9 (60.0-65.9)	22.4 (19.9-24.9)	6.5 (5.1-7.9)	8.1 (6.5-9.8)	*0.51*
Total	62.8 (60.6-64.9)	23.5 (21.7-25.3)	6.1 (5.1-7.0)	7.7 (6.5-8.8)	

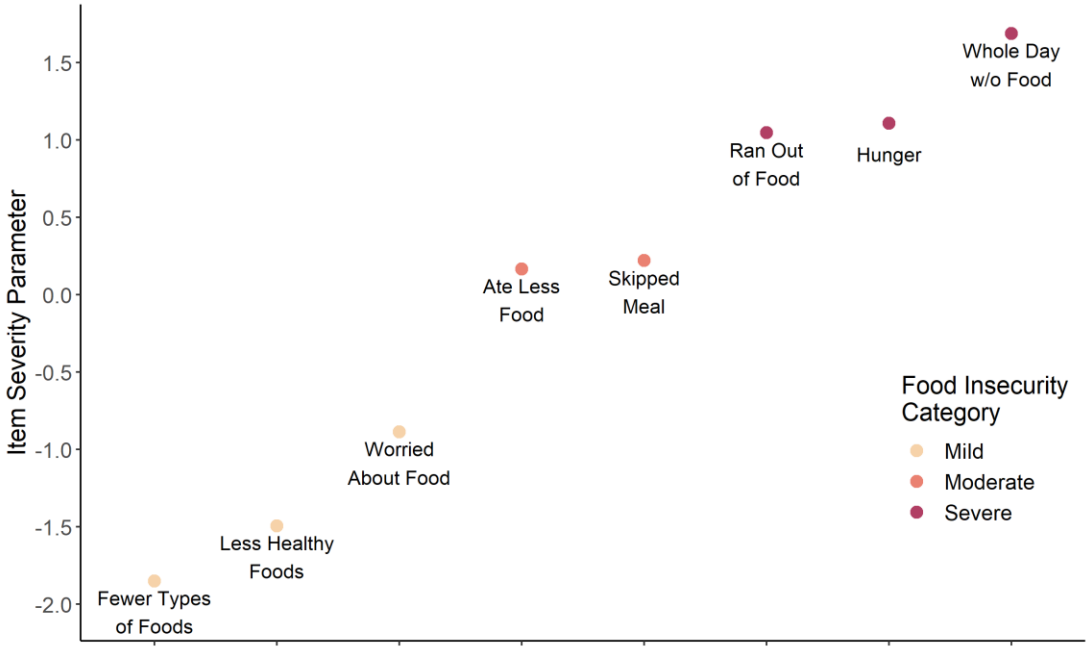

Figure 5.2 FIES item severity parameters

Our qualitative findings indicated that food security is an important driver of circular migration. Several migrant mothers and fathers expressed that they leave home every year to 'fill their stomachs'. As described above, during the months spent away from home on the kiln, financial constraints to food are less compared to home because of regular weekly allowance disbursements.

> Here, whatever we want to eat, it happens. At home, we have to think twice. *Jharkhandi mother of three, Patna*

The uncertainty of food acquisition at home also emerged as one reason for family members to migrate together as a unit.

> [My wife and children] could have stayed at home, but then I would need to send money. The boss may or may not give money. What will they eat there? That's why I brought them with me. *Jharkhandi father of two, Patna*

5.3.4 Household Dietary Patterns

According to household food availability survey data, rice and tubers were reported to be available in the household almost daily by most circular migrant households on the kiln (Figure 5.3). Wheat, pulses and snack foods (mainly consisting of packaged biscuits and savory crisps) were also available in the household, on average, more than half of the days in a week. Corresponding to seasonal availability, green leafy vegetables were available more often in the winter compared to the summer. Fruits and animal source foods were available in the household the least frequently.

Qualitative results support our survey data findings of daily rice and potato availability, and frequent availability of pulses. High consumption of rice was explained as a cultural preference by many migrant interviewees from Jharkhand.

> We people [from Jharkhand] eat rice, both times. We don't feel full from eating roti. It's become habit. The people from here, they say 'how do you people eat rice?' We say to them 'how do you people eat roti?' They say 'if we eat rice, we'll feel hungry all day'. We say 'if we eat roti, we'll feel hungry all day'. [Eating roti] we'll never feel at peace. It's become habit, no? Everyone from Jharkhand, it's our habit. *Jharkhandi mother of one, eight months pregnant, Rohtas*

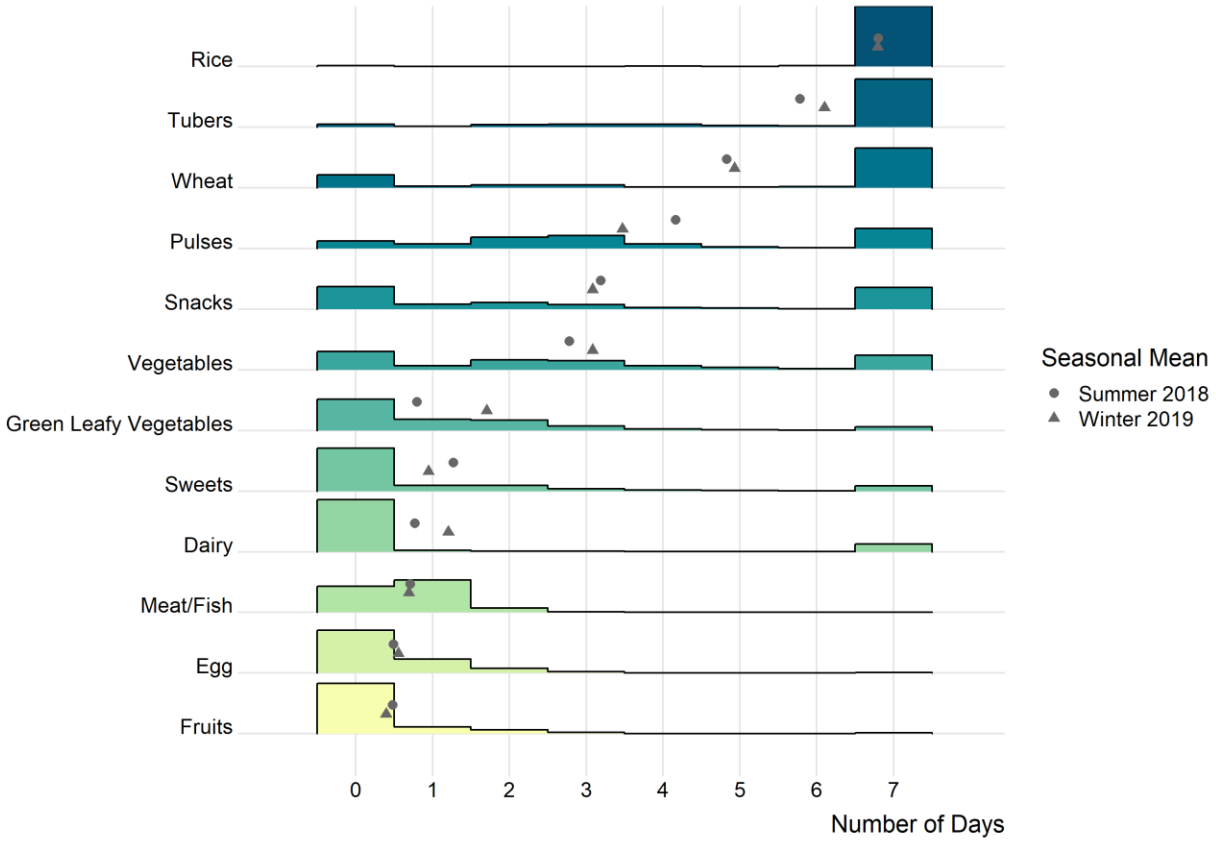

Figure 5.3 Histogram of number of days in the previous week food group was available in the home, June 2018 and January 2019, n=1,960

Availability of snack foods was also high in our survey findings. Four mothers mentioned purchasing snack foods such as biscuits and savory packaged foods for their children. Some were aware of the unhealthy nature of certain processed foods. For example, one mother explained:

> I get Horlicks (malt-based fortified sweetened drink powder) for [my son]. Before, those Kurkure (savory processed crispy snack) that are sold in all the shops, I used to feed him *a lot* of those. Then people told me, 'Don't feed him this'. So, I stopped, now I don't feed those to him anymore. I mix Horlicks in hot water, add a little bit of sugar, and give it to him.
>
> *Jharkhandi mother of one, 9 months pregnant, Patna*

The reasons for lower availability or consumption of green leafy vegetables during migration compared to while at home included the lack of affordability as described above; in addition, one mother mentioned the lack of food storage in the summer heat coupled with once-a-week visits to the market as a barrier to purchasing green leafy vegetables.

> If we get too many greens then they will dry out. Potatoes, daal, these things last. *Jharkhandi mother of four, Gopalganj*

Lastly, repeating the importance of wild foods, one father said:

> Over there, in Jharkhand, I eat more green vegetables, after drying them. Here I have to buy them and eat. At home, I can just break them off and eat them. We don't have to buy them, they're always there. *Jharkhandi father of one, Gopalganj*

All interviewees except one reported purchasing and preparing chicken or fish once a week during migration, on their day off, reflected in Figure 5.3. At home however, some migrants expressed animal source foods were eaten only when there was money available to purchase them.

> Meat, fish, if we get it [at home], we eat it. If we don't get it, we don't eat it. Only when there's money can we eat, no? *Jharkhandi mother of four, Rohtas*

With respect to quantity of food, three migrant men shared they consume a greater amount of food and more often during migration because of the increased caloric demands from doing manual labor. Some women, however, shared that they eat less often and less quantity while living on the kiln due to the workday schedule.

> At home, we can sit and eat. Here, it's as if we don't have the right to eat. We eat, wash our hands, and get to work… Here, if we get to eat twice then we eat twice, otherwise, we don't... At home, we eat a bit more. We sit around and can eat comfortably whenever we feel hungry. Here, after coming back from tiring work, what will we eat? *Bihari mother of four, Patna*

The qualitative findings also revealed how women's workday schedules explained differences in child feeding practices between home and destination. Eight of the eleven interviewed mothers were breastfeeding at the time of the interview, and would breastfeed only before and after working. While one mother said that even at home, she was working in the fields all day and therefore couldn't breastfeed often, most described they breastfeed less often during migration.

> At home, whenever I'd sit, he would feed, and here I'm working, so all day he feeds one or two times. *Bihari mother of four, Patna*

Older children were also fed before and after work, and would feed themselves while their parents were working; younger children were cared for and fed by older siblings, relatives or neighbors.

> The kids keep playing. I make food when I come back. If they're hungry in between they feed themselves. Our hands are full of dirt, it's muddy work. *Jharkhandi mother of four, Patna*

5.4 Discussion

This mixed-methods study explored how circular migrant families experience changes between

home and destination food environments, and how these changes affect food security and dietary patterns during migration.

We found that the majority of circular migrants utilize diverse non-market sources of food during the months residing in their home village. These sources include home production of crops and animal source foods, harvesting wild indigenous foods from common lands, trading, and government food entitlements. During the months residing at the destination, on the other hand, the only source of food is the private market. Our findings demonstrate that a variety of food sources does not imply a greater diversity in food choice, purchase, and consumption. For those who own land at home, the crops grown by the household largely define the food choices available. During migration for work in the brick industry, there is a reliable and consistent availability of cash, which allows families to purchase sufficient food and regularly consume nutritious food groups that might not otherwise be affordable at home, such as fish and meat. The regularity of income thus seems to result in food security or less severe experiences of food insecurity during the migration period. The cash allowance aspect of migration to the kilns may also potentially explain our FIES item severity findings. In the global scale based on FIES data from 121 countries including India, worry and anxiety about running out of food due to lack of money or resources ranks as the mildest experience of food insecurity (18). In the context of our study however, worry about running out of food ranked more severe than eating fewer kinds of foods and inability to consume healthy foods. A possible explanation is that the experience of worry is expressed farther along the food insecurity spectrum compared to the general population because of the assurance of receiving weekly advances for food purchases. While these cash advances were deducted from earnings at the end of the season, at least in the short-term, the system seems to enable food security for many families.

Our results demonstrate that while types of foods available and food prices were mostly similar between home and destination, circular migration, even within an industry known for exploitative practices, is an important strategy that can improve food affordability and prevent severe food insecurity. While for some, this may only be a temporary effect that allows for survival, for others it may be a pathway out of extreme poverty. This has important policy implications pertaining to the social protection of internal migrants. Despite the enormous contribution of internal migrants to the Indian economy, the government has historically adopted an anti-migration position (8). Enactment of programs such as the National Rural Employment Guarantee Act (NREGA) intends to prevent distress migration from rural areas. Urban spaces remain hostile to migrants by failing to provide adequate and safe housing, water and sanitation facilities, education, and rations, further marginalizing groups that already face caste and class discrimination. The migration narrative in India equates migration with urbanization and burdened urban systems; the concerns of rural-to-rural family migrants have largely been overlooked by policymakers. Continued investments in agriculture, such as irrigation infrastructure, and strengthening implementation of rural employment schemes are important measures to ensure that migration remains a choice. For those who choose to engage in circular migration for livelihood, migration must be made safer by enforcing existing labor legislation, such as the Building and Other Construction Workers Act (19), that protects migrants from exploitation and outlines minimum wages, safety standards, and provisions for employees, including on-site child care facilities and sanitation access. Additionally, policies based on domicile status which exclude migrants from entitlements need to be amended; for example, the portability of PDS rations for internal migrants has long been recommended by migration experts (8, 12). Ensuring that migrants are linked to the National Food Security Act (20) programs,

including PDS and ICDS, at both home and destination sites, is critical in allowing circular migrant families to increase savings earned from seasonal work.

It is important to note that although circular migration may allow families to meet minimum energy requirements, it is far from likely nutritional adequacy is being met. Our findings demonstrate that during migration, on average, cereals and tubers were available most days of the week, whereas fruits and animal source foods were available less than one day of the week. The cost of the EAT Lancet recommended dietary intake for a healthy and sustainable diet (21) for rural India is $3.33 per person per day for the least expensive foods (22). This is over three times the actual amount spent on diets in rural India, which is $0.62 per person per day for the least expensive foods, and $1.00 per person per day for average priced foods. Fruits and animal source foods, the most expensive food groups, represent the greatest share of the cost of the recommended diet, and the greatest deficits in actual diet spending. Food systems overall need to be strengthened to enable affordability of nutritious foods for the poor, and efforts to do so must be sensitive to the realities of migration. For example, recommendations to diversify diets at the household level such as kitchen gardening and behavior change communication implemented by community health workers do not consider families who are away from their homes for several months of the year. Distribution of non-staple foods through PDS and ICDS programs, coupled with realization of these entitlements for migrants as described above is one potential migrant-inclusive way to improve access to affordable, nutritious foods.

Due to the timing of our qualitative research, almost all of the interviewees recruited were from tribal communities in Jharkhand, where land protection laws grant access to land for agriculture. Thus, we did not have a good representation of research participants who do not have land for production of crops; this is a significant limitation to our qualitative analysis. From

our survey data, the FIES reference period of one year did not allow us to explore food insecurity specifically during the period of migration. We recommend further research explore the validity of FIES measurement using relative time periods. Such research would be useful in other fields of research other as well, where experiences may mark changes in food security, for example, extreme weather events.

Our work has several strengths. We present rich insights into the experiences of migrants with respect to changes in their food environments and food security through the utilization of mixed methodologies. Furthermore, while existing research has studied changes in diets and food security among rural-to-urban migrants, we examined a substantial but understudied rural-to-rural stream. This allowed us to analyze experiences of food environment shifts in the context of migration as a process, rather than changes due to urbanicity. Although our research was conducted in the brick kiln setting, findings may also be relevant in other industries, such as agriculture, where families temporarily migrate as a unit.

In conclusion, our findings suggest circular migration is an important strategy used by many poor households to improve food security and to some extent dietary diversity by enhancing affordability of foods. It is important to recognize that these changes, while positive for some families, may be temporary, and not always lead to transformative upward mobility. While explicit inclusion of migrants in food security policy frameworks is necessary, for circular migrant families who migrate in the context of exploitative industries, upholding fundamental labor rights such as fair wages, safe housing and sanitation, and education of children is paramount in addressing some of the root vulnerabilities underlying chronic food insecurity.

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Chapter 6. Circular migration and child nutrition: a comparison of children from family circular migrant, male migrant, and non-migrant households in Bihar, India.

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Abstract

Objective: Circular migration is a critical livelihood strategy undertaken by many rural households in India to cope with poverty and food insecurity. We examined the associations of child nutrition and migration among three groups: children who engage in circular migration with their families, children in households with a male migrant member, and children in households that do not engage in migration.

Design: We combined two data sources – a study of circular migrant families residing on brick kilns throughout Bihar, and data on non- and male migrant households from a parallel nutrition cohort study implemented in 10 districts. We used propensity score weighting to create balanced groups on wealth, land ownership, paternal education, child age and sex, and district proportion of Scheduled Castes and Scheduled Tribes.

Results: We found that children who engage in circular migration are about one-third as likely to be stunted compared to similar non-migrant children, but over twice as likely to be wasted. Children in circular migrant households were less likely to experience any and severe food insecurity, and also less likely to access public health and nutrition services, including immunization, iron supplementation and deworming medicines.

Conclusions: In the context of the decline of the pro-poor welfare state and increasing agricultural instability, migration for livelihood can enable nutrition security for households, and should thus be facilitated by enforcing labor policies that outline fair pay, safety standards and child care. Risks to nutrition should be addressed through programs targeted to migrant families while they are in their destinations. Households located in high outmigration regions that do not engage in migration are also important target groups for livelihood and maternal and child nutrition programs.

6.1 Introduction

India is home to one third of the world's children under five who are chronically undernourished or stunted, and over one half of the world's children under five who are acutely undernourished or wasted (1). The basic causes of poor nutrition include poverty and social marginalization (2), which strongly persist in India. Yet, despite decades of large-scale implementation of nutrition and food security programming by the state targeted to the poor, the prevalence of stunting and wasting in some states of the country has increased in recent years (3).

Over 60 percent of the Indian population relies on agriculture for livelihood, either as farmers or farm labor (4). Agriculture only represents 18 percent of India's gross domestic product (5); however, in many low- and middle-income countries, the sector does not experience rapid growth proportional to population expansion (6). In India, the majority of land ownership is smallholdings of less than one hectare, which is insufficient for the reproduction of most households (5). In this context, outmigration is a critical component of a multiple livelihood strategy undertaken by many rural households in India to cope with poverty and food insecurity. Labor migration is highly gendered; 85 percent of labor migrants are men, the greatest proportion of whom work in the service sector (42 percent) (7). Among women labor migrants, the greatest proportion (34 percent) migrate for work in agriculture. This pattern demonstrates

important gender differences in seasonality, duration, and destinations of migrants with implications on household structures at home and in destinations. For example, rural-to-rural streams of migration can often involve temporary, short-term movement of the whole family, including young children, over short distances. The phenomenon of ‘missing men’ from source villages, on the other hand, arises from substantial migration of unaccompanied male household members to farther urban centers, for longer periods of time.

The nutritional pathways can differ substantially among these varying gendered migration streams. Children who remain in the origin may have improved nutrition due to increased food security, improved diet quality and access to health care from remittances sent by migrating male members (8). Conversely, the psychological effects of parental absence, and the reduced time and energy of the remaining caregivers due to additional household responsibilities can have detrimental effects on child nutrition. Children who accompany their parents who migrate for work may benefit from increased income, but unhygienic living conditions in many places of destination may result in poor nutrition outcomes. Children who move are also disconnected from social protections such the Integrated Child Development Services (IDCS), the national community-based nutritional supplementation and early childhood development program, and the Public Distribution System (PDS), the main pillar of India’s food security strategy which provides subsidized grains to eligible beneficiaries. Insights into the influences of male and family migration on child nutrition can inform policy to better reach intended beneficiaries at home and in their places of work.

Literature on the impacts of migration on child nutrition in India has primarily focused on children of rural-to-urban permanent migrants. These studies suggest that compared to urban non-migrant children, children of rural-to-urban migrants are more likely to be undernourished

(9, 10). Duration of migration is an important consideration; compared to recent migrants, long-term migrants can eventually obtain access to health care (11), water and sanitation services, and PDS entitlements (12). Migration in India, however, is dominated by short-term, circulatory patterns, and as mentioned above, for accompanying children, rural-to-rural movement. Those most likely to engage in circular migration include Scheduled Castes and Scheduled Tribes, lesser educated, and landless or smallholding households (13, 14). How nutrition differs between non-migrant children in rural source areas and circular migrant children has not been studied. The objective of this study is to compare nutrition status among circular migrant children with non-migrant children – both in households with male migrant members and households that do not engage in any migration. We further explore differences in the determinants of nutrition status among the three groups including access to health care, water and sanitation, food security, illness, and diet to understand the potential ways migration operates in influencing nutrition status.

6.2 Methods

6.2.1 Study context

There is substantial variability throughout India with respect to poverty, agrarian dynamics, migration outflows, and child nutrition. We conducted our study in the state of Bihar, the third most populous state in India, and the poorest (15). Bihar is also the least urbanized; 87 percent of the population lives in rural areas (16), largely relying on farming for livelihood. Agricultural performance of the state is poor (17); small landholdings, lack of irrigation infrastructure and climate shocks all contribute to very high temporary outmigration from the state.

To study nutrition among children who engage in circular migration with their families, we focused our research in the brick industry. Brick kilns rely on migrant labor for manual brick production, which is seasonal and occurs in the dry months, approximately October to June. Recruitment is carried out by labor contractors, who provide an advance sum of money; this debt is paid off by workers over the course of the season. Due to the practice of recruiting male-female pairs, family units including young children migrate and live on-site in rudimentary housing for the duration of the season.

6.2.2 Data sources

This study was conducted by CARE India and Emory University. We combined data from two different surveys implemented by CARE India in Bihar during the same time period.

Children who accompany their families during circular migration. In June 2018 we conducted a stratified cluster design survey across a total of 519 randomly selected brick kilns throughout Bihar. Per district (stratum) we randomly selected eighteen brick kilns using a district-wise list of operational brick kilns obtained from the Bihar Department of Mines and Geology. For each sampled kiln, we identified eligible households residing on-site based on the following criteria: 1) self-identification as a circular migrant household, defined as living away from their home block (sub-district) for employment purposes for a total of at least 60 days in the previous year, with at least one return home during that year; and 2) presence of at least one child under three years of age at the kiln. From the household line listing of eligible circular migrant families, we randomly selected three households, one with a child zero to eleven months of age, and two with children 12 to 35 months of age. A household survey questionnaire was administered to the

mother of the selected child, and height/recumbent length and weight data were collected for each selected child.

We collected data on 1094 children under three in June 2018; we restricted the present analysis to the subset of children whose state of origin is Bihar (n=540) (Figure 6.1).

Children from male migrant and non-migrant households. From August 2017 to July 2018, CARE India implemented a longitudinal cohort study with the objective of determining the incidence of severe acute malnutrition (SAM). Ten districts were chosen, one from each of the ten CARE programmatic regions. Within the ten districts, three villages were purposively selected based on accessibility to the district capital. All children under five years of age from the selected 30 villages were enrolled into the open cohort. A household survey was administered to the caregiver once during the study period. The instrument included a migration module, which identified members of the household who migrated for work for at least two months in the previous one year. Weight data and information on illness in the previous month for each child was collected monthly, and height/recumbent length data was collected once every three months. We interpolated weight data for the interval months based on the preceding and subsequent weight measures.

A total of 6554 children under five were included in the cohort study. For this analysis, we restricted the data to children under three years of age for whom weight and height (measured or interpolated) were available for June 2018. We further subset the analysis to children who were from households that engaged in male only migration (n=925) and households that did not engage in any migration during the previous one year (n=1257) (Figure 6.1).

All data were collected digitally by CARE staff who were trained on the survey instrument and anthropometric measurement.

6.2.3 Outcomes of interest

Primary outcomes. Our primary outcome of interest was stunting and wasting, defined as a height-for-age and weight-for-height z-scores, respectively, of less than negative two standard deviations. Z-scores were calculated using WHO references (18).

Secondary outcomes. We used the UNICEF Conceptual Framework of the Determinants of Child Undernutrition (2) to determine secondary outcomes of interest. At the level of underlying determinants, we measured food insecurity in the previous one year using the Food Insecurity Experiences Scale (FIES) (19). Household food availability was measured by asking the respondent how many days of the previous one week food groups were available; a predetermined list, developed by CARE India, of 31 food groups commonly consumed in the region was used. Data on primary source for drinking water and access to sanitation was also collected. Access to the public health system was assessed by asking if the child ever received any immunization, ever received iron supplementation for children six months and older, and received deworming medicine in the last six months for children 12 months and older. Among the immediate determinants, we measured illness by collecting information on diarrhea and acute respiratory infection (ARI) symptoms in the previous one month, and infant feeding practices of current breastfeeding among children under six months, timely initiation of complementary feeding among children six to eight months and minimum acceptable diet among children 6 to 23 months (20).

6.2.4 Propensity score weighting

To create groups of comparable children with respect to important factors that predict migration,

we conducted propensity score weighting to ensure adequate balance. We weighted on the following covariates: wealth quintile, land ownership (dichotomous), paternal education (any/none), child age in months, child gender, and proportion of district population that are Scheduled Caste (SC) or Scheduled Tribe (ST). Wealth quintile was calculated using principal component analysis methods of household asset ownership data. For district SC and ST proportion, we used data from the Socio Economic and Caste Census 2011 (21) to classify each district in Bihar as high SC and ST (combined proportion of SC and ST greater than 20 percent) or low SC and ST (combined proportion of SC and ST less than or equal to 20 percent).

We utilized the multiple groups covariate balance propensity score (CBPS) (22) methodology to generate propensity scores and corresponding weights. CBPS optimizes covariate balance and prediction of treatment assignment; in this case, propensity scores represent the likelihood of engaging in family migration.

6.2.5 Statistical analysis

We first conducted descriptive statistics to explore differences in sociodemographic characteristics by family migrant, male migrant and non-migrant households. We then conducted weighted bivariate analyses between migrant group and the secondary outcomes of interest. To obtain weighted odds ratios for the association of migration group with nutrition status, we ran separate logistic regression models with stunting and wasting as outcomes and migration group as the exposure of interest. We checked for interaction of migration group and child gender; since there was no evidence of interaction, the final models adjusted for age in months and child gender. Alpha was set at 0.05. All analyses were conducted in R and SAS. The WeightIt (23) and cobalt (24) packages in R were used to generate propensity score weights and balance diagnostics.

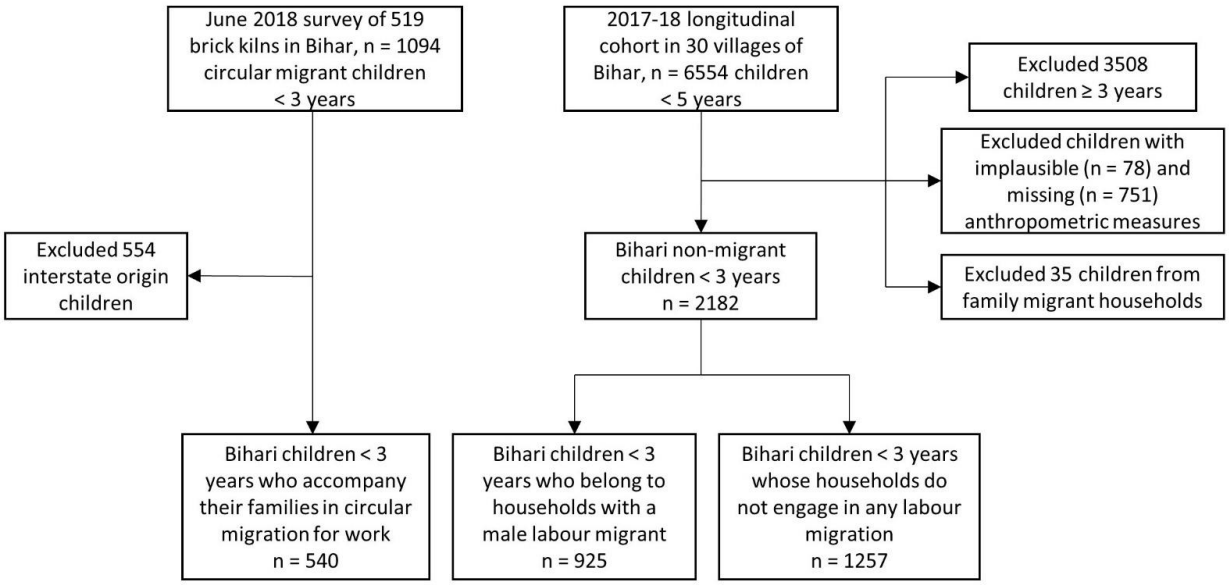


Figure 6.1 Flow chart of participant selection for analysis

6.3 Results

6.3.1 Population characteristics

Sociodemographic characteristics differ by migrant type (Table 6.1). At the time of the study, family migrants had been residing on the kiln of enumeration for an average of 6.5 months. Family circular migrants who migrate to work in brick kilns were more likely to originate from districts with a high proportion of Scheduled Castes and Scheduled Tribes, less likely to own land, and were more likely to be uneducated and from the poorer wealth quintiles compared to households who did not migrate or have male migrant members.

Family circular migrants were also less likely to have a PDS ration card compared to the other migrant groups, and among those who did, were more likely to have the Antyodaya card (issued to the poorest of the poor).

Table 6.1 Population characteristics by migration group, Bihar 2018

	Non-migrant HH n (%)	Male migrant HH n (%)	Family migrant HH n (%)
District SC & ST population			
Low	951 (75.7)	639 (69.1)	135 (25.0)
High	306 (24.3)	286 (30.9)	405 (75.0)
Land ownership			
No	639 (50.8)	489 (52.9)	416 (77.0)
Yes	618 (49.12)	436 (47.1)	124 (23.0)
Wealth quintile			
Lower	123 (9.8)	107 (11.6)	314 (58.1)
Second	215 (17.1)	183 (19.8)	147 (27.2)
Middle	275 (21.9)	219 (23.7)	50 (9.3)
Fourth	293 (23.3)	232 (25.1)	21 (3.9)
Higher	351 (27.9)	184 (19.9)	8 (1.48)
PDS card			
No	481 (38.3)	330 (35.7)	295 (54.6)
Yes	776 (61.7)	595 (64.3)	245 (45.4)
PDS card type			
APL	162 (20.9)	109 (18.3)	26 (10.6)
BPL	470 (60.6)	365 (61.3)	139 (56.7)
Antyodaya	69 (8.9)	44 (7.4)	37 (15.1)
Annapurna	56 (7.2)	50 (8.4)	17 (6.9)
Don't Know	19 (2.5)	27 (4.5)	26 (10.6)
Household size			
mean (sd)	7.4 (3.3)	7.0 (3.2)	6.4 (2.8)
Paternal education			
None	621 (49.6)	465 (50.3)	448 (86.3)
Any	630 (50.4)	460 (49.7)	71 (13.7)
Maternal education			
None	836 (66.5)	620 (67.0)	514 (95.2)
Any	421 (33.5)	305 (33.0)	26 (4.8)
Child gender			
Male	647 (51.5)	472 (51.0)	279 (51.7)
Female	610 (48.5)	453 (49.0)	261 (48.3)
Child age (months)			
mean (sd)	19.3 (9.5)	19.7 (9.9)	16.3 (9.0)

After calculating and applying propensity score weights, adequate balance among the three migrant groups was achieved on district SC and ST population, wealth quintile, land ownership, paternal education, child gender, and child age. Balance diagnostics are summarized in the supplementary tables and figure.

6.3.2 Nutrition status

Figure 6.2 shows the weighted distributions of HAZ and WHZ by migration group. HAZ distributions (6.2a) of child migrants were shifted to the right compared to non-migrant children and children in households with male migrants, indicating a lower prevalence of stunting among children who migrate with their families. Overall stunting was 77.8 percent among children under three in non-migrant households, 73.7 percent among children in households with male migrants, and 55.0 percent among circular migrant children. WHZ distributions were shifted to the left for child migrants compared to the other migrant groups (6.2b), indicating a higher prevalence of wasting among children who migrate. Overall wasting was 18.6, 24.0 and 34.1 percent, among children in non-migrant, male migrant and family migrant households, respectively.

The adjusted odds ratio estimates of stunting and wasting reflect the z-score distributions. Adjusting for age and gender, children in non-migrant households that are similar to family circular migrant households were almost three times as likely to be stunted but 55 percent less likely to be wasted compared to children who engage in circular migration. Children in households with a male migrant member were over twice as likely to be stunted and 40 percent less likely to be wasted compared to circular migrant children (Table 6.2).

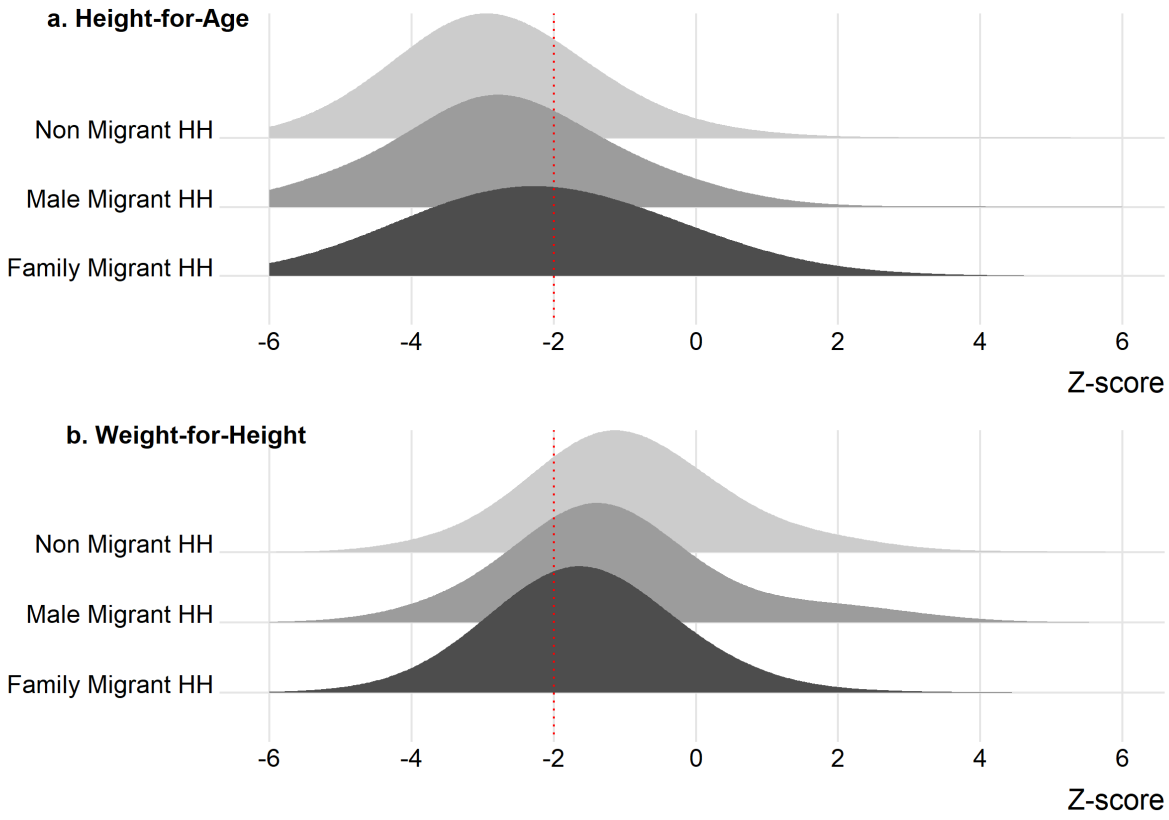


Figure 6.2 Height-for-age (a) and weight-for-height (b) z-score distributions by migration group, Bihar 2018

Table 6.2 Age and sex adjusted estimates of the association between migration type and nutrition status

	Stunting OR (95% CI)	Wasting OR (95% CI)
Migration type		
Non-migrant HH vs family migrant HH	2.79 (1.87-4.16)	0.45 (0.27-0.73)
Male migrant HH vs family migrant HH	2.26 (1.51-3.40)	0.59 (0.37-0.95)
Child age (months)	1.03 (1.01-1.05)	1.01 (0.99-1.02)
Child gender (Female)	0.82 (0.59-1.15)	0.90 (0.60-1.36)

Stunting and wasting prevalence by age group is shown in Figure 6.3. Under one year of age, the prevalence of stunting among migrant children was substantially lower than the prevalence among the other two migrant groups, whereas after one year, the prevalence among all three groups are similar.

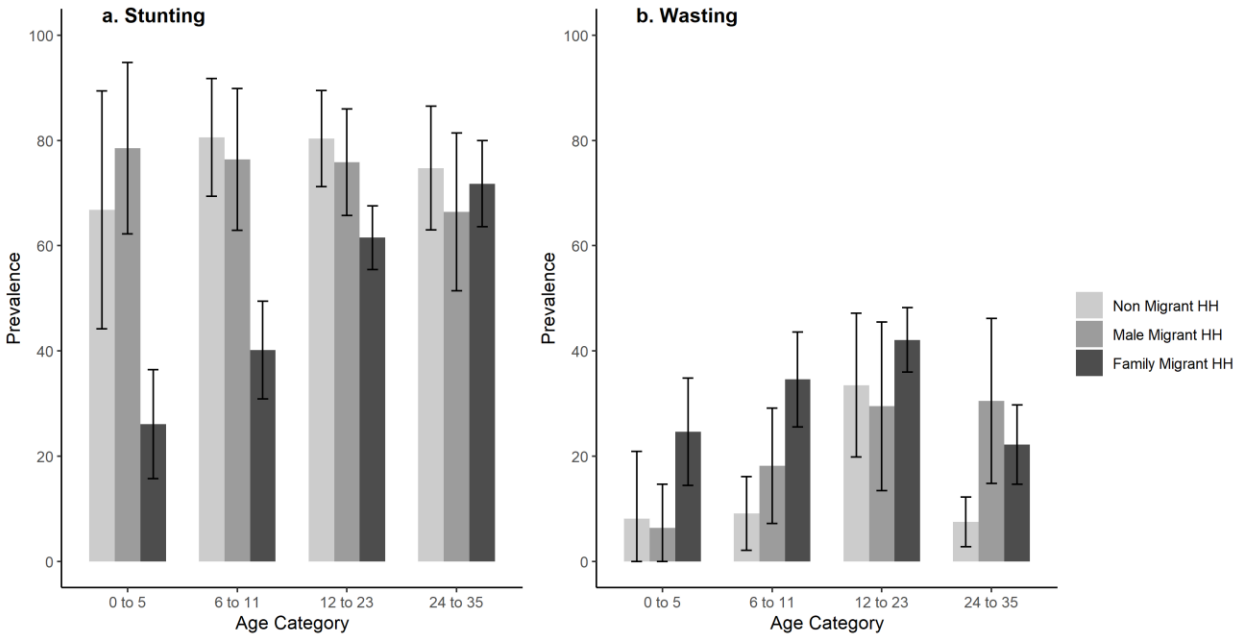
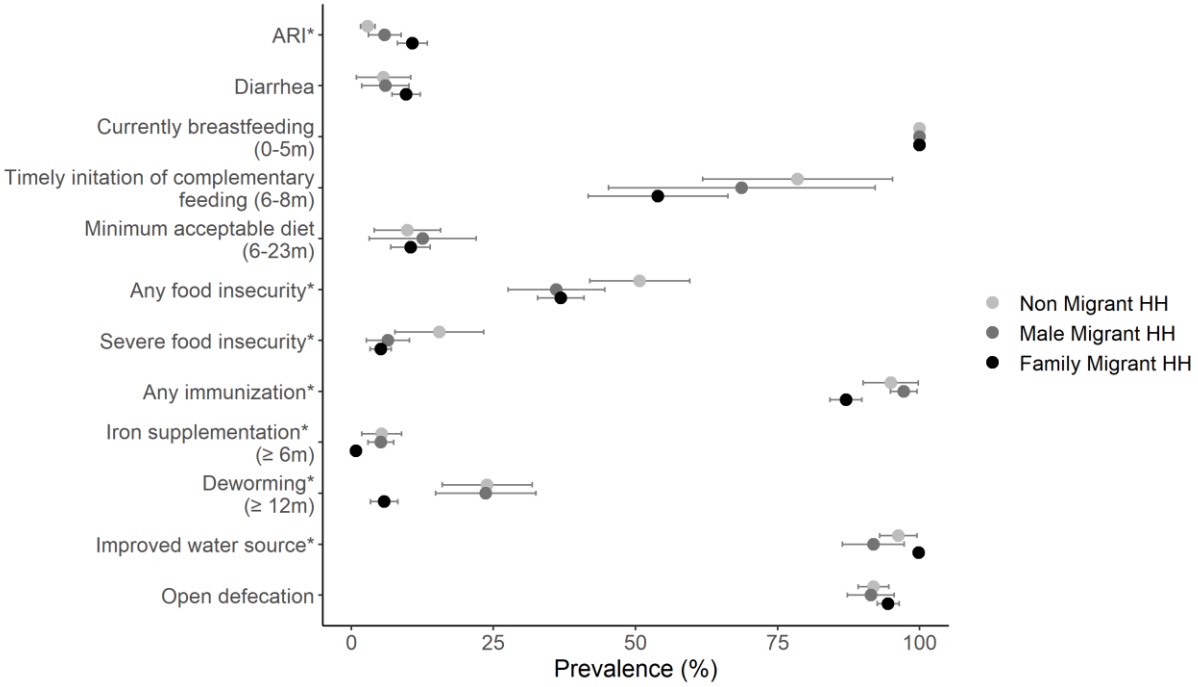


Figure 6.3 Stunting (a) and wasting (b) prevalence by age category and migration group, Bihar 2018

6.3.3 Determinants of nutrition status

Children who migrate and live on brick kilns were more likely to have had ARI in the previous month (eleven percent) compared to children from male migrant and non-migrant households (six percent and three percent, respectively); there was no difference in diarrhea prevalence (Figure 6.4). There were also no significant differences among the three migration groups in terms of feeding practices – current breastfeeding among children under six months of age (100 percent among all groups), timely initiation of complementary feeding among children six to eight months, and minimum acceptable diet among children 6 to 23 months. Circular migrant

families were less likely to experience any food insecurity in the previous year compared to households that didn't engage in any migration. Access to community-based health and nutrition interventions delivered by front-line health workers was lower among children in circular migrant households compared to male migrant and non-migrant households; this included ever receiving any immunization, ever receiving iron supplementation, and receiving deworming medicine in the previous six months. Access to an improved water source was slightly higher among migrant families during migration, whereas open defecation was similar across all groups, over 90 percent.



** $p < 0.05$*

Figure 6.4 Illness, feeding practices, food insecurity, community-based health coverage, and water and sanitation indicators by migration group, Bihar 2018

While coverage by the primary public health system's community-based interventions was low, the majority of respondents across all groups reported seeking healthcare from the

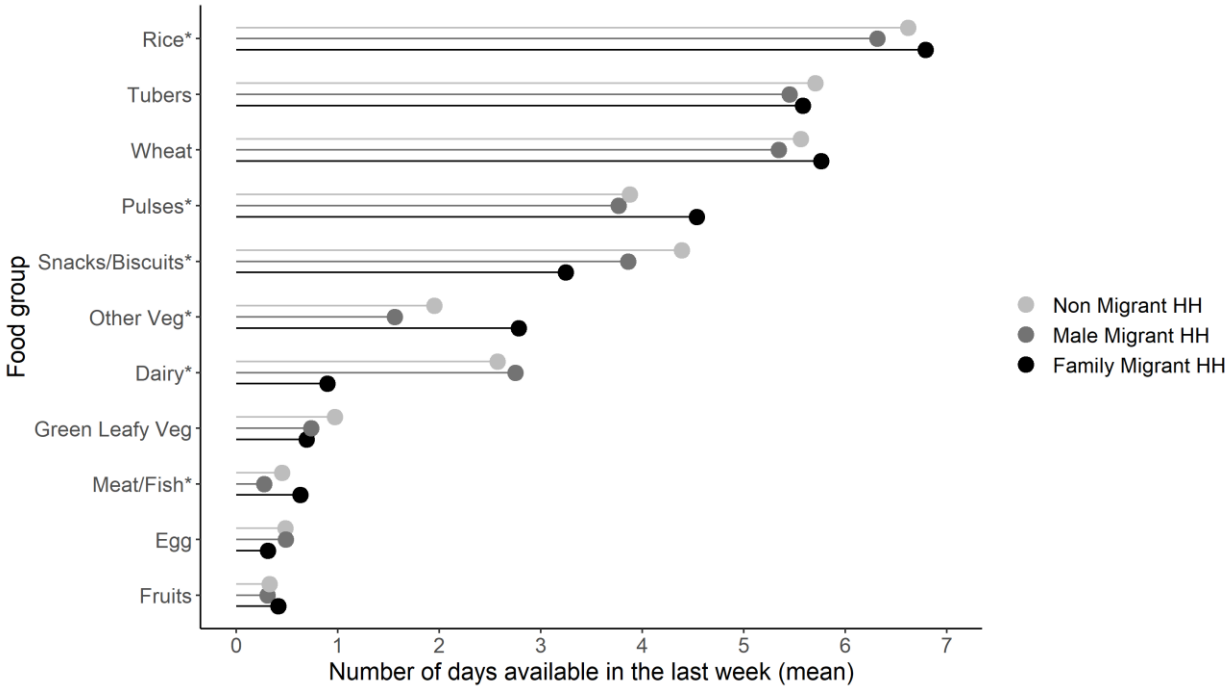
private system. Among children who had ARI or diarrhea in the previous month, 87 percent of children from non-migrant households, 95 percent of children from households with male migrants, and 95 percent of migrant children were taken to a private health provider (including pharmacists and registered medical practitioners). Among other sources of health information, relatives or friends were consulted by 19 percent of caregivers in male migrant households, compared to less than one percent among non-migrant households, and four percent among family migrant households (data not shown).

Household food availability in the previous week is displayed in Figure 6.5. Among all migrant groups, rice, tubers and wheat were available almost every day of the previous week on average, whereas green leafy vegetables, meat/fish, egg, and fruits were available less than one day of the week on average. Migrant families were more likely to have pulses, vegetables, and meat/fish, and less likely to have dairy available in the previous week compared to non-migrant households and households with a male migrant member.

6.4 Discussion

Our study aimed to compare nutrition between children who accompany their families in circular migration and children who remain in their village of residence but have a high propensity to migrate based on wealth, land ownership, father's education, age, gender, and district SC and ST profile. We found that children in circular migrant families were about one-third as likely to be stunted compared to similar children from non-migrant households. Circular migrant children were over twice as likely to be wasted, however, compared to similar children from non-migrant households. These divergent findings imply that migration for livelihood is an important factor in considering how the pathways of child nutrition operate. Specifically, determinants of nutrition

such as food security, hygiene environment, and health access are not static and can vary throughout the year depending on whether a child is at home or is migrating.



** p < 0.05*

Figure 6.5 Household food availability by migrant group, Bihar 2018

For instance, we found that during migration, which may be up to eight to ten months of the year for work in the brick industry, migrant children appear to have more frequent access to certain nutritious foods such as meat/fish, pulses and vegetables, compared to similar non-migrant children. Food security is also higher among migrant households compared to similar non-migrant households. Indeed, our qualitative analysis of the changes in food environments between home and destination, circular migrant respondents overwhelmingly shared that food was more affordable during migration because of regular cash allowances for food purchases [unpublished]. Improved dietary quality over the course of several repeated episodes of

migration may be one explanatory factor in the observed differences in stunting among migrant groups. Conversely, migrant children in our study were less likely to have received services from the community-based health system compared to children who were residing in their home villages. Growth monitoring and the detection, treatment, and referral of acute malnutrition cases is carried out by Anganwadi workers, the ICDS front-line health workers; migrant children living on brick kilns and construction sites are not generally reached by this system, possibly contributing to prolonged acute malnutrition resulting in a higher prevalence of wasting among migrant children.

There also may be factors specific to the brick kiln setting that increase the incidence of wasting. We observed that migrant children were more likely to experience ARI symptoms in the previous month compared to non-migrant children. In addition to being a leading cause of child mortality, ARI can result in a decreased appetite, additional nutrient demand, and malabsorption of nutrients, resulting in a loss of muscle mass. Exposure to particulate matter pollutants is widespread on brick kilns, specifically clay dust from the process of molding, drying, and carrying bricks, as well as smoke from the burning of coal and biomass needed to fire bricks. Previous studies conducted in brick kilns in India and Pakistan have reported high respiratory illness among laborers (25-27). Young children living on brick kilns, although not working, are nonetheless exposed to these pollutants, as are pregnant women. In utero and early life exposure to ambient air pollution has been linked to reductions in child linear growth in South Asia (28, 29). Our study did not explore air quality, but this is a critical research need (30).

It is important to note that while stunting was the lowest among children who migrate with their families, the prevalence of stunting is high for all three groups of children compared to overall Bihar estimates for the same age group. 44.1 percent of children 0 to 35 months are

stunted in Bihar (16) compared to our overall estimate of 68.7 percent. Similarly, open defecation among all three groups is over 90 percent, compared to the rural state-wide average of 73 percent. These points reiterate that circular migrant families, and households that that are similar but don't engage in migration are among the very poor and most marginalized. Our findings suggest that for households that do engage in circular migration for livelihood, there are certain nutritional advantages with respect to diet and food security, as well as certain risks. These multidirectional influences of migration on nutrition, and differences in determinants depending on home versus destination spaces need to be further understood; research utilizing a systems-based approach that considers the interplay among multiple factors across the immediate, intermediate, and underlying determinants of nutrition (31) is necessary to better inform programs aiming to reduce undernutrition among vulnerable groups.

Our results suggest that children from male migrant households are largely similar to children from non-migrant households with respect to nutrition status and determinants of nutrition. However, these findings may be a result of low ESS of both groups after propensity score weighting. Additional limitations to our study include the exclusion of important covariates, namely maternal nutrition status. While we observed a typical pattern of stunting by age among circular migrant children, stunting among infants in non-migrant and male migration households was very high, ranging from 65 to 80 percent, potentially a result of intra-uterine growth restriction and poor maternal nutrition. Reflecting our household food availability data, this may imply diets among women migrants of reproductive age are improved compared to non-migrant women; this should be further explored. Lastly, due to the cross-sectional nature of the study, we are unable to assess whether nutrition status preceded migration. In other words, it is a possibility that households with better nourished children more likely to migrate. However, the

majority of circular migrant households in our study (68 percent) had been migrating for three or more years, since before the birth of the index child.

Our study has several strengths. This is the first analysis to compare nutrition among circular migrant children to similar children from non-migrant and male migration households in origin areas; by using propensity score weighting methods, we were able to ensure comparability among all three groups. We were also able to capture, to some extent, the social network aspect of migration by using district level data on the proportion of SC and ST households. Lastly, we focused our work in Bihar, which experiences high poverty, agricultural distress, undernutrition, food insecurity, and the greatest outmigration in the country.

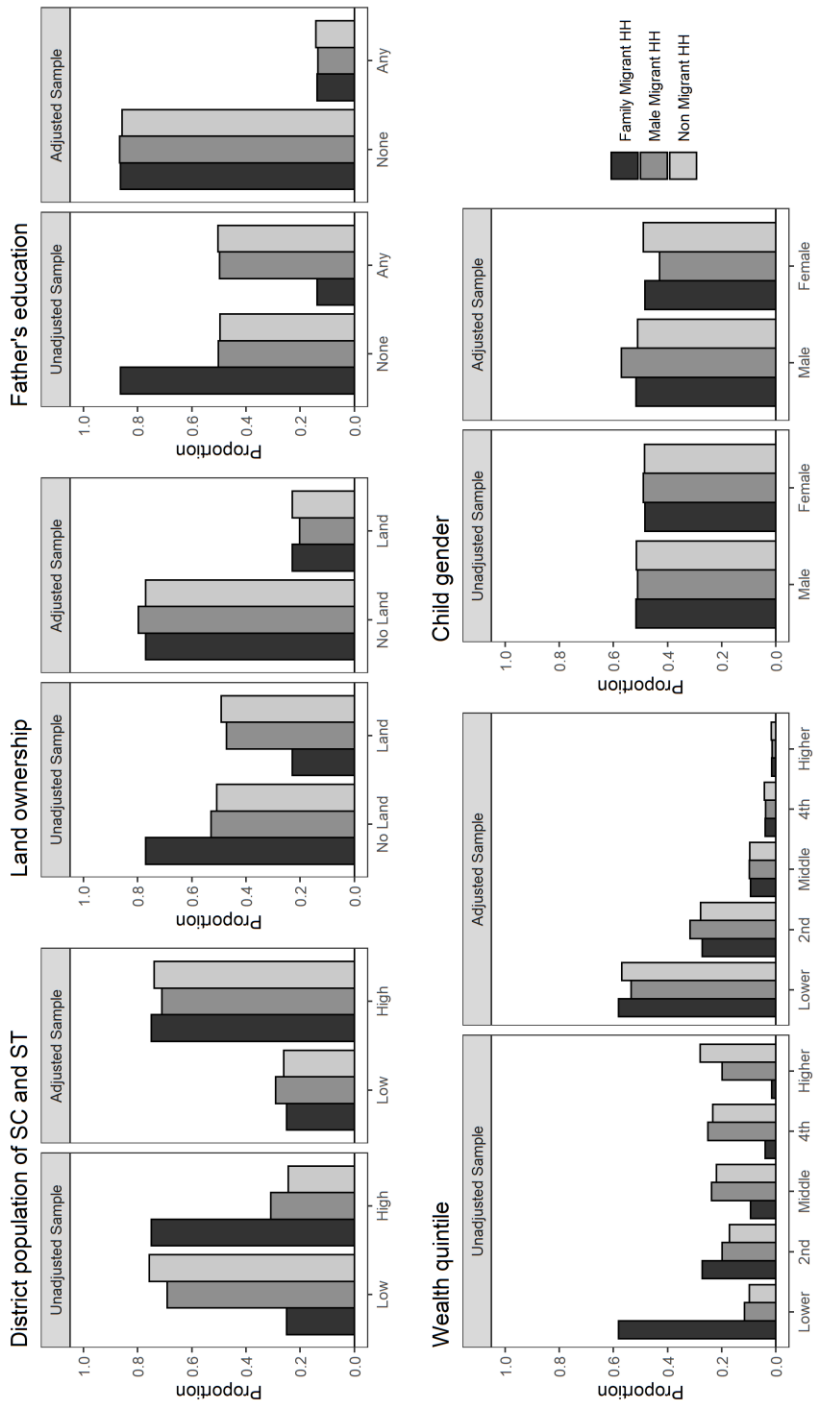
Our findings have important implications on policies pertaining to migration and social protection. As many have recommended (32, 33), revising ICDS and PDS guidelines to make state-led food security and nutrition programs accessible to women and children migrants is necessary. Further, it is crucial to recognize that with the diminishing of the pro-poor welfare state over previous decades, household wealth represents increasing importance in predicting child nutrition outcomes (34). Within the context of agricultural instability in the state, migration for livelihood can enable nutrition security for households, and should thus be facilitated by enforcing labor policies that outline fair pay, safety standards, and child care. Risks to nutrition brought about by migration should be prevented through programs targeted to migrant families while they are in their destinations. Households located in high outmigration regions that do not engage in migration are also important target groups for livelihood and maternal and child nutrition programs.

Supplemental Table 6.1 Maximum standardized mean difference (SMD) before and after propensity score weighting

	Maximum SMD before weighting	Maximum SMD after weighting
SC/ST District Profile (high)	0.51	0.04
Land ownership	0.26	0.03
Wealth quintile*		
Lower	0.48	0.05
Second	0.10	0.04
Middle	0.14	0.01
Fourth	0.21	0.00
Higher	0.26	0.00
Paternal education	0.37	0.01
Child gender (female)	0.01	0.05
Child age (months)	0.36	0.06

Supplemental Table 6.2 Effective sample size (ESS) by migrant group

	Unadjusted ESS	Adjusted ESS
Non-migrant HH	1257	123
Male migrant HH	925	121
Family migrant HH	540	540



Supplemental Figure 6.1 Balance graphs of unadjusted and adjusted covariates by migration group, Bihar 2018

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Chapter 7. Discussion

This dissertation examined how circular migration, an important livelihood strategy for millions of rural households in India, is associated with child nutrition in Bihar, the state experiencing the highest movement in the country. Our first research aim focused on children who accompany their parents during circular migration for work in the brick kilns. We analyzed how experiencing first migration during the first six months of life interacts with a key feature of circular migration – repeated movement – to predict stunting and wasting. As a part of this aim, we also explored the state of the determinants of nutrition status among migrant children; that is, the underlying and immediate factors that influence nutrition, including food security, sanitation, access to health care, feeding practices, and illness.

In our second aim, we explored how circular migrant parents of accompanying young children experience their food environments in their destination and at home. We used mixed methods to analyze differences between home and destination in terms of sources of food, market and household food availability, accessibility, food prices, affordability, and convenience. We also validated the FIES for use within our study population.

Lastly, in our final aim, we compared nutrition status and the determinants of nutrition status among children from family circular migrant households, children from households with a male migrant member, and children from non-migrant households. We used multinomial propensity score methods to create balance among the three groups such that non-migrant and male migrant households resembled circular migrant households with respect to important factors including wealth, land ownership, paternal education, and district population of SC and ST. Our analyses thus estimate the nutritional associations of migration for non-migrant children like those who engage in circular migration with their families.

7.1 Key findings

7.1.1 The pathways to nutrition

Our findings suggest that circular migration influences determinants along the key pathways of nutrition in multidirectional ways. Among the underlying determinants of nutrition, food security and affordability of foods seems to be improved during migration. Our qualitative exploration in Aim 2 revealed that the experience of most migrant families we interviewed was an increased ability to purchase sufficient and diverse foods during migration compared to while at home. Indeed, compared to non-migrant households that are similar to family circular migrants on household level factors including wealth, land ownership and paternal education, results from Aim 3 showed that family circular migrants were less likely to have experienced any and severe food insecurity in the previous year. Likewise, households with male migrant members also experienced less severe food insecurity compared to non-migrant households.

While food security has often been defined and measured as economic access to food, it must also be considered in the context of aspects more traditionally discussed in the food sovereignty domain, such as control over how food is produced and consumed, as well as over natural resources including land and water (1). Craven and Gartaula (2) also discuss the importance of approaching food security from the lens of social well-being, which 'places emphasis on the status and symbolic value assigned to different lifestyles and how they are viewed as a means to achieve food security.' Our qualitative data were important in analyzing the socio-cultural factors of a household's food security. For example, the weekly purchase of animal source foods, such as fish and chicken, held high social value. Overall however, unlike streams of labor migration that may enhance a family's social status at home, many migrants whom we interviewed expressed the undignified and grueling conditions of their work in the

kilns, the loss of food entitlements and community shared food, and the lack of control over when food is purchased and consumed; this reiterates the importance of considering the specificities of industry and caste. Thus, migrating to the brick kilns for livelihood does not necessarily lead to securing food through means that reflect food sovereignty.

The second important underlying determinant of nutrition status that we discuss here is access to the community-based public health system, namely services through the ICDS such as nutrition counseling, and provision of take-home rations to young children and pregnant and lactating women, as well as services through the National Rural Health Mission (NRHM) such as promotion of immunization and institutional deliveries. As findings from Aim 3 demonstrate, children who engage in circular migration were less likely to receive health and nutrition services compared to children in male migrant and non-migrant households. Our findings of lower coverage of services, namely ever receiving any immunization, ever receiving iron supplementation, and receiving deworming medicine in the previous six months, among circular migrant children, suggest a broader disconnect with the public health system, inclusive of additional crucial nutrition services such as antenatal care, growth monitoring, and referral to Nutritional Rehabilitation Centers (NRC) in the case of SAM.

7.1.2 Nutrition status

With respect to stunting, one of our primary outcomes, we found that overall, circular migrant children were less than half as likely to be stunted compared to children in similar non-migrant and male migrant households. This does not imply circular migration is necessarily protective against child stunting; in Aim 1 we found that among children who first experienced migration from birth or in the first six months of life, those who experienced multiple migrations were 1.6 to 2.1 times more likely to be stunted compared to those who were experiencing their first

migration. We also observed that stunting patterns by age group among migrant children were typical in that prevalence increased with age category, whereas stunting among similar children in non-migrant and male migrant households was very high among all age categories. By two years of age, however, stunting among migrant children was just as high as among non-migrant and male migrant children, around 70%.

Considering these findings jointly, we conjecture that overall, circular migration may enable nutritional advantages in dietary intake for both mothers and children compared to members in non-migrant and male migrant households *like them*. In other words, among households who are most likely to engage in these precarious streams of migration – that is, poor, lesser educated, landless and from districts with high populations of marginalized groups, those who move as a family are possibly better off with respect to stunting than they may have been had they not migrated for livelihood. Specifically, improved maternal dietary intake among women who engage in circular migration may prevent intra-uterine growth failure and thus stunting among infants. However, despite this advantage, characteristics of many destination environments such as limited access to adequate sanitation and essential health services such as immunization can result in increased susceptibility to infection including diarrhea, and thus wasting; indeed, wasting was considerably higher among migrant children compared to other groups across all age groups, especially among infants zero to five months. Despite the traditional programmatic approach of viewing wasting and stunting as different phenomenon (3), it is accepted that they have shared risk factors (4, 5), and furthermore, repeated episodes of wasting can result in linear growth failure (6). These nutritional insults, beginning early in life and accumulative over repeated migrations, may therefore increase the risk of later stunting.

Our findings indicate the need to better understand nutrition dynamics among circular migrants in between migration episodes, in the place of origin. In other words, while overall, migrants are different from non-migrants in a number of ways, are first time circular migrants different from those households who have migrated multiple times and if so, how do such differences influence child nutrition? For instance, debt is a key driver of migration, particularly in industries such as brick manufacturing, where labor contractors provide an advance sum to households which are then paid off during the course of the season; sometimes indebtedness to the kiln owner at the end of the season is what continues the cyclical pattern of migration, in what is bondage. Debt can also arise from medical emergencies, wedding costs, agricultural expenses, etc. Our study, like many, used a single time measure of asset ownership to represent wealth, which is inadequate in understanding the fluctuations of income and debt that households experience in between migration cycles. These fluctuations are important drivers of both circular migration and maternal and child nutrition.

7.2 Strengths and innovations

Our work begins to fill a substantial gap in the literature by exploring nutritional status and the determinants of nutrition among circular migrant children in their rural place of destination – a group of migrants and a stream of migration both understudied in the internal migration literature.

For our study of circular migrant children residing on brick kilns with their families, we had a large, state-wide sample that was representative of all legally operating kilns in the state. By collecting detailed migration history, we were able to explore the association of nutrition with early life and repeat migration, characteristic of circular patterns of temporary movement. We

conducted our research in Bihar, arguably the most relevant state to study internal rural-to-rural movement. Additionally, we implemented two waves of the survey, one in summer and one in winter, to capture seasonal associations with nutrition and its determinants.

Through the use of a mixed-methods approach that included qualitative methods of data collection, we garnered rich insights into how migrants perceive changes in their food environments, diets, and experiences of food security between home and destination. These findings enabled important contextual understanding to our survey findings.

To our knowledge, our work includes the first comparative analysis of nutrition among circular migrant children and similar children from non-migrant and male migration households in origin areas. By using propensity score weighting methods, and data from the same time period, we were able to ensure comparability among all three groups. We were also able to capture, to some extent, the social network aspect of migration by using district level data on the proportion of SC and ST households.

7.3 Limitations

This set of studies has several limitations. While the brick industry is a major recruitment site for circular migrant families, there are other streams, such as for work in construction and agriculture. The nutritional associations of migration we observed may be unique to the brick industry due to the system of payment and geographic isolation of rural kiln sites. Furthermore, while Bihar is an important context to study, physical and nutritional environments may be different in richer destination states, such as Punjab and Haryana.

A major limitation to our research is the cross-sectional design. Thus, in Aim 1 we could not attribute the differences in nutrition status we observed between children who have migrated

once versus those who have migrated multiple times to the phenomenon of repeat migration. Similarly, in Aim 3 we could not infer that migration of children causes a decrease in the risk of stunting, or an increase in the risk of wasting. Ideally, a longitudinal prospective study that followed the same circular migrant and non-migrant families annually over time, and before migrant families begin engaging in circular migration would provide more accurate estimates of the effects of circular migration on child nutrition status. This would also minimize confounding by allowing for measurement of important time-varying confounders such as wealth, whereas collecting wealth data once at the time of the survey may be a predictor or an outcome of migration.

There are also some important covariates for which we did not have data. For example, indicators of maternal nutritional status such as BMI are important predictors of child nutrition (7), and may also be affected by labor migration. Related to this, data on micronutrient status of mothers and children as well as biomarkers of environmental enteropathy and parasitic infections, such as hookworm, would be valuable given the increased likelihood of poor nutrient absorption and/or losses due to the lack of sanitation in the brick kiln setting. Similarly, air quality is another confounding variable which would be important to capture, again in the context of migration to brick kilns as well as more broadly, urban settings in India (8).

7.4 Implications

7.4.1 Research

The research that comprises this dissertation is exploratory in that the nutrition of circular migrant children is a relatively understudied area. The vast majority of migration literature focuses on the impacts on poverty, both in the destination and in the source village through the

study of remittances (9). There is also a growing field of study on the well-being and experiences of women who remain in origin sites that examines the impacts of circular male migration on social aspects such as changing gender roles, women's decision-making, and women's security (10). With the exception of Shah's study of brick kilns as a site for young people to escape social constraints of home and experience romantic and sexual freedom that demonstrated non-economic drivers of migration (11), there is very little research on female migration and social and familial structures. Our research has shed some preliminary light on the potential influences of changing family dynamics as a result of circular family migration on maternal and child nutrition. Specifically, the nuclearization of the family unit during migration may imply less caregivers are available for providing childcare compared to the traditional joint family structure, but also fewer household members among whom food needs to be distributed, and potentially less sources of information (or misinformation). The nuclearization of the family unit may allow mothers to avoid power imbalances with elders, especially in-laws, who can influence child feeding practices; women's migration and contribution to family income may also affect self-esteem and confidence, which are positively associated with recommended infant and young child feeding guidelines (12). This line of research should be further explored to understand how migration as a nuclear family unit between home and destination affects social and household dynamics as they relate to food and nutrition.

Our research has also raised two important methodological areas of inquiry relating to research among migrant populations. The first is concerning the FIES, a globally calibrated scale measuring the latent trait of economic access to food; the validated reference periods for recalling experiences of food insecurity are the previous 30 days and the previous 12 months. For our use in all three aims, we utilized the one-year reference period, which encompasses time both

at home and during migration, thus making it difficult to analyze food security as it relates to migration. We propose research validating the use of event-based reference periods for the FIES among migrant populations, for example ‘after you migrated this year’, or ‘before you migrated for the first time’, similar to the Life History Calendar method for retrospective research (13). Such research would be useful in other fields of research other as well, where experiences may mark changes in food security, for example, extreme weather events.

The second methodological question our research raises is how missingness of children due to migration affects population-based survey estimates of coverage and outcome indicators. Results from Aim 3 have shown that both ICDS coverage and nutrition indicators can differ substantially between migrant and non-migrant children from similar regions of the state. Circular migrant children are likely not captured in surveys such as the NFHS and thus estimates may be skewed. Similarly, intervention strategies and evaluations based on data from high outmigration regions may also be inaccurate. Understanding the extent of missingness and ways to capture accurate data is an important next research step.

7.4.2 Program

There are some important programmatic priorities suggested by our findings. We found an alarmingly high prevalence of wasting among circular migrant children, especially in the summer season. This is potentially due to an increased incidence of diarrhea as a result of widespread open defecation, combined with an increase in diarrheal pathogens and density of enteric disease vectors (14, 15). The BOCW states that employers are responsible for providing and maintaining latrines for workers; Section 243 of the Act describes specifications such as privacy, lighting, and separate latrines for males and females if there are female workers on-site (16). Yet, among the brick kilns we sampled, over 90% of respondents reported open defecation.

A survey of brick kilns in Punjab found that while around 70% had latrines provided by the owner, many respondents reported defecating in the open even if there was a latrine present because of a limited quantity of toilets, or because water wasn't available for the latrines (17). Implementation of this aspect of the BOCW thus seems to vary substantially by state; monitoring and enforcement of the Act is an important programmatic action to control diarrheal disease and likely prevalent environmental enteric dysfunction, predictive of several forms of malnutrition (18).

We also found a high prevalence of ARI, a leading cause of child mortality, among migrant children living on brick kilns. Exposure to particulate matter pollutants is widespread on brick kilns, specifically clay dust from the process of molding, drying, and carrying bricks, as well as smoke from the burning of coal and biomass needed to fire bricks. Previous studies conducted in brick kilns in India and Pakistan have reported high respiratory illness among laborers (19-21). Young children living on brick kilns, although not working, are nonetheless exposed to these pollutants, as are pregnant women. While Bihar is one of the few states in the country to have taken steps towards adoption of cleaner kiln technologies (22), many chemical and environmental hazards still remain. Use of personal protective equipment such as face masks has been an action recommended for compliance with occupational safety (23), but this is not included in current legislation in India, nor are we aware of any targeted interventions promoting the use of face masks to prevent respiratory infection among kiln workers in India. Reports from other countries in the region that also rely on traditional, manual processes of brick production, and where protective equipment has been used, indicate that mask adherence is low due to discomfort and lack of awareness (24-26), barriers which can potentially be addressed in appropriate intervention design.

While the above points recommend targeting improved health and nutrition services to circular migrant families at their place of destination, it is imperative to note that coverage of the public health outreach system is very poor among children in non-migrant and male migrant households that are similar to circular family migrant households. For example, only around five percent of children in both non-migrant and male migrant households ever received iron supplementation in our study, compared to the higher, albeit suboptimal, 22 percent state-wide average of children 6 to 59 months who received iron supplementation in the previous one week (27). Similarly, while open defecation was close to 95 percent among circular migrant families at their place of destination, 91 percent of non-migrant and male migrant households reported open defecation in our study. This is compared to around half of the rural population who are estimated to defecate in the open at the end of the Swachh Bharat Mission in Bihar (28). We stress that households that don't engage in migration but face the same socioeconomic vulnerabilities as circular migrant households such as poverty, landlessness, lack of education, and social discrimination are poorly reached by government health services despite not engaging in repeated movement. Therefore, in addition to reaching families who move at their destination, it is equally critical to reach families who don't move, but are marginalized by these vulnerabilities.

7.4.3 Policy

Migration and labor experts have long articulated recommendations for the explicit inclusion of internal migrants in India's social protection policy framework, beginning with a consensus on the operational definition of circular migration, and enumeration to capture the invisibilized streams of migration, including temporary internal migrants, women and children migrants, intrastate, and rural-to-rural migration. Recommendations broadly include:

- Portability of domicile food security and health entitlements, such as subsidized food rations through the PDS, and health insurance through the Rashtriya Swasthya Bima Yojana (RSBY) scheme;
- Expanded coverage of front-line health workers in the ICDS program to include women and children who move;
- Safe, dignified work conditions and access to hygienic, adequate housing in the place of destination;
- Financial inclusion through access to formal banking and remittance transfer mechanisms;
- Fair wages and access to the justice system to report violation of labor laws;
- Education for children of migrants who are out of school due to their parents' movement, either in their place of origin or destination (29-32).

Our findings support these policy visions; however, we note they are oriented towards addressing the systematic exclusion of migrants from urban spaces. Our findings illustrate the gaps in entitlements and protections among families who engage in rural-to-rural migration; policy efforts must also explicitly consider social protection inclusion of migrants in rural destination environments, which often are less regulated and more disconnected from the health system. For example, we found that among both migrant and non-migrant caregivers of children who experienced illness in the previous month, the vast majority sought care in the private sector. Indeed, the private health sector accounts for 75 percent of health services in the country (33); most healthcare in rural India is provided by practitioners with no formal training (34). For circular migrants in their place of destination, the risks of utilizing these rural medical practitioners can be exacerbated by language barriers, discrimination, and the fact that in the brick industry as we observed, kiln owners and managers often are the gatekeepers to healthcare

in migrants' unfamiliar destination settings. Health policy targeted towards rural-to-rural migrants must therefore address the challenges of the rural healthcare system.

Secondly, we bring attention to the increasing importance of household wealth in improving nutrition within the context of the decline of the pro-poor welfare state of India (35). We stress that migration can enable household wealth, and thus policy efforts should facilitate safe migration for livelihood. Ending exploitative recruitment practices and payment systems that engender bonded labor and deny workers of their fair wages must be prioritized. Investments in rural development and agriculture infrastructure are also important to ensure engagement in circular migration for livelihood remains a choice.

7.5 Conclusion

This dissertation explored nutrition among an important, but understudied group – young children who engage in rural-to-rural circular migration with their families. We found complex associations between child nutrition and circular migration patterns, indicating that migration of children has some nutritional advantages, particularly with respect to food security and dietary diversity. Engaging in migration also implies some nutritional risks, namely exposure to unhealthy environments and decreased access to health services while away from home. These determinants, operating multi-directionally, may explain the differences in stunting and wasting we observed between migrant and non-migrant children. Programmatic and policy efforts should adopt approaches to improve nutrition among circular migrant children that recognize the multifaceted ways circular migration can influence nutrition, and must also prioritize households in rural India that experience similar class, education and caste vulnerabilities as circular migrant households but do not engage in migration.

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