

MERCHANT MOTHERS AND FISHERMEN FATHERS: PARENTAL INVESTMENT AND  
SUBSISTENCE WORK AMONG THE BOAT-DWELLING SHODAGOR OF RURAL  
BANGLADESH

---

A Dissertation

Presented to

the Faculty of the Graduate School

at the University of Missouri

---

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

---

by

KATHRINE E. STARKWEATHER

Dr. Mary Shenk, Dissertation Supervisor

DECEMBER 2016

The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

MERCHANT MOTHERS AND FISHERMEN FATHERS: PARENTAL  
INVESTMENT AND SUBSISTENCE WORK AMONG THE BOAT-  
DWELLING SHODAGOR OF RURAL BANGLADESH

presented by Kathrine E. Starkweather,

a candidate for the degree of Doctor of Philosophy,

and hereby certify that, in their opinion, it is worthy of acceptance.

---

Professor Mary Shenk

---

Professor Mark Flinn

---

Professor Robert Walker

---

Professor David Geary

## ACKNOWLEDGEMENTS

I would first and foremost like to thank the Shodagor of Matlab, Bangladesh who were kind, generous, and welcoming of me. They allowed me to be a part of their lives for nearly 12 months between 2011 and 2014 and have forever made an impression on my heart. They gave of their time and their energy and were unfailingly patient – even when asked to sit for an hour and a half and answer incredibly boring questions about the ages of everyone in their families. They trusted me and allowed me to witness parts of their culture that are not often shared with outsiders – a gift for which this anthropologist is forever grateful. Finally, they were friends. They laughed with me (and Ripa) on a daily basis. They shared their concerns and their struggles. They shared religious ceremonies, funerals, jokes, and biscuits. They walked us home at night to ensure our safety. I hope this dissertation does justice to the time I spent with them.

To Fatema Tuz Zohora (‘Ripa’), my research assistant and best friend for 9 months in 2014. When I met Ripa, she was interviewing to be someone else’s research assistant, but I knew within minutes what a natural she would be at this job. Her outgoing, kind, and persistent nature allowed the Shodagor to trust her – and by proxy, me. She forged ahead in the face of difficulty on a nearly daily basis, and sat patiently, waiting respondents out who were reluctant to talk with us. She sat with me at the dinner table for long conversations about our work and about life more broadly. She shared her own life, her family, and her wedding with me, helping me understand Bangladeshi culture and also giving me a friend and a family when I was so far away from home. Without Ripa, I would not have the quality of data that I do, nor (probably) my sanity. I would not have this dissertation.

To Sabrina Mahtab, my research assistant for 3 months in 2011. Sabrina was the first of my wonderful assistants whose kindness and patience won over the Shodagor and helped them gain trust in me. She and I only spent a few months with the Shodagor, but even 3 years later, they remembered her and spoke kindly of her – a great testament to her characteristics as a researcher and a person.

To Fayeza Orpita who introduced me to both Sabrina and Ripa, who provided support and laughs, and who continues to be a friend.

I would like to thank Dr. Mary Shenk, my advisor and number 1 champion during the six years I spent at the University of Missouri. I decided to do my PhD at Missouri as Mary's student not only because of the cupcake she bought me the first time we met, but because of her drive and dedication to her work. Mary and I had many, many long meetings and conversations over the years and after each one I left feeling more inspired, more dedicated, and more excited about my work than I had before. Mary pushed me to be a better scholar. She did everything within her power to make sure I reached the goals I set for myself, including going through countless (14...) rounds of edits on grant proposals and manuscripts, allowing me to stay for free in her hotel rooms at conferences so that I could afford to attend, and supporting me during difficult times in my life. When I decided to work with Mary, I knew I had chosen someone who would challenge and teach me, but also someone whose success I could strive to emulate. After 6 years of hard work, I continue to strive, but hope that she's as happy with the end result as I am.

To Dr. Raymond Hames, my Master's advisor at the University of Nebraska, without whom I would never have become an anthropologist. It was Ray's charismatic teaching that drew me to anthropology as an undergraduate and his patience and



willingness to work with me prior to graduate school that put me on this path. He introduced me to the work of Hrdy, Trivers, Kaplan, Hill, Gurven, Hurtado, Draper, Lancaster, and all the other greats (including Hames) in our field and got me excited about school in a way I hadn't been before. Ray intimidated the hell out of me when I was an undergraduate student, but has become my mentor who lifts me up when I need it most.

To my wonderful friends who provided endless support in the field. Roslyn Fraser-Schoen was kind enough to take me to Bangladesh with her in 2011 and teach me the ropes. Her patience (and occasional scolding) allowed me to adjust to a new environment and to gain a love and respect for a brand new country because I was able to see it through her eyes. Because of her, I got omelets when I could no longer stomach hard boiled eggs, and because of her guidance, I was able to return to the field in 2014 and do the same for others. Gretchen Perry and Martin Daly were the beneficiaries of that guidance, but may have helped me more than I helped them. Dinners in the field and multiple Skype sessions after they returned home made my research better. All three of these people supported me intellectually and emotionally during my 12 months in the field. What would I have done without them?

Thanks to my committee members, Dr. Mark Flinn, Dr. Rob Walker, and Dr. Dave Geary who challenged me to find new perspectives, to do the best work I can, and to be the strongest version of myself.

To all of my other wonderful friends, who color my life. To my Peeps for all the miles we ran together and to those of you who became more than just running friends over the years. To Jared and Nico – my UNL posse, to Drew Bailey who made me go to

happy hour and be social with other academics, to Liz Bailey who embraced and befriended me and let me be a part of her awesome friend group, to Kestrel and Erin for unfailing support, to Becky and Kelsey – two of the best Criagslist roommates ever, to Monica for teaching me how to bake chocolate cake and for being my closest friend during my last year of grad school, to Russell for being my respite and my comic relief. To Siobhan, Dawn, Ryan, and all of my other non-Mizzou anthropology friends. To Lacey for years of laughter.

Finally, to my family, without whom I would never have made it through graduate school. Thank you to my mom, Kathie, who has been my role model since I was a child. She showed me what it was to be a strong, independent woman who goes after what she wants. She taught me how to stand up for myself and others and how to have self-confidence. My mom always supported me in pursuit of my goals, even when it made life harder for her. She has been my #1 fan, my friend, and my rock. Thank you to my sister who has had to put up with a know-it-all older sister all of her life. She is always there for me, no matter how far we are apart geographically, and will be one of my closest friends for the rest of our lives. For Dwayne, Wayno, and Oliver the most important men in my life. Especially to Gracie who reminds me every day to NEVER GIVE UP. To Nellie, who went through all 8 years of graduate school with me and to Walter who kept me company during late night writing sessions – and basically every other minute of every other day.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....ii

LIST OF TABLES AND FIGURES.....

ABSTRACT.....

Chapters

1. INTRODUCTION.....1

- The Sexual Division of Labor
  - Individual Differences in the Division of Labor
  - Ecological Differences in the Division of Labor
  - Economy of Scale Model
  - Risk Model
- Reproduction and Parental Investment
  - Mothers
  - Fathers
  - Alloparents
- Health Outcomes of Parental Investment
- Research Questions
- Study Population: The Shodagor of Bangladesh
  - Group Structure
  - Domestic Cycle
  - Economy: Men’s Work
  - Economy: Women’s Work
  - Bangladeshi Ecology
  - Local Ecology
  - Shodagor Ecology and Risk
- Fieldwork

2. Shodagor Family Strategies: Balancing Work and Family on the Water.....27

- Introduction
  - Does the stage in family’s domestic cycle affect division of labor?
    - Prediction 1
    - Prediction 2
  - How does local ecology impact division of labor between households?
    - Prediction 3
    - Prediction 4
  - Do alloparents affect how labor is divided between husbands and wives?
    - Prediction 5
    - Prediction 6

- Methods
  - Study Population
  - Data Collection
  - Variables
    - Outcome Variable
    - Predictor Variables
  - Analyses
- Results
- Discussion

3. Risk-Taking Mothers and Stay-at-Home Fathers: Shodagor Risk and Parenting Strategies.....73

- Introduction
  - Shodagor Sexual Division of Labor
  - Economy of Scale Model
  - Risk Model
- Methods
  - Study Population
  - Bangladeshi & Local Ecology
  - Data Collection
  - Data Analysis
- Results
  - Wife’s Occupation
  - Husband’s Parenting Strategy
  - Individual Coefficients of Variation
- Discussion

4. Effects of Household Traits and Heritable Variation on Shodagor Health...105

- Introduction
  - Direct Effects on Growth
    - Prediction 1
    - Prediction 2
  - Indirect Effects on Growth
    - Prediction 3
    - Prediction 4
    - Prediction 5
    - Prediction 6
  - Inheritance of Body Size
    - Prediction 7
- Methods
  - Study Population
  - Data Collection
  - Analysis
- Results
- Discussion
- Conclusions

5. Conclusions.....	149
Nuclear Family-Focused Strategies	
Ecology and the Division of Labor	
Childcare Needs Also Affect the Division of Labor	
The Nuclear Family and Shodagor Health Outcomes	
Study Limitations	
Future Directions	
APPENDIX.....	167
1. Open-ended interview consent form	
2. Open-ended interview questions	
3. Quantitative survey, Spot Sampling and Anthropometric measures consent form	
4. Anthropometric measures child assent script	
5. Quantitative survey (first)	
6. Focal follows parental consent form	
7. Quantitative survey (second)	
REFERENCES.....	215
VITA.....	240

## LIST OF TABLES AND FIGURES

Tables	Page
1. Summary statistics and Chi-square analyses comparing categorical predictor variables in Chapter 2 across four strategies.....	51
2. Summary statistics and ANOVA analyses comparing continuous predictor variables in Chapter 2 across four strategies.....	52
3a. Multinomial Logistic Regression Outcomes comparing families who practice the ‘Traditional’ strategy to families in other three strategies.....	55
3b. Multinomial Logistic Regression Outcomes comparing families who practice the ‘Split Year’ strategy to families in other three strategies.....	55
3c. Multinomial Logistic Regression Outcomes comparing families who practice the ‘Work Together’ strategy to families in other three strategies.....	56
3d. Multinomial Logistic Regression Outcomes comparing families who practice the ‘Leave Kids Home’ strategy to families in other three strategies.....	56
4. Coefficients of Variation of income for different groups of Shodagor.....	75
5. Coefficients of Variation compared across Wife’s Occupation.....	75
6a. Summary statistics for continuous predictor variables in Chapter 3.....	77
6b. Summary statistics for categorical predictor variables in Chapter 3.....	89
7. Binomial Logistic Regression results comparing women across occupations.....	92
8. Binomial Logistic Regression results comparing husbands across parenting strategies.....	94
9. Multivariate Regression results for Wife’s CV.....	95
10. Multivariate Regression results for Husband’s CV.....	95
11a. Summary statistics for continuous predictor variables in Chapter 4.....	109
11b. Summary statistics for categorical predictor variables in Chapter 4.....	109
12. List of all predictor variables screened for inclusion in LMMs.....	123
13. Descriptive genealogy statistics.....	128

14. MCMCglmm fixed effect posterior means for height.....	132
15. MCMCglmm fixed effect posterior means for weight.....	133
16. MCMCglmm fixed effect posterior means for BMI.....	133
17. Variance component posterior modes, variance component ratio posterior modes, and fit statistics from MCMC models.....	134

## Figures

1. Map of Matlab, Bangladesh with stars indicating locations of 5 Shodagor bohor.....	17
2. Map of family strategy by bohor location.....	57
3. Husbands' parenting strategy across women's occupations.....	93
4. Husbands' income based on how far they live from the Meghna, compared across seasons.....	98
5. Height (cm) by age (years) for children, mothers, and fathers.....	124
6. Weight (kg) by age (years) for children, mothers, and fathers.....	124
7. BMI by age (years) for children, mothers, and fathers.....	125
8. LMS (lambda-mu-sigma) curve fit for height (cm) across age (years) in females and males.....	129
9. LMS (lambda-mu-sigma) curve fit for weight (kg) across age (years) in females and males.....	129
10. LMS (lambda-mu-sigma) curve fit for BMI across age (years) in females and males.....	130
11. Z-scores of height LMS curve for females and males.....	130
12. Z-scores of weight LMS curve for females and males.....	131
13. Z-scores of BMI LMS curve for females and males.....	131
14. Violin plots show complete posterior distributions of the 1,000 heritability estimates retained from each MCMC model.....	135

## ABSTRACT

This dissertation addresses three general research questions. First, what are the socioecological conditions that lead Shodagor families to employ particular strategies in order to balance subsistence work and childcare? Second, why do Shodagor men and women pursue particular occupational strategies that are cross-culturally unusual while others divide labor in ways that are more in line with other societies? And third, how do Shodagor subsistence and childcare strategies, all of which are concentrated within the nuclear family and influenced by the constraints of the Shodagor socioecology, influence nutritional outcomes for children and parents? I find that the concentration of resource sharing and childcare duties within the nuclear family is associated with husbands and wives cooperating in order to fulfill a family's subsistence and childcare needs. I also find that specific aspects of the ecology – how far an individual lives from a major market, and how far he or she lives from the Meghna River – as well as a family's childcare needs play key roles in determining the specific strategies families will employ in order to meet those needs. Finally, I show that while some factors concentrated within the nuclear family influence Shodagor health outcomes within the family in accordance with theoretical and cross-cultural predictions, others do not. These findings have implications for human behavioral ecological theory, which are discussed.



## CHAPTER ONE: Introduction

Parents across species face the same tradeoff: they must choose whether to invest their time and energy in direct childcare or in provisioning themselves and their families. As Royle and colleagues (2014, p. 776) said, “A parent spending more time foraging to provision offspring will have less time for offspring defense. Parents have to balance these competing demands when deciding how to allocate time to each activity.” This decision is an especially challenging one for human parents, given the long dependent period of children and the fact that parents often have multiple dependent children at the same time. While human fathers allocate far more time to provisioning than to childcare cross-culturally (Marlowe 2000), mothers face a heavier burden. They are simultaneously necessary for offspring survival (Sear & Mace 2008) and significant providers of or processors of calories to their families’ diets (Kaplan et al. 2000), which is likely the reason that women’s work cross-culturally is almost always more compatible with childcare than men’s work (Bliege Bird & Codding 2015). Humans divide labor by sex and men and women rely on a number of different factors when making decisions about which subsistence strategies to pursue, including necessities of childcare, potential mating opportunities, individual condition, and ecological constraints like proximity to resources, resulting in differences across societies in how labor is divided between men and women. It is rare, however, to see major differences within societies regarding the division of labor between men and women and the strategies employed by individual families to balance subsistence labor with childcare.

The Shodagor of Matlab, Bangladesh are a semi-nomadic community of people who live and work on small wooden boats, making the extensive system of rivers and

canals that traverse the country they call home. They are one of only a few groups in the world whose people live on boats and are recognized by mainstream, land-dwelling Bangladeshis as a culturally separate and lower-status group. The Shodagor face a cross-culturally unique set of socioecological constraints on the decisions they make regarding subsistence labor and childcare resulting in families employing one of four distinct strategies. Each of these strategies will be outlined in this dissertation, as will the constraints that are unique to the Shodagor, the characteristics that describe families in different strategies will be discussed, and the specific socioecological factors that influence families' decisions about which strategy to employ will be teased apart.

### **The Sexual Division of Labor**

Across all types of societies, individuals tend to specialize in tasks of production and reproduction. When these individuals cooperate with others who specialize in alternative tasks and all share the resulting products, this is referred to as the *division of labor*. Historically, anthropologists have described the division of labor as gendered because in nearly all documented societies, subsistence tasks are divided by gender. For example, in many foraging societies, men's primary economic task is hunting big game, while women's primary economic task is foraging for plant foods and easy-to-get, small game (Lee & DeVore 1968; Dahlberg 1981). Lancaster and Lancaster (1983) and Lovejoy (1981) suggested that the sexual division of labor is an essential part of the human pair bond; the man and woman cooperate within the pair bond by targeting different foods to share with one another, so that everyone in the household benefits.

Individual differences and ecological differences can influence how labor is divided in the household and within a society.

*Individual Differences in the Division of Labor*

Individual decisions regarding how labor is divided between the sexes are likely affected by differences in individual condition, which includes factors like age, health, numbers of alloparents available, number of children in the family, and ages of parents and children. Each of these should act on either the need for parents to perform direct childcare or their need to provision the family. For instance, more children in a family result in greater need for provisioning, but may also result in greater need for direct parental care. Quinlan et al. (2003) and Meehan (2009) show that the presence of alloparents can free mothers from the burdens of direct childcare and allow them to spend more time engaged in economic pursuits. Kaplan et al. (2000) show how age affects men's and women's productivity in subsistence work, with men reaching their peak daily energy production between the ages of 30 and 45. Women's peak energy production was more variable than men's across the foraging societies examined by Kaplan et al. (2000), but results generally showed that women produce the most calories per day during their post-reproductive years. Finally, age of children as well as overall age of the family, or a family's stage in the domestic cycle, can have an effect on the allocation of time to childcare and subsistence activities. Fortes (1958) refers to the *domestic cycle* as the normal and expected changes in age and membership a family experiences over time. These changes have been found to have an impact on kinship structure, including marriage patterns (Berreman 1975) and children's contributions to the household economy (Lee & Kramer 2002).

### *Ecological Differences in the Division of Labor*

Kaplan et al. (2000) also show in their study of forager contributions to the diet that the effects of age on productivity vary based on a group's ecology. Hadza men and women are able to out-produce their conspecifics among the Ache and the Hiwi at every age because the Hadza live in a lush environment with an abundance of both plant and animal foods. Ache women produce the most calories per day around the age of 25, then produce a relatively steady amount throughout their lives, while Ache men produce the majority of calories when they are between their early 20s and mid-50s, but show a rapid decline in caloric production beginning at the age of 45. The Ache ecology is such that few plant foods are easily available and hunting is a highly skilled, time-, and labor-intensive process, meaning that Ache men provide most of the calories to the group and primarily do so when they are physically capable of successful hunting trips.

Based on the Kaplan et al. (2000) findings, one can reasonably conclude that ecological constraints appear to be affecting foraging productivity. Optimal foraging theories, which focus on patterns expected if foragers behave so as to obtain a high net rate of energy acquisition while foraging (Winterhalder 1981), would suggest that these differences occur across ecologies because foragers in each ecology are making decisions that optimize their caloric return. However, optimal foraging theories do not account for the sharing of goods within a group or household (Jochim 1988), and as Marlowe (2007) pointed out, if the sexual division of labor is an adaptation that benefits the household, foraging behaviors of men and women may only appear optimal at the level of the household. At this level, Jochim (1988) and Marlowe (2007) create predictions based on the availability and stability of resources, both suggesting that the distinction of male vs.

female tasks should depend on the resources in the surrounding ecology. There are two models commonly used by human behavioral ecologists to explain the sexual division of subsistence labor between men and women: the economy of scale model and the risk model.

### *Economy of Scale Model*

The economy of scale model is based on the presumption of a shared goal between husband and wife to divide subsistence labor in a way that maximizes household economic efficiency (Becker, 1985). While this does not necessarily always lead to men hunting and fishing and women gathering and processing, either constraints or comparative advantages held by one sex for particular activities may result in the predictable patterns that we see across cultures in how labor is divided between the sexes. Women are biologically constrained by the energetic and time demands of pregnancy and breastfeeding, which may constrain them in such a way that it is most efficient for them to specialize in subsistence activities that are compatible with childcare, such as gathering and processing. Brown (1970) suggested that women should undertake economic activities that are low-risk, close to home, and could easily be interrupted and resumed in order to meet the needs of demanding children. This can give men a comparative advantage in tasks that are incompatible with childcare and require years of training and practice, such as hunting (Brown, 1970; Hurtado et al., 1985; Lancaster, 1978). Consequently, men, who are not constrained by childbearing and lactation have been found in many foraging societies to pursue resources that are risky, dangerous, and unpredictable (Lancaster & Lancaster 1983), and which require men to travel farther from home than the resources women pursue.

The economy of scale model implies that, to some extent, men's foraging decisions are based on women's foraging activities, which tend to be low-variance, provide low mean returns, and be used to feed women's own families. In turn, men are free to pursue higher-variance, higher-mean resources (Hurtado et al., 1992; Kaplan et al., 1990). A dynamic relationship between men's and women's foraging decisions combined with seasonal changes in childcare constraints or the productivity of resources should result in men allocating less time to foraging of particular resources that women allocate more time to, and vice versa (Bliege Bird and Bird, 2008). The model focuses on sharing of resources between men and women within the household, which can result in a complementarity of key macro-nutrients (Gurven et al., 2009), as well as greater overall household production (Becker, 1985). Resource sharing also commonly occurs between families within the same group and the economy of scale model suggests that this helps individual families buffer against long-term risk. High-variance resources tend to be shared more widely than low-variance resources, which may be shared primarily with a woman's own children and husband (Bliege Bird and Bird, 2008). So, when men pursue higher-variance, higher-risk strategies, they do so because they have a buffer which ensures their families will be provided for regardless of their economic success. This buffer includes a wife who cares for children and pursues lower-variance resources that produce reliable returns to ensure the family is fed, and an extra-familial sharing network.

### *Risk Model*

The risk model focuses on the costs and benefits of unpredictability in the acquisition of resources and assumes that individual foraging goals will cause those costs and benefits to be weighed differently. If the primary goal of foraging is consumption, an

individual should be risk-averse and pursue low-variance, low-mean resources. That is, those who gain greater benefits from consuming the resources they forage for or from using them to feed family members will do better with a strategy that provides reliable returns on a regular basis (Bliege Bird, 2007). Alternatively, if the goal of subsistence work centers around food's social utility, and one can gain status through resource sharing, an individual should be more risk-prone and pursue higher-variance, high-mean resources (Bliege Bird and Bird, 2008). Data from the Ache (Kaplan et al., 1990), the Hadza (Hawkes et al., 1991), the Ju/'hoansi (Lee, 1979), and other societies has suggested that men often specialize in high-variance resources – usually through hunting – while women often specialize in low-variance resources. As sexual selection theory predicts, when male variability in reproductive success is higher than female variability, males can increase their own reproductive fitness at a much higher rate by mating with multiple partners than they can by provisioning a limited number of offspring with only one partner (Trivers 1972). Hawkes (1990) and Smith and Bliege Bird (2000) argue that men pursue high-variance resources because success in such pursuit and subsequent group-wide sharing of these resources can improve men's social status and reproductive potential. While a number of researchers have presented evidence that men's big game hunting is aimed at provisioning their wives and offspring (e.g. Flinn, et al. 2007; Kaplan, et al. 2000; Lancaster & Lancaster 1983; Marlowe 2005; Trumble, et al. 2013; Wood & Marlowe 2013), Hawkes (1991) suggested that big game hunting among the Aché and the Hadza (Hawkes, et al. 2001) represent energy invested in mating effort, rather than parenting effort. Data suggests that in some cases, men ignore smaller, more dependable

calorie packages, such as small game or vegetable foods, in pursuit of unreliable big game (i.e. Smith & Bliege Bird 2000; Smith et al. 2003; Hawkes et al 2014).

Meanwhile, women in a society may focus on low-risk resources and form cooperative, intergenerational bonds as a way to buffer against risk and ensure their families have enough to eat (Bliege Bird and Bird, 2008). Bliege Bird and Bird (2008) point out that while this will usually result in risk-prone men and risk-averse women, “we should also expect shifts in goals of one gender or the other that correspond with shifts in the availability of resources associated with different levels of variance” (p. 658). Codding and colleagues (2011) show that this is true for the Ache, Martu, and Meriam – men tend to choose high-energy resources regardless of risk, while women choose low-risk resources in spite of energy returns.

Bliege Bird and Codding (2015) propose examining multiple “divisions of labor” rather than a singular “human sexual division of labor,” as cooperation is possible between any two individuals, regardless of their sex. An intergenerational division of labor, for instance, has been demonstrated in many societies. Hawkes and others (Hawkes 2003; Hawkes, et al. 1997, 118, 2000) famously found that postmenopausal Hadza women can gather enough vegetable food to supplement the calories brought in by their younger, reproductive counterparts. Hurtado, et al. (1992) found that Aché and Hiwi women of different ages who cooperate produce more foraged food, with postreproductive women digging roots and younger women with children picking fruit, than women who did not cooperate with other women. Scelza and Bliege Bird (2009) found evidence for female-female cooperative networks among Martu kin.



## **Reproduction and Parental Investment**

The divisions of labor are not relegated to the economic sphere; they also encompass child provisioning and childcare. Parental investment is defined as *any investment by the parent in an individual offspring that increases the offspring's chance of surviving at the cost of the parent's ability to invest in other offspring* (Trivers 1972). Parental Investment theory suggests that parents should invest in current offspring when the benefits of investing outweigh the costs (Trivers, 1972). Biological differences between the sexes require a high initial investment in offspring from women, in the form of large, energetically expensive ovum that are limited in number, as well as long periods of pregnancy and lactation, and a very low initial investment from men, in the form of a nearly unlimited number of small, energetically inexpensive sperm (Bateman 1948). Therefore, we expect women's investment in offspring to remain consistent throughout the offspring's dependent years, while men's investment should show much greater variance (Trivers 1972).

There are a number of ways in which parents can invest in their offspring. Initially, parents invest sex cells and energy (Trivers 1972). After birth, parents can invest by feeding, holding, protecting, playing with, cleaning, or teaching the child; activities that contribute directly to the child's survival. Parents may also indirectly contribute to a child's ability to succeed socially and find a suitable mate by earning money to pay for a child's education (Quinlan 2003), buying clothes or household goods, arranging a marriage (Borgerhoff-Mulder 1998; Shenk & Scelza 2012), or providing social connections that facilitate rites of passage such as social initiation (Scelza 2010).

*Mothers*

Maternal care is assumed to be obligate in humans (as it is with all mammals) (Trivers, 1972), which means that it is necessary for child survival. As a necessity, maternal care is much less variable than paternal care and more likely to come in the form of direct care (Sear & Mace 2008). Cross-culturally, mothers are universally the primary caretakers and main providers of direct care for children (Turke 1988; Hawkes et al. 1997; Gibson & Mace 2005; Hrdy 2005; Kramer 2005; and others). However, Hrdy (1992, 1999) argues that mothers are rational decision makers, just like fathers, and will invest optimally in their children in accordance with current environmental constraints and future reproductive opportunities. While we know that mothers do choose to disinvest completely in some offspring (i.e. Daly & Wilson 1980; Hrdy 1992), what seems to be much more common in humans is mothers balancing time between direct and indirect investment. In other words, mothers cannot always care for infants and small children while simultaneously engaging in economic tasks (Hames 1988, 1992; Hill and Hurtado 1996; Ivey 2000; Ivey Henry et al. 2005; Levine 1988; Peacock 1985), even in societies in which women's work is thought to be compatible with childcare. So, mothers must tradeoff between investing time in direct childcare or in economic activities.

### *Fathers*

In contrast, paternal care among humans is facultative, meaning that it is not always necessary for child survival and should, therefore, vary with environmental demands (Geary 2000). Accordingly, paternal care is quite variable cross-culturally in the amount of time spent with children, the type of care provided, and the effects of that care (e.g. Hames 1988; 1992; Hewlett 1992; Winking et al. 2009). Among traditional societies, hunter-gatherer fathers tend to provide the most direct care for children

(Marlowe, 2000). Aka fathers are at the high end of the range, holding or being within an arm's reach of their infants up to 47% of the day (Hewlett 1991). At the other end of the spectrum, fathers in pastoral societies sometimes provide 0% of direct care for infants and young children (e.g. Harkness and Super 1992; Munroe and Munroe 1992). Across all types of societies, fathers tend to interact with their children only around 25-35% the amount of time that mothers do (Lamb et al., 1985). Several factors are known to influence the amount of direct care fathers give their children. The amount of time a father spends in proximity to his children is associated with the amount of time he allocates to care (Marlowe, 2000). Meehan (2005) found that Aka fathers increase the amount of direct care they give when the children's maternal relatives are not present. Trivers (1972) and Hrdy (1992) suggest, one parent's time spent in childcare should be inversely related to the other parent's time spent on the same activity. Winking and colleagues (2009) support this conjecture with data from the Tsimane forager-horticulturalists, showing that fathers' direct care of children is at least somewhat contingent on mothers' childcare and other activities.

If women's and men's subsistence work is based on a dynamic relationship that determines the type of work and time allocated to work a husband and wife will perform and the time that women spend in childcare is dependent upon the time men spend in childcare, the economy of scale model also suggests that women's and men's subsistence work and childcare should be complementary in a zero-sum game. Kaplan and colleagues (2009) take productive and reproductive behavior into account in their model of complementarity when they suggest that sex-specific specialization in men's and women's roles increases "the returns to economic and reproductive cooperation between

men and women” (p. 3291), resulting in the human pair bond. There is increasing evidence from families in modern Western industrial societies that shifts toward mothers being the primary breadwinner are associated with fathers staying home to care for children (Doucet and Merla, 2007; Latshaw, 2011; Raley et al., 2012; Rushing and Powell, 2015).

### *Alloparents*

Hrdy (1999; 2005) suggests that alloparents play a key role in the development of human families, providing mothers with the help they need to successfully bear and rear children. Alloparents are anyone other than a child’s parents who engage in some parenting activity and usually include grandmothers, siblings, and other female relatives. They often engage in direct care, supplementing mothers’ care (e.g. Turke 1988; Hawkes et al. 1997; Gibson & Mace 2005; Hrdy 2005; Kramer 2005). In a cross-cultural review, Kramer (2010) shows that alloparents can account for anywhere from 13.2% (Hewlett 1988 for the Aka) to 51.4% (Kramer 2005 for the Maya) of all direct care received by a child.

Alloparents can also provide indirect investment in children by, for example, helping provision nursing mothers (Hawkes et al. 1997). Sear et al. (2009) find that the presence of specific alloparents, namely maternal grandmothers and elder sisters, significantly increases survival and anthropometric status of children. Other studies have also found that the presence of alloparents is beneficial for mother’s fertility (Quinlan & Quinlan 2008) and child outcomes (Sear et al. 2009). Hrdy (1999) and Quinlan and Quinlan (2008) suggest that alloparents may specifically benefit mothers by freeing them from direct childcare responsibilities and allowing them to work. Qualitative data from

my 2011 pilot study suggest that alloparents care for young Shodagor children when mothers are working, therefore, women with more alloparents available are predicted to spend more time working and less time directly caring for children than women with fewer alloparents available.

### **Health Outcomes of Parental Investment**

A large body of literature has shown that higher levels of both direct and indirect parental investment, such as calories (e.g. de Onis et al. 2012), breastfeeding duration (e.g. Bloss et al., 2004; Nahar et al., 2010), number and severity of illnesses (e.g. Adair and Guilkey, 1997; Silventoinen, 2003), household income (e.g. Dasgupta, 1994), and parental education (e.g. Alom et al., 2012; Rieger and Trommlerova, 2016) will result in better nutritional outcomes for all members of the family. In a number of cases, an increase in mother's income, education, or decision-making authority in the household has a positive influence on child growth measures (Engle 1991; Folbre 1986; Hoddinott & Haddad 1991; Phipps & Burton 1998; Rouf 2011; Reiger 2016). Case studies across cultures have found that men, compared to women, disproportionately spend their income on goods for their personal consumption while women are more likely to purchase goods for the household, and particularly for children (Folbre, 1986; Guyer, 1980; Guyer and Peters, 1987; Hawkes, 1991; Lancaster and Lancaster, 1983). These direct contributions from mothers have been linked to better nutritional outcomes of height, weight, and body mass index for children across cultures (Engle, 1991; Hoddinott and Haddad, 1991; Phipps and Burton, 1998; Rouf, 2011). Adequate height and weight are often used as a proximate measure of parents' reproductive success, an important indicator of

evolutionary fitness (Fisher 1930), and are commonly associated with higher rates of survival (Chen, et al. 1980; WHO 1995; Blackwell, et al. 2001; Engeland, et al. 2003; Nandy, et al. 2005), lower rates of chronic illness (Adair & Guilkey 1997; Blackwell, et al. 2001; Engeland, et al. 2003; Lim, et al. 2012), and greater lifetime reproductive success (Martorell et al 1981; Kirchengast et al 1998; Blackwell, et al. 2001; Samaras et al 2003; Sear, et al. 2004; Stulp, et al. 2012).

### **Research Questions**

In this dissertation, I will address three main sets of research questions:

- 1. What are the socioecological conditions that lead Shodagor families to employ particular strategies in order to balance subsistence work and childcare?** The unique Shodagor ecology – living on boats, surrounded by water year-round – places particular constraints on family and economic life and leads to Shodagor parents dividing labor by employing one of four distinct strategies to balance childcare and provisioning needs. Chapter 2 will describe the conditions that lead a family to choose one strategy over another by testing predictions about socio-ecological factors that impact the sexual division of labor, including a family's stage in the domestic cycle, aspects of the local ecology, and the availability of alloparents.
- 2. Specifically, why do individual women and men pursue particular occupational strategies that are cross-culturally unusual while others follow divisions of labor more in line with other societies?** While many families employ a division of labor between husband and wife that follows cross-cultural

trends, there is one group of Shodagor families in which the roles of mother and father reverse for half of the year: mothers take on relatively high levels of economic risk selling goods door-to-door, an occupation that results in highly variable returns and is totally incompatible with childcare, while fathers forgo work to stay home as the primary caregiver of young children. Chapter 3 will examine the social and environmental characteristics that influence women's and men's choices.

- 3. Finally, how do Shodagor subsistence and childcare strategies, all of which are concentrated within the nuclear family and influenced by the constraints of the Shodagor socioecology, influence nutritional outcomes for children and parents?** We know that a number of household-level factors impact growth in other societies, including nutrition, breastfeeding duration, number of children in a family, and women's autonomy. Chapter 4 will determine the importance of these variables to health outcomes (height, weight, and BMI) while simultaneously quantifying genetic variation in these traits among the Shodagor.

### **Study Population: The Shodagor of Bangladesh**

The Shodagor are distinct from land-dwelling, village Bangladeshis (the Shodagor term for whom is *grihosto*) in a number of ways, including cultural aspects like religion, political organization, subsistence strategies, and kinship structure (see Novak 1993 for a full description of village Bangladeshi culture in Matlab). The Shodagor speak a distinct dialect of Bengali and also have their own language. They are Muslim, but are often described by other Bangladeshis as “Muslim in name only” because of their religious

observances and ceremonies that more-closely resemble ancient Hindu traditions than Muslim practices. Shodagor also have an animist belief system, recognizing and worshipping the Ganges River during semi-annual ceremonies.

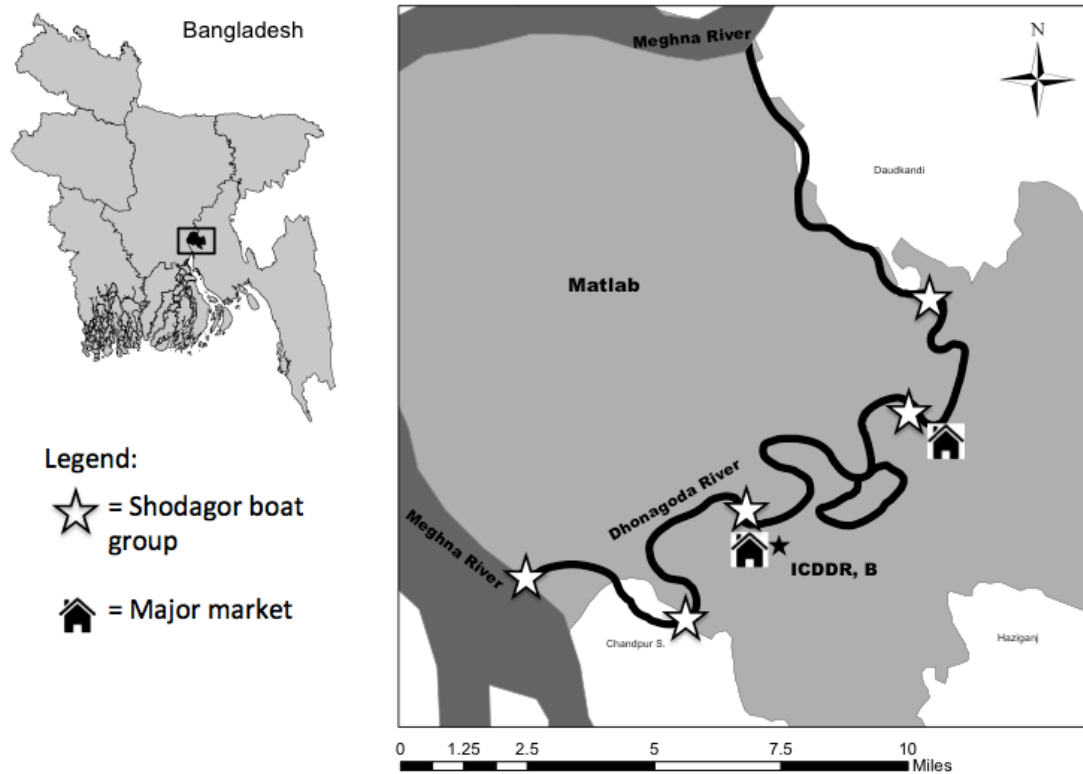
Marriage payments among the Shodagor have very recently begun to shift from a primarily brideprice system towards dowry, a shift that village Bangladeshis underwent approximately 50 years ago (Amin & Cain 1997). Kinship is recognized bilaterally. Inheritance of identity is traced through the father, while property is inherited from mother and father. As is common among nomadic or semi-nomadic groups (Ember 1975), Shodagor post-marital residence patterns are multilocal. Almost half (49%) of ever-married individuals in Matlab lived patrilocally after marriage, while 21% lived matrilocally, 16% lived bilocally (near both husband's and wife's family), and 14% lived neolocally. While there are always exceptions to the rule, and these patterns are changing under conditions of market transition and labor migration, village Bangladeshis have strong and long-standing patrilineal, patrilocal traditions.

### *Group Structure*

The population is semi-nomadic, with some families moving to different locations throughout Bangladesh an average of 2 times each year and other families moving very infrequently or not at all. When not moving between locations, families situate their houseboats within preexisting *bohor*, which translates directly to mean “fleet” or “convoy” and refers to a distinct cluster of Shodagor boats. Houseboats never reside permanently outside of a bohor and smaller fishing boats are used as the primary mode of transportation between house boats and the land. There are 5 distinct bohor within Matlab (Figure 1).



Figure 1. Map of Matlab, Bangladesh with stars indicating locations of 5 Shodagor bohor.



Shodagor political organization is largely egalitarian by status, though each bohor has a recognized *shordar* (headman). Shordars obtain their position either through primogeniture, with the oldest son inheriting leadership status from his father, or through an election held among the other shordars. Some Shodagor people in Bangladesh have given up their nomadic lifestyle, buying very small amounts of land and building houses. It is agreed upon by most Shodagor that families who live in houses have slightly higher status than those who live on boats and that those who have lived in houses the longest have the highest status within the community. The Shodagor are also mostly gender egalitarian with women in many families playing a role in making decisions for the family and having the ability to move freely in public and private spaces.

### *Domestic Cycle*

Shodagor boys and girls live at home with their parents in nuclear family households throughout childhood and until they get married. For Shodagor men, first marriage occurs at the age of 23 years, on average, while women first marry at the age of 16.5 years on average. Men marry an average of 1.4 times in their lives and women marry an average of 1.14 times in their lives. Eleven percent of individuals in this study have ever been in a polygynous marriage. After marriage, the new couple moves into their own boat and forms a new household. Men average 24.7 years of age when their first child is born and women average 17.8 years of age at first birth. Women who have likely completed fertility (those 45 years or older) have an average of 5.7 children, however, preliminary analyses of birth spacing data suggest that total fertility for younger women will be lower.

### *Economy: Men's Work*

While the Shodagor are largely integrated into Bangladesh's cash economy, almost all families practice some subsistence fishing as well. Shodagor men primarily work as fishermen with 85% of the men in Matlab fishing for at least some portion of the year. Some men also engage in day labor (11%), selling household goods (7%), and other types of work (2%) throughout the year, with 18% of men reporting more than one occupation.

### *Economy: Women's Work*

Almost half (44%) of Shodagor women work as saleswomen at least half of the year, traveling on foot for up to 10 hours each day, carrying heavy baskets on their heads, selling household goods in markets and door-to-door in villages. Selling goods is totally

incompatible with childcare and, in fact, no women reported ever taking dependent children with them while doing this type of work. Selling goods is an occupation that requires women to incur higher economic, safety, and reputational risks than men, but also has the potential to be a high-reward strategy in that women who sell goods often make more money than their husbands do fishing. Some women also fish with their husbands (31%) for all or part of the year and others are primarily housewives (34%) for at least a portion of the year. These economic roles differ dramatically from those of the landed Bangladeshis, with men heavily engaged in agriculture and wage labor and women almost never working outside of the home (Amin 1998).

### *Bangladeshi Ecology*

The ecology of Bangladesh plays an important role in Shodagor lifestyle. Every year, for approximately half of the year, large portions of the entire country of Bangladesh are covered in water, as a result of monsoon rains and Himalayan snow melt (Hofer & Messerli 1997). The Shodagor refer to this half of the year, which typically begins in June, as the “rainy season.” During June, July, and August, monsoon rains come regularly, but for the Shodagor, the season usually extends through the end of October when the waters have receded to the point that roads are dry and accessible. The other months of the year are referred to as the “dry season,” when water levels of the country’s rivers and canals decrease and land is visible in places that previously were completely submerged.

While the actual living conditions of most Shodagor do not change drastically between the seasons (they continue to live on boats on the water all year), what does change are the economic opportunities. During the dry season, fishing prospects vary

across Bangladesh, but as water levels rise, fishing becomes abundant throughout the country, with the availability of larger amounts and different types of fish making fishing a particularly profitable venture. During this half of the year, nearly all Shodagor men and some women fish nearly every day. Consequently, selling goods is nearly impossible and highly unprofitable for women during the rainy season. Many of the roads in the rural parts of the country are submerged in water, making transportation and access to potential customers very difficult. The dry season brings access to roads, making it a profitable time for women to sell goods as it is much easier to move about the country by foot or rickshaw during the dry season; during the rainy season many places must be accessed by boat.

#### *Local Ecology*

There are also two aspects of the specific ecology of Matlab that are important for Shodagor groups. First, the distance a family lives from a market town will determine the ease with which women can obtain goods to sell. Women do not store the goods they sell in their own homes, but instead they are held by a *mahajan* (middleman) in a shop in the nearest major market. Each selling day, women travel first to the market to collect their basket of goods, then out to the countryside to sell. Before returning home, women deposit their goods in the shop for the night and settle accounts with the mahajan. There are two major market towns in Matlab and two of the five bohor are located within a 5 or 10 minute walk from those towns, while the other three groups are located an hour or more away. Distance to market is less important for the success of men's fishing. Men do sell most their fish in markets at the end of each day, but this can be done at minor

markets as well as major markets. Minor markets are located all over the countryside and all 5 bohor in Matlab live within walking distance of a minor market.

The second aspect of the Matlab ecology that is relevant to the Shodagor is the distance a family lives from the intersection of the Donagoda River and the Meghna River, as this will determine fishing opportunities throughout the year. The Donagoda is the main river that runs through the middle of Matlab and is approximately equivalent in size to the Missouri River. The Meghna is one of the three largest rivers in Bangladesh. Its average width is approximately 5 kilometers, which is nearly equivalent to the widest point of the Mississippi River, and at its widest point, the Meghna is approximately 6 miles from shore-to-shore during the dry season. At the mouth of the Donagoda, where it connects with the Meghna, the river is wide and deep and there is an abundance of fish, in both number and variety, year-round. As the Donagoda travels away from the Meghna, especially during the dry season, water levels are lower and numbers and varieties of fish diminish. Shodagor groups who live closer to the Meghna will have year-round fishing opportunities that are potentially profitable, while those who live farther away will find fishing most profitable during the rainy season and much less profitable during the dry season.

#### *Shodagor Ecology and Risk*

Living on a boat that is surrounded by water year-round means that children, especially those who are very young and inexperienced swimmers, are at constant risk of drowning. This requires almost constant and close monitoring of those children, which is almost always done by either mother or father. In addition to keeping a close eye on children, parents use a number of different techniques to ensure that children do not

wander too close to the edge of the boat and accidentally fall into the water, including placing fence-like barriers between the child and the edge of the boat or having an older sibling or cousin help monitor the child. Children typically begin to learn to swim around the age of 4 and are considered sufficiently competent swimmers by the time they are 5. Incidentally, this is the approximate age when parents tend to let their children roam free, allowing them to play with friends or older siblings without much, if any, monitoring by parents. Up until the age of 5, though, it is extremely uncommon to see the child without an adult nearby. This adult is usually the mother or father, but also sometimes a grandparent, a much older sibling (age 12+) or an adult aunt or uncle.

### **Fieldwork**

Fieldwork for this project took place from March 6<sup>th</sup>, 2014 to November 24<sup>th</sup>, 2014. This project aimed to collect qualitative and quantitative data on all adults and children living in Shodagor communities in Matlab, Bangladesh through a mixed-methods approach. During this time, I conducted open-ended interviews with a sub-set of the adult population, one round of quantitative surveys with all adults which gathered demographic and basic socioeconomic data, a second round of quantitative surveys with a sub-set of the population focused on specifics of income earning and childcare, and two rounds of anthropometric data and direct observation data (in the form of spot sampling and focal follows) from all adults and children in the Matlab Shodagor population who agreed to participate in this project. (See Appendices for all interview instruments and consent forms used for this project.) Informal interviews were conducted throughout the duration of the project in the form of conversations about particular behaviors, beliefs,

and history of the Shodagor. Participant observation data was also collected throughout, also as an informal method. Data were collected with assistance from Fatema Tuz Zohora, my primary research assistant, and Sidiqzaman.

The first month of this phase (March 6<sup>th</sup>-April 1<sup>st</sup>) was spent in Dhaka, Bangladesh, preparing to go into the field. On April 1<sup>st</sup>, I traveled from Dhaka to Matlab, Bangladesh where I began my fieldwork. During the month of April, Fatema and I pre-tested both the quantitative survey and open-ended interviews we would conduct. We also gathered a full census of all Shodagor people living on boats in Matlab and spent time getting to know the people in the communities we would work in for the next 8 months. When final research permissions came through from ICDDR,B in late April, Ripa and I began obtaining consent from all adults and collecting anthropometric measurements on every consenting/assenting member of the Matlab Shodagor community, which was finished in May totaling 178 adults and 164 children under the age of 18. Fatema and I conducted 8 open-ended interviews with Shodagor men and women and collected quantitative survey data throughout the month of May. On June 1<sup>st</sup>, Sidiqzaman was hired temporarily in order to ensure that all remaining quantitative surveys were conducted prior to the end of June and the beginning of the Muslim holy month of Ramadan. Between May 1<sup>st</sup> and June 28<sup>th</sup>, 2014, we conducted quantitative surveys with 178 Shodagor adults. Only 14 adults in the entire community did not participate in this project; some were sick or never home while 4 declined to participate in one or more parts of the project. I began collecting direct observation data in the form of spot sampling during this time on all consenting adults and all children for whom their parent(s) gave consent. Upon entering a Shodagor group, I scanned every individual in

the group and recorded what he/she was doing, who he/she was with, and where he/she was located. Spot sampling data collection continued throughout the duration of my time in Matlab.

Ramadan began on Monday, June 28<sup>th</sup>, 2014 and ended one month later on July 28<sup>th</sup>. During this month, work in the field was difficult for two reasons. First, my research assistant, Fatema, was fasting, making the grueling daily demands of traveling to and from Shodagor groups difficult for her. Second, many of the Shodagor were fasting as well, meaning that they were largely unwilling to engage in research activities, such as interviews, which would require expenditure of their time and energy. Therefore, the month of July was spent in the offices of ICDDR,B, Matlab. I built the databases into which all of the anthropometric and quantitative survey data would be entered. I also planned out the second phase of the research project, obtained permission from the IRBs at the University of Missouri and ICDDR,B for additional direct observation data to be collected, and wrote the second quantitative survey that would be administered during August, September, and October.

From mid-August through mid-September, the second round of anthropometric data was collected. The first round was collected at the end of the dry season, when incomes are typically low and food is scarcer than during the rest of the year. The second round was collected at the height of the rainy season, which is a far more abundant season for the Shodagor. The second round of quantitative surveys was collected between late-August and late-October. Originally, I planned to conduct this round of surveys with each of the 178 adults who participated in the first round of quantitative surveys. However, for logistical reasons the second survey could only be conducted with a



subsample of the population. One difficulty that Fatema and I ran into was that the changing seasons caused the sun to set earlier, shortening the number of daylight hours that were available to conduct interviews as individuals would often work away from home until just before the sun set. This was only problematic for reaching Shodagor in the two northernmost groups in Matlab because travel on the roads to those groups was dangerous after dark. Travel to and from the 3 other groups was much more feasible – we often traveled by boat to the group closest to the Meghna and the other two groups were close enough to our home for us to return safely after dark.

Spot sampling continued through the end of the project, but focal follows of children under the age of 5 were conducted between September 1<sup>st</sup> and November 18<sup>th</sup>. During the early months of collecting spot-sampling data, I noticed that children under the age of 5 are monitored by a parent or other adult almost constantly. In order to have a more thorough understanding of parental investment during this time period, I added continuous focal follows to my data collection. Focal follows focused on 20 children under the age of 5 and their caregivers who lived in two of the five Shodagor bohor in Matlab. These children were chosen based on parental consent as well as logistic efforts required to find children at home during daylight hours in other groups. I watched each dyad for 10-minute periods of time and continuously recorded every interaction the two individuals had with each other. Following every 10 minutes of observation, I rested for 20 minutes. I observed in 2 hour time periods, for a total of 4 continuous focal observations per family per day, or 40 minutes per day. I visited every child a maximum of 2 times per week for 8 weeks, resulting in approximately 160 minutes of observation per child and a total of 3,200 observation minutes.

In this dissertation, I will analyze data obtained from the two rounds of quantitative surveys and anthropometric measurements in order to address the research questions laid out above. Specifics of each analysis are presented in the ‘Methods’ sections of Chapters 2, 3, and 4. Data gathered from qualitative interviews – formal and informal – and participant observation is often used to assist in interpreting the results of analyses. Chapter 2 answers the question “What are the socioecological conditions that lead Shodagor families to employ particular strategies in order to balance subsistence work and childcare?” using data from the first quantitative survey. In Chapter 3, the second question, “Specifically, why do individual women and men pursue particular occupational strategies that are cross-culturally unusual while others follow divisions of labor more in line with other societies?” is addressed using more specific income data that was collected in the first and second quantitative surveys. And finally, Chapter 4 addresses the question “How do Shodagor subsistence and childcare strategies, all of which are concentrated within the nuclear family and influenced by the constraints of the Shodagor socioecology, influence nutritional outcomes for children and parents?” with data from the first quantitative survey and both rounds of anthropometric measurements.

## CHAPTER 2: “Shodagor Family Strategies: Balancing Work and Family on the Water”

### Introduction

All parents face tradeoffs: they must decide how much time and energy to devote to particular tasks involving direct care of children (e.g. holding, feeding, soothing) as well as provisioning. While fathers tend to allocate more time to provisioning than to childcare (Geary 2000; Marlow 2000), mothers simultaneously provide the majority of children’s direct care (Sear and Mace 2008) and are significant providers and processors of calories for their families’ diets (Kelly 1995; Lee 1968; Marlowe 2001). This is likely one reason that women’s work is almost always more compatible with childcare than men’s work (Bliege Bird and Codding 2015). Humans account for this compatibility, as well as other factors such as ecological constraints, individual condition, and the availability of alloparents, when dividing labor by sex and making decisions regarding subsistence strategies. Variation in these factors often results in predictable differences of labor division by sex between societies (e.g. Codding et al. 2011; Jochim 1988; Marlowe 2007), though it is unknown how these factors may influence within-society differences or how they may influence the strategies employed between families to balance subsistence labor with childcare.

Labor is divided in a number of different ways, including by generation or social class, but anthropologists have focused largely on describing and explaining divisions of labor by sex because similar patterns have been observed across a number of different foraging societies – men are primarily hunters and women primarily gatherers (Lee and DeVore 1968; Ember 1978; Dahlberg 1981; Marlowe 2007) – and because dividing economic labor by sex in predictable ways has important implications for other aspects of

human social organization, such as pair bonding (Lancaster and Lancaster 1983; Lovejoy 1981) and food sharing (e.g., Kaplan et al. 1990; Hill and Kaplan 1993; Bliege Bird and Bird 1997; Hawkes 1990).

The classic theory behind the human sexual division of labor is based in formal economic models of labor specialization (Becker 1985), suggesting that females' intrinsic advantage over males in the production and care of children leads them to specialize in economic tasks that are compatible with pregnancy and childcare. Brown (1970) further suggested that women should undertake economic activities that are low-risk, close to home, and could easily be interrupted and resumed in order to meet the needs of demanding children. Evidence to support these theories and others (see Gurven and Hill 2009; Hill 1988; and Bliege Bird 1999; Hawkes 1991) is mixed. Levels of the compatibility of women's work with childcare vary across societies (Marlowe 2007) and some studies show that women do not alter their foraging behavior significantly when encumbered by pregnancy, lactation, or the presence of young children (e.g. Goodman et al. 1985; Hurtado et al. 1992). Also, while men's and women's production strategies diverge from one another in a number of societies (e.g. Lee 1979), there are examples of societies where the resources pursued by men and women are similar (e.g. Hewlett 1992).

Regardless of differences in how labor is divided across societies (e.g. Bliege Bird et al. 2001; Hewlett 1992; Hurtado et al. 1992; Lee 1979), there are consistent trends found in nearly all cases: men tend to pursue higher-variance resources that require taking on more risk while women tend to pursue lower-variance, lower-risk resources (Coddington et al. 2011), and the work that women do is almost universally *more compatible* with childcare than is the work that men do (Coddington and Bliege Bird 2015; Marlowe

2007). These trends continue in industrialized countries today with women engaging in the majority of domestic labor, whether they work outside the home or not, and men dominating labor-intensive occupations like logging and metalworking (Bureau of Labor Statistics 2014).

Not surprisingly, there are also common cross-cultural trends in the division of childcare labor that reflect the trends in subsistence labor. Mothers provide the majority of direct care to young children (Konner 2005) while the amount of care provided by fathers is much more variable (e.g. Hames 1988; 1992; Hewlett 1992; Winking et al. 2009). Fathers in foraging societies spend more time caring for infants and children on average than do fathers who practice other types of subsistence (Marlowe 2000). For example, Hadza fathers held infants 5.4% of the time that they were in camp (Marlowe 1999a), though they spend time near their young children 11.6% of the day and sleep with them at night (Marlowe 1999b). Aka fathers are at the high end of the range, holding or being within an arm's reach of their infants up to 47% of the day (Hewlett 1991). At the other end of the spectrum, fathers in pastoral societies sometimes provide 0% of direct care for infants and young children (e.g. Harkness and Super 1992; Munroe and Munroe 1992). Across all types of societies, fathers tend to interact with their children around 25-35% the amount of time that mothers do (Lamb et al. 1985). Trivers (1972) and Hrdy (1992) suggest that investment from one parent will be directly related to investment from the other parent and Winking et al. (2009) shows that Tsimane fathers' direct care is at least partially contingent on mothers' care and activities.

The division of labor by sex is usually considered at the level of the community, examining why most women or men in the society undertake particular tasks (but see

Bliege Bird 2007; Hewlett 1992; and Marlowe 2003 for exceptions). Marlowe (2007) pointed out that the division of labor should also be examined at the household level, suggesting that optimality of husbands' and wives' division of subsistence tasks may become evident only in this context. This also allows for inclusion of childcare tasks in the model, which can play an important role in determining how labor is divided (Hurtado et al. 1985). Kaplan et al. (2009) include childcare in their model of the complementarity of the division of labor, indicating that the human pair bond evolved because husbands and wives undertake productive tasks that complement each other and enable them to efficiently support the nuclear family. This model suggests that mothers' subsistence work and direct care of children should directly complement fathers' subsistence work and direct care of children, both in the specific tasks undertaken by each parent as well as amount of time allocated to each task (though the model also assumes self-sufficiency of the nuclear family and does not take into account sharing of childcare or food).

The Shodagor of Matlab, Bangladesh are a semi-nomadic community of people who live and work on small wooden boats, surrounded by water year-round. They are one of only a few groups in the world whose people live on boats (see Ivanoff et al. 1997 and Sather 1997 for other examples). They are also culturally distinct from land-dwelling Bangladeshis (Ahmed 1962), and their lifestyle results in important ecological differences as well with respect to economic opportunities and child risk. The Shodagor face a particular set of socioecological constraints that impact the decisions they make regarding subsistence labor and childcare.

First, about half of the women in the population engage in an occupation that is entirely incompatible with childcare. They sell household goods to women living on land, walking during most daylight hours and carrying heavy baskets on their heads. When asked, 100% of women who sell reported never having taken a dependent child with them when they sell. Other women engage in occupations that are compatible with childcare: about a third of the women fish for a living and the remainder are housewives. Almost all men in the population (90%) fish as their primary occupation.

Possibly in response to the incompatibility of women's selling with childcare, some Shodagor men engage in their own cross-culturally unusual behavior: they stay home for 6 months of the year as primary caregivers of their children. While their wives work outside of the home for half of the year, these men are responsible for all forms of direct care of children – holding, feeding, soothing, cleaning, protecting, etc. The exact amounts of time these fathers spend in particular activities is not yet known, but in no other recorded culture do a significant portion of the population of fathers forgo work outside the home in order to stay home and care for children.

Second, a combination of seasonality and local ecology affect work opportunities and the potential for success for both selling and fishing (for more detailed description see 'Methods'). Selling primarily occurs during Bangladesh's dry season (November to April), when roads are accessible. Proximity to a major market also affects one's ability to sell. Women collect their goods at the market every morning prior to work, so transaction costs increase for selling as distance from a market increases. Fishing is also affected by seasonality, with a greater number and variety of fish available during the

rainy season, though the closer one lives to the Meghna River (one of the three major rivers of Bangladesh), the less the seasons affect fishing success.

Finally, the fact that Shodagor families are surrounded by water year-round impacts childcare needs. Young children in all types of environments are vulnerable to ecologically-imposed dangers (e.g. Hewlett and Lamb 2005), however life on a boat poses a constant and immediate danger. Drowning is a major cause of child death in Bangladesh for people who live on the land, causing 83% of deaths for children under the age of 5 in 2003 (UNICEF 2009); therefore it is an even greater threat for the Shodagor. This is important for two reasons. First, it requires that young children be watched diligently at all times. Shodagor children are usually considered competent swimmers around the age of 5, so younger children are constantly monitored by at least one adult (Starkweather 2016). Second, this affects the age at which older siblings and cousins, etc. can serve as reliable alloparents for young children. Hames and Draper (2004) point out that whether a child can serve as a helper or not depends on suitable ecological circumstances, with semi-permanent or permanent residences and larger household sizes promoting “safe areas” conducive to allocaregiving. Reliable alloparents must be focused enough to watch children very closely and must also have the strength and swimming ability to save a child should he or she ultimately fall in the water (Starkweather 2016). These restrictions limit the overall pool of available alloparents families can call on for help.

The degree to which individual families’ sets of constraints vary has resulted in families within the community employing four different strategies in order to balance economic and childcare priorities. Briefly, I label and describe these four strategies as



follows (with more detailed descriptions found in ‘Methods’): (1) ‘Traditional’: mother stays home all year as primary caregiver for children while father works outside the home all year; (2) ‘Split Year’: mother works during the dry season while father stays home as primary caregiver, and roles reverse in the rainy season; (3) ‘Work Together’: mother and father work together all year and take the children along; and (4) ‘Leave Kids Home’: mother and father work all year (some work together, some separately) and leave children at home. The purpose of this paper is to examine between-household differences in the four strategies used to divide subsistence and childcare labor between husbands and wives. It asks the following questions: (1) Does the stage in a family’s domestic cycle affect how husband and wife divide labor? (2) How does local ecology impact division of labor between households? (3) Do alloparents affect how labor is divided? Theoretical motivations are provided and predictions are tested under the umbrella of each of these questions. This is the first ethnographic or empirical description of any aspect of Shodagor culture, therefore a number of aspects of the culture are discussed in detail. Results will indicate how specific aspects of the Shodagor socioecology impact decision-making in the realms of subsistence work and childcare. Implications for the study of the division of labor cross-culturally will also be discussed.

*Does the stage in family’s domestic cycle affect division of labor?*

A family’s domestic cycle refers to the normal and expected changes in age and membership a family experiences over time (Fortes 1958). For instance, in the early stages of the domestic cycle a family consists of a newly-married couple. As time progresses that couple may have one baby, then potentially another. As all members of

the family age, the family will go from a young couple with young, dependent children to a middle-aged couple with adolescent children, to an older couple with adult children who have families of their own. These changes can affect a number of things with regard to the division of labor. First, age and individual condition of mother and father can impact how much time they spend working and how productive they are. Kaplan et al. (2000) show that men's rates of production in different subsistence activities across foraging societies tends to peak when men are in their mid-20s and drop off rapidly after the age of 45 or so, depending on the activity. Women in foraging societies tend to have peak production years late in life – mostly after their reproductive careers are over. Earlier in adulthood, women are often encumbered by pregnancy and lactation. Hurtado and colleagues (1992) and Marlowe (1999; 2003) found that Ache and Hadza mothers (respectively) decrease or cease subsistence production during pregnancy and lactation, though for Ache mothers this decrease is less pronounced when fruits and roots are in season – resources that are less labor-intensive to acquire than others. Of Shodagor women's three occupations, selling is most labor-intensive and the only one that is entirely incompatible with infant care. Staying home is compatible with breastfeeding and care of infants, as is fishing: women who fish often do so while simultaneously breastfeeding infants. Shodagor women breastfeed exclusively for an average of 9 months and fully wean their children at 2.25 years, while the average inter-birth interval is 3.87 years, therefore there are a number of pre-menopausal women at any given time who are neither pregnant, nor breastfeeding (Starkweather 2016).

*Prediction 1: Family strategies in which mothers sell goods (Split Year and Leave Kids Home) are less likely to include families with pregnant or lactating mothers.*

Beyond individual condition of mother and father, the constellation of the family may have the most impact on how mother and father divide subsistence labor and childcare. As the total number of dependent children (Hurtado et al. 1992) as well as the number of weaned children (Hurtado et al. 1985) increased, Ache mothers increased both the time they spent foraging and their caloric returns. Kramer (2004) suggests that the age range of dependent children in a family will impact the number of children who are reliant on others for care and resources and the number of older siblings available to help parents meet the needs of the younger children. All of this affects the competing demands on parents to feed and provide direct care for multiple children of different ages. The implication of this is that parents with only young children are responsible for meeting all of children's needs – and must divide their labor accordingly. Two of the Shodagor family strategies (Traditional and Split Year) involve at least one parent staying home with children year-round as primary caregiver while the other parent engages in subsistence work. The other two strategies (Work Together and Leave Kids) involve both parents working away from home year-round.

*Prediction 2: Family strategies that involve at least one parent staying home year-round (Traditional and Split Year) will be younger overall (or at an earlier stage in their domestic cycle) than strategies that involve both parents working year-round.*

*How does local ecology impact division of labor between households?*

Behavioral ecologists have shown that ecology plays a vital role in determining the subsistence strategy employed by a particular society (e.g. Hames 1979; Pate 1986; O'Connell and Hawkes 1981; Winterhalder 1981). Among other factors, the ecology determines which resources are available for human use as well as the stability of those resources. Therefore, the division of labor by sex should also be influenced by ecology (Bliege Bird 1999; Copping et al. 2011; Jochim 1988; and Marlowe 2007).

Jochim (1988) suggests that optimal foraging theory, which assumes that animals will forage in a way that maximizes energy captured while minimizing time and energy expended (Stephens and Krebs 1986), can be used to explain how labor is divided by sex. However, optimal foraging theory typically focuses on an individual forager in a particular environment and ignores the potential for collecting and sharing of complementary resources. Marlowe (2007) suggests that sex-specific foraging behavior should be considered in the context of habitat variation in order to determine optimality. He hypothesizes that when husbands and wives cooperate to provide resources for a household, women will forage in a way that reflects the constraints of pregnancy, breastfeeding, and childcare, and in response men will forage optimally for foods that are not available to women. This should lead to men and women in less seasonal, more productive habitats to pursue overlapping resources and a stricter division of labor by sex in more seasonal habitats. Results from a study using the Standard Cross-Cultural Sample support these hypotheses (Marlowe 2007). Adding risk to the model and examining the division of labor among the Ache, Martu, and Meriam in-depth, Copping and colleagues

(2011) found that habitats with high-energy, low-risk resources support a ‘convergent’ division of labor, or one in which husbands and wives work together to procure similar resources. This allows mothers and fathers to provide a reliable flow of resources to their children. Alternatively, when resources are associated with higher levels of risk, the tasks performed by men and women should diverge.

Theoretically, families living in the same society should face similar ecological constraints on a broad scale – they share latitude and biome (i.e. tropical forest, desert, grassland) and are subject to the same natural occurrences. However, more specific differences between families or groups within the same society, such as distance to the nearest market town (von Rueden 2011), can impose particular ecological constraints on some families and not others. There are two aspects of the local ecology in Matlab, Bangladesh that differentially affect Shodagor access to and predictability of resources: distance to the Meghna River and travel time to a major market. There are 5 distinct Shodagor *bohor* (groups or clusters of boats) in Matlab that are situated along the Donagoda River, an offshoot of the Meghna River (Figure 1). These bohor exist at varying distances from the Meghna River and also from the two major market towns in Matlab. Fish is a high-energy resource that offers lowered risk of failure year-round the closer one gets to the Meghna River. Women’s selling is a higher-risk occupation than fishing and shorter travel time to a market enables women to sell while incurring lower opportunity costs. Distance to the Meghna and travel time to a market measure two different aspects of the ecology.

*Prediction 3: The closer a family lives to the Meghna River, the more convergent labor will be. That is, families who engage in the Work Together strategy should live closer to the Meghna than families who engage in other strategies.*

*Prediction 4: The closer a family lives to a market, the more divergent labor will be, with women selling and men fishing. Families who engage in the Split Year or Leave Kids Home strategies will live closer to a market than families who engage in other strategies.*

*Do alloparents affect how labor is divided between husbands and wives?*

Alloparents may impact the sexual division of labor because their care frees up mothers, allowing them to spend more time away from their children (e.g. Ivey 1993; 2000). Though women are typically engaged in tasks that are more compatible with childcare than men, that does not mean that children do not encumber women's work. As Hurtado and colleagues (1992) showed, having a nursing infant can negatively impact mother's foraging production. Also, mother's efforts directed toward parenting has been found to reduce effort that is available for subsistence activities (Hurtado et al. 1985; Ivey 1993). Alloparental care has been associated with children being weaned at earlier ages (e.g. Quinlan et al. 2003; Quinlan and Quinlan 2008) as well as mothers returning to work earlier (Quinlan et al. 2003) and spending more time working away from home (Meehan 2009). Since Shodagor mothers who sell goods spend several hours per day away from home and away from their children therefore, they should require more alloparental help. Mothers who fish typically work with their husbands and take children

with them. Coddling and colleagues (2011) suggest that a convergent division of labor in which husband and wife are performing similar subsistence tasks – and sometimes working together – may require less reliance on alloparents.

*Prediction 5: Shodagor family strategies that involve mothers selling goods (Split Year and Leave Kids strategies) will have more alloparents available to help care for children.*

*Prediction 6: Shodagor families engaged in the Work Together strategy will have fewer alloparents available than families in other strategies.*

## **Methods**

### *Study Population*

This study focuses on the Shodagor of Matlab, Bangladesh. Matlab is a mostly rural subdistrict, located within Chandpur District, approximately 59 kilometers southeast of the capitol city of Dhaka. Matlab consists of a few small towns and approximately one hundred forty villages and is home to approximately 200,000 people (Bangladesh Bureau of Statistics 2010; ICDDR,B 2014). The Donagoda River, which is a branch of the Meghna River (one of the 3 largest rivers in Bangladesh) cuts through the middle of Matlab and flows into the Meghna at the southernmost tip of Matlab's landmass, just east of where the Meghna and Padma rivers meet. Shodagor people live throughout Bangladesh, though the exact locations and numbers are currently unknown. There has been no previous research published on the Shodagor; therefore all ethnographic data

comes from observations, informal conversations, qualitative and quantitative interviews I conducted with the help of two Bangladeshi research assistants during 2011 and 2014.

The Shodagor are distinct from land-dwelling, village Bangladeshis (who the Shodagor call *grihosto*) in a number of ways, including cultural aspects like religion, political organization, subsistence strategies, and kinship structure (see Novak 1993 for a detailed description of village Bangladeshi culture). The Shodagor speak a distinct dialect of Bengali as well as a Shodagor-specific language. They are Muslim, but are often described by other Bangladeshis as “Muslim in name only” because of their religious observances and ceremonies that more-closely resemble ancient Hindu traditions than Muslim practices. Shodagor also have an animist belief system, recognizing and worshiping the major rivers of the region during semi-annual ceremonies.

Marriage is primarily monogamous with mild levels of polygyny. Divorce occurs, but usually early in a marriage before the birth of the first child. The primary reason for dissolution of marriage is death of a spouse. Most marriages are arranged by parents or relatives, though love marriage is not atypical, and most are endogamous within the Shodagor subculture. Marriage payments among the Shodagor have recently begun to shift from a primarily brideprice system towards dowry, a shift that village Bangladeshis underwent approximately 50 years ago (Amin and Cain 1997). Kinship is recognized bilaterally: inheritance of identity is traced through the father, while property is inherited from mother and father. As is common among nomadic and semi-nomadic groups (Ember 1975), Shodagor post-marital residence patterns are multilocal. My data show that almost half (49%) of ever-married individuals in Matlab lived patrilocally after marriage, while 21% lived matrilocally, 16% lived bilocally (near both husband’s and



wife's family), and 14% lived neolocally. While there are always exceptions to the rule, village Bangladeshis, in contrast, have strong and long-standing patrilineal, patrilocal traditions (Aziz 1979).

### Bohor Structure

Traditionally, all Shodagor were semi-nomadic, moving two to three times per year to different locations throughout Bangladesh. Now approximately half of all Shodagor families in Matlab move an average of 2 times each year – some moving throughout the country and some moving between *bohor* (distinct groups or clusters of boats) in Matlab. Other Shodagor families in Matlab move very infrequently or not at all. When not moving between locations, families always situate their houseboats within preexisting bohor – houseboats never reside permanently outside of a bohor. Smaller boats are used as the primary mode of transportation for fishing and for traveling between the houseboat and the land. Families indicate choosing to live in particular bohor for a number of reasons including to be close to relatives, for work opportunities, and because older generations lived in the same bohor.

Among the 5 Shodagor bohor in Matlab, size ranges from 8 to 18 households with an average size of 15 households. The largest bohor included in this study is made up of 32 Shodagor families who have moved onto the land within the last 5 years and live in makeshift houses on very small pieces of land. These families are heavily integrated with those living on boats through kin and cultural ties. There are other Shodagor families living in Matlab who have lived in houses that are similar to land-dwelling Bangladeshis' for 10 or more years who were not included in this study.

Shodagor political organization is largely status egalitarian, though each bohor has a recognized *shordar* (headman). Shordars obtain their position either through primogeniture, with the oldest son inheriting leadership status from his father, or through an election held among the other shordars if either (a) there is no older son or eligible relative of the previous shordar available or (b) a new bohor is formed. It is agreed upon by most Shodagor that families who live in houses have slightly higher status than those who live on boats and that those who have lived in houses the longest have the highest status within the community. The Shodagor are also relatively gender egalitarian with women in many families playing a role in decision-making within the family and within Shodagor society and most women moving freely in public and private spaces. The autonomy of Shodagor women is strikingly different from that of village women, for whom purdah is a common practice, women's sexual reputations are closely guarded, and work outside the home is uncommon (Amin 1997).

### Domestic Cycle

Shodagor boys and girls live at home with their parents in nuclear family households throughout childhood and until they get married. Based on data collected by the author (using methods that will be described below), for Shodagor men, first marriage occurs at the age of 23 years, on average, while women marry at the age of 16.5 years on average. Men marry an average of 1.4 times in their lives and women marry an average of 1.14 times in their lives. After marriage, the new couple moves into their own boat, which they often pay for themselves, and form a new household. Men average 24.7 years of age when their first child is born and women average 17.8 years of age at first birth. Women who have likely completed fertility (those 45 years or older) have an average of

5.7 children; however, preliminary analyses of birth spacing data suggest that total fertility for women in more recent generations will be lower.

#### Economy: Men's Work

Shodagor men primarily work as fishermen, with 90% of the men in Matlab fishing for at least some portion of the year. Men sell their catch in the markets in exchange for money though almost all practice subsistence fishing as well. Some men also engage in day labor (11%), selling household goods (7%), and other types of work (2%) throughout the year, with 18% of men reporting more than one occupation.

Regardless of occupation, neither fish nor cash are shared extensively outside of nuclear families.

#### Economy: Women's Work

Almost half (44%) of Shodagor women work at least half of the year selling goods in markets and door-to-door in villages. Some women also fish with their husbands (31%) for all or part of the year and others are primarily housewives (34%) for at least a portion of the year. These economic roles differ dramatically from those of the landed Bangladeshis, with men heavily engaged in agriculture and wage labor and women rarely working outside of the home (Amin 1998).

#### Bangladeshi Ecology

The ecology of Bangladesh plays an important role in Shodagor lifestyle. Every year, for approximately half of the year, large portions of the entire country of Bangladesh are covered in water, as a result of monsoon rains and Himalayan snowmelt (Hofer and Messerli 1997). The Shodagor refer to this half of the year, which typically begins in June, as the "rainy season." During June, July, and August, monsoon rains

come regularly, but for the Shodagor, the season usually extends through the end of October when the waters have receded to the point that roads are dry and accessible. The other months of the year are referred to as the “dry season,” when water levels of the country’s rivers and canals decrease and land is visible in places that previously were completely submerged.

While the actual living conditions of most Shodagor do not change drastically between the seasons (they continue to live on boats on the water all year), what does change are the economic opportunities. During the dry season, fishing prospects vary across Bangladesh, but as water levels rise, fish become abundant throughout the country, with the availability of larger amounts and different types of fish making fishing a particularly profitable venture. During this half of the year, nearly all Shodagor men and some women fish every day. Selling goods is nearly impossible and highly unprofitable for women during the rainy season because many of the roads in the rural parts of the country are submerged in water. This makes transportation and access to potential customers very difficult. The dry season brings access to roads, making it a profitable time for women to sell goods.

#### Local Ecology

There are also two aspects of the specific ecology of Matlab that are important for Shodagor. First, the distance a family lives from a market town will determine the ease with which women can obtain goods to sell. Women do not store the goods they sell in their own homes, but instead they are held by a *mahajan* (middleman) in a shop in the nearest major market. Each selling day, women travel first to the market to collect their basket of goods, then out to the countryside to sell. Before returning home, women

deposit their goods in the shop for the night and settle accounts with the mahajan. There are two major market towns in Matlab and two of the five bohor are located within a 5 or 10-minute walk from those towns, while the other three bohor are located an hour or more away. Distance to market is less important for the success of men's fishing. Men do sell most of their fish in markets at the end of each day, but this can be done at major and minor markets. Minor markets are located all over the countryside and all 5 bohor in Matlab live within walking distance of a minor market.

The second aspect of the Matlab ecology that is relevant to the Shodagor is the distance a family lives from the confluence of the Donagoda River and the Meghna River, as this will determine fishing opportunities throughout the year. The Donagoda is the main river that runs from north to south through the middle of Matlab. The Meghna is one of the three largest rivers in Bangladesh. Its average width is approximately 5 kilometers, which is nearly equivalent to the widest point of the Mississippi River, and at its widest point, the Meghna is approximately 6 miles from shore-to-shore during the dry season and even larger during the rainy season. At the mouth of the Donagoda, where it connects with the Meghna, the river is wide and deep and there is an abundance of fish, in both number and variety, year-round. As the Donagoda travels away from the Meghna, especially during the dry season, water levels are lower and numbers and varieties of fish diminish. Shodagor who live closer to the Meghna will have year-round fishing opportunities that are potentially profitable, while those who live farther away will find fishing most profitable during the rainy season and less profitable during the dry season.

### *Data Collection*

The following study is based on interview data that were collected over the course of 12 months of fieldwork during 2011 and 2014. All adult Shodagor living in Matlab, Bangladesh, were eligible to participate in the interview portions of this study. An individual was considered an adult if (a) he or she was age 18 or older at the time of the interview, and (b) had ever been married. Among the Shodagor, an individual is considered to be a social adult when he or she gets married, regardless of age. However, Institutional Review Boards in the US consider an individual to be an adult at the age of 18, regardless of marital status. The only married individuals under the age of 18 were female; therefore, when interviewing married individuals under the age of 18, consent was obtained from both the woman being interviewed and either her husband or a parent, and the husband or parent was also present during the interview. Individuals were excluded from this study if they declined to participate, if they were away from home during the study period, or if they had health conditions that precluded them from participating.

After obtaining informed consent from all participants, quantitative survey interviews were conducted in two rounds. The first round was conducted between May and July 2014. It included over 232 questions, lasted between 45 and 90 minutes, and focused on demographic information and family histories, basic economic data (such as income and occupation data), indirect parental investment data, and family and women's health histories. Of the 172 total adult Shodagor in Matlab, 71 men and 87 women participated in this interview (N=158), accounting for an almost complete population sample. Fourteen adults either declined to participate for reasons including health issues,

or were away from home every time interviews were conducted. The second survey was conducted in September and October 2014 and asked questions about specifics of economic practices and income, parental investment, and collected household inventories. A smaller sample of 34 men and 41 women participated in this survey. Men and women were asked to participate in this second survey if they lived in one of the 3 bohor located closest to the Meghna River for logistical reasons.

The current study includes 64 Shodagor families, living across each of the 5 bohor in Matlab. Families were included in this analysis if they had dependent children at the time of the study, if both parents lived in the household (boat or house), and if data were available on income and occupation over the last year. Families were excluded from this analysis if they did not meet the above criteria. For example, one family was excluded from the analysis because the parents were divorced, and another family was excluded because the mother had mental health problems that disabled her from both work and childcare activities. All data in this study are cross-sectional.

### *Variables*

#### Outcome Variable

The outcome variable for this study is *family strategy*. Families were coded with a particular strategy for the last year based on reports of seasonal employment and income that were given as a part of the two surveys. In the first survey, respondents were asked about income earned during the previous rainy season and dry season as well as primary and secondary occupations. Seasonal income reports from the previous year – whether or not a particular man or woman earned income during each season – were used to create

the family strategy categories (amount of income was not used for this purpose).

Individuals were also asked to report whether or not they worked together with their spouse for half of the year or all of the year. In the second survey, individuals were asked what type of work they do in each season (e.g. fishing, selling goods, childcare, does not work) and who cares for their children while they work. These data points, along with observation data regarding whether children go fishing with their parents or are left home, were used to determine the particular strategy each family practices and to code them accordingly. This is a categorical variable with four distinct family strategies: *traditional strategy* (N=17), *split year strategy* (N=17), *work together strategy* (N=12), and *leave kids home strategy* (N=18).

#### Traditional Bangladeshi Strategy

Families that employ the *Traditional Strategy* most closely resemble the land-dwelling Bangladeshi families' economic and parenting behaviors. In these families, the father works all year while the mother stays home all year as primary caregiver for their children.

#### Split Year Strategy

Some Shodagor parents split the year between economic and parenting pursuits, with mother and father each working for approximately half the year. In these families, fathers typically fish during the rainy season while mothers stay home with the children, and mothers work during the dry season, selling goods door-to-door, while fathers stay home with the children.



### Work Together Strategy

Other Shodagor parents work together all year and take the children along with them. The primary occupation of both mother and father in these families is fishing, so each plays an important role on the boat, with the father typically checking the hooks or nets while the mother rows the boat and sorts the fish. Children who are old enough to help in some way often do so, while younger children play on their own. It is unknown who provides the most care for young children during the workday, but some families begin taking their children along to work with them as soon as the mother is sufficiently recovered from childbirth. Infants will then often sleep on their mothers' laps, waking to nurse while mother is rowing the boat.

### Leave Kids Home Strategy

Finally, in some Shodagor families, both mother and father work all year, whether together or separately, but leave their children at home. In these cases, an alloparent may look after the children or, if the children are considered old enough, they may stay on their own all day without any official supervision.

### Predictor Variables

Predictor variables listed in Tables 1 and 2 were selected specifically to test the predictions outlined above. The number of predictor variables in the multivariate model was limited to 6 based on an *a priori* power analysis and were selected based on bivariate results and theoretical relevance. *Mother's age* and *child under 5 (dummy)* were used in

the multivariate model as variables representative of a family's stage in the domestic cycle. Mother's age was chosen above father's age and average age of children because (1) all three are highly collinear (mother's age and father's age:  $r(75) = .90, p < .001$ ; mother's age and average age of children:  $r(78) = .93, p < .001$ ; father's age and average age of children:  $r(69) = .88, p < .001$ ) and (2) mother's age is a biologically limiting factor in the family's ability to reproduce. Whether or not a family has a child under the age of 5 was chosen because it represents an important constraint on families' childcare needs. *Time to market (dummy)* and *distance to the Meghna (in kilometers)* are ecological variables that each measure distinct aspects of a family's ecology, as explained above. Of course in a semi-nomadic culture, 'local' ecology is relative to the location that a family is in at any given point in time. In this study, both measures of ecology were collected at the time of the initial interview and at the same time that the data regarding family strategy was collected. Time to market represents the ease with which women can sell goods as one of their primary occupations.

Table 1. Summary statistics and Chi-square analyses for categorical variables, comparing families across four strategies: Traditional, Split Year, Work Together, and Leave Kids Home.

Variable	Traditional (N)	Split Year (N)	Work Together (N)	Leave Kids Home (N)	Chi-square <sup>1</sup>
<b>Outcome Variable:</b>					
Family Strategy	19	17	13	18	
<b>Domestic Cycle:</b>					
Pregnant/Breastfeeding Mother					
Yes	4	2	2	2	0.904
No	15	15	11	16	
Child Under Age 5					
Yes	14	14	7	4	15.629**
No	5	3	6	14	
Dowry					
Yes	4	4	5	3	2.121
No	15	13	8	15	
<b>Ecology:</b>					
Time to Market					
<10 minutes	13	15	1	15	25.778***
>10 minutes	6	2	12	3	
<b>Alloparents:</b>					
Available Alloparent					
Yes	7	12	4	7	6.156
No	12	5	9	10	
Paternal Grandfather in Group					
Yes	4	4	4	1	3.499
No	15	13	9	17	
Paternal Grandmother in Group					
Yes	6	7	5	4	1.656
No	13	10	8	14	
Maternal Grandfather in Group					
Yes	6	5	4	1	4.570
No	13	12	9	17	
Maternal Grandmother in Group					
Yes	6	7	6	3	3.729
No	13	10	7	15	
Child Over Age 10					
Yes	4	8	5	12	8.056*
No	15	9	8	6	

This was first recorded as a continuous variable but was recoded into a binary variable in order to distinguish between families who live within 10 minutes of a market (coded as 0)

and those who live more than 45 minutes away (coded as 1), as no families are located in between 10 and 45 minutes from a market. The distance to the Meghna River indicates the potential for profitability of fishing during different seasons. *Number of available alloparents* measures the number of individuals reported in the survey as available allocaregivers who also live in the same bohor as each family. Finally, *household income* is included in the model as a control variable to ensure that income is not accounting for the majority of variability between strategies.

Table 2. Summary statistics and ANOVA analyses for continuous variables

Variable	Traditional Mean (SD)	Split Year Mean (SD)	Work Together Mean (SD)	Leave Kids Home Mean (SD)	ANOVA F <sup>1</sup>
<b>Domestic Cycle:</b>					
Mother's Age	25.68 (9.20)	28.35 (9.25)	30.46 (12.50)	35.67 (10.38)	3.122*
Father's Age	34.56 (11.07)	38.59 (13.62)	35.00 (14.76)	45.88 (11.87)	2.667†
Average Age of Children	6.05 (6.74)	7.85 (6.31)	10.58 (9.16)	14.07 (7.07)	4.212**
Number of Children	2.16 (2.19)	2.88 (2.20)	3.15 (1.68)	3.39 (1.69)	1.324
Dowry Payment (ln)	2.03 (4.06)	2.19 (4.09)	3.24 (4.30)	1.54 (3.54)	0.474
<b>Ecology:</b>					
Time to Market (min)	35.00 (46.10)	14.12 (28.95)	62.69 (28.40)	14.17 (22.90)	6.920***
Distance to Meghna (km)	8.48 (5.90)	9.42 (4.34)	2.94 (2.68)	6.61 (2.09)	6.882***
<b>Alloparents:</b>					
Num Available Alloparents	0.42 (0.61)	1.06 (0.83)	0.31 (0.48)	0.41 (0.51)	4.899**
<b>Control:</b>					
Household Income (ln)	11.41 (0.72)	11.92 (0.79)	11.78 (0.66)	11.49 (0.69)	1.817

### Analyses

The relationships between family strategy and categorical predictor variables were examined using a chi-squared test. If an overall effect was found, follow-up pairwise comparisons were performed in order to determine the significance of mean differences between each pair of conditions. For continuous predictor variables, the relationships between the outcome and the predictors were examined using an ANOVA test in order to determine whether or not there are significant mean differences among

families employing different strategies. Independent-samples *t*-tests were then run in order to determine between-strategy differences.

Next, given that *family strategy* is a categorical outcome variable, a multinomial logistic regression was conducted to test the predictions above and look for factors that distinguish one strategy from another. Variables included in the model were based on bivariate results and an *a priori* power analysis. When conducting a multinomial logistic regression, a reference category is chosen and the maximum likelihood of each predictor variable for all other categories are compared to the reference. The goal of this analysis is to determine how each category compares to the others and there is no empirical or theoretical reason for justifying using one category or family strategy as the baseline. Therefore, the regression was conducted 4 times, each time using a different family strategy as the reference category in order to test predictions and fully understand which of these 6 independent variables significantly distinguish between family strategies.

## **Results**

*Does the stage in family's domestic cycle affect division of labor?*

Bivariate results did not support the first prediction, which states that family strategies in which mothers sell goods (Split Year and Leave Kids Home) should be less likely than other families to have a mother who is pregnant or breastfeeding. The chi-square test showed that families in all strategies are equally likely to have a pregnant or breastfeeding mother (Table 1). Based on this result as well as the fact that the variable *pregnant or breastfeeding mother (dummy)* did not contribute significantly to the multivariate model, it was not included in the final model.

Bivariate analyses show mixed results regarding the second prediction, which states that families practicing Traditional and Split Year strategies should be younger than those practicing Work Together and Leave Kids Home strategies. The chi-square test found that families in Traditional and Split Year strategies were more likely to have a child under the age of 5 than families in the Leave Kids Home strategy; however families who Work Together are as likely to have a child under 5 as they are not to and significantly equally likely as families in all other strategies (Table 1). ANOVA results, confirmed using t-tests, show that mothers ( $t(35) = 3.101, p = 0.004$ ), fathers ( $t(32) = 2.877, p = 0.007$ ), and children ( $t(35) = 3.533, p = 0.001$ ) in families who practice the Traditional strategy and mothers ( $t(33) = 2.196, p = 0.035$ ) and children ( $t(33) = 2.733, p = 0.010$ ) in families who practice the Split Year strategy are significantly younger than those who practice the Leave Kids Home strategy. However, fathers in the Split Year strategy are not significantly younger than those in the Leave Kids Home strategy and mothers, fathers, and children in both Traditional and Split Year strategies are not significantly younger than those in the Work Together strategy (Table 2).

Results from the multinomial logistic regression show that when controlling for ecology, presence of alloparents, and household income, mother's age was not significantly different between any of the four strategies and families in the Traditional and Split Year strategies were only marginally significantly more likely than those in the Leave Kids Home strategy to have a child under the age of 5 and equally as likely as families who Work Together (Tables 3a-b).

Table 3a. Multinomial Logistic Regression Outcomes ( $X^2=68.75$ , Pseudo  $R^2 = 0.66$ ,  $N = 63$ ), compared to Traditional family strategy.<sup>1</sup>

Variable	Split Year Odds Ratio (95% CI)	Work Together Odds Ratio (95% CI)	Leave Kids Home Odds Ratio (95% CI)
<b>Domestic Cycle:</b> <b>Mother's Age</b> <b>Child Under 5 (Dummy)</b>	1.063 (0.94, 1.21) 1.461 (0.13, 17.14)	0.989 (0.86, 1.14) 0.388 (0.03, 5.31)	1.062 (0.96, 1.18) <b>0.122 (0.01, 1.27) †</b>
<b>Ecology:</b> <b>Time to Market (Dummy)</b> <b>Distance to Meghna (Km)</b>	0.385 (0.05, 2.89) <b>1.279 (1.01, 1.62)*</b>	<b>20.645 (1.20, 355.11)*</b> 0.833 (0.63, 1.11)	<b>0.082 (0.01, 1.33) †</b> 0.808 (0.58, 1.14)
<b>Alloparents:</b> <b>Number of Available Alloparents</b>	<b>5.909 (1.22, 28.52)*</b>	0.175 (0.02, 1.68)	2.808 (0.53, 14.91)
<b>Control:</b> <b>Household Income (Ln)</b>	<b>3.514 (0.96, 12.81)†</b>	2.201 (0.37, 12.96)	1.293 (0.39, 4.29)

<sup>1</sup> Statistical significance is represented as follows: \*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ; †  $p < .10$ .

Table 3b. Multinomial Logistic Regression Outcomes, compared to Split Year family strategy.

Variable	Traditional Odds Ratio (95% CI)	Work Together Odds Ratio (95% CI)	Leave Kids Home Odds Ratio (95% CI)
<b>Domestic Cycle:</b> <b>Mother's Age</b> <b>Child Under 5 (Dummy)</b>	0.941 (0.83, 1.06) 0.684 (0.06, 8.03)	0.931 (0.79, 1.10) 0.266 (0.01, 6.26)	0.999 (0.89, 1.12) <b>0.083 (0.01, 1.32) †</b>
<b>Ecology:</b> <b>Time to Market (Dummy)</b> <b>Distance to Meghna (km)</b>	2.596 (0.35, 19.46) <b>0.782 (0.62, 0.99)*</b>	<b>53.596(2.12, 1355.53)*</b> <b>0.651 (0.46, 0.92)*</b>	0.214 (0.01, 4.84) <b>0.632 (0.44, 0.91)*</b>
<b>Alloparents:</b> <b>Number of Available Alloparents</b>	<b>0.169 (0.04, 0.82)*</b>	<b>0.030 (0.01, 0.37)**</b>	0.475 (0.09, 2.43)
<b>Control:</b> <b>Household Income (Ln)</b>	<b>0.285 (0.08, 1.04)†</b>	0.626 (0.09, 4.47)	0.368 (0.09, 1.40)

Table 3c. Multinomial Logistic Regression Outcomes, compared to Work Together family strategy.

Variable	Traditional Odds Ratio (95% CI)	Split Year Odds Ratio (95% CI)	Leave Kids Home Odds Ratio (95% CI)
<b>Domestic Cycle:</b> Mother's Age Child Under 5 (Dummy)	1.011 (0.88, 1.17) 2.574 (0.19, 35.22)	1.075 (0.91, 1.27) 3.762 (0.16, 88.55)	1.074 (0.93, 1.24) 0.313 (0.02, 5.36)
<b>Ecology:</b> Time to Market (Dummy) Distance to Meghna (km)	<b>0.048 (0.01, 0.83)*</b> 1.200 (0.90, 1.60)	<b>0.019 (0.01, 0.47)*</b> <b>1.535 (1.09, 2.17)*</b>	<b>0.004 (0.00, 0.15)**</b> 0.970 (0.64, 1.46)
<b>Alloparents:</b> Number of Available Alloparents	5.703 (0.59, 54.75)	<b>33.700 (2.66, 424.43)**</b>	<b>16.014 (1.39, 184.27)*</b>
<b>Control:</b> Household Income (Ln)	0.454 (0.08, 2.67)	1.596 (0.22, 11.39)	0.587 (0.10, 3.36)

Table 3d. Multinomial Logistic Regression Outcomes, compared to Leave Kids Home family strategy.

Variable	Traditional Odds Ratio (95% CI)	Split Year Odds Ratio (95% CI)	Work Together Odds Ratio (95% CI)
<b>Domestic Cycle:</b> Mother's Age Child Under 5 (Dummy)	0.941 (0.85, 1.05) <b>8.222 (0.79, 85.74) †</b>	1.01 (0.90, 1.12) <b>12.014 (0.76, 189.98) †</b>	0.931 (0.81, 1.07) 3.194 (0.19, 54.69)
<b>Ecology:</b> Time to Market (Dummy) Distance to Meghna (km)	<b>12.125 (0.75, 196.19) †</b> 1.237 (0.88, 1.74)	4.671 (0.21, 105.55) <b>1.582 (1.10, 2.28)*</b>	<b>250.322 (6.85, 9152.24)**</b> 1.031 (0.68, 1.56)
<b>Alloparents:</b> Number of Available Alloparents	0.356 (0.07, 1.89)	2.104 (0.41, 10.74)	<b>0.062 (0.01, 0.72)*</b>
<b>Control:</b> Household Income (Ln)	0.774 (0.23, 2.56)	2.719 (0.72, 10.34)	1.703 (0.30, 9.23)

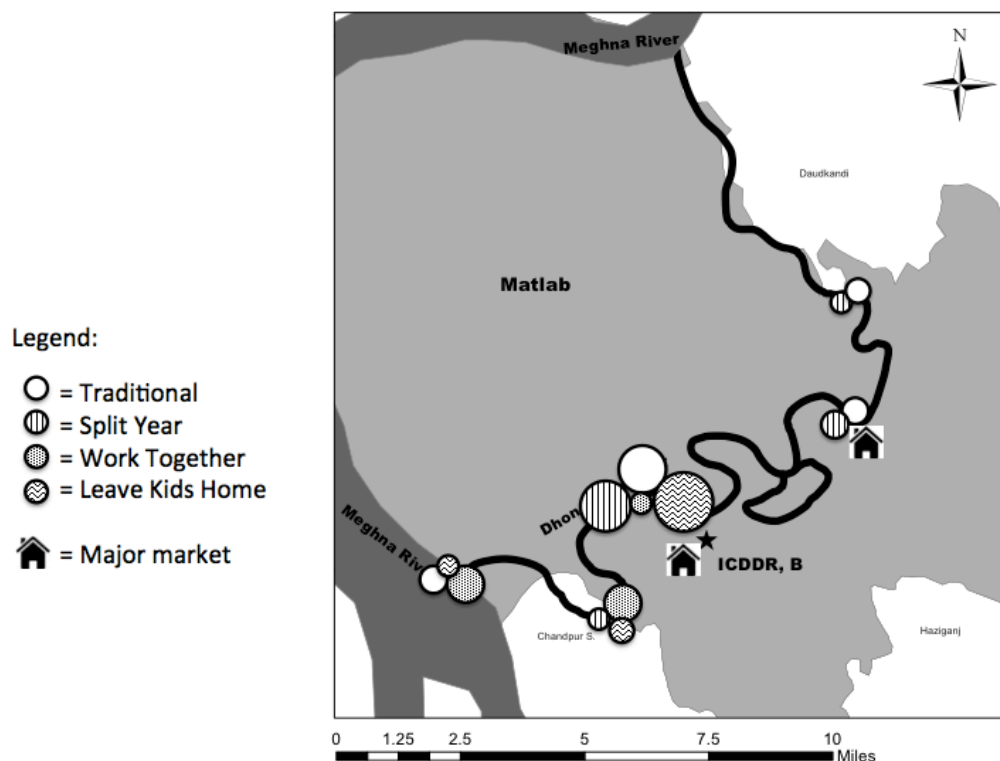
*How does local ecology impact division of labor between households?*

Figure 2 visualizes the proportion of families in each bohor who employ each strategy. Prediction 3 states that families who Work Together should live closer to the Meghna River than families in other strategies. Bivariate results clearly support this prediction with Work Together families living significantly closer to the river than Traditional families ( $t(30) = 3.158, p = 0.004$ ), Split Year families ( $t(28) = 4.724, p <$



0.001), and Leave Kids Home families ( $t(29) = 4.276, p < 0.001$ ) (Table 2). Multinomial logistic regression results (Table 3c) only partially support this prediction. Families who Work Together are more likely to live closer to the Meghna than families who employ the Split Year strategy, when controlling for domestic cycle variables, alloparents available, and household income. However, families in the Split Year strategy are also more likely to live farther from the Meghna than Traditional or Leave Kids Home families (Table 3b).

Figure 2. Map of family strategy by bohor location.



Bivariate and multivariate results only partially support Prediction 4, which suggests that families in the Split Year and Leave Kids Home strategies will live closer to a major market than families in the other strategies. An ANOVA showed that while Split Year ( $t(28) = 4.591, p < 0.001$ ) and Leave Kids Home ( $t(29) = 5.265, p < 0.001$ ) families live closer to a market than Work Together families, neither live significantly

closer to a market than Traditional families (Table 2). Chi-square results (Table 1) and multinomial logistic regression results support this pattern (Table 3a-d). Split Year and Leave Kids Home families, along with Traditional families, are more likely to live less than 10 minutes from a major market than Work Together families. Leave Kids Home families are also more likely to live less than 10 minutes from a major market than Traditional families.

*Do alloparents affect how labor is divided between husbands and wives?*

Prediction 5, which states that Split Year and Leave Kids Home families will have more alloparents available than Traditional or Work Together families, was only partially supported. A chi-squared test shows no significant differences between strategies in whether a family has any alloparent available or not (Table 1). ANOVA results show that Split Year families have more alloparents available than families in all other strategies – Traditional ( $t(34) = 2.657, p = 0.012$ ), Work Together ( $t(28) = 2.913, p = 0.007$ ), and Leave Kids Home ( $t(32) = 2.750, p = 0.010$ ) – and no other strategies are significantly different from one another (Table 2). Multinomial logistic regression results show that when controlling for all other variables in the model, Split Year families have significantly more alloparents available than Traditional and Work Together families, but not more than Leave Kids Home families (Table 3b). Also, Leave Kids Home families have significantly more alloparents available than Work Together families (Table 3c). These findings also partially support Prediction 6, which suggests that Work Together families will have fewer alloparents available than families in any other strategy.

*Strategy-by-strategy breakdown*

After controlling for the other variables in the multinomial logistic regression model, families employing the **Traditional strategy** are more likely to have a child under the age of 5 and live farther from a market than Leave Kids Home families and closer to a market than Work Together families. They also live closer to the Meghna River, have fewer alloparents available, and a lower household income than Split Year families.

Families employing the **Split Year strategy** are more likely to have a child under the age of 5 in the household than the Leave Kids Home Families. They live closer to a market than Work Together families, have more alloparents available than Traditional and Work Together families, and have a higher household income than Traditional families. These families live farther from the Meghna River than families in all other strategies.

Families employing the **Work Together strategy** live farther from a market than families in all other strategies. They also live closer to the Meghna than Split Year families and have fewer alloparents available than Split Year or Leave Kids Home families.

**Leave Kids Home** families are less likely to have a child under the age of 5 in the household than the Traditional or Split Year families. They live closer to a major market than Traditional families or Work Together families, live farther from the Meghna than Split Year families, and have more alloparents available than Work Together families.

## Discussion

Though several models have been examined, there is no one model that effectively explains the division of labor between men and women in a society or a household (Bliege Bird and Codding 2015). These results indicate that a family's stage in the domestic cycle, their local ecology, and the availability of alloparents will affect how they divide subsistence and childcare labor at the household level. These factors also interact in particular ways for Shodagor families and it appears that families choose their economic strategies based on the constellation of constraints that they face. The results of these analyses have implications for theory regarding the sexual division of labor across cultures and inform how Shodagor family economic and parenting strategies should be contextualized in future studies.

### *Family's stage in domestic cycle predicts parents' year-round proximity to children*

A number of factors contribute to stage of the domestic cycle a family inhabits at any given moment, including parents' ages, age of children (i.e. age distribution, average age of all children, age of youngest child), and mother's breastfeeding status. Theory (e.g. Brown 1970; Kaplan et al. 2009) and ethnographic evidence (e.g. Hurtado et al. 1992; Marlowe 1999; 2003) suggest that mothers who are pregnant or breastfeeding should engage in work that is most compatible with their physical limitations. However, Shodagor mothers who were either pregnant or exclusively breastfeeding at the time of this study were no more likely to engage in one family strategy – or one occupation ( $X^2(2) = 0.784, p = 0.676$ ) – over another. One possible explanation for this is that only 10 women in the society were either pregnant or exclusively breastfeeding at the time the

survey was conducted. More data may bear out differences across strategies that do not currently show up.

Clear evidence for the impact of the family's stage in the domestic cycle on how they divide labor is found when examining age variables. For the Ache (Hurtado et al. 1992) and the Maya (Kramer 2004), the stage in a family's domestic cycle affects parents' ability to spend time working away from home and away from children. On average, Shodagor Traditional and Split Year families, in which one parent stays home year-round as the primary caregiver, are younger than Leave Kids Home families in which both parents work away from home and away from children year-round. What seems to be the most important factor, though, is whether or not a family has a child under the age of five. Even when controlling for mother's age, families who have at least one child under the age of 5 are significantly more likely to have either the mother or father stay home with the child(ren), while those without a child under the age of 5 are likely to have both mother and father working away from the children.

Drowning is a primary cause of death for children under the age of 5 in Bangladesh (UNICEF 2009; ICDDR,B 2014) and is of major concern for Shodagor parents. One prevention strategy is to have a responsible and able-bodied caregiver with children at all times. The risk of drowning is likely the main thing motivating parents with young children to undertake a strategy that involves a parent being the primary caregiver and simultaneously forgoing an opportunity to work and earn money. Once children are confident swimmers, it seems that most mothers and fathers will choose a strategy that allows both adults in the family making money.

Contrary to expectations, parents who work together all year and take kids along with them are just as likely to have a child under the age of 5 as families in all of the other strategies. Together families may be the most flexible in terms of childcare, given that both parents are present on the boat and at least one can easily be within arm's length of young children at all times. Mothers who fish can carry infants on their laps while they row the boat or sort through fish. Families who take older children fishing with them usually put those children to work on the boat. Therefore, the stage a family is at in their domestic cycle – and specifically whether they have a child under the age of 5 or not – distinguishes between families in which one parent stays home with children year-round and families in which children are left at home without a parent, but does not distinguish Work Together families from others.

*Local ecology determines subsistence opportunities*

In a cross-cultural study of foragers, Marlowe (2007) found that the types of resources men and women pursue diverge from one another in environments where resources are affected by seasonality. Copping et al. (2011) suggest that the division of labor should diverge when resources that provide high returns can only be acquired at high levels of risk. For the Shodagor, the circumstances that lead to a divergent division of labor in both models overlap. Families who live closer to the Meghna River are less affected by seasonality, as fish are abundant year-round, while for those who live farther from the Meghna fish are most consistently available during the rainy season. Proximity to a major market provides women with opportunities to sell goods, an occupation which

is also affected by changing seasons and is possible for most women only during the dry season.

In support of both Marlowe (2007) and Codding et al. (2011), proximity to a major market is associated with a divergent division of labor: families who practice Split Year and Leave Kids Home strategies live closer to a major market than families who Work Together. Women in these two strategies sell goods for at least half of the year and men fish. Women's ability to sell, in particular, is impacted by seasonality and outcomes are high-risk, high-reward. Families employing the Traditional strategy also live closer to a major market than families who Work Together and the Traditional strategy also represents a divergent division of labor, with men working outside the home year-round and women staying home, managing the household and caring for children. There is no reason to believe that either men or women in this strategy are affected by seasonality, nor is there evidence to suggest that men are undertaking particularly high-risk occupations. Most men whose wives stay home either fish year-round or work in shops or in the market on the land, for which proximity to a major market may be providing alternative work opportunities.

Also in support of Marlowe (2007) and Codding et al. (2011), proximity to the Meghna River is associated with a convergent division of labor: families who Work Together, in which husband and wife fish together year-round, live closer to the Meghna than Split Year families. However, Traditional families and Leave Kids Home families live closer to the Meghna than Split Year families, too. Leave Kids Home families provide an interesting case because while the work men and women do is divergent for half of the year (with women selling and men fishing), most families engage in

convergent labor during the other half of the year (with men and women fishing together). It makes sense for these families to live close to the Meghna and close to a major market.

A family's time to market and distance to the Meghna are not mutually exclusive of one another. That is, a family can live within 10 minutes of a market and also within 10 kilometers of the Meghna. And while it is useful to compare individual strategies based on how close they are to either a market or the Meghna, the results show that rather than only the proximity of a particular aspect of the ecology making one or more strategies most feasible, it may be that the distance away excludes families from engaging in any other strategy. Families in the Work Together strategy live farther away from a major market than families in any other strategy. They are most likely to live more than 10 minutes away from a market and live 63 minutes away on average. This distance is likely too far from a market to make women's selling a feasible occupation. Similarly, families in the Split Year strategy live farther from the Meghna than those in any other strategy – an average of 9.42 kilometers away. This distance may make fishing year-round an unprofitable venture and may limit the majority of fishing to the rainy season. Therefore, ecology determines which occupational opportunities are available to families, but also determines which opportunities are not available. Those that are not available primarily distinguish between Split Year families, in which the division of labor is most divergent, and Work Together families, in which the division of labor is most convergent.

*Alloparents allow mothers to work away from children*



Alloparents across societies have been found to free mothers from the requirements of childcare, allowing them to spend more time away from home (e.g. Ivey 1993; 2000) and allowing them to return to work (e.g. Quinlan et al. 2003; Meehan 2009). Shodagor mothers in the Split Year and Leave Kids Home strategies are away from home for many hours a day and for at least half the year. Earlier results show that Split Year families are likely to have a child under the age of 5 and therefore have at least one child who needs constant monitoring. Mothers stay home as primary caregiver for half of the year while fathers are working and fathers stay home as primary caregiver for the other half of the year while mothers are selling goods. It is not clear how these families benefit from alloparents, but Split Year families have more alloparents than Traditional or Work Together families.

The same results show that Leave Kids Home families are unlikely to have a child under the age of five. This has two possible implications where alloparents are concerned. First, requirements for caregivers will be different: they will not be required to give constant attention to children who can swim, nor will they require the physical capabilities to save a child from the water. Second, these lowered requirements will result in an increased pool of available alloparents. Though caregivers' responsibilities may be different, they should still be necessary for performing tasks like feeding and general care for children over the age of 5 who can swim but who may not be able to cook or do other household tasks. Leave Kids Home families have statistically similar numbers of alloparents available as Split Year families and more alloparents available than Work Together families.

Traditional and Work Together families have the fewest number of available alloparents. For Work Together families, this is consistent with Coddling and colleagues' (2011) suggestion that where division of labor converges on similar resources, fewer alloparents should be necessary. In this case, fewer alloparents are necessary because children are on the fishing boat with both parents. Alloparents are also less available for these families because most of the families who live nearby also employ the Work Together strategy – which leaves very few potential caregivers behind in the bohor who parents could leave their children with. In general, a convergent division of labor is associated with fewer alloparents available while families practicing a more divergent division of labor, in which mothers work away from their children, have more alloparents available.

#### *The Shodagor division of labor*

The stage in a family's domestic cycle, the specific aspects of their local ecology, and the availability of alloparents impact how Shodagor families divide labor within the household. The intersection of these three factors seem to explain why a family chooses a particular division of labor strategy and why the Shodagor families of Matlab have four distinct strategies they can employ.

The Shodagor ecology – homes surrounded by water throughout the year – imposes constraints on families with young children and necessitates that any caregiver be responsible and physically capable to mitigate the risk of child drowning. For families with young children who live close to a major market, women's selling is only possible when such a caregiver is available. In the case of the Split Year families, this caregiver is

the children's father, though alloparents are also available to help. Split Year families also live far away from the Meghna River, which primarily makes fishing profitable during the rainy season. A combination of these constraints leads to men and women splitting the year between working and childcare, ensuring that one parent is providing for the family while the other keeps children alive.

Families with young children who simultaneously live relatively close to the Meghna and a major market tend to employ the Traditional strategy, with mother staying home year-round as the primary caregiver and father working outside the home year-round, fishing or working in the market at a shop. Ecology makes either option plausible. Lack of available alloparents likely motivates mothers to stay home; however there may also be a cultural factor leading some families to choose the Traditional strategy. Many young women who do not work reported that their parents paid a higher dowry under the specific agreement that their daughters would not have to work after marriage. Parents may be doing this for a number of reasons. First, they could be concerned for their daughters' safety, as selling goods can be risky to one's physical well-being (risks include transportation accidents, theft, or assault or harassment by village men of these women traveling alone). Parents could also be concerned about their daughters' reputations. While others in Shodagor society do not hold women in low regard for working outside the home, this is not the case among village Bangladeshis, among whom *purdah*, the practice of female seclusion, is common and women's sexual reputations are closely guarded (Amin 1997). It is possible that some Shodagor parents believe that protecting a daughter's reputation among the larger village community may improve her status both among the Shodagor and the villagers. However, bivariate analyses show no

evidence either that dowry was more likely to be paid for women in the Traditional strategy (Table 1) or that a higher dowry was paid by these women's parents (Table 2). More data is needed in order to fully flesh out this relationship.

For families who do not have a child under the age of five it is less important to have a parent at home with children all year, but these families are still constrained by the availability of alloparents as well as the local ecology. Leave Kids Home families live in an ecology that is relatively close to both the Meghna and a major market, just like Traditional families. However, having older children and more alloparents available allows mothers and fathers to work away from home – and away from their children – year-round. Mothers often fish with their husbands during the rainy season when selling is difficult and sell goods during the dry season, while fathers typically fish all year.

Families who work together are not significantly different in age than families in any other strategy and are just as likely as all other families to have a child under the age of five. The most relevant constraints for Work Together families seem to be ecology and availability of alloparents. These families live close to the Meghna, which makes fishing profitable year-round. They also live farther away from a major market than families in any other strategy, which limits women's and men's choices in occupation to either fishing or staying home. Individuals who fish with their spouse or other members of the nuclear family do not have to split their catch or their income at the end of the day, which means that as long as there is not any other, more profitable work available, spouses can earn the most money by working together. The lack of availability of alloparents necessitates children going along with their parents on the fishing boat.

For the Shodagor, having a child under the age of 5, time from a major market, distance from the Meghna River, and number of available alloparents interact to explain why labor is divided in particular ways. Specific ecological factors will differ based on the society, but when examining between-household differences in how labor is divided between husbands and wives, each of these variables is likely important in the model.

*Implications for the study of the sexual division of labor*

Marlowe (2007) suggests that a deeper understanding of the sexual division of labor requires an examination of how labor is divided at the household level. He shows that a Hadza wife's pregnancy or lactation status can affect the husband's labor strategy (Marlowe 2003). Others show that the age of a husband or wife (Kaplan et al. 2000), age (Hurtado et al. 1985) or age distribution (Kramer 2004) of children, and presence of alloparents (Ivey 1993; 2000; Quinlan et al. 2003; Meehan 2009) impact individual subsistence practices. However, in none of these cases do the researchers look at the impact of these circumstances on household subsistence strategies. Similarly, ecology impacts how men and women divide economic labor between societies (Jochim 1988; Marlowe 2007; Copping et al. 2011), but within-society or between-household differences are not considered. Ecological models also do not include childcare tasks. The Shodagor offer an example of a society that has between-household differences in the strategies they employ to divide labor. This paper shows the importance of including childcare in any household-level examination of the division of labor. The results also show that a family's domestic cycle stage, local ecology, and available alloparents must

be taken into consideration to fully comprehend the factors that distinguish between strategies.

Jochim's (1988) and Marlowe's (2007) ecological models regarding the sexual division of labor both focus on the resources found in a given ecology as a proxy for the subsistence opportunities that are available. The results from the Shodagor suggest that considering resources that are *not* available in a given ecology may be just as important to consider when attempting to understand why one society engages in particular subsistence tasks or pursues particular resources and not others. Formal application of optimal foraging theory would elucidate the point at which one strategy or occupation is not economical to pursue and should be excluded from consideration.

The Shodagor are an unusual culture in a number of ways, but the fact that some women and men engage in roles that are opposite of those found in nearly all other human societies is relevant to the study of how they divide labor. Shodagor women who sell goods are engaging in an occupation that is entirely incompatible with childcare. This is a behavior that is extremely unusual cross-culturally. Women who work with their husbands and/or pursue the same resources as their husbands engage in different tasks which are more compatible with childcare than the tasks men engage in (e.g. Hewlett 1992; Hurtado et al. 1985). Even most women in the modern West have occupations that are more likely to be compatible with breastfeeding and childcare than men (Bliege Bird and Copping 2015).

A little more than half of the women who sell goods also have children under the age of 5, which means that during the dry season when women are selling, they need an alternate caregiver for their children. In these cases, the father steps in and stays home for

half of the year, opting to be the primary caregiver for his children rather than work outside the home. Hewlett (1992) reported that Aka fathers spend around 50% of their time in close proximity to their children, which is more than what has been reported for any other society (Marlowe 2000). And while Aka fathers' care allowed mothers to engage in other tasks – just as alloparents have been shown to do in other societies – even Aka fathers are not the primary caregiver for their children all day, 6 months out of the year as this group of Shodagor fathers are. These families' closeness to a major market provides selling opportunities for women and their distance from the Meghna means that fishing is only reliably profitable during the rainy season. What is unclear, however, is why fathers stay home when these families also have more available alloparents than families in other strategies. Perhaps they stay home because their opportunities to make money elsewhere are limited and perhaps the benefit of fathers' abilities to keep children alive as primary caregivers outweigh any added benefit that may come from additional income. An examination of time allocation data for fathers and alloparents during the dry season is necessary to understand the duties performed by each and the benefits that come from those duties. Further analyses of the characteristics of fathers who stay home as well as analyses of the potential benefits to fathers, mothers, and children in these families is necessary to fully understanding the implications this has on studies of the sexual division of labor.

The purpose of this paper was to examine the differences between Shodagor families who engage in different strategies for dividing labor within the household. Three research questions were addressed regarding the impact of a family's stage in the domestic cycle, local ecological variables, and the availability of alloparents. Each of

these plays a role individually in explaining why Shodagor men and women engage in different occupations, but the intersection of all three factors best explains why a family chooses one division of labor strategy over the other three practiced within the Matlab Shodagor. Most models of the division of labor examine the effect of one or two variables on how men and women as broad groups divide labor within or across societies. These models do not typically explore the intersecting effects of multiple variables, nor do they look at the division of labor at the level of the household. These may be useful steps to take in the future to allow us to understand how and why labor is divided between men and women in different cultures.



## **CHAPTER 3: “Risk-Taking Mothers and Stay-at-Home Fathers: Shodagor Risk and Parenting Strategies”**

**Coauthored with Mary K. Shenk**

### **Introduction**

Humans in most societies divide labor by sex in predictable ways: women do the majority of childcare, as well as work that is more compatible with childcare and provides reliable returns thus requiring less economic risk, while men provide much less direct care for children and do work that is less compatible with childcare and is economically riskier than women’s work. Two theories have commonly been used to explain this pattern: the economy of scale model (Becker, 1985) and the risk model (Bird, 1999; Bliege Bird and Bird, 2008). The Shodagor of Matlab, Bangladesh are a semi-nomadic community of people who live and work on small wooden boats, surrounded by water year-round. This unique ecology presents constraints that influence the way Shodagor mothers and fathers balance subsistence labor with childcare (Starkweather, in press). While many Shodagor families employ a division of labor between husband and wife that follows cross-cultural trends, there is one group of Shodagor families in which the roles of mother and father reverse for half of the year: mothers take on relatively high levels of economic risk selling goods door-to-door, an occupation that results in highly variable returns and is incompatible with childcare, while fathers forgo work to stay home as the primary caregiver of young children. In this paper, we examine the social and environmental characteristics that influence women's and men's choice of subsistence and childcare strategies, particularly those that lead some Shodagor women to choose an

occupation that produces high-variance results and some Shodagor men to forgo income-earning and stay home as primary caregivers for children. Our goal is to answer the following three research questions: (1) What are the socioecological factors that distinguish between women with different primary occupations? (2) Do husbands parent for half of the year in response to wives' occupational or risk strategies, or do they do so in response to other socioecological cues? And, (3) What are the general factors that predict women and men taking on higher levels of economic risk? We situate our findings within the scope of two prominent models of the sexual division of labor: the economy of scale model and the risk model.

#### *Shodagor Sexual Division of Labor*

Nearly all Shodagor men (90.1%) in our sample fish for a living with most selling the majority of their catch in the markets in exchange for cash and most also saving a portion of their catch for their family to consume on a regular basis; little of their catch is shared outside of the nuclear family—in fact, between-household sharing of any subsistence resource is uncommon for all Shodagor men and women. Men who do not fish as their primary occupation are either elderly and do not work (2.8%) or work in the market (7.1%). Fishing is generally a low-risk occupation for Shodagor men and women. In this paper, we calculate risk as the coefficient of variation (CV) in mean income, a commonly used measure of economic risk (Coddington et al., 2011; Tucker et al., 2013; Winterhalder, 1990) because it can be used to compare variance across different units of measurement. Shodagor fishing has an average coefficient of variation of 53.6 for all men and women, and an average CV of 60.7 for men – a rate similar to Meriam shellfishing

(Coddling et al., 2011), but lower than CVs reported for oceanic (e.g. Coddling et al., 2011) or freshwater (e.g. Tucker et al., 2013) fishing in other parts of the world (see Tables 4 and 5 for breakdown of CVs). Most Shodagor men who fish do so year-round (though some occasionally supplement their income with day labor when fishing prospects are low), however 20.3% of men who fish only do so for half of the year, during the rainy season (approximately May through October). During the dry season (approximately November through April) these men stay home and take care of children while their wives are selling goods-- unusual behavior for men cross-culturally.

Table 4. Coefficients of Variation

Shodagor CVs	
Men (overall)	60.7
Women (overall)	111.6
Women's Fishing	46.4
Women's Selling	152.7
Men's & Women's Fishing (taka)	53.6
Men's & Women's Fishing (kgs caught)	48.1

Table 5. Coefficient of Variation by Wife's Occupation

Occupation	Husband's CV	Wife's CV	Household CV
Fishing	52.2	46.4	54.6
Selling	55.8	152.7	63.4
Housewife	46.2	-	46.2

In contrast to men, Shodagor women have one of three primary occupations: fishing (37.7%), selling goods (39.3%), or staying home as a housewife (23.0%). Two of these occupations – fishing and staying home – are in line with trends for women's work cross-culturally. Women's fishing is (1) compatible with childcare: women who fish often do so with their husbands and often bring children of all ages along (Starkweather, in press). Women's fishing is also (2) a low-risk, reliable-return occupation with an average CV of 46.4, which is lower than the CV for nearly all animal resources across

societies (e.g. Coddling et al., 2011; Tucker et al., 2013). Being a housewife is also compatible with childcare and incurs no economic risk. Being a housewife is also by far the most common occupation for non-Shodagor women in Bangladesh who live on the land (Roy et al., 2009) and very common in other agricultural societies around the world (Burton and White, 1984)—though it should be noted that 'housewives' in agricultural societies may be responsible for significant amounts of labor in terms of processing agricultural products (Burton and White, 1984) in addition to duties of cooking, cleaning, and taking care of children.

The third occupation Shodagor women undertake, selling goods, is cross-culturally unusual in two ways. First, women's selling is (1) entirely incompatible with childcare, requiring women to walk long distances while carrying a heavy basket on their heads. Most Shodagor women who sell goods report working outside of the home for 8 or more hours per day, most days of the week, for 6 months each year during the dry season; while selling they *always* leave their children at home or with relatives (Starkweather, in press). Second, selling is also (2) an economically, physically, and reputationally high-risk occupation, with an average CV of 152.7, that can either produce negative returns or returns that are much higher than those produced by women's or men's fishing (Table 6a.). A CV of 152.7 is similar to those produced by small game hunting and open-water fishing cross-culturally (Coddling et al., 2011), both of which are often male strategies (for exceptions, see Bliege Bird and Bird, 2008; Goodman et al., 1985; Noss and Hewlett, 2001). Shodagor men do not sell goods door-to-door (except in rare instances when they accompany their wives, usually due to pregnancy) because this is not a niche that is available to men. Door-to-door selling involves visiting the homes of non-Shodagor, rural

Bangladeshi families during the day when only women are home. It is considered inappropriate for an unrelated man to enter the homes of non-Shodagor women without their husbands present, therefore selling is a dyadic interaction between women only. Simultaneously, this niche is very unlikely to be filled by non-Shodagor women given that purdah – the practice of female seclusion – is a common practice in rural Bangladesh and work outside the home is uncommon (Amin 1997).

Table 6a. Summary statistics (Continuous predictor variables)

Variable	<i>n</i>	Mean	SD	Min	Max
Wife's CV	61	0.59	0.66	0.00	2.78
Husband's CV	57	0.52	0.32	0.00	1.27
Wife's Income	61	667.93	671.10	-1050.00	3000.00
Husband's Income	56	1354.08	994.39	0.00	4700.00
Wife's Age	62	29.40	10.22	16.0	60.0
Husband's Age	62	37.92	13.37	20.0	70.0
Time to Market (min)	62	35.65	40.70	5.0	120.0
Distance to Meghna (km)	62	7.11	5.09	1.0	19.0
Wife's Hours per Week	62	46.94	37.36	0.00	98.0
Husband's Hours per Week	62	60.34	31.26	0.00	100.0
Number Available Alloparents	62	0.58	0.71	0.00	2.0

Women who trade or sell goods in other societies are only somewhat similar to Shodagor women in terms of these factors. Other women who trade or sell don't usually take their children along, but often stay close enough to home that they can return to breastfeed or care for children as needed (Seligmann, 2001). Women traders in the upland Philippines may take on a higher-than-usual amount of economic risk due to increasing market access (Milgram, 2001), though women traders elsewhere – like women in most societies – have lower-risk occupations than their husbands (Seligmann, 2001). So, what might lead Shodagor women to choose this higher-risk occupation over more traditional occupations? Likewise, what might lead some men to choose to stay home while their wives work rather than continue to fish for guaranteed returns?

Given the incompatibility of selling goods with childcare, Shodagor families in which mothers sell must find an alternative source of childcare. Given that Shodagor generally live on their boats—or at least within a few steps from the water—it is especially important for families with children under the age of 5, who are generally not reliable swimmers, for caretakers to be strong enough and responsible enough to protect children from the risk of drowning. Almost all Shodagor families with a child under the age of 5 solve this problem by having a parent serve as the primary caregiver at all times. Usually this is the mother, but in families where mothers sell goods, many fathers take on this responsibility during the dry season, accounting for 20.3% of all Shodagor families in Matlab. There are two models that are commonly used to explain the division of labor in traditional societies: the economy of scale model and the risk model.

#### *Economy of Scale Model*

The economy of scale model is based on the presumption of a shared goal between husband and wife to divide subsistence labor in a way that maximizes household economic efficiency (Becker, 1985). While this does not necessarily always lead to men hunting and fishing and women gathering and processing, either constraints or comparative advantages held by one sex for particular activities may result in the predictable patterns that we see across cultures in how labor is divided between the sexes. Women are biologically constrained by the energetic and time demands of pregnancy and breastfeeding, which may constrain them in such a way that it is most efficient for them to specialize in subsistence activities that are compatible with childcare, such as gathering and processing. This can give men a comparative advantage in tasks that are incompatible

with childcare and require years of training and practice, such as hunting (Brown, 1970; Hurtado et al., 1985; Lancaster, 1978).

The economy of scale model implies that, to some extent, men's foraging decisions are based on women's foraging activities, which tend to be low-variance, provide low mean returns, and can be used to feed women's own families. In turn, such activities by women leave men free to pursue higher-variance, higher-mean resources (Hurtado et al., 1992; Kaplan et al., 1990). A dynamic relationship between men's and women's foraging decisions combined with seasonal changes in childcare constraints or the productivity of resources should result in men allocating less time to foraging of particular resources that women allocate more time to, and vice versa (Bliege Bird and Bird, 2008). The model focuses on sharing of resources between men and women within the household, which can result in a complementarity of key macro-nutrients (Gurven et al., 2009), as well as greater overall household production (Becker, 1985). Resource sharing may also commonly occur between families within the same group and the economy of scale model suggests that this should help individual families buffer against long-term risk. High-variance resources, often obtained by men, tend to be shared more widely than low-variance resources, which may be shared by a woman primarily with her own children and husband (Bliege Bird and Bird, 2008). Thus when men pursue higher-variance, higher-risk strategies, they do so because they have a buffer which ensures their families will be provided for regardless of their economic success. Thus, application of the economy of scale model to our question regarding women's risk should lead us to expect women who sell and take on more risk to do so as a part of a dynamic relationship with men's economic risk-taking, and that women should have a comparative advantage

– or men a comparative disadvantage – that allows them to succeed in selling goods. We would also expect women who sell to have allomaternal care available for young children, whether in the form of the children's father or another relative or caretaker.

Data from all types of societies show that women do, in fact, engage in work that is more compatible with childcare than men's work and that women and men follow similar patterns in how they allocate time to childcare (see Bliege Bird and Coddling, 2015 for a review). Typically, mothers are responsible for a great majority of the direct childcare that takes place worldwide (Konner, 2005). Maternal care, especially through breastfeeding, is obligate in humans, meaning that it is necessary in order to keep young children alive (Sear and Mace, 2008). In contrast, paternal care is quite variable cross-culturally in the amount of time spent with children, the type of care provided, and the effects of that care (e.g. Hames 1988; 1992; Hewlett 1992; Winking et al. 2009). Among traditional societies, hunter-gatherer fathers tend to provide the most direct care for children (Marlowe, 2000). Aka fathers are at the high end of the range, holding or being within an arm's reach of their infants up to 47% of the day (Hewlett 1991). At the other end of the spectrum, fathers in pastoralist societies sometimes provide no direct care for infants or young children (e.g., Harkness and Super 1992; Munroe and Munroe 1992). Across all types of societies, fathers tend to interact with their children only around 25-35% the amount of time that mothers do (Lamb et al., 1985). Several factors are known to influence the amount of direct care fathers give their children. The amount of time a father spends in proximity to his children is associated with the amount of time he allocates to care (Marlowe, 2000). Meehan (2005) found that Aka fathers increase the amount of direct care they give when the children's maternal relatives are not present.



Trivers (1972) and Hrdy (1992) suggest that one parent's time spent in childcare should be inversely related to the other parent's time spent on the same activity. Winking and colleagues (2009) support this conjecture with data from the Tsimane forager-horticulturalists, showing that fathers' direct care of children is at least somewhat contingent on mothers' childcare and other activities.

If women's and men's subsistence work is based on a dynamic relationship that determines the type of work and time allocated to work a husband and wife will perform and the time that women spend in childcare is dependent upon the time men spend in childcare, the economy of scale model also suggests that women's and men's subsistence work and childcare should be complementary in a zero-sum game. Kaplan and colleagues (2009) take productive and reproductive behavior into account in their model of complementarity when they suggest that sex-specific specialization in men's and women's roles increases "the returns to economic and reproductive cooperation between men and women" (p. 3291), resulting in the human pair bond. There is increasing evidence from families in modern Western industrial societies that shifts toward an increasing likelihood of mothers being the primary breadwinner are associated with an increased likelihood of fathers staying home to care for children (Doucet and Merla, 2007; Latshaw, 2011; Raley et al., 2012; Rushing and Powell, 2015). Based on the economy of scale model, we expect that Shodagor fathers who take on the role of primary caregiver for half of the year will do so in response to their wives' economic ability to pursue strategies of selling or fishing, the compatibility or incompatibility of those strategies with childcare, their family's childcare needs (i.e. do they have a young child,

is there adequate allocare available), and a comparative advantage in childcare or a comparative disadvantage in fishing during the dry season.

### *Risk Model*

The risk model focuses on the costs and benefits of unpredictability in the acquisition of resources and assumes that individual foraging goals, which often differ by the gender of the forager, will cause those costs and benefits to be weighed differently. If the primary goal of foraging is consumption, an individual should be risk-averse and pursue low-variance, low-mean resources. That is, those who gain greater benefits from consuming the resources they forage for or from using them to feed family members will do better with a strategy that provides reliable returns on a regular basis (Bliege Bird, 2007). Alternatively, if the goal of subsistence work centers around food's social utility, and one can gain status through resource sharing, an individual should be more risk-prone and pursue higher-variance, high-mean resources (Bliege Bird and Bird, 2008). Data from the Ache (Kaplan et al., 1990), Hadza (O'Connell et al., 1991), Ju/'hoansi (Lee, 1979), and other societies have suggested that men often specialize in high-variance resources – usually through hunting – while women often specialize in low-variance resources. Hawkes (1990) and Smith and Bliege Bird (2000) argue that men pursue high-variance resources because success in such pursuit and subsequent group-wide sharing of these resources can improve men's social status and reproductive potential. Meanwhile, women may focus on low-risk resources and form cooperative, intergenerational bonds as a way to buffer against risk and ensure their families have enough to eat (Bliege Bird and Bird, 2008). Bliege Bird and Bird (2008) point out that while this will usually result in

risk-prone men and risk-averse women, “we should also expect shifts in goals of one gender or the other that correspond with shifts in the availability of resources associated with different levels of variance” (p. 658). Copping and colleagues (2011) show that this is true for the Ache, Martu, and Meriam – men tend to choose high-energy resources regardless of risk, while women choose low-risk resources in spite of energy returns.

The risk model doesn't necessarily account for any childcare provided by men, however, in accordance with the model's assumed goal for men who pursue high-risk resources, Hawkes and colleagues (1995) suggest that men may engage in direct care as a form of mating effort in an attempt to either sustain their relationship with their current partner or improve their chances at obtaining a new partner. Parental investment in offspring may enhance the reproductive fitness of a parent if it increases survivorship of offspring, but the cost of this investment is reduced time and energy available to invest in future offspring and pursuit of mates. Therefore, there should be a trade-off between parenting and mating effort (Trivers, 1972). However, as Hawkes and colleagues (1995) posit, care provided to a man's own biological children not only potentially increases the chances that those children will survive (though the evidence is mixed in this regard, see Sear and Mace 2008), but may also help the man retain his current mate. Care for an unrelated child might afford a man future mating opportunities with the child's mother (Marlowe, 1999). For Shodagor women who sell goods and pursue a high-risk strategy, we would expect behavior to be oriented towards goals similar to men: social or reproductive benefit. Husbands of these women may favor consumption of resources and respond to women's strategies accordingly by taking on less economic risk.

## Methods

### *Study Population*

This study focuses on the Shodagor of Matlab, Bangladesh. Matlab is a mostly rural subdistrict or *thana*, located within Chandpur District, approximately 59 kilometers but 4-5 hours travel southeast of the capitol city of Dhaka (Figure 1). Matlab consists of a few small towns and approximately one hundred forty villages and is home to approximately 200,000 non-Shodagor people (Bangladesh Bureau of Statistics 2010; ICDDR,B 2014) and 342 Shodagor people (178 adult and 164 children). The Donagoda River, a branch of the Meghna River (one of the 3 largest rivers in Bangladesh) cuts through the middle of Matlab and flows into the Meghna at the southernmost tip of Matlab's landmass, just east of where the Meghna and Padma rivers meet. Shodagor people live throughout Bangladesh, though their exact locations and numbers are currently unknown. There has been no previous scholarly research published on the Shodagor of Matlab, and little work on other nomadic populations in Bangladesh (see Ahmed, 1962 for an exception); therefore all ethnographic data comes from observations, informal conversations, and qualitative and quantitative interviews I conducted with the help of two Bangladeshi research assistants during 2011 and 2014.

Traditionally, all Shodagor were semi-nomadic, moving two to three times per year to different locations throughout Bangladesh. Now approximately half of all Shodagor families in Matlab move an average of 2 times each year – some moving throughout the country and some moving between *bohor* (distinct groups or clusters of boats) in Matlab. Other Shodagor families in Matlab move infrequently or not at all. When not moving between locations, families always situate their houseboats within

preexisting bohor – houseboats never reside permanently outside of a bohor. Smaller boats are used as the primary mode of transportation for fishing and for traveling between the houseboat and the land.

Among the 5 Shodagor bohor in Matlab (Figure 1), size ranges from 8 to 48 households with a median size of 15 households. The largest bohor included in this study is made up of 16 families who live on boats and 32 Shodagor families who have moved onto the land within the last 5 years and live in makeshift houses on small pieces of land at the water's edge. These families are heavily integrated with those living on boats through kin and cultural ties. There are other Shodagor families living in Matlab who have lived in houses that are similar to land-dwelling Bangladeshis' for 10 or more years; these families were not included in this study.

### *Bangladeshi & Local Ecology*

The ecology of Bangladesh plays an important role in Shodagor subsistence and movement patterns. Every year, for approximately half of the year, large portions of the entire country of Bangladesh are covered in water, as a result of monsoon rains and Himalayan snowmelt (Hofer and Messerli 1997). The Shodagor refer to this half of the year, which typically begins in May, as the “rainy season.” During June, July, and August, monsoon rains come regularly and fields are fully flooded, but for the Shodagor, the rainy season usually extends through the end of October when the waters have receded to the point that roads are dry and accessible for travel by foot and rickshaw. The other months of the year are referred to as the “dry season,” when water levels in the

country's rivers and canals decrease and land is visible in places that previously were completely submerged.

While the actual living conditions of most Shodagor do not change drastically between the seasons (they continue to live on boats on the water all year), what does change are the available economic opportunities. During the dry season, fishing prospects vary across Bangladesh, but as water levels rise, fish become abundant throughout the country, with the availability of larger amounts and different types of fish making fishing a particularly profitable venture during the rainy season. During this half of the year, nearly all Shodagor men and some women fish every day. Selling goods is nearly impossible and highly unprofitable for women during the rainy season because many of the roads in the rural parts of the country are submerged in water. This makes transportation and access to potential customers very difficult. The dry season brings access to roads, making it a profitable time for women to sell goods.

There are also two aspects of the specific ecology of Matlab that are important for Shodagor. First, the distance a family lives from a market town will determine the ease with which women can obtain goods to sell. Women do not store the goods they sell in their own homes, but instead they are held by a *mahajan* (middleman) in a shop in the nearest major market. Each selling day, women travel first to the market to collect their basket of goods, then out to the countryside to sell. Before returning home, women deposit their goods in the shop for the night and settle accounts with the mahajan. There are two major market towns in Matlab and two of the five bohor are located within a 5 or 10-minute walk from those towns, while the other three bohor are located an hour or more away (Figure 1). Distance to a market is less important for the success of men's

fishing. Men do sell most of their fish in markets at the end of each day, but this can be done at both major and minor markets. Minor markets are located all over the countryside and all 5 bohor in Matlab are within walking distance of a major or minor market.

Also relevant to the Shodagor is the distance a family lives from the confluence of the Donagoda River with the Meghna River, as this will determine fishing opportunities throughout the year. The Donagoda is the main river that runs from north to south through the middle of Matlab. The Meghna is one of the three largest rivers in Bangladesh. Its average width is approximately 5 kilometers, which is nearly equivalent to the widest point of the Mississippi River, and at its widest point, the Meghna is approximately 6 miles from shore-to-shore during the dry season and even larger during the rainy season. At the mouth of the Donagoda, where it merges with the Meghna, the river is wide and deep and there is an abundance of fish, in both number and variety, year-round. As the Donagoda travels away from the Meghna, especially during the dry season, water levels are lower and the numbers and varieties of fish diminish. Shodagor who live closer to the Meghna will thus have profitable year-round fishing opportunities, while those who live farther away will find fishing most profitable during the rainy season and less profitable during the dry season.

### *Data Collection*

Data were collected over the course of 9 months of fieldwork during 2014. All adult Shodagor living in Matlab, Bangladesh, were eligible to participate in the interview portions of this study. After obtaining informed consent from all participants, quantitative survey interviews were conducted in two rounds. The first round was conducted between

May and July 2014. It included over 232 questions, lasted between 45 and 90 minutes, and focused on demographic information and family histories, basic economic data (such as income and occupation data), indirect parental investment data, and family and women's health histories. Of the 172 total adult Shodagor in Matlab, 71 men and 87 women participated in this interview (N=158), comprising an almost complete population sample. Fourteen adults either declined to participate for reasons including health issues, or were away from home every time interviews were conducted. The second survey was conducted in September and October 2014 and asked questions about specifics of economic practices and income, parental investment, and collected household inventories. A subsample of 34 men and 41 women from the 3 bohor located closest to the Meghna River participated in this survey. Income data from this survey were used to supplement any incomplete income data from the main survey. Sample size and bohor inclusion were limited due to logistical reasons, including travel safety and seasonal change, which resulted in earlier sunsets and difficulty with interviewing people during daytime hours.

The current study includes 123 Shodagor individuals, 62 women and 61 men, living across all 5 bohor in Matlab. Individuals were included in this study if either they or their spouse were working regularly at the time of data collection. This resulted in 18 individuals being excluded from the study. Five men and their spouses were excluded because they were the only men in the population who did not fish as their primary occupation. This was done in order to control for variation that may be connected to their different occupation, but which we did not have the statistical power to examine



formally; these families are also likely to be unusual in other ways. Finally, 8 individuals were excluded due to missing data points. All data in this study are cross-sectional.

*Data Analysis*

Summary statistics were calculated for all variables of interest (Tables 6a and 6b). Coefficients of variation were calculated for all men in the sample and all women in the sample who earn an income (Table 4), and for men and women by women’s occupation (Table 5). Individual-level CVs were also calculated for each individual in the sample using income data from the last 3 days the individual worked. *Wife’s CV* and *Husband’s CV* are used as predictors in the logistic regression models and as outcome variables in the OLS models.

Table 6b. Summary statistics (Categorical predictor variables)

Variable	<i>n</i>	Variable	<i>n</i>
Wife’s Occupation		Child Under 5 (Dummy)	
Fish	24	Yes	35
Sell	25	No	24
Housewife	13	Time to Market (Dummy)	
Husband Parents ½ Year		0-10 minutes	36
Yes	12	> 10 minutes	25
No	49	Distance to Meghna	
Lives on Boat (Dummy)		< 8 kilometers	42
Yes	43	> 8 kilometers	20
No	19	Residence Pattern	
Child Under 3 (Dummy)		Patrilocal	21
Yes	23	Matrilocal	21
No	36	Neolocal	18

Other predictors of interest included: *husband’s age*; *wife’s age*; *husband’s income* and *wife’s income*, calculated by summing the individual’s profit from the last three days he or she worked; *husband’s hours per week* and *wife’s hours per week*, both of which reflect the total number of hours each individual works per week on an average

week; *husband parents 1/2 year (dummy)*, a binary variable in which ‘no’ indicates that a man is not the primary caregiver of his children at anytime during the year and ‘yes’ indicates that a man stays home as the primary caregiver of children for half of the year and works away from home for the other half of the year; *time to market (minutes)*, a continuous variable that reflects the number of minutes it takes an average adult to walk between their bohor and a major market; *distance to Meghna (dummy)*, a binary variable in which ‘< 8’ indicates that an individual lives less than 8 kilometers from the Meghna River and ‘> 8’ indicates that an individual lives more than 8 kilometers from the Meghna; *uxorilocal residence*, *virilocal residence*, and *neolocal residence*, each indicating that an individual’s nuclear family lives near the mother’s extended family, the father’s extended family, or near no extended family (respectively); *child under 5 (dummy)*, a binary variable for which ‘no’ indicates that there is not a child in the family under the age of 5 and ‘yes’ indicates that there is; *child under 3 (dummy)*, a binary variable for which ‘no’ indicates that there is not a child in the family under the age of 3 and ‘yes’ indicates that there is; and *number of available alloparents*, which measures the number of individuals reported in the survey as available allocaregivers who also live in the same bohor as the family. Alloparents included grandmothers and grandfathers, older brothers and sisters, aunts, uncles, and neighbors, but not fathers.

Binomial logistic regressions were conducted to determine the predictors that distinguish between women who fish, sell goods, and are housewives. The analysis was conducted in three rounds, with the condition ‘fish’ as the comparison group in the first round, the condition ‘sell’ as the comparison group in the second round, and the condition ‘housewife’ as the comparison group in the third round. A binary logistic regression was

also conducted to compare fathers who fish for ½ of the year to fathers who fish all year and determine the characteristics that might lead a father to choose one strategy over the other. For the binary logistic regression models, results are presented as odds ratios (ORs). Multivariate OLS regressions were also performed with *wife's CV* and *husband's CV* as outcome variables. Prior to running all regressions, we screened predictor variables and selected the best set of variables to include in each model using the results of covariate screening with likelihood ratio tests. Covariate screening was run in R v. 3.3.1 (R Core Team, 2016) and all other statistical analyses were run using Stata 14.1.

## **Results**

### *Wife's Occupation*

Binomial logistic regression results indicate that time to a major market, distance to the Meghna River, whether or not a family has a child under the age of 3, and the number of available alloparents all have a significant relationship with the occupation a mother chooses (Table 7). Husband's CV was retained in the final model using the Hosmer and Lemeshow Goodness of Fit test, but was not significantly associated with wife's occupation.

Women who fish are more likely to live farther away from a major market than women who sell goods or women who are housewives. They are also more likely than housewives to live within 8 kilometers of the Meghna River. ANOVA results show that women who fish live an average of 3.0 kilometers from the Meghna, while women who sell live 9.0 kilometers and housewives live 9.83 kilometers away from the Meghna ( $F =$

16.60,  $p < 0.001$ ). Finally, multivariate results show that women who fish have fewer alloparents available than all other women (Table 7).

**Table 7. Binomial Logistic Regression Results, Outcome Variable: Wife's Occupation**

Variable	Occupation: Fish Odds Ratio (95% CI) <sup>1,2</sup>	Occupation: Sell Goods Odds Ratio (95% CI) <sup>3</sup>	Occupation: Housewife Odds Ratio (95% CI) <sup>4</sup>
Husband's Economic Strategy: Husband's CV	0.14 (0.01, 5.65)	3.30 (0.20, 54.45)	0.65 (0.06, 6.66)
Ecology: Time to Market (minutes)	<b>1.04 (1.01, 1.07)**</b>	<b>0.92 (0.87, 0.97)**</b>	1.01 (0.99, 1.03)
Distance to Meghna (dummy)	<b>0.01 (0.00, 0.30)**</b>	0.69 (0.11, 4.47)	<b>7.08 (1.34, 37.46)*</b>
Family Characteristics: Unweaned Child Under 3(dummy)	0.92 (0.37, 2.30)	<b>0.20 (0.05, 0.83)*</b>	<b>2.51 (1.13, 5.57)*</b>
Number of Available Alloparents	<b>0.17 (0.04, 0.70)**</b>	<b>16.43 (2.11, 128.07)**</b>	0.55 (0.17, 1.79)

<sup>1</sup> Statistical significance is represented as follows: \*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ; †  $p < .10$ .

<sup>2</sup> Pseudo  $R^2 = 0.640$ \*\*\*; Goodness of Fit = 13.58

<sup>3</sup> Pseudo  $R^2 = 0.713$ \*\*\*; Goodness of Fit = 10.15

<sup>4</sup> Pseudo  $R^2 = 0.330$ \*\*\*; Goodness of Fit = 9.84

Women who sell goods are more likely than women who fish or housewives to live closer to a major market. On average, ANOVA results show that they live 9.05 minutes from a major market, while women who fish live and average of 62.27 minutes and housewives live an average of 38.33 minutes away from a market ( $F = 13.526$ ,  $p < 0.001$ ). Women who sell are less likely to have a child under the age of 3 who is still breastfeeding and also have more alloparents available than all other women (Table 7). Finally, Chi-squared results show that women who sell are more likely than other women to have a husband who parents for half of the year and stays home and cares for children during the other half of the year ( $X^2 = 25.470$ ,  $p < 0.001$ ) (Figure 3).

Women who are housewives are more likely than women who fish to live more than 8 kilometers away from the Meghna River. They are more likely than all other women to have a child under the age of 3 who they are still breastfeeding (Table 7).

### *Husband's Parenting Strategy*

Binomial logistic regression results show that men who stay home as primary caregiver of children for half of the year and fish for the other half of the year have wives with higher CVs than men who fish all year (Table 8). These men have more alloparents available and are less likely to live neolocally than men who fish all year, although residence pattern is only a marginally significant predictor. Bivariate results are also informative. Chi-squared results show that 11 of 13 fathers who parent for half the year have children under the age of 5 ( $X^2 = 4.125$ ,  $p = 0.04$ ) and that all fathers who parent for half the year have wives who sell ( $X^2 = 25.470$ ,  $p < 0.001$ ). All fathers who parent for half the year also live within 10 minutes of a major market ( $X^2 = 11.854$ ,  $p < 0.001$ ), averaging a 5 minute walk, while fathers who fish all year live an average of 44.58 minutes from a major market ( $F = 11.252$ ,  $p = 0.001$ ).

Figure 3. Husband's parenting strategy across women's occupations.

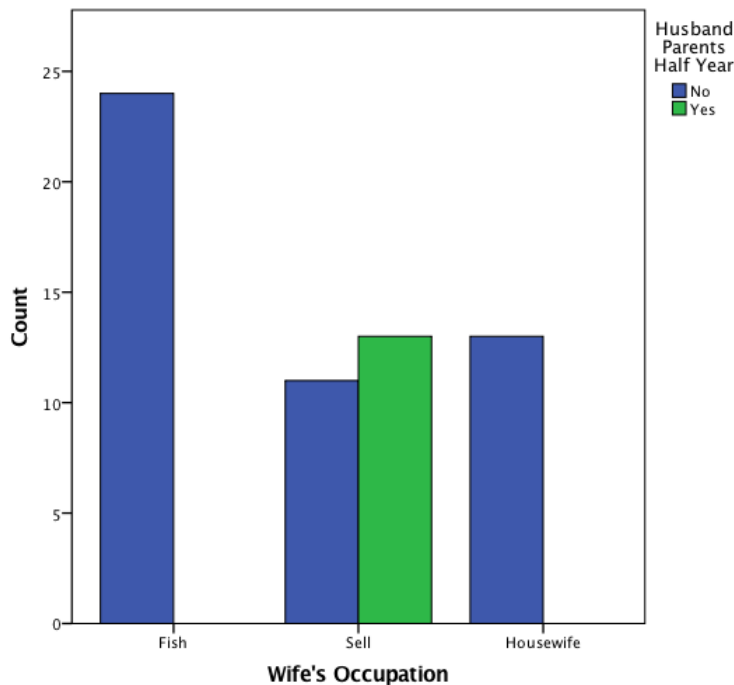


Table 8. Binomial Logistic Regression Results; Outcome Variable: Husband Parents Half Year

Variable	Husband Parents ½ Year Odds Ratio (95% CI) <sup>1,2</sup>
Wife's Economic Strategy: Wife's CV	<b>5.35 (1.42, 20.22)*</b>
Family Characteristics: Child Under 5 (dummy)	0.94 (0.11, 8.12)
Number of Available Allopuments	<b>8.42 (1.88, 37.66)**</b>
Neolocal Residence	<b>0.11 (0.01, 1.15)†</b>

<sup>1</sup> Statistical significance is represented as follows: \*\*\* p < .001; \*\* p < .01; \* p < .05; † p < .10.

<sup>2</sup> Pseudo R<sup>2</sup> = 0.551\*\*\*; Goodness of Fit = 11.81

### *Individual Coefficients of Variance*

Outcome variables for the two multivariate OLS regression models run are *Wife's CV* and *Husband's CV*. Results show that wife's individual CV is not significantly predicted by having a husband who parents for half the year, when we control for whether a wife sells goods or not (Table 9). Wife's CV is significantly negatively associated with the number of hours her husband works in an average week and marginally significantly and negatively associated with husband's income. Wife's CV is also significantly positively associated with the number of hours the wife works in an average week, and is significantly positively associated with the wife selling goods. Regression results for husband's CV show that it is significantly positively associated with living on a boat (as opposed to living in a house) and marginally significantly positively related to wife's CV, meaning that husband's risk increases along with wife's risk (Table 10).

Table 9. Multivariate Regression Results  
 Outcome Variable: Wife's CV ( $R^2 = 0.487^{**}$ )

Variable	$\beta$ (Std Error)
Husband Parents ½ Year (Dummy)	-0.14 (0.22)
Husband's Hours per Week	<b>-0.32 (0.01)**</b>
Husband's Income	<b>-0.20 (0.00) †</b>
Wife's Hours per Week	<b>0.32 (0.01)**</b>
Wife Sells Goods (Dummy)	<b>0.52 (0.18)***</b>

Table 10. Multivariate Regression Results  
 Outcome Variable: Husband's CV ( $R^2 = 0.141^*$ )

Variable	$\beta$ (Std Error)
Live on Boat (Dummy)	<b>0.35 (0.90)*</b>
Wife's CV	<b>0.26 (0.063)†</b>

## Discussion

In this study, we find that Shodagor women who sell goods and take on more economic risk do so in response to a comparative advantage in selling afforded by living a short distance from a major market as well as a comparative advantage for women due to their ability to enter the homes of non-Shodagor women. This is simultaneously a comparative disadvantage for men, who are unable to fill this niche. Women also sell goods in concert with having husbands who take on more risk than other men, and in response to childcare needs: they are unlikely to have a child under the age of 3 who are unweaned, but for those who do have young children, husbands stay home as caregivers while women work while additional alloparents are also available. Women who fish and are housewives also seem to be responding simultaneously to comparative advantages and disadvantages based on their ecological settings as well as a lack of available allomaternal care. We also find that men who stay home as child caregivers for half of the year seem to be responding to their wives' strategies of selling goods and their

families' childcare needs. Overall, our results show that men and women appear to respond to one another dynamically in terms of economic risk-taking strategies and childcare strategies, in accordance with the economy of scale model of the sexual division of labor.

*What are the socioecological factors that distinguish between women with different primary occupations?*

Women who fish and are housewives are engaging in occupations that follow common trends across cultures: compatibility with childcare and pursuit of low-variance resources (in the case of fishing). By contrast, women who sell goods are engaging in an occupation that produces higher-variance returns than fishing and is totally incompatible with childcare. While it is important to understand what leads Shodagor women to choose a particular occupation, the most important question is why would women sell? Multivariate results suggest that women who sell are different from women who fish or stay home because they have a buffer that allows them to incur risk. They have husbands who stay home for half of the year while they work (which suggests some complementarity), are least likely to have a child under the age of 3 who are still breastfeeding, and also have more alloparents available to them than women in other occupations. Alloparents in these cases likely play the role of watching children for short periods of time while fathers go to the market or engage in other tasks nearby. However, fathers are feeding, bathing, soothing, playing with, and supervising children for the majority of the day while mothers are at work. These women's husbands also produce higher variance returns than other women's husbands, but still only average a CV of 55.8.



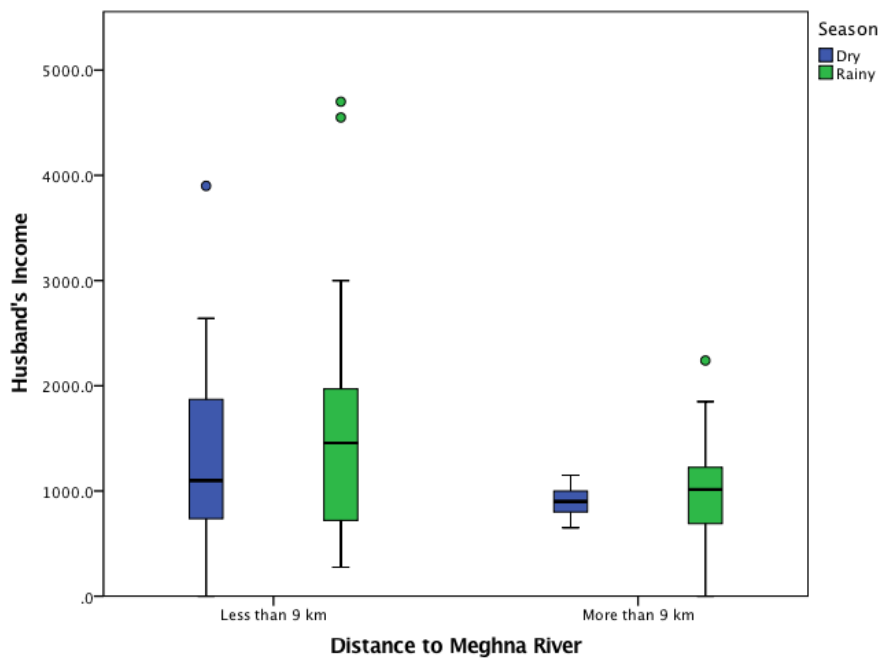
Women who sell live closer to a major market than women who fish or stay home, making access to goods more convenient and thereby lowering transaction costs for selling. Finally, women who sell are filling a niche that is only available to them.

When women fish, they most often do so with their husbands and some or all of their children. Based on observational data, men on the fishing boats (which are not big enough for more than 2 adults) tend to do the methodical – and slightly risky – work of balancing near the side of the boat, pulling up and clearing nets and hooks as efficiently as possible. Women usually steer the boat and sort the catch, throwing back whatever they can't eat or make a profit from. Women's fishing appears to largely be driven to by ecology. Fisherwomen simultaneously live farther from a major market and closer to the Meghna than all other Shodagor women. People who live closer to the Meghna are more likely to have profitable fishing opportunities year-round, while people who live farther from the Meghna are likely to have more profitable fishing opportunities in the rainy season and less profitable opportunities during the dry season (at least not without traveling closer to the Meghna) (Figure 4). They also have the fewest number of alloparents available, which may be another important factor given that the tasks women engage in while fishing are generally compatible with childcare (for instance, some women can breastfeed an infant while they steer the boat).

Women who stay home all year as housewives have husbands who work all year and engage in low-variance fishing. They seem to live in an ecology that neither lends itself to selling, given that they live an average of a 38.33-minute walk from a major market, nor does it make fishing year-round especially profitable, given that they are likely to live more than 10 kilometers from the Meghna River. They are also more likely

to have a child under the age of 3 who are not weaned than women who fish or sell, further impeding their ability to sell goods. Based on observational data, alloparents help mothers by holding babies while mothers cook, do laundry, or engage in other household tasks. While alloparents are not *necessary* for mothers to be able to do these tasks, they certainly help.

Figure 4. Husbands' Income based on how far they live from the Meghna, compared across seasons.



*Do husbands parent for half of the year in response to wives' occupational or risk strategies, or do they do so in response to other socioecological cues?*

Some Shodagor husbands work for half of the year then stay home for the other half of the year as primary caregivers for children while their wives work. As of yet we have found no ethnographic account of fathers in any traditional society systematically

choosing to provide this much direct care for children. Wife's economic risk is an important difference between husbands who stay home for half of the year and those who work all year. Even when controlling for Wife's Occupation (as we did in one model, but not the final model), Wife's CV is higher for husbands who fish half the year, suggesting complementary roles for husbands and wives in these families. Similar to women who sell, husbands who fish half the year are likely to have more alloparents available to help them out than husbands who work all year (and don't necessarily need the help of alloparents). Fathers who stay home for half of the year are bearing the brunt of the childcare load, but with mothers gone from home for up to 14 hours per day, fathers still need to buy food from the markets and take care of basic household tasks. The availability of alloparents likely allows them to do these things and keep the household running efficiently. As a corollary to number of alloparents available, men who stay home half the year are also less likely to live neolocally than men who work all year. In other words, men who fish only half of the year are more likely to live in the same bohor as either his family or his wife's family. This is true even when controlling for the number of alloparents, which is important to point out because we might assume that living near family is likely to be strongly correlated with having more alloparents.

Not all families in which women sell have fathers who stay home half of the year – only those with children under the age of 5 (only one man stays home for half of the year who does not have children under the age of 5 – and his youngest child is exactly 5). But all fathers who stay home for half of the year have wives who sell. It is not the wife's occupation, though, that seems to be driving this choice but her increased economic risk. Bivariate results do not show a difference in risk between men who work all year or half

the year. Therefore, it doesn't seem that the levels of risk are complementary of one another, but that the act of direct childcare frees women to pursue higher risk.

*What are the factors that predict women and men taking on higher levels of economic risk?* It appears that either women take on more risk in response to their husbands' reduced subsistence behavior or husbands who have risk-taking wives choose to work less hard and take fewer risks. While a husband's choice to parent for half of the year does not influence a wife's risk, his hours spent working and his income do. When husbands work fewer hours per week and make less money, controlling for whether they parent for half of the year or not, wives take on more risk. Wives who take on more risk also work more hours per week than wives who take on less risk, controlling for whether they sell goods or not. While the direction of causality is not clear, these results may indicate that as men decrease time spent in productive work and as their income decreases, women respond by working more hours per week and taking on riskier subsistence behaviors, perhaps in attempt to pursue a high-risk, high-reward strategy, in hopes of making up for husband's lower income in order to ensure the family is fed. In contrast, these results might also indicate that husbands reduce their productivity and level of risk in response to the long hours and high levels of risk being taken on by their wives. Regardless of the direction of causality, these results suggest a complementary relationship between women's risk and men's behavior, though not necessarily between women's and men's risk levels as we might expect.

Men's economic risk is low across all men because Shodagor fishing strategies and locations generally produce low-variance returns. However, results from the

multivariate model show that men's and women's risk are positively related, meaning that as women increase their levels of economic risk – sometimes to levels as high as 277.6, which are in line with some types of big-game hunting in other societies (Coddington et al., 2011) – husbands also increase risk. This relationship is unexpected in the context of either the economy of scale or risk models, both of which suggest that individuals should only take on more risk if their spouse or members of the opposite sex take on less risk in order to provide a buffer against overall risk and ensure children are fed adequately. Results from the OLS model also show that men who live on boats take on more risk than men who live in make-shift houses on the land. Men who live on boats are often working with the goal of saving money in order to buy a small plot of land and build a make-shift house on it, therefore they may be more interested in pursuing a high-risk, high-reward strategy. Interestingly, Shodagor women who live on boats take on less risk than Shodagor women who live on the land, though this is likely to be a result of the fact that most women who fish live on boats while some women who sell live on the land.

*Women's and Men's Strategies are Best Explained by the Economy of Scale Model*

Cross-culturally, men pursue resources that are economically higher-risk and produce less reliable returns than the resources women tend to pursue. Regardless of their underlying motives, men are often able to pursue such resources because they have a buffer that protects against risk for themselves and their families. This buffer comes from a (1) sharing network within the nuclear family, which protects against short-term risk, in the form of wives who (1a) pursue reliable resources that are used to feed the family and

are often complementary to men's resources in macronutrient makeup, and (1b) who provide the majority of direct care for children, as well as (2) extra-familial sharing networks that buffer against long-term risk. The economy of scale model suggests this is a result of husbands' and wives' shared goals of household efficiency in economic and childcare behaviors. The risk model indicates divergent goals for husbands and wives, with husbands focused on social status and future reproductive opportunities and wives focused on feeding themselves and their children.

Women who sell seem to do so and to take on more short-term economic risk because they have a buffer against long-term risk: they have a husband who stays home with their children while they are out selling and more available alloparents than other women, both of which allow them to stop exclusively breastfeeding almost 3 months earlier than other women and do work that is incompatible with childcare ( $t = 1.85$  (45),  $p < 0.10$ ). Ecology is also playing a role. Women who sell live closer to a market than women who stay home and farther from the Meghna than women who fish. Living closer to a market results in easier access to the goods women sell, lowering transaction costs. Living farther from the Meghna means that fishing is most reliably profitable during the rainy season. This may mean that women's selling is a better option than any fishing – either men's or women's – would be during the dry season. These findings are supported with the results from the binomial logistic regression, which show that men who stay home as primary caregiver of children for half of the year have wives who are more likely to sell goods and take on more risk, have more alloparents available, and are more likely to live near extended family than men who work all year.

Women and men also appear to respond dynamically to one another's subsistence and childcare behaviors, as an economy of scale model would predict. Not only do men parent in response to women's risk and occupation, but women respond to men's reduced subsistence behavior by working more hours and taking on more risk. Contrary to expectations, however, women's and men's pursuit of higher-variance strategies are not complementary of one another, based on coefficients of variation. However, results showing that the husbands of women who take on more variance work fewer hours per week and earn less money suggests a potential for complementarity. The economy of scale model would predict that women would increase their economic risk as men lower theirs in order to buffer against short-term risk for the family and ensure that children and parents have enough food to eat. The risk model would predict a similar outcome, with one sex taking on less risk in response to the other's high-risk strategies.

There are two potential explanations for this positive association between Shodagor women's and men's risk. First, the Shodagor may be mating assortatively on risk. That is, more risk-prone women marry more risk-prone men, and vice versa. We know that humans engage in assortative mating on other characteristics (e.g., Buss, 1984), though whether or not this is the case for risk-taking strategies among the Shodagor is currently unclear. Second, and in line with the economy of scale model, women and men could be working cooperatively to pursue a common goal that goes beyond subsistence purposes. Such goals may include buying land, building a home on the land, or forms of home improvement. Previous research on Shodagor nutritional outcomes suggests that household income does not significantly affect the height, weight, or BMI of children or parents (Starkweather and Ahsan, in prep), indicating that

nutritional needs may be adequately met through fishing and that minimal income is necessary for providing adequate food. Shodagor husbands and wives may both pursue higher-risk strategies than their peers in hopes of producing higher-reward returns that would enable them to meet a goal that requires more than just a few days' income. Finally, it is true that fishing is low risk compared to selling and that even men who pursue "higher-risk" strategies take on relatively low levels of risk. So, while men's risk increases or decreases along with women's risk, the absolute change in risk for men may be minimal and may still be low enough to buffer against women's higher-risk strategies.



## **CHAPTER 4: Effects of household traits and heritable variation on Shodagor health**

Coauthored with Monica H. Ahsan

### **Introduction**

Growth-related health research is important because it identifies individual and population-wide challenges related to nutrition, illness, or other aspects of the socioecology. Poor growth and health outcomes continue to be major problems in Bangladesh and other developing nations, where they are linked to malnutrition (de Onis et al. 2012) and chronic illness (Adair and Guilkey, 1997; Blackwell et al., 2001; Engeland et al., 2003). Among children and adults, these conditions lead to high levels of morbidity and mortality (Chen et al., 1980; Nandy et al., 2005; WHO, 1995), and can lead to lowered reproductive success for adults (Martorell et al., 1981; Blackwell et al., 2001; Sear et al., 2004; Stulp et al., 2012). Children rely on parents and other family members (as well as themselves in some circumstances) to provide adequate nutrition to support growth as well as protection from and care for illnesses that can negatively impact height and weight. A number of direct and indirect measures of this investment – such as calories (e.g. de Onis et al. 2012), breastfeeding duration (e.g. Bloss et al., 2004; Nahar et al., 2010), number and severity of illnesses (e.g. Adair and Guilkey, 1997; Silventoinen, 2003), household income (e.g. Behrman & Deolalikar 1988; Foster 1995), and parental education (e.g. Alom et al., 2012; Rieger and Trommlerova, 2016) – have been shown to impact growth and health outcomes across societies.

The Shodagor of Matlab, Bangladesh are a semi-nomadic community of people who live and work on small wooden boats, surrounded by water year-round. Nearly all (90%) of Shodagor men fish as their primary occupation. Shodagor women either fish with their husbands (31%), sell household goods door-to-door in the villages (44%), or stay home as housewives (25%). They are one of only a few groups in the world whose people live on boats (see Ivanoff et al. 1997 and Sather 1997 for other examples). They are also culturally distinct from land-dwelling Bangladeshis (Ahmed 1962), and their lifestyle results in important ecological differences as well with respect to economic opportunities and child risk. Prior to this study, which took place over 12 months in 2011 and 2014, no ethnographic or empirical research has been conducted among the Matlab Shodagor. Therefore, we know very little about Shodagor growth, health, or factors that may be impacting health in children and adults in this population. There is a set of unusual socioecological constraints that the group faces which likely influences particular aspects of parental investment and the nuclear family in this population, in turn influencing the health outcomes of its members.

For the majority of this population, all components of family life are carried out on small wooden boats, including cooking, cleaning, eating, playing, and sleeping. This constrains household (boat) membership to the nuclear family. It also presents a unique risk of drowning to young children who are unable to swim, resulting in primary care of children under the age of 5 almost always being relegated to the mother or father. In some families, the father even stays home for 6 months of the year as primary caregiver of children while the mother works – an extremely unusual behavior cross-culturally. Economic practices are also focused on the nuclear family with sharing of either fish or

money rarely occurring outside of the nuclear family, and with husbands and wives in several families fishing together year-round. Finally, nearly half of all Shodagor women engage in an occupation that opposes two of the most common trends that characterize women's work across all types of societies: women's work is almost always more compatible with childcare than men's work, and women's work tends produce more reliable returns than men's work. In contrast, selling goods door-to-door is completely incompatible with childcare and produces much more variable returns than fishing. One set of measures that have a consistent impact on growth and health in the developing world are those that measure increasing female autonomy – typically women's income and decision-making authority (e.g. Engle, 1991; Folbre, 1986; Reiger, 2016). In all cases, the more autonomy a woman has in a household, the less likely her children are to suffer from poor growth measures. Shodagor women who sell goods have a significant amount of autonomy, while Shodagor women who fish or stay home have less autonomy than women who sell but more than most Bangladeshi women who live on the land.

The purpose of this paper is to characterize the impacts of socioeconomic variables on the health outcomes of children, mothers, and fathers in this population, and to estimate the amount of variation in height, weight, and BMI attributed to genetic variation among the Shodagor. Based on the unique Shodagor socioecology and the strong nuclear family focus of childcare and economic efforts, we expect direct and indirect measures of investment that are concentrated within the nuclear family to contribute to the health of all family members, but such predictors may have different effects on different members of the nuclear family. We estimate heritabilities of height, weight, and BMI using an "animal model" framework (Kruuk, 2004), incorporating

complex genealogical relationships in the population to derive genetic variance components. These results exclude the effects of relatedness and highlight socioeconomic variables of importance to health outcomes, and can be used to inform policy and aid campaigns focused on the Shodagor and other populations in Bangladesh.

### *Direct Effects on Growth*

Growth is affected by a number of factors that are related to an individual's socioecology as well as factors that are either direct or indirect measures of parental investment – any investment by the parent in a child that increases the child's chance of survival at the cost of the parent's ability to invest in other children (Trivers 1972). The most direct way a parent can invest in a child's growth is by providing food, as this plays a role in determining how much energy is available for growth (Gunnell et al. 2000; Rivera et al. 1995; Silventoinen 2003). Chronic caloric deficits during childhood lead to growth stunting – or low height-for-age, which reflects a process of failure to reach linear growth potential (WHO, 1995) – while caloric deficits during adulthood and acute bouts of under-nourishment during childhood are associated with low body weight relative to age and height (de Onis et al., 2012). Total caloric intake is not the only important measure of nutrition, however. Micronutrient deficiencies early in life, particularly protein deficiencies, have also been linked to growth stunting (Demment et al. 2003; Underwood 1999) and low body weight relative to age (Truswell 2012). The Shodagor diet consists mainly of rice and fish and occasionally a very thin lentil soup (*dal*) and most individuals eat 2-3 times per day. Families who live near major markets and who have higher household incomes may also occasionally eat vegetables and

chicken, but regardless of income, fish is a reliable source of protein that is available to families in which one or more of the adult members fishes for a living (see Tables 11a and 11b. for summary statistics). Therefore, we predict that **families for whom fish is available for at least a portion of the year will have children and parents who are taller, weigh more, and have higher BMIs than families who do not have access to fish.**

Table 11a. Summary statistics (Continuous predictor variables)

Variable	<i>n</i>	Mean	SD	Min	Max
Number of Children	173	4.07	2.56	1.00	9.00
Household Income (Ln)	173	11.32	2.09	0.00	12.95
Wife's Income Percentage	173	0.39	0.30	0.00	1.00
Years Exclusively Breastfed	173	0.81	0.56	0.04	3.00

Table 11b. Summary statistics (Categorical predictor variables)

Variable	<i>n</i>	Variable	<i>n</i>
Sick Last Year (dummy)		Access to Fish	
Yes	83	No	6
No	90	½ Year	57
Lifetime Illness (dummy)		All Year	110
Yes	12	Parental Education (dummy)	
No	161	Yes	29
Mother's decision-making		No	144
Yes	132		
No	41		

Breastfeeding is another form of direct investment in a child's nutrition. It is energetically costly for mothers, but has proven positive effects on children early in life (Oddy, 2001). Exclusive breastfeeding for the first 6 months of life is associated with better growth, improved immunity, and lower rates of severe malnutrition, while earlier weaning is associated with poorer measures of growth (e.g. Bloss et al., 2004; Nahar et al., 2010). However, after the first 6 months of life exclusive breastfeeding can no longer sustain infant growth and development (Hinde and Milligan, 2011; McDade and

Worthman, 1998) and the impact of breastfeeding on growth once children's diets are supplemented with other food sources becomes more difficult to characterize. The World Health Organization (WHO) (2001) recommends supplementary breastfeeding up to and beyond 2 years, and some reports from the developing world indicate positive impacts of prolonged breastfeeding on growth (e.g. Marquis et al., 1997; Onyango et al., 1999). Others show a negative effect on growth when breastfeeding is extended into the toddler years (e.g. Fawzi et al., 1998) and some studies have found no relationship at all (e.g. Bhutta et al., 2008; Mattison et al., 2015). One clear positive impact of breastfeeding on children is increased immunity throughout childhood (McDade et al., 2014), which may indirectly affect growth. In accordance with WHO standards, Shodagor mothers breastfeed exclusively for an average of 9.3 months and continue supplementary breastfeeding until children are an average of 2 years and 3 months old. Mothers report stopping exclusive breastfeeding for a number of reasons, including so that they could return to work and because they were losing too much weight. Supplementary food varies between families, but common foods given to supplement breastfeeding are bananas, a mixture of rice and cow's milk, and biscuits. We predict that **longer duration of breastfeeding will positively impact children's height, weight, and BMI and negatively impact mothers' weight and BMI.**

#### *Indirect Effects on Growth*

Infectious diseases like diarrheal diseases and some respiratory illnesses have negative impacts on child weight and on height when such diseases are chronic (Rowland et al. 1977; Adair & Guilkey 1997; Cole & Parkin 1997; Silventoinen 2003). This is of

particular concern in Bangladesh where diarrhea, respiratory illnesses, and other infectious disease are common among children (UNICEF 2009), where these have been linked to poor growth outcomes (Black et al. 1984; Rahman et al. 2009) and where rates of immunization and access to health care are low among the poorest families (Chowdhury et al. 2003). Not all illnesses have the same effects on child growth, however. Rowland, et al. (1977) found negative relationships between gastroenteritis and child height and weight and between malaria and child weight in The Gambia, but did not find relationships between other categories of illness and measures of child growth. Therefore, while we may expect longer bouts of diarrhea to affect child growth, one ear infection or cold may not have the same impact. In some cases, illness may be an indirect measure of parental investment as health behaviors like doctor visits and immunizations may prevent or lessen the frequency, length or severity of illnesses (Timus & Lush 1995). Shodagor parents generally report few serious lifetime illnesses and less serious illnesses over the previous year for themselves and their children. They also report seeking help for children's minor illnesses 97% of the time during the previous year. Therefore, we predict that **number of serious lifetime illnesses will negatively impact growth for all individuals, though whether a child or parent has had any sickness over the last year will have no effect on growth measures.**

The size of a family can also influence growth of all of its members. As Trivers (1972) points out, investment in one child is often given at a cost to their siblings and, intuitively, more individuals in a household requires resources to be spread thinner, and several studies have shown that large family size is a risk factor for malnutrition. This is especially true for societies in the developing world or small-scale societies where food

and money are sometimes scarce anyway. For example, in a sample of Bedouin children from 1982, current family size had a negative impact on height-for-age for all members (Forman et al., 1995). In a highland Mexican region, children from larger households are significantly shorter and consume diets of poorer quality than those from smaller households (Pelto et al., 1991). For the Maya, a small-scale farming community in southeastern Mexico, larger family size was associated with lower height and weight, though younger siblings had the greatest impact on older siblings' growth (Kramer et al., 2016). In Timor-Leste, higher numbers of children were associated with lower height but higher BMIs within the family, though short stature was likely confounding BMI results (Judge et al., 2012). Depending on the society, household makeup can vary greatly. In rural Bangladesh for example, non-Shodagor families live in extended-family households where results have been mixed: Joshi and Schultz (2007) showed a reduction in fertility improved the weight and BMI measures of family members, while Perry (in press) found that number of children in a family did not impact height or weight of family members. In Shodagor nuclear family households where the only household members are parents and children and number of children ranges from 1 to 9 with an average of 4.07, we expect number of children to be more likely to impact growth than total household size. Specifically, we predict that **higher numbers of children in a family will be associated with lower height, weight, and BMI for the children and lower weight and BMI for parents.**

Household income is often used as a measure of indirect parental investment and is positively correlated with child growth outcomes in a number of developing societies around the world (Black et al. 2013; Mani 2014; Krishna et al. 2015) including in



Bangladesh (Foster 1995; Perry, in press). In foraging societies, all or the majority of food children eat comes directly from the environment, therefore, types and amounts of food children have access to are dependent upon parents' foraging success (as well as the success of other adults in societies where resource sharing is common) (Hagen et al. 2001; Marlowe 2003; Sear & Mace 2008). In societies with cash-based economies, however, the amount and types of food available to children are dependent upon parents' incomes as well as parents' decisions regarding food expenditures (Haddad et al. 1997). Average annual household income for the Shodagor is 149,171 BDT (Bangladeshi taka), which is approximately 1,888.00 American dollars, though incomes range from 31,200 BDT (~\$394.94) to 422,933 BDT (~\$5,353.58). Given the Shodagor mixed economy, diets are limited both by fishing success and household income, but informal qualitative interviews with Shodagor indicate that families with higher incomes occasionally buy vegetables and different types of protein like chicken or duck. Therefore, **higher household income should have a positive impact on height for children and on weight and BMI for all family members.**

Nutrition, illness, and income are interrelated and all affect child height and weight, but the relationship is complicated. We know that low income is associated with poor nutrition, higher rates of illness, and poor growth measures (Behrman & Deolalikar 1988; Dasgupta 1994; Foster 1995). We also know that particular micronutrients in the diet not only impact growth (Demment et al. 2003; Underwood 1999), but also affect health, as Lim, et al. (2012) found in a comparative risk assessment across 21 regions of the world. What is unclear, however, is the relationship between household income and nutritional quality of the family's food across societies: an increase in household income

does not always result in an increase of micronutrients in the diet (see Haddad et al. 2003 for a review). One potential explanation for this is that it may not be the amount of income but the *income earner* that determines how money is spent.

In a number of cases an increase in mother's income, education, or decision-making authority in the household has a positive impact on child growth measures (Engle 1991; Folbre 1986; Hoddinott & Haddad 1991; Phipps & Burton 1998; Rouf 2011; Reiger 2016). Case studies across cultures have found that men, compared to women, disproportionately spend their income on goods for their personal consumption while women are more likely to purchase goods for the household, and particularly for children (Guyer, 1980; Folbre, 1986; Guyer and Peters, 1987). Hoddinott and Haddad (1991) found similar results for women in Cote d'Ivoire indicating that an increase in the percentage of household income that is made by women results in a higher proportion of the household budget spent on food as well as better height-for-age measures for children. Similar findings have been repeated in Canada (Phipps and Burton, 1998), Guatemala (Engle, 1991), and Bangladesh (Rouf, 2011).

On average, Shodagor women earn 39.5% of the household income with men earning the remaining 60.5%. Women also have a fair amount of autonomy within the family and the society. Women and men report at an equal rate that women help make decisions about how to spend money on food (52%), household items (61%), and sending children to the doctor (60%). Qualitative life history interviews conducted in 2011 indicate that women have been working outside the household, trading and selling goods, for at least the last 50 years. They also indicate that women have played a role in family decision-making throughout the group's history. Income-earning and decision-making

authority are two commonly used measures of female autonomy worldwide (Balk 1997; Blumberg 1994) and are also linked to better child growth outcomes, as discussed above (Engle 1991; Folbre 1986; Hoddinott & Haddad 1991). Mother's education seems to have a similar impact on child growth, improving height (e.g. Thomas et al., 1990; Semba et al., 2008; Rieger and Trommlerova, 2016) and BMI (e.g. Ahmed et al., 1998), however father's education may also positively affect child growth (e.g. Alom et al., 2012). It is very uncommon for Shodagor adults to have any education. Only 13% of the adults in this study have any education, including having learned to read or write. It is becoming more common for parents to send their children to school now, but is still rare with only 18.5% of children age 18 and under receiving any education. We predict that **measures of female autonomy – percentage of household income and decision-making authority – as well as parents' education will have a positive impact on child height, weight, and BMI and adult weight and BMI.**

### *Inheritance of Body Size*

Substantial genetic components of height, weight, and BMI have been well-established in human populations, indicating that there is some amount of variation in these health measures that can be attributed to genetics independent of environmental influences (Visscher et al., 2008). The exact amount of variation in these variables attributed to genetic variation varies greatly between populations, throughout the lifespan, and across growth measures. Previous studies indicate heritabilities that range from 60-90% for height (e.g. Macgregor et al., 2006; Silventionen et al., 2003; Yang et al., 2015), 40-85% for weight (e.g. Dubois et al., 2012), and 30-90% for BMI (e.g. Maes et al.,

1997; Nan et al., 2012; Yang et al., 2015). Quantifying the proportion of variation in height, weight, and BMI attributed to genetic variation among the Shodagor is informative of the relative impacts of genetic and environmental variables on these health outcomes.

Environmental quality should have a predictable impact on the additive genetic effect of growth (Silventoinen, 2003). In poorer-quality or more variable environments, like those found in Bangladesh and other parts of the developing world, there are more factors that could negatively impact growth and a higher probability that one aspect or another of the environment will afflict a large portion of the population. Therefore, environmental factors should account for more variance in growth measures than genes (Roberts et al., 1978; Silventoinen, 2003). In other words, we expect genetic variation to be lower relative to environmental variation among populations with variable environments. However, as the environment improves and there is less variation across individuals, genetic contributions should account for more variance. Most of the current heritability estimates for height, weight, and BMI come from the developed world. A study of twin cohorts across eight affluent Western societies showed that, in general, there are only minor differences between populations in how much influence genetics have on variation in height (Silventoinen et al., 2003). However, one study examined the impact of the Second World War on height between individuals living in Finland and Sweden and found that the poorer and more variable health and nutritional environment experienced by Finns before the war had a negative impact on height, which improved as the Gross National Product in Finland increased rapidly post-war (Silventoinen et al., 2001).

Age can also affect heritability of growth measures, though there is some dispute about the overall effect of shared environment on these measures. While some studies show a decrease in heritability with age (i.e. Nan, et al. 2012), others show an increase, particularly for weight and BMI (i.e. Dubois, et al. 2012). Again, the key factor should be variance within the environment – if individuals are exposed to more environmental variation as they age, the additive genetic effect should decrease with age and vice versa.

Finally, each of these measures is differentially susceptible to environmental influence throughout the lifespan, leading to more or less variability in additive genetic effect. Height is a long-term measure that reflects a process of additive effects throughout childhood and adolescence that are the result of continuous states of optimal or suboptimal health and/or nutritional conditions (WHO, 1995). Growth in height is finished for all individuals by the age of 19 (de Onis et al., 2007), but stunting in growth can occur due to acute bouts of poor health or malnutrition during childhood. While catch-up growth may occur once the cause for stunting is removed, if the cause becomes chronic, short stature will result and cannot be reversed once a child reaches puberty (Prader, 1977).

In contrast, weight represents a synthesis of linear growth and body proportion that responds to both long-term and short-term changes (de Onis et al., 2012). Weight can be a complex trait to interpret because, for example, low body weight-for-age measures fail to distinguish between short people of adequate body weight and tall, thin people (WHO, 1995). Weight, as a measure of overall body size, is more susceptible to environmental influences throughout the lifespan than height.

BMI reflects whether or not an individual's weight is high or low for their height at any given age. Unlike independent measures of height and weight, changes in BMI primarily indicate short-term nutritional fluctuations (Rahman et al., 2009), and should be more sensitive to environmental changes throughout the lifespan than either height or weight. Therefore, it is not surprising that cross-cultural studies show heritability estimates for BMI that range from 30-90% (e.g. Maes et al., 1997; Nan et al., 2012; Yang et al., 2015).

A number of studies confirm that both genes and the environment contribute significantly to the variation in growth and completed body size (Schousboe et al., 2003; Xia, et al. 2016). However, teasing apart genetic from environmental effects can be challenging, particularly when related individuals also share an environment. Using an “animal model” – a form of mixed model first developed by quantitative geneticists and used for plant and animal breeding in which the explanatory terms are a mixture of fixed effects and the random effects of the additive genetic value of individual animals (Kruuk, 2004) – allows us to quantify genetic effects on height, weight, and BMI for the Shodagor. We estimate heritabilities using this model framework in order to understand how much of an impact household environmental factors and genetic variation each have on Shodagor height, weight, and BMI. This simultaneously informs us of the amount of variance in these traits that is left unexplained by our measured variables. **Regardless of the proportion of variance that is being explained, we expect genes to have the greatest explanatory power for height, given the low amount of plasticity in the trait. Weight and BMI should have lower heritabilities due to the flexibility of the traits in their ability to respond to changes in the environment.**

## **Methods**

### *Study Population*

This study focuses on the Shodagor of Matlab, Bangladesh. Matlab is a mostly rural subdistrict, located within Chandpur District, approximately 59 kilometers southeast of the capitol city of Dhaka (Figure 1). Matlab consists of a few small towns and approximately one hundred forty villages and is home to approximately 200,000 people (Bangladesh Bureau of Statistics 2010; ICDDR,B 2014). The Donagoda River, which is a branch of the Meghna River (one of the 3 largest rivers in Bangladesh) cuts through the middle of Matlab and flows into the Meghna at the southernmost tip of Matlab's landmass, just east of where the Meghna and Padma rivers meet. Shodagor people live throughout Bangladesh, though the exact locations and numbers are currently unknown. There has been no previous scholarly research published on the Shodagor of the Matlab region in English and apparently little in Bangla either; therefore all ethnographic data comes from observations, informal conversations, qualitative and quantitative interviews I conducted with the help of two Bangladeshi research assistants during 2011 and 2014.

Traditionally, all Shodagor were semi-nomadic, moving two to three times per year to different locations throughout Bangladesh. Now approximately half of all Shodagor families in Matlab move an average of 2 times each year – some moving throughout the country and some moving between *bohor* (distinct groups or clusters of boats) in Matlab. Other Shodagor families in Matlab move very infrequently or not at all. When not moving between locations, families always situate their houseboats within preexisting bohor – houseboats never reside permanently outside of a bohor. Smaller

boats are used as the primary mode of transportation for fishing and for traveling between the houseboat and the land.

Among the 5 Shodagor bohor in Matlab (Figure 1), size ranges from 8 to 32 households with an average size of 15 households. Seventy-one percent of all families live in the same group as some of their extended family members for at least part of the year. The largest bohor included in this study is made up of Shodagor families who have moved onto the land within the last 5 years and live in makeshift houses on very small pieces of land, as well as other families who live nearby in their boats. These families are heavily integrated with those living on boats through kin and cultural ties. There are other Shodagor families living in Matlab who have lived in houses that are similar to land-dwelling Bangladeshis' for 10 or more years who were not included in this study.

#### *Data Collection*

This study is based on interview and anthropometric data that were collected on 158 adults and 178 children over 9 months in 2014, resulting in an almost complete population sample of Matlab Shodagor. This research was reviewed and approved by the University of Missouri's Institutional Review Board as well as the Ethical Review Committee at the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b). All members of the Shodagor group in Matlab were eligible to participate in this study. Written consent was obtained from all participating adults. Adult parents or guardians also gave written consent for children's participation and prior to participation, children gave assent. This study includes data on 94 children from birth to age 18 as well as 37 fathers and 42 mothers for whom there were no missing data.



Quantitative survey interviews were conducted between May and July 2014. The survey focused on demographic information and family histories, basic economic data (such as income and occupation data), indirect parental investment data, and family and women's health histories. Fourteen adults either declined to participate for reasons including health issues, or were absent from the group every time interviews were conducted.

Anthropometric data was gathered in two rounds from adults and children. The first round of data was collected over a 1-month period during April and May 2014, which is the end of the dry season in Bangladesh and a time when incomes tend to be lower and fish less abundant. The second round of data was collected during August and September 2014 at the end of the rainy season. Length or height was collected depending on the age of the individual. For children who were unable to stand upright independently, they were laid on a flat surface and measured to the nearest 0.1 cm by stretching a tape measurer from heel to crown. All individuals who could stand upright independently stood on a flat surface and were measured to the nearest 0.1 cm by stretching a tape measurer from crown to the ground. Weights to the nearest 0.1 kg were collected using an electronic scale on a firm, flat surface. If children were too young to be weighed independently, they were weighed with their mother, whose weight was then subtracted from the combined total. Measures presented are cross-sectional.

### *Analysis*

We investigated heritable and socioecological sources of variation in health outcomes (height (cm), weight (kg), and BMI) among the Shodagor using linear mixed

models (LMMs). These enabled us to estimate genetic variance components (heritabilities) using the earlier described "animal model" framework (Kruuk, 2004), incorporating complex genealogical relationships in the population. Although our genealogy is limited to three generations, this method utilizes all types of relationships among individuals, including parents, offspring, siblings, half-siblings, cousins, etc. Therefore, these heritability estimates are based on more complex genealogical relationships than those resulting from standard single-parent offspring regressions (or other comparable methods). Prior to running LMMs, we screened predictor variables (potential fixed effects) (Table 12) and selected the best set of fixed effects to include in each model using the results of covariate screening with likelihood ratio tests (LRT). Each LMM had one random effect for each individual's identity within the genealogy, resulting in variance component estimates of heritable variation in height, weight, and BMI. Markov chain Monte Carlo (MCMC) simulations of LMMs produced variance component distributions of heritabilities as well as regression coefficient distributions for the selected predictors in each model. We modeled height, weight, and BMI outcomes for Shodagor children as well as their parents, including interaction effects for each predictor variable with a factor level variable specifying individual type (child, mother, or father). Results from these analyses are informative as to which predictor variables are relevant to health outcomes in this population, how those socioeconomic variables influence different members of the population (i.e. how each predictor influences each outcome for children, mothers, and fathers), and the extent to which heritable variation contributes to the variation in height, weight, and BMI in this population.

Table 12. List of all predictor variables screened for inclusion in LMMs.

Predictor Variables	
Number of children*	Wife's income percentage*†‡
Sicknesses (dummy)	Years exclusively breastfed†‡
Lifetime illnesses (dummy)	Parental education (dummy) †‡
Household income	Mother's decision-making (dummy)
Access to fish	

\* Retained in the height LMM  
 † Retained in the weight LMM  
 ‡ Retained in the BMI LMM

Body mass index (BMI) and accompanying statistics were calculated for children using the igrowup and WHO 2007 reference tables (de Onis et al., 2007) in R v. 3.3.1 (R Core Team, 2016). Adult BMI was calculated using the standard BMI equation (height (kg)/weight (m)<sup>2</sup>). Outliers were removed following visual inspection of data points that were flagged implausible by WHO cutoffs ( $\pm 6$  standard deviations) (Figures 5-7). Height (cm), weight (kg), and BMI were transformed in order to account for changing means and variances over age using Lambda-Mu-Sigma (LMS) curves. In order to account for the effects of age and sex on height, weight, and BMI, we fit LMS curves to each outcome variable separately for males and females (Figures 8-10) (Cole, 1990). In order to maintain reliable fit of LMS curves at older ages with few data points, we truncated age for height at 30 years. Age was truncated at 50 years for weight and BMI (Figures 8-10). We fit LMS curves across ages 0-30 years for height, and 0-50 years for weight and BMI within sex using the GAMLSS package in R (Rigby and Stasinopoulos, 2005). We then took z-scores of each outcome variable from its respective LMS curve to account for the effects of age and sex on height, weight, and BMI (Figures 11-13). These z-scores were

then used as the outcome variables in the LMMs, eliminating the need to include age and sex as fixed effects.

Figure 5. Height (cm) by age (years) for children, mothers, and fathers.

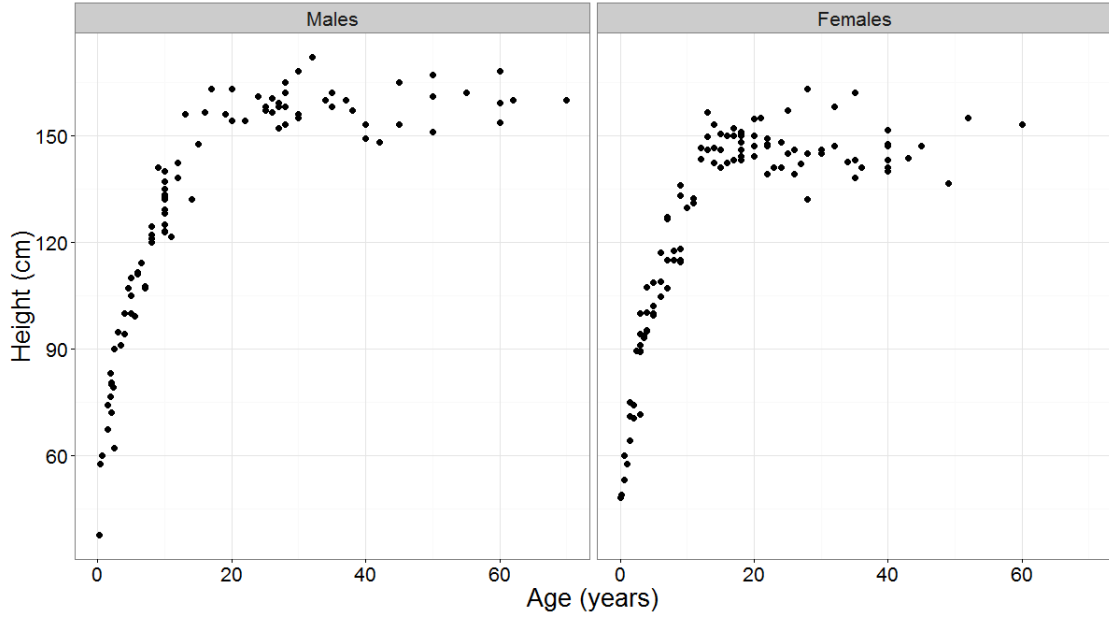


Figure 6. Weight (kg) by age (years) for children, mothers, and fathers.

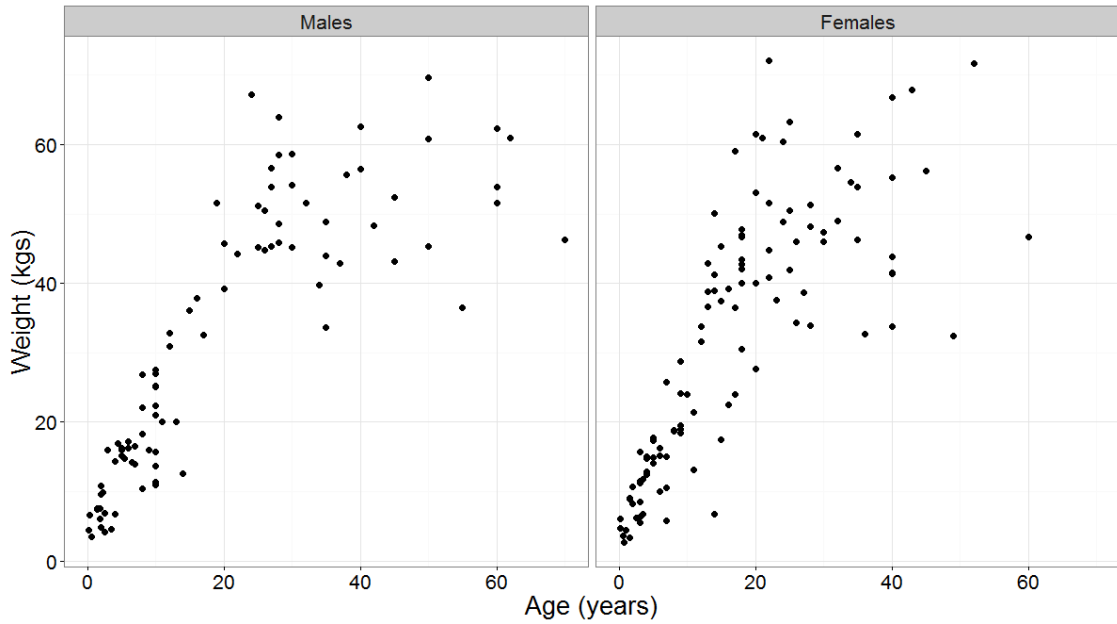
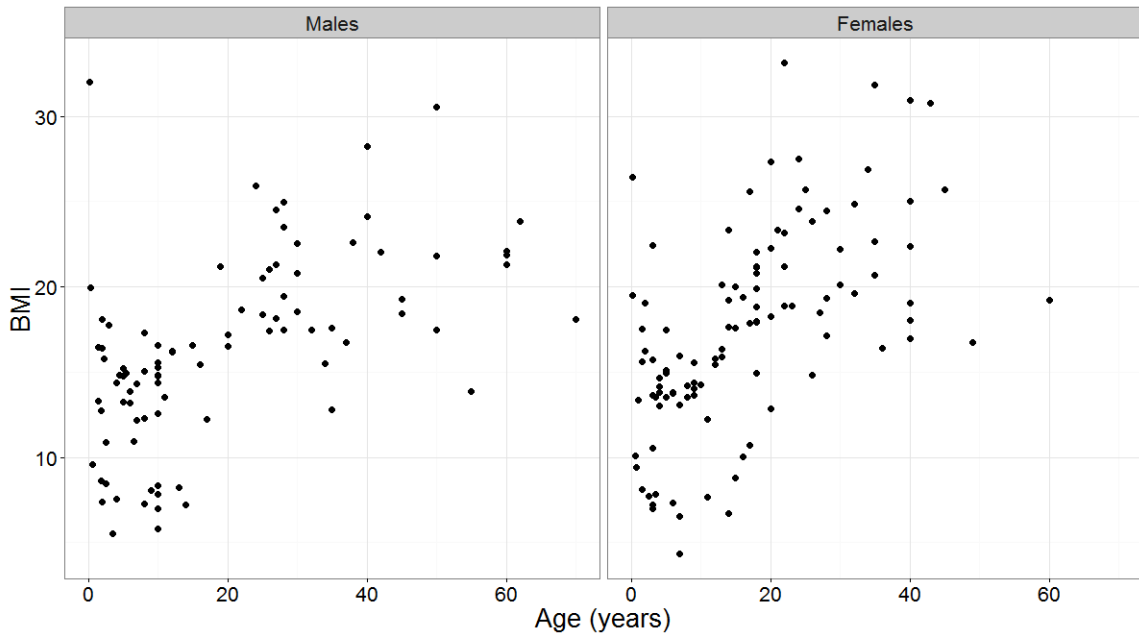


Figure 7. BMI by age (years) for children, mothers, and fathers.



In order to assess which socioecological traits are associated with health outcomes among the Shodagor, we screened nine predictor variables (Table 12). Number of children refers to the number of children in each child's household, and years exclusively breastfed reflects the amount of time in years that each child was breastfed exclusively. All screened predictors are household-level variables, and are thus shared between children and their parents. Sickesses, lifetime illnesses, parental education, and mother's decision-making are all dummy variables for each household, for example indicating whether either parent has any education in the household, etc. Household income was log-transformed, and access to fish is a categorical variable indicating whether members of a household have access to fish none of the year, half of the year, or all year. We used the Solarius package in R (Ziyatdinov et al. 2016) to screen these nine covariates with the z-scored outcome variables, implementing likelihood ratio tests (LRTs) and choosing the most likely combinations of predictors to include as fixed effects in subsequent LMMs. A

subset of the data containing all individuals with non-missing information for the selected predictors was used for each model to retain maximum sample size.

Since these data are comprised of nuclear families, we used LMMs to estimate genetic variance component ratios of heritability for each outcome variable separately. By using a mixed model framework, we simultaneously modeled identity within the genealogy as a random effect to estimate heritability as well as selected fixed effects to estimate their socioecological impacts on the outcome variables independent of confounding genetic variation. We ran three LMMs with the LMS z-scores of height, weight, and BMI as the outcome variables, fixed effects selected from the LRT covariate screening, and a random, estimated genetic effect for each model. This random effect produces genetic variance components, capturing any variation in the outcome variables that can be attributed to shared genes among relatives represented by relatedness among individuals in the genealogy. Equation 1 shows the general LMM in matrix form.

$$y = X\beta + Z_1u_1 + e \quad (1)$$

$y$  is the  $n \times 1$  vector of the outcome variable (z-scores of height, weight, or BMI).  $X$  is an  $n \times p$  matrix of the  $p$  fixed effects, and  $\beta$  is a  $p \times 1$  vector of fixed effect regression coefficients.  $Z$  is an  $n \times q$  design matrix representing  $q$  random effects with  $u$  as the vector of solutions for each random effect (only one for genetic variance in these models), and  $e$  is the residual error (Kruuk, 2004). The fixed effect matrix ( $X$ ) associates height, weight, or BMI z-scores with the respective predictor variables. Random effect matrix ( $Z$ )

situates individuals within the genealogy, capturing their relatedness to everyone else in the population.

We ran MCMC simulations of all LMMs using the MCMCglmm package in R (Hadfield, 2010) in order to obtain posterior distributions of genetic variance components and fixed effect results. MCMC simulations ran for 10,500,000 iterations with a burn-in of 500,000 and thin of 10,000 in order to retain 1,000 samples for the posteriors. We used parameter expanded priors for all models to facilitate chain mixing by setting prior means to 0 ( $\alpha.\mu = 0$ ) and prior covariance matrices to 1,000 ( $\alpha.V = 1000$ ). Variance component distributions of the random genetic effect were used to calculate heritability ratios that represent the proportion of variation in the outcome variables attributed to genetic variation (Equation 2).

$$h^2 = \frac{V_g}{V_g + V_e} \quad (2)$$

$V_g$  is the vector of 1,000 random effect variance components, and  $V_e$  is the vector of residuals. This produced distributions of 1,000 variance component ratios (heritability estimates) for each outcome variable. Fixed effect coefficients produced results that show the impact of each predictor on the respective outcome variable for each type of individual in the population (children, mothers, and fathers). This was produced by including interaction terms for "type" of individual with each fixed effect within the LMMs. Heritability estimates reflect population-wide genetic variation for each trait (they are not specific to the "type" of individual).

## Results

There were 227 individuals in the genealogy used for deriving heritability estimates (Table 13). Although this genealogy only includes three generations, all relationships between parents, offspring, siblings, half-siblings, etc. are utilized in this animal mixed model framework. 173 individuals were retained in the final phenotypic dataset used for running LMMs, representing 94 children, 37 fathers, and 42 mothers. Raw height data from these individuals show predictable height patterns across age, with increasing variance at later ages (Figure 5). Weight shows more variation across all ages compared to height, particularly for adults over 30 (Figure 6). BMI displays the most variation in young children, as we would expect from such a composite measure, and continues to exhibit large variance across all ages (Figure 7).

Table 13. Descriptive genealogy statistics.

Individuals	227	Maternal grandmothers	107
Maternities	222	Maternal grandfathers	107
Paternities	222	Paternal grandmothers	99
Full sibs	564	Paternal grandfathers	99
Maternal sibs	6291	Maximum pedigree depth	3
Maternal half sibs	651	Mean pairwise relatedness	0.038
Paternal sibs	7214		
Paternal half sibs	1574		



Figure 8. LMS (lambda-mu-sigma) curve fit for height (cm) across age (years) in females and males. Centile curves are marked at 0.38, 2.27, 9.1211220, 25.25, 50, 74.75, 90.88, 97.72, and 99.62 as justified in Cole (1994). Age was truncated at age 30.

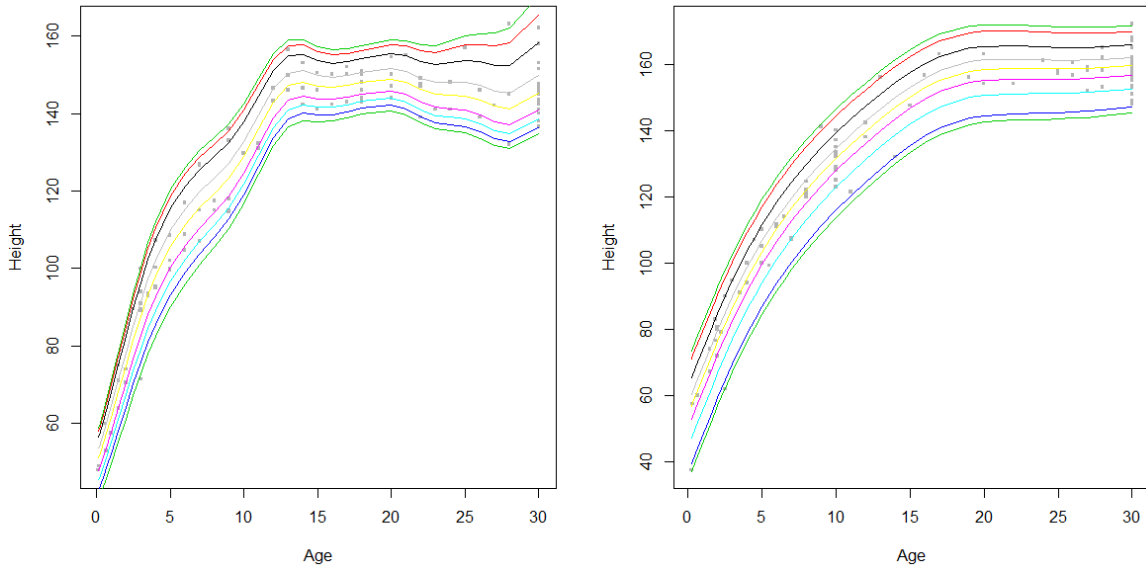


Figure 9. LMS (lambda-mu-sigma) curve fit for weight (kg) across age (years) in females and males. Centile curves are marked at 0.38, 2.27, 9.1211220, 25.25, 50, 74.75, 90.88, 97.72, and 99.62 as justified in Cole (1994). Age was truncated at age 50.

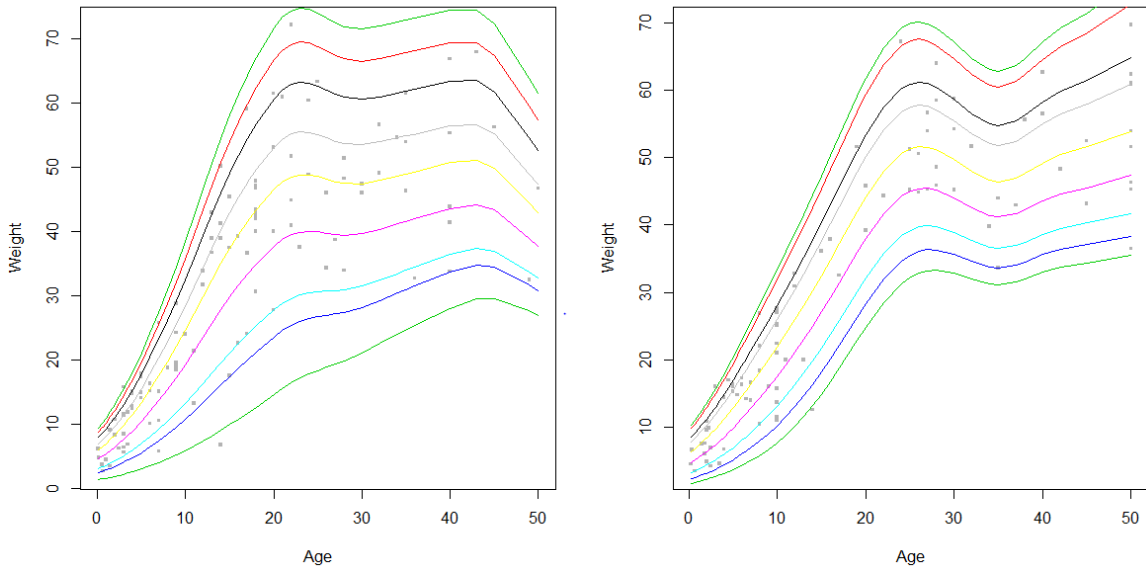
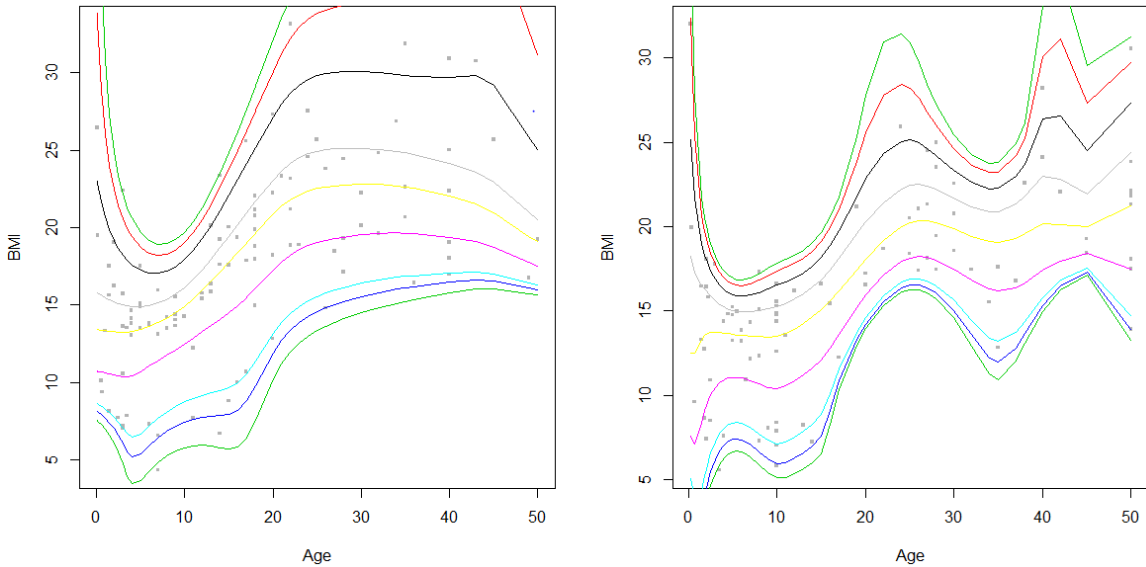


Figure 10. LMS (lambda-mu-sigma) curve fit for BMI across age (years) in females and males. Centile curves are marked at 0.38, 2.27, 9.1211220, 25.25, 50, 74.75, 90.88, 97.72, and 99.62 as justified in Cole (1994). Age was truncated at age 50.



LMS curves provide normalized centile standards for this population from which to calculate z-scores (Figures 8-10). LMS curves are used to produce growth curves when repeated measures are available for a set of individuals (Cole, 1990), but they allow us to obtain centile standards for the Shodagor using cross-sectional data by fitting curves through trends in the trait means and variances across age. Using this method separately for each sex then accounts for both the effects of sex and of age on the outcome variables. Z-scores calculated from these LMS centiles are specific to this population, and the effects of age and sex no longer appear in these transformed variables (Figures 11-13).

Figure 11. Z-scores of height LMS curve for females and males.

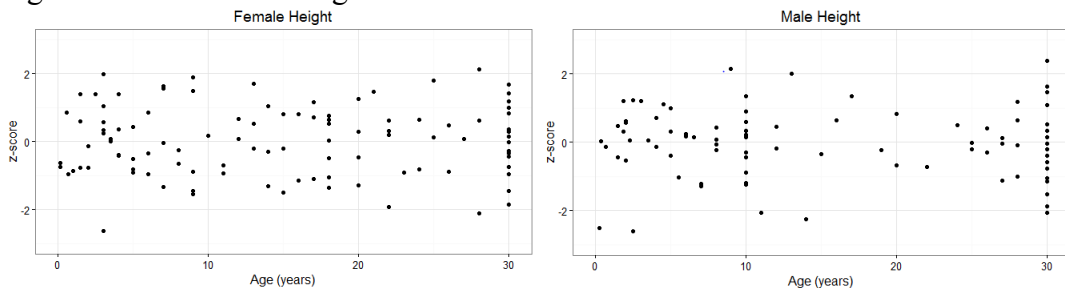


Figure 12. Z-scores of weight LMS curve for females and males.

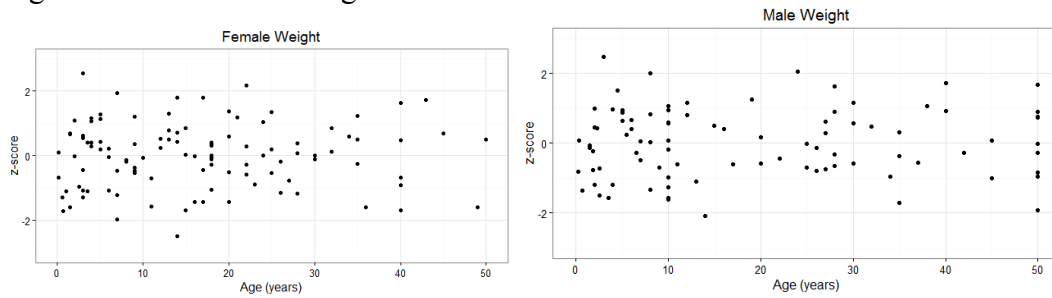
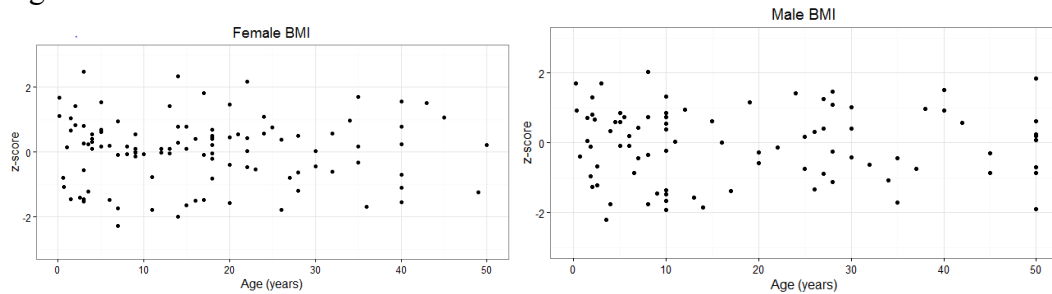


Figure 13. Z-scores of BMI LMS curve for females and males.



Results of covariate screening with likelihood ratio tests revealed that the number of children in each nuclear family, wife's income percentage, average years children were breastfed, and parental education covary with health outcomes among the Shodagor (Table 12). The effects of these variables were partitioned by individual type, revealing their separate impacts on children, mothers, and fathers in this population. Betas and credible intervals in Tables 14-16 are reported directly for children from the model results, because they were the intercept group in these models. Model results produced beta differentials for "types" mother and father relative to "type" child, so we added these differentials to the estimates for children in order to produce interpretable betas and credible intervals for all types of individuals. Furthermore, these fixed effects are independent of any confounding genetic influence because genetic variance is simultaneously modeled as a random effect in these LMMs from the genealogy.

Neither number of children nor wife's income percentage has a significant relationship with height for children, mothers, or fathers (Table 14). Number of children

in the household shows the strongest relationship with height among children, exhibiting a weak positive average impact on their heights. Wife's income percentage has quite variable effects on all types of individuals, particularly fathers. Credible intervals for this fixed effect span wide ranges, indicating that the relationships between wife's income percentage and height vary in this population (Table 14). The marginal  $R^2$  statistic for this LMM represents the amount of variation in z-scored height attributed to these two fixed effects (Table 17) (Nakagawa and Scheilzeth, 2013). Number of children and wife's income percentage explain 5.7% of the variation in the outcome variable height.

Table 14. MCMCglmm fixed effect posterior means, 95% credible intervals, and significance tests for the height model.  $\beta$ s are reported separately for each type of individual (child, mother, or father), showing the impact that each fixed effect has on height for each type of individual in the population. Credible intervals encompass 95% of the 1,000 samples retained for each estimate.

<b>HEIGHT</b>						
	<b>Number of Kids</b>			<b>Wife's Income %</b>		
	$\beta$	CI	MCMC <i>P</i>	$\beta$	CI	MCMC <i>P</i>
<b>Child</b>	0.082	(-0.019, 0.172)	0.084	0.271	(-0.520, 0.936)	0.452
<b>Mother</b>	-0.012	(-0.247, 0.215)	0.178	0.930	(-0.932, 2.756)	0.228
<b>Father</b>	0.024	(-0.215, 0.257)	0.424	1.084	(-1.055, 2.993)	0.240

Table 15. MCMCglmm fixed effect posterior means, 95% credible intervals, and significance tests for the weight model.  $\beta$ s are reported separately for each type of individual (child, mother, or father), showing the impact that each fixed effect has on weight for each type of individual in the population. Credible intervals encompass 95% of the 1,000 samples retained for each estimate.

	WEIGHT								
	Wife's Income %		Breastfeeding (years)		Parent Education				
	$\beta$	CI	MCMC P	$\beta$	CI	MCMC P	$\beta$	CI	MCMC P
<b>Child</b>	0.047	(-0.656, 0.751)	0.908	0.025	(-0.363, 0.398)	0.876	-0.460	(-1.034, 0.176)	0.132
<b>Mother</b>	-0.473	(-2.212, 1.380)	0.382	-0.535	(-1.484, 0.468)	0.066	-0.052	(-1.468, 1.425)	0.372
<b>Father</b>	0.772	(-1.169, 3.002)	0.262	-0.850	(-1.884, 0.189)	0.010	0.485	(-1.087, 2.196)	0.074

Table 16. MCMCglmm fixed effect posterior means, 95% credible intervals, and significance tests for the BMI model.  $\beta$ s are reported separately for each type of individual (child, mother, or father), showing the impact that each fixed effect has on BMI for each type of individual in the population. Credible intervals encompass 95% of the 1,000 samples retained for each estimate.

	BMI								
	Wife's Income %		Breastfeeding (years)		Parent Education				
	$\beta$	CI	MCMC P	$\beta$	CI	MCMC P	$\beta$	CI	MCMC P
<b>Child</b>	-0.261	(-0.991, 0.481)	0.470	-0.179	(-0.571, 0.201)	0.392	-0.493	(-1.077, 0.114)	0.116
<b>Mother</b>	-1.047	(-2.920, 0.800)	0.178	-0.416	(-1.409, 0.653)	0.476	-0.086	(-1.690, 1.369)	0.384
<b>Father</b>	0.014	(-1.953, 2.212)	0.724	-0.778	(-1.822, 0.342)	0.086	0.080	(-1.541, 1.754)	0.306

Average years children were breastfed has a significantly negative relationship with father's weight, indicating that the longer children are breastfed, the less their fathers tend to weigh (Table 15). This fixed effect exhibits a nearly significant negative relationship with mother's weight. Parent education has a nearly significant relationship with weight in fathers, showing that men in families where one parent has some education weigh more on average. Wife's income percentage has variable effects on weight in all types of individuals, as it did with height. These fixed effects account for 12.6% of the variation in z-scored weight (Table 17).

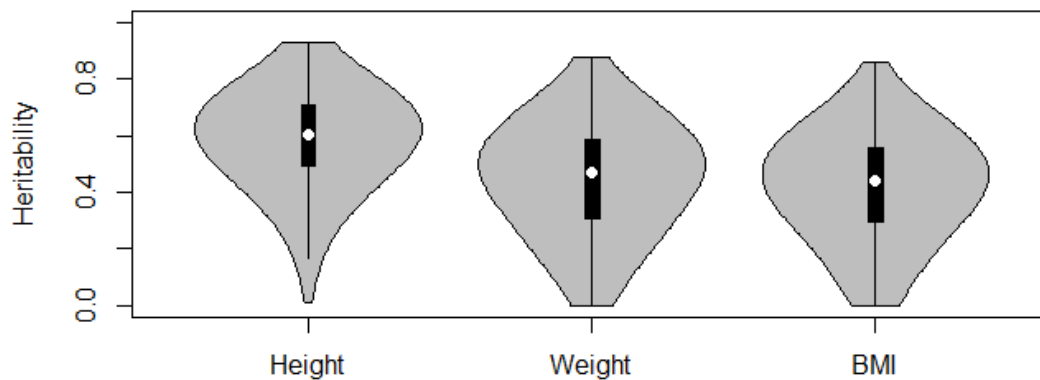
Table 17. Variance component posterior modes with 95% credible intervals ( $V_A$ ), variance component ratio posterior modes with 95% credible intervals (Heritability), and fit statistics from MCMC models. Heritabilities represent the proportion of variation in each outcome variable explained by relatedness among individuals.  $R^2_m$  measures the proportion of variation explained by only the fixed effects of each model (see Tables 12-14 for fixed effects in each model), and  $R^2_c$  is that explained by both the model fixed effects and heritable variance component.

	$V_A$	Heritability	$R^2_m$	$R^2_c$
<b>Height</b>	0.831 (0.197, 1.681)	0.669 (0.250, 0.860)	0.057	0.679
<b>Weight</b>	0.635 (2.180 e <sup>-6</sup> , 1.262)	0.505 (0.070, 0.790)	0.126	0.516
<b>BMI</b>	0.527 (5.937 e <sup>-6</sup> , 1.139)	0.486 (6.025 e <sup>-6</sup> , 0.683)	0.103	0.562

None of the fixed effects modeled have significant relationships with BMI in this population (Table 16). Average years children were breastfed has a nearly significant relationship with father's BMI, indicating that the longer children are breastfed, the lower father's BMI tends to be. Both wife's income percentage and parent education have variable relationships with BMI among all types of individuals. Despite the lack of significant associations between these fixed effects and BMI, these variables explain 10.3% of the variation in BMI among all individuals in this population.

Once we account for genetic variation in these LMMs, they explain over 50% of the variation in all of the outcome variables, as noted in the conditional  $R^2$  values (Table 17). This statistic represents the amount of variation accounted for by both the model fixed and random effects (Nakagawa and Scheilzeth, 2013). Height shows the strongest heritability in this population, with a posterior mode of 0.669 (Table 17). This indicates that genetic variation accounts for 66.9% of the height variation among the Shodagor. Weight has a slightly smaller genetic variance (50.5%), and BMI has the lowest heritability at 0.486 (Table 17). Figure 14 displays the full posterior distributions of heritability estimates from each model (distributions of 1,000 MCMC samples).

Figure 14. Violin plots show complete posterior distributions of the 1,000 heritability estimates retained from each MCMC model.



## Discussion

In this study, we found that the combined influence of household-level socioecological variables and genetic variability account for approximately 68% of the variance in height, 52% of the variance in weight, and 56% of the variance in BMI for the

Shodagor of Matlab, Bangladesh. The Shodagor are a previously unstudied society who face unique socioecological conditions that result in major childcare and economic responsibilities being concentrated within the nuclear family. We know that a number of household-level factors impact health outcomes in other societies, including nutrition, breastfeeding duration, number of children in a family, and women's autonomy. And while our results show no relationships between health outcomes and predictor variables like illness, household income, access to fish, and mother's decision-making authority, and surprisingly weak relationships between outcomes and predictor variables such as number of children in each household and wife's income percentage, the average number of years mothers spent breastfeeding and whether or not parents have any education have substantial associations with weight and BMI, particularly for fathers.

For height, the linear mixed model included number of children and wife's income percentage as predictors. Number of children reflects the long-term additive nature of the measure while wife's income percentage reflects investment within the last year. While we primarily expect measures to impact height that have contributed to an individual's nutrition or health over the lifetime, more recent measures of investment should also contribute to the variance in the measure as a component of lifetime conditions; more recent measures may also be correlated with earlier measures and thus serve as an estimate of long-term conditions. Weight and BMI should also be affected by a combination of lifetime factors and recent investment. For the Shodagor, breastfeeding duration and parents' education – both long-term investments – as well as wife's income percentage – a measure of recent investment – contribute to variance in weight and BMI.



### *Breastfeeding impacts adult body size*

One of the most direct influences on growth and overall health is diet. The amount and quality of food people consume are tied directly to achievement of healthy height, weight, and BMI (de Onis et al., 2012). For the first six months of life, the WHO recommends that mothers exclusively breastfeed children, as breast milk has the calories, nutrients, and antibodies necessary to support growth and overall health (Oddy, 2001). After six months of age, breast milk alone cannot meet all nutritional needs and mothers should begin supplementing children's diets with other food (Hinde and Milligan, 2011). Weaning can be a risky time for children, as the food available may not always be sufficient in amount or quality (e.g. Motarjemi et al., 1993). Therefore, we predicted that a Shodagor family's access to fish should have a significant impact on height for children and weight and BMI for all family members, as fish is a reliable source of high-quality protein that men and women who fish for a living have access to at no cost. We also predicted that longer breastfeeding duration should have a positive effect on children's height, weight, and BMI, as well as a negative effect on mother's weight and BMI because lactation is energetically costly.

Breastfeeding duration, but not fish availability – the only other measure of nutritional investment – was retained as a predictor in our mixed models to explain some of the variance in Shodagor weight and BMI. Availability of fish may not substantially impact variation in our outcome variables, however, because such a large portion of the adult population fishes regularly. Of all Shodagor in Matlab, 90% fish for at least half of the year. The other 10% of the population is primarily made up of families in which men have jobs in a market and make higher and more stable incomes than men and women

who fish. Therefore, fish may be most important in the diet for families with the lowest or most variable incomes, all of whom have access to fish. Therefore, breastfeeding may be a much better measure of nutritional investment and contribute more to variation in growth and health in this population.

For Shodagor children, the number of years they were breastfed only impacts their weight and BMI when considered in concert with the other predictor variables in the models, and is not significantly contributing to variation in weight or BMI on its own. This also means we cannot predict the direction of the relationship between time breastfed and weight/BMI for children; greater time of exclusive breastfeeding has a positive relationship with child weight and BMI sometimes, but also has a negative relationship with these outcomes some of the time. One reason for this is the fact that exclusive breastfeeding can no longer adequately support child growth after 6 months. With the average time of Shodagor exclusive breastfeeding at 9.3 months, it is possible that children who are exclusively breastfed past 6 months could begin to lose weight or show slow growth for age.

For adults, however, the length of time a mother breastfeeds her children has an independent, negative impact on her weight and BMI as well as her husband's. The energetic needs of lactating women are typically 20-25% higher than those of non-lactating women (Prentice et al., 1996), so for women in low income populations or nutritionally-stressed societies, lactation often leads to weight loss (e.g. Adair and Popkin, 1992). As we predicted, this is also the case for Shodagor women whose weight decreases as the amount of time they spend exclusively breastfeeding increases, though this relationship is only marginally significant. The relationship between husband's

weight and mother's breastfeeding duration is much stronger, though there are no previous studies that support this relationship. There are two possible explanations. First, survey data show that Shodagor mothers often either stop working or significantly decrease the amount of time they spend working while they are breastfeeding exclusively (Starkweather, 2016). Though some women continue to fish during this time, women who sell cease work completely while breastfeeding. Marlowe (2003) showed that Hadza husbands respond to their wives' pregnancy and lactation by increasing their foraging productivity. It is possible that Shodagor men are doing the same and expending more calories in the process, leading to weight loss. It is also possible that household income and/or fishing returns decrease while a woman is not working which may reduce the amount of food the family consumes. Families in which mothers do not work outside the home have lower incomes on average than all others (Starkweather, in press), though there is not currently enough evidence to say definitively that this is primarily the result of breastfeeding. However, if a household is resource-strapped while the mother is lactating, it makes sense that both mother's and father's weight and BMI may decrease in response.

*Women's autonomy affects height, weight, and BMI*

Measures of women's autonomy have been found to positively affect child health outcomes across societies (Engle 1991; Folbre 1986; Hoddinott & Haddad 1991). One of the primary indicators of autonomy, women's income (either her raw income or percentage of the household income), has been tied closely to increases in children's height, weight, and BMI (Engle 1991; Folbre 1986; Hoddinott & Haddad 1991; Phipps & Burton 1998; Rouf 2011; Reiger 2016). One of the major reasons for this relationship is

that women spend their money differently from men: men are more likely to spend their income on disposable or leisure items or activities (e.g. alcohol), whereas women are more likely to spend their income on items for children or the household (e.g. food, clothing) (Engle, 1991; Phipps & Burton, 1998; Rouf, 2011). An increase in either a woman's income or her decision-making ability regarding family finances will therefore likely lead to better health and nutritional status for children and other members of the family.

The Shodagor are unique from the land-dwelling Bangladeshis in a number of ways, but one of the most striking is in the role women play in each society. For non-Shodagor women in rural Bangladesh, *purdah* – the practice of female seclusion – is a common practice, women's sexual reputations are closely guarded, and work outside the home is uncommon (Amin 1997). By contrast, 75% of Shodagor women work outside of the home. Almost half sell goods in local markets and door-to-door in villages and are away from home most days of the week from sunrise to sunset for six months of the year. Women who fish often do so with their husbands and earn 50% of the household income or less, depending on how often they work. Women who sell goods have the potential to earn more money than their husbands – a trend that is unusual across all cultures. Shodagor women also report a level of authority within the family with 76% of women being equal or primary decision makers with regards to things like how money is spent, whether she works or not, and when to take children to the doctor. This is also unusually high compared to non-Shodagor women (e.g. Balk, 1997).

As predicted, Shodagor women's income percentage was retained in our models in association with variation in children's and parents' height, weight, and BMI. The

directionality of the effect is unclear, however. Given Shodagor women's decision-making ability within their households, it is possible that women have some say in how money is spent regardless of their own income. It is also true that Shodagor men do most of the shopping so women do not actually spend their own income themselves. In either instance, we would expect overall household income to have more of an impact on health outcomes, but this is not the case. Contrary to our prediction, household income is not retained in any of the final models and neither is women's decision-making authority. More detailed data on men's and women's expenditures is needed in order to understand the relationship between women's income and health outcomes for the Shodagor, but it is possible that Shodagor women generally have relatively high levels of autonomy resulting in relatively little variation within the study population and thus relatively little importance of these variables in explaining variation among Shodagor.

Education is also often an indicator of women's autonomy and has been linked to growth outcomes cross-culturally (e.g. Ahmed et al., 1998; Reiger, 2016), though the mechanism through which this occurs is not always known. Caretakers with education have been found to feed children more frequently, with fresher food, and in cleaner areas (Guldan et al., 1993). Mother's education is also typically associated with more autonomy for women, which affects child outcomes through women's decision-making authority in the household (Ahmed, et al. 1998; Aslam and Kingdon, 2012). Fewer studies have focused on father's education as a potential predictor of children's health outcomes, however, it was found to be a better predictor of reduction in childhood stunting in Bangladesh and the Philippines than mother's education (Rahman and Chowdhury, 2007; Ricci and Becker, 1996; Semba et al., 2008). Chen and Li (2009)

point out that father's education may be more important in developing countries where fathers often have more education than mothers—this may be especially true if most women have no education, or where there is more variation in education among fathers than mothers. Aslam and Kingdon (2012) found differing mechanisms among a Pakistani population through which fathers' and mothers' education may impact child health: while mothers' education tends to have greater long-term effects on child height and weight *vis a vis* knowledge of in-home health-related activities, more education for fathers results in better health-seeking behavior such as immunizations.

Among the Shodagor, it is uncommon for adults to have any education. Only 13% of the adults in this study have any education, including having learned to read or write. Nine fathers average 3.22 years of education and 11 mothers average 4.36 years of education. Due to the small number, both parents were lumped together and the variable reflects whether or not either parent has some education, although doing so has the potential to underestimate the influence that years of education may have on growth outcomes. For Shodagor children, parents' education, in conjunction with the other predictors in our models, does account for some of the variation in weight and BMI for children and parents, though the mechanism thorough which parents' education is affecting Shodagor child health outcomes is unclear as is the directionality of the effect for children's and parents' weight, and children's and mothers' BMI. There is a weak independent effect of parents' education on father's weight with more education associated with higher weight on average. This effect is odd because there is no reason to expect that education would differentially enhance father's weight, but not the weight of his wife or children. One potential explanation is that the composite nature of the

measure is reflecting bigger body size for men who have or whose spouse has some education. More data is needed to fully flesh out this relationship.

### *More children, taller children*

A negative relationship has been well established cross-culturally between larger household size and the health outcomes of household members, particularly children (e.g. Forman et al., 1995; Pelto et al., 1991). However, some studies have also found no effect of family size on children's health outcomes (e.g. Hesketh et al., 2003). While number of children does account for variation in height for the children in the family, as we predicted, it does not account for variation in weight or BMI. However, contrary to our prediction, the relationship between height and number of children is positive, albeit weak, indicating that the more children a family has, the taller those children are. One potential explanation for this unusual relationship is that taller mothers tend to have more surviving children than shorter mothers (e.g. Allal et al., 2004; Sear et al., 2004) and also tend to have taller children in general (Reiger and Trommlerova, 2016), so this could lead family size to be positively associated with the height of its children. It is also possible that this reflects an underlying interaction between families' overall wealth or diet quality, number of children, and average height of children. We do not see a relationship between household income and height, although it is possible that different measures of family income or wealth may show different results. Finally, it is possible that access to an effectively unlimited resource – fish – allows families with consistent fishing success to provide adequate calories for more children. It may be the case in societies where children contribute to the economic production of the household that an increase in

number of children would be positively associated with growth measures, although it is not clear that this is the case for Shodagor children. While Shodagor children do occasionally fish for fun and some accompany their parents while fishing, it is unknown whether children do enough work to subsidize themselves in terms of calories. Further exploration into the correlates of Shodagor family size could more fully illuminate this relationship.

*Illness does not significantly influence outcome variables in this sample*

Contrary to our prediction, whether or not a person has had a serious illness in his or her lifetime did not have a strong enough association with variation in growth among the Shodagor population to warrant retention in our mixed models. As predicted, neither does having an illness of any type during the previous year. Illness is a well-established driving factor behind child growth (Cole & Parkin 1997; Adair & Guilkey 1997; Silventoinen 2003; Lim, et al. 2012). Diarrheal and respiratory illnesses are of serious concern for Bangladeshi families, and both have been linked to poor growth measures in a number of cases (Black et al. 1984; Chowdhury et al. 2003; UNICEF 2005; Rahman et al. 2009). Acute diarrhea can lead to temporary weight loss, while chronic diarrhea can cause stunting, wasting, and ultimately death (Becker, 1991). Respiratory infections are particularly damaging to growth when they become chronic as they have been found to negatively impact the amount of food children are willing to consume (Black et al., 1984).

In all cases of illness, parents' response to child illness (i.e. taking a child to the doctor) can lead to quicker recovery, lower severity of the illness, and lower likelihood of



reinfection (Timus & Lush, 1995). There is evidence that Shodagor parents seek treatment for sick children nearly every time a sickness occurs, however the source of treatment varies. Parents either take children to a village doctor, someone who employs supernatural methods of healing, a pharmacist, or a medical doctor. Village doctors cost less than pharmacists or medical doctors, so families typically seek help from them either when illness is not seen as severe or when all other treatment sources have been exhausted. No data was gathered on types of illnesses people had so no direct relationship can be inferred between actual severity of illness and type of doctor visited. However, if parents sought appropriate help for severe illnesses, this may have mitigated the effect that those illness have had on health outcomes. It is also possible that children with illnesses severe enough to impact growth significantly did not survive long enough to participate in this study.

*Heritable variation contributes to overall variation in height, weight, and BMI*

Heritability estimates allow us to determine the amount of variance in a trait that can be attributed to variation in genes (Visscher et al., 2008). Heritabilities of height, weight, and BMI that have been estimated so far have mostly been done for Western populations, which makes it difficult to generalize the findings to non-Western populations and small-scale societies given that the additive genetic effect in growth measures is expected to be higher in wealthier or less variable environments (Silventoinen, 2003). Our results indicate that the additive effects of genes play a large role in Shodagor growth variation. The heritabilities of 66.9%, 50.5%, and 48.6% for height, weight, and BMI, respectively, are in keeping with the trends found in Western

societies. They also indicate that compared to most other studies, heritability of all three measures is at the low end of the ranges established in other societies, which is in line with Silventoinen's (2003) expectation regarding societies living in poorer environments. While we do not have the data to necessarily compare the state of the Shodagor environment to others around the world, it is probably safe to say that it is poorer than those found in Australia, Denmark, or the United Kingdom (Silventoinen et al., 2003). Again, given the additive and inflexible nature of height as a measure of health and the fact that conditions encountered throughout childhood will be reflected in completed height, the relatively low heritability of height likely indicates that long-term environmental factors are playing a role in the variance left unexplained for height. We would expect more acute health issues and more recent nutritional deficits to play a larger role in explaining the remainder of the variance for weight and BMI, given the more flexible nature of these measures in their ability to respond to short-term changes in the environment.

## **Conclusions**

The results of this study indicate that a number of behaviors within the nuclear family, such as breastfeeding and wife's income earning, contribute to variance in Shodagor health outcomes and body size. Other household-level factors, like parents' education and number of children, also contribute, though the combined effect of these variables each on height, weight, and BMI account for less than 13% of the variation in growth and health outcomes. This indicates that the socioecology of the nuclear family is important for the well-being of its members, though genetic variance explains the

majority of the variance in height, and approximately half of the variance in weight and BMI for the Shodagor. The negative impact of breastfeeding behaviors on mothers' and fathers' weight and BMI needs to be explored further as does the role of wife's income percentage on all measures. One of the most interesting trends in the developing world has been the impact of a mother's autonomy in the family on the well-being of her children. Given the unusual cultural role of women in Shodagor society and the unique nature of women's selling cross-culturally, the fitness-related outcomes should be explored in much more detail.

This study faces several limitations. First, the cross-sectional nature of these data means that we are unable to address trends in growth within the society. This also results in a relatively small sample size. Data were collected on all available individual Shodagor people in Matlab, resulting in a nearly complete population sample, which is beneficial in many ways, but collecting growth measures in a longitudinal fashion will provide more information about Shodagor growth in general as well as the factors that influence it. This study is also lacking empirical data on diet or nutritional intake. Access to fish is the only current measure of Shodagor nutrition we have, and we are unable to use it to make specific inferences about how much fish is consumed. Diet is one of the primary drivers of growth and would likely explain a significant amount of variation in Shodagor health outcomes. Finally, more detailed data on household expenditures is needed in order to explain the relationship between women's income percentage and the family members' weight and BMI. Regardless, this is a first attempt to understand the factors that are affecting Shodagor health outcomes, and these results will inform future examinations of the data.

Understanding the factors that impact child growth and child and adult health outcomes can have important health care and policy implications. Bangladesh has been a major focus of governmental, non-governmental, and non-profit research and intervention that has focused on child nutrition and health, and improving rates of morbidity and mortality. Matlab, Bangladesh is home to the longest running demographic surveillance project in the world, which is conducted through the non-governmental organization ICDDR,B (International Centre for Diarrheal Disease Research, Bangladesh). Since the 1960's, ICDDR,B has conducted demographic research and provided medical care and outreach and education on basic health practices. Scientists began researching nutrition and growth in Matlab in 2001 (see Persson et al., 2012 for description) and ICDDR,B recently began focusing on implementing nutritional interventions (ICDDR,B, 2014). However, though the Shodagor live in Matlab, none of the families in this study are included in any of the research conducted by ICDDR,B, and none have benefited from the interventions (Starkweather, 2016). This study shows that Shodagor behaviors within the household have an effect on growth and health for children and adults, suggesting that further research and interventions could positively impact Shodagor growth as well as morbidity and mortality associated with malnutrition.

## CHAPTER 5: Conclusions

In this dissertation, I addressed three general research questions. First, what are the socioecological conditions that lead Shodagor families to employ particular strategies in order to balance subsistence work and childcare? Second, why do Shodagor men and women pursue particular occupational strategies that are cross-culturally unusual while others divide labor in ways that are more in line with other societies? And third, how do Shodagor subsistence and childcare strategies, all of which are concentrated within the nuclear family and influenced by the constraints of the Shodagor socioecology, influence nutritional outcomes for children and parents? We find that the concentration of resource sharing and childcare duties within the nuclear family is associated with husbands and wives cooperating in order to fulfill a family's subsistence and childcare needs. We also find that specific aspects of the ecology – how far an individual lives from a major market, and how far he or she lives from the Meghna River – as well as a family's childcare needs play key roles in determining the specific strategies families will employ in order to meet those needs. Finally, we show that while some factors concentrated within the nuclear family influence Shodagor health outcomes in accordance with theoretical and cross-cultural predictions, others do not. In this chapter, I will discuss these findings and how they are connected with theory. I will also discuss the broader limitations of this study as well as future directions for research with the Shodagor.

### *Nuclear family-focused strategies*

Anthropologists have long been focused on the importance of the nuclear family across societies (Hurtado et al., 1992; Lancaster and Lancaster, 1983; Levi-Strauss, 1956; Malinowski, 1913; Murdock, 1949, 1960; Sahlins, 1972), particularly the cooperative nature the husband-wife relationship can take, and the implications of that relationship for the sexual division of labor (Becker, 1985; Lancaster and Lancaster, 1983; Lovejoy, 1981). There has also been an emphasis on the variety of forms a human family can take (Fox, 1967; Lancaster and Lancaster, 1987; Van den Berghe, 1990) and a recent shift toward the view that human parenting is a cooperative endeavor, and has likely required assistance from non-nuclear family members throughout human history (Hrdy, 2009; Kramer, 2010; Sear and Mace, 2008; Sear, 2015). The results from Chapters 2 and 3 indicate that both things are true for the Shodagor, though "cooperative parenting" among the Shodagor is more focused within the nuclear family than the more generalized alloparenting that is common in many small-scale human societies.

Alloparents appear to play an important role in allowing some women to take on an occupation (selling goods) that is incompatible with childcare and incurs higher economic risk than other occupations. Alloparents simultaneously allow some fathers to stay home for half of the year as the primary caregiver of their children. In these cases, alloparents likely play the role of watching children for short periods of time while fathers go to the market or engage in other tasks nearby. However, fathers are feeding, bathing, soothing, playing with, and supervising children for the majority of the day while mothers are at work. Conversely, a lack of alloparental support appears to constrain women in their occupational choices as families with fewer alloparents available tend to

employ strategies that require mothers to be the primary caregivers of their children year-round. These findings are consistent with other studies that show alloparents can free women from constraints of childcare and allow them to return to work earlier than they would without help (Hrdy, 1999; Quinlan and Quinlan, 2008).

Shodagor society is also heavily nuclear family-focused, which is evident in household formation, childcare, and economic behaviors. All Shodagor families in this study live on small wooden boats or in small make-shift houses near the water (or even sometimes over it), and the size restricts the number of family members who can live within the household. Only seven percent of all households have members from more than two generations, *including* families who tie their boats together with parents' or in-laws' boats. Most families (71%) live in the same bohor as extended family members, but only share living space with nuclear family members.

While alloparents are important in shaping women's and men's strategies and behaviors, nearly every Shodagor family concentrates the majority of direct care within the husband-wife dyad. Survey data shows that only 2 of the 39 families with at least one child under the age of 5 leave young children with an alloparent during the day while both mother and father work outside of the home. In both cases, the alloparent is an older sibling. Men who stay home as primary caregivers of their children have more alloparents available than men who work all year, though fathers are performing the majority of caregiving tasks – feeding, bathing, soothing, playing with, and supervising children for the majority of the day – while mothers are at work. Alloparents in these cases likely play the role of watching children for short periods of time while fathers go to the market or engage in other tasks nearby. In only 3 of 57 of families with a child under the age of

10 was someone other than a parent or older sibling responsible for supervising or caring for that child. In all other cases, children under the age of 10 are staying home with either their mother or father as their primary caregiver, being watched by older siblings or, as described in Chapter 2 going fishing with their parents year-round. Of course, it is not uncommon for mothers or older siblings (usually older sisters) across cultures to provide the majority of direct care for young children (Kramer, 2010; Sear and Mace, 2008), but it is unusual for fathers to forgo subsistence or wage-earning activities in order to care for children (Marlowe, 2000). Therefore, the Shodagor go to unusual lengths to ensure a responsible member of the nuclear family is the primary caregiver of children at almost all times. In the rare cases when paternal care to this extent has been documented, such as in modern, Western families (Doucet and Merla, 2007; Latshaw, 2011; Raley et al., 2012) and among the Ifugao in the upland Philippines (Milgram, personal communication), it is often done in response to women's wage-earning opportunities as is the case among the Shodagor.

Shodagor economic pursuits are also often focused within the nuclear family. In 46% of families, the husband and wife work together for at least half of the year. In most cases, they fish together and often take their children along. Occasionally when a spouse is unavailable, either mother or father will go fishing with an older child. The type of fishing that Shodagor do is often most efficient with two or more people on the boat and fishing with a member of the nuclear family prevents earnings from being split with unrelated coworkers (or at least coworkers from other nuclear families). A husband may also accompany his wife when she sells goods, though only one couple does this regularly and others usually only sell together if the wife is pregnant. In that case, the



husband will carry her basket of goods for her, but will not enter the homes of the non-Shodagor women she is selling to as it would be culturally inappropriate for him to do so.

Resource sharing is also rare for the Shodagor. Men and women who fish with individuals who are not members of their nuclear family report splitting profits equally, and occasionally report sharing a small portion of their catch with extended family members, but otherwise sharing outside of the nuclear family is not a widespread practice. This is common in market-based economies, where the types of resources that can be traded for similarly-valued, complementary resources – including cash – are not typically shared outside of the household (Behrens, 1992; Gurven et al., 2015; Yellen, 1990). Resources also tend to be kept within the nuclear family more often when they produce low-mean, low-variance returns, which is most often the case for resources procured by women (Bird, 1999). As described in Chapter 3 fish are a low-mean, low-variance resource that is procured by nearly all Shodagor men and a third of Shodagor women. While fish are often traded for cash in the market, many families regularly keep a portion of their catch to eat. Women's selling produces higher-variance returns, but those returns are always accrued in cash. At the end of the day, nearly all profits from both men's and women's work are shared only within the nuclear family. The concentration of childcare and economics within the nuclear family is associated with Shodagor families employing particular strategies to manage childcare and subsistence needs, as outlined in Chapters 2 and 3, and has implications for Shodagor health outcomes, discussed in Chapter 4.

### *Ecology and The Division of Labor*

The results from Chapters 2 and 3 show that ecology is a key factor influencing how husbands and wives divide subsistence and childcare labor. The ecological conditions faced by all Shodagor – being surrounded by water year-round – place particular constraints on families’ childcare strategies. Young children in all types of environments are vulnerable to ecologically-imposed dangers (e.g. Hewlett and Lamb 2005), however life on a boat poses a constant and immediate danger. Drowning is a major cause of child death in Bangladesh for people who live on the land, causing 83% of deaths for children under the age of 5 in 2003 (though in the past infectious disease was one of the leading causes of death across age groups) (UNICEF 2009); therefore it is an even greater threat for the Shodagor. This is important for two reasons. First, it requires that young children be watched diligently at all times. Shodagor children are usually considered competent swimmers around the age of 5, so younger children are constantly monitored by at least one adult. Second, this affects the age at which older siblings and cousins, etc. can serve as reliable alloparents for young children. Hames and Draper (2004) point out that whether a child can serve as a helper or not depends on suitable ecological circumstances, with semi-permanent or permanent residences and larger household sizes promoting “safe areas” conducive to allocaregiving. Reliable alloparents must be focused enough to watch children very closely and must also have the strength and swimming ability to save a child should he or she ultimately fall in the water. These restrictions limit the overall pool of available alloparents families can call on for help. The strong trend towards a *parent* acting as primary caregiver for most young children

and constantly monitoring children who are unable to swim is also a likely result of the restrictions imposed on families by the ecology.

In addition to the impact of the ecology on childcare behaviors, specific aspects of the ecology have a clear influence on men's and women's occupational strategies. The Bangladeshi ecology poses particular challenges for fishing and women's selling, depending on a family's location. During the rainy season (May-October), monsoon rains and snowmelt cause rivers to swell, flooding large portions of the country and submerging rural roads in Matlab, which makes selling difficult if not impossible. Some women may sell sporadically during this time, depending on the extent of flooding, but most women forgo selling altogether until roads dry out. In contrast, fishing becomes more profitable and more reliable in the rainy season, regardless of a family's location. At the mouth of the Donagoda, where it connects with the Meghna, the river is wide and deep and there is an abundance of fish, in both number and variety, year-round. As the Donagoda travels away from the Meghna, especially during the dry season, water levels are lower and numbers and varieties of fish diminish. Shodagor who live closer to the Meghna will have year-round fishing opportunities that are potentially profitable, while those who live farther away will find fishing most profitable during the rainy season and less profitable during the dry season. Some Shodagor families (39%) move to a new bohor an average of 2 times per year, which allows them some control over the ecological constraints that will impact their work. However, most families in Matlab who move, choose bohor that are located less than an hour from their initial location and do not differ dramatically in terms of general ecology.

During the dry season (November-April), waters recede and fishing becomes a less reliable endeavor for Shodagor who live farther away from the Meghna River, but as roads dry, selling is once again a possibility for women who live close to a major market, which determines the ease with which women can obtain goods to sell. Distance to market is less important for the success of men's fishing. Men do sell most of their fish in markets at the end of each day, but this can be done at major and minor markets. Minor markets are located all over the countryside and all 5 bohor in Matlab live within walking distance of a minor market.

Marlowe (2007) found that the types of resources men and women pursue diverge from one another in environments where resources are affected by seasonality. For example, the resources that Copper Eskimo men and women pursue almost never overlap and this is associated with the fact that the availability of resources changes with the seasons (*World Cultures*, 2005). Conversely, in the Pacific Northwest in which animal and plant resources are available year-round, Paiute men and women often pursue similar resources (*World Cultures*, 2005). Coddling et al. (2011) suggest that the division of labor should diverge when resources that provide high returns can only be acquired at high levels of risk. Both Chapters 2 and 3 show that proximity to a major market is associated with a divergent division of labor: families who practice the Split Year and Leave Kids Home strategies live closer to a major market than families who Work Together. Similarly, women who sell goods live closer to a major market than women who fish or are housewives. Also in support of Marlowe (2007) and Coddling et al. (2011), proximity to the Meghna River is associated with a convergent division of labor: families who Work Together, in which husband and wife fish together year-round, live closer to the

Meghna than Split Year families, and women who fish live closer to the Meghna River than women who sell or are housewives. Housewives (women in the Traditional strategy) are as likely as all other women to live near a major market, but live farther from the Meghna than women who sell or fish. In essence, they live in a bit of a no-man's land. They are neither close enough to a major market, which allows women lowered transaction costs for selling, nor are they close enough to the Meghna River to make fishing a reasonable option for women. It is currently unclear why these families do not move to bohor that would mediate these constraints. Women who are housewives are also often constrained by childcare.

#### *Childcare Needs Also Affect Division of Labor*

Shodagor families' childcare needs also influence how labor is divided. Kaplan and colleagues (2009) suggest that husbands and wives, as part of the sexual division of labor, undertake productive tasks that complement each other and enable them to efficiently support the nuclear family. Trivers (1972) and Hrdy (1992) both theorize that investment from one parent will be directly related to investment from the other parent. Kaplan and colleagues (2009) combine household productive and reproductive demands and propose that mother's and father's work and childcare should be complementary, both in the specific tasks each parent does and in the amount of time they spend in the tasks. This should be particularly true when there is an overlap between men's and women's reproductive interests and when the nuclear family is the most important economic unit within the society.

As I discussed earlier, Shodagor families with young children face particular constraints and have different childcare needs than families with older children. Results from Chapter 2 show that families who have at least one child under the age of 5 are significantly more likely to have either the mother or father stay home with the child(ren), while those without a child under the age of 5 are likely to have both mother and father working away from the children. Results from Chapter 3 show that nearly all men who stay home as primary caregivers for half of the year have a child under the age of 5. Results from this paper also parse the relationship between women's occupation and child age further, showing that mothers who are housewives are more likely than any other women to have a young child in the family, while those who sell are least likely. However, breastfeeding also has an impact. Specifically, women who sell goods are less likely than all other women to have a child under the age of 3 who is still breastfeeding and housewives are most likely to have a breastfeeding child under the age of 3.

This is interesting because family strategies and men's parenting behaviors are more closely associated with whether or not a family has a child under the age of 5 – an indicator of a child's ability to swim and a lowered risk of drowning, as well as an indicator of the intensity of childcare that is required from caregivers. But women's occupations are associated with breastfeeding status. Selling is totally incompatible with breastfeeding and care of young children and bivariate results show that women who sell goods breastfeed exclusively for an average of 7.8 months. Fishing and being a housewife are much more compatible with breastfeeding and childcare, and women who fish and are housewives breastfeed for an average of 10.3 months and 10.8 months, respectively. These results are consistent with theory (e.g. Brown 1970; Kaplan et al.

2009) and ethnographic evidence (e.g. Hurtado et al. 1992; Marlowe 1999; 2003), which suggest that mothers who are pregnant or breastfeeding should engage in work that is most compatible with their physical limitations. Findings are also consistent with evidence from the Ache (Hurtado et al. 1992) and the Maya (Kramer 2004), showing that the ages of children in a family affect parents' ability to spend time working away from home and away from children. These results also suggest that the strategies available to mothers may influence how mothers optimize between childcare and work: if a mother is forced to choose between the two behaviors, she may wean earlier in order to return to work earlier, but if work is compatible with childcare, a mother can invest in both simultaneously (Hrdy, 1992).

#### *The Nuclear Family and Shodagor Health Outcomes*

Cross-cultural research has shown that a number of factors that are concentrated within the nuclear family can impact health outcomes including nutrition (de Onis et al. 2012), breastfeeding duration (e.g. Bloss et al., 2004; Nahar et al., 2010), number of children in a family (e.g. Judge et al., 2012; Pelto et al., 1991), and women's autonomy (Engle 1991; Folbre 1986; Hoddinott & Haddad 1991). Adequate height and weight are often used as a proximate measure of parents' potential reproductive success, an important indicator of evolutionary fitness (Fisher 1930), and are also commonly associated with higher rates of survival (Chen, et al. 1980; WHO 1995; Blackwell, et al. 2001; Engeland, et al. 2003; Nandy, et al. 2005), lower rates of chronic illness (Adair & Guilkey 1997; Blackwell, et al. 2001; Engeland, et al. 2003; Lim, et al. 2012), and greater lifetime reproductive success (Martorell et al 1981; Kirchengast et al 1998; Blackwell, et

al. 2001; Samaras et al 2003; Sear, et al. 2004; Stulp, et al. 2012). One way to determine whether there is a relationship between Shodagor family strategies and any reproductive fitness benefits a family may gain from practicing such strategies is to examine how variation in the height, weight, and BMI of Shodagor relates to ecological and social factors concentrated within the nuclear family. Ultimately, predictors such as number of children in each household and wife's income percentage have surprisingly weak relationships with health outcomes, whereas average number of years mothers spent breastfeeding and parental education levels have substantial associations with weight and BMI, particularly for fathers.

Heritability estimates of height, weight, and BMI were also modeled in order to determine the amount of variance in each trait that can be attributed to variation in genes among the Shodagor. Heritability measures of 70%, 50%, and 49% for height, weight, and BMI, respectively, are somewhat complicated by the fact that many Shodagor parents and children in our sample share a household. This means that the percent of variance being explained for each outcome by heritability also includes some random effects that are the result of a shared environment such as similar risks of exposure to contaminated water or poor sanitation (Rivera et al., 1995; Gunnell et al., 2000; Dangour et al., 2013), diet, and activity levels (Rivera et al., 1995; Gunnell et al., 2000; Silventoinen 2003). All of these factors are known to influence health outcomes and explain between-family variation in the outcomes. However, only 60% of individuals in the study currently share a household with their parents or siblings, and 30% are adults who are living in their own nuclear family households. Thus, we have some confidence in attributing much of the variance explained by this random effect in the mixed model to an additive genetic effect.



Regardless, the dataset used in these analyses has limitations and more data is needed in order to fully understand the factors impacting Shodagor height, weight, and BMI, as well as the implications of these measures for reproductive success.

### *Study Limitations*

This study faces three primary limitations. First, the sample size is relatively small and presents limitations on the types of analyses that can be run and the interpretations of the results, particularly with regards to growth measures. This can result in false negatives, underestimating the effects of particular predictors on outcomes. However, the sample does represent a nearly complete population sample of Matlab Shodagor. Of the 172 total adult Shodagor in Matlab, 71 men and 87 women participated in this interview (N=158). Fourteen adults either declined to participate for reasons including health issues, or were away from home every time interviews were conducted. There are reports of at least 3 other Shodagor bohor in Bangladesh and while it was not feasible to collect data on these groups during the 2011 and 2014 field seasons, I plan to get complete census data for all groups in the future and to collect demographic information for as many of the individuals as possible with a goal of obtaining data on all Shodagor in Bangladesh.

A second limitation of this study is the cross-sectional nature of data collection. This is also particularly limiting with regards to analyses of growth and nutritional outcome data. A longitudinal dataset will allow me to determine growth trends over time, get a more complete picture of the socioecological effects on these trends, and have a better understanding of specific nutritional or health challenges the group – or particular

families – face. Longitudinal data will also allow insight into how family strategies change over time and over the course of a family’s domestic cycle. Cross-sectional data only allows me to analyze the relationship between a family’s current socioecology and the subsistence and childcare strategies they employed during the previous year. I intend to return to Bangladesh periodically over the next several years to collect repeated measures on child growth as well as adult weight and BMI and potentially other measures of health.

Finally, much more detailed income data will allow for more nuanced and complex analyses of risk, overall income, and wealth of individuals and households. Pilot testing early in the field process revealed that while Shodagor men and women are excellent in their ability to remember specific earnings and expenditures from particular days, they are not good at estimating monthly, seasonal, or annual income, nor are they able to confidently report earnings from more than a handful of days at a time. For this reason, income and expenditures were collected for the “last 3 days” an individual worked for all Shodagor who participated in the study. A more detailed accounting of previous days worked was collected later in the field season for a subset of the population. In order to fully understand individuals’ economic behavior, similar income data will need to be collected at regular intervals, multiple times throughout the year.

### *Future Directions*

I plan to continue conducting fieldwork among the Shodagor throughout my career and have plans for 3 upcoming projects. The first project will use new and existing time allocation, survey, and anthropometric data from the Shodagor to build on work

from this dissertation and test hypotheses regarding the importance of fathers in human evolution as well as the human pair bond, particularly as it relates to the complementarity of mothers' and fathers' parenting behaviors and the survival and well-being of children. This project will test the following hypotheses. First, among families with working mothers and fathers who act as primary caregiver at least some of the time, mothers and fathers should show similarities in the types of direct care they engage in. Second, fathers should engage in direct care a higher percentage of time than has been found cross-culturally. Cross-culturally, for example, mothers spend the most time giving direct care and doing things like holding and feeding, while fathers spend much less time than mothers and mostly engage in activities like playing. In Shodagor society, I predict fathers will spend significantly more time than fathers in other societies engaging in the same types of direct care as mothers, such as holding, feeding, soothing, putting to sleep, etc. The third hypothesis I will test is that, assuming these similarities in type and amount of care, both mothers and fathers should have a significant impact on children's survival and well-being.

The second project will examine the importance of the grandmother's own life stage on both the type and amount of care she gives grandchildren and the effect of that care, potentially calling into question grandmothers as the primary driver of extended lifespan for human females (as Hawkes, et al. suggest it is). Grandmothers play an important role in Shodagor culture. However, grandmothers have different fitness interests at different stages in their own reproductive lifespan. Combining the two competing hypotheses suggests that women should direct their investment toward their own children as long as is possible and necessary, then redirect investment toward

grandchildren once they no longer have dependent grandchildren at home. Sear, et al. (2000) show that this may be happening in the Gambia, with grandmothers who are post-reproductive having a larger positive effect on nutritional status of grandchildren than do grandmothers who are still reproductively viable and who may be acting primarily as mothers. I will use time allocation data to test the hypothesis that, among the Shodagor, a woman's reproductive life stage (pre- or post-menopausal) and that of her children (dependent on parents or independent) should determine the amount of care she will provide her grandchildren and the effect that care has on grandchildren's health and chance of survival.

Finally, I plan to examine the relationship between human behavior and biology by measuring Shodagor men's and women's changes in testosterone levels, depending on behaviors related to subsistence work. The economic roles that Shodagor men and women take on, in which men fish with different constellations of individuals (sometimes with wife and children, sometimes with other men, sometimes alone), and many women do work that is both incompatible with childcare and high risk (economically, as well as for the women's safety and reputation) provide an excellent opportunity to understand gendered hormonal responses to childcare, risk, income, and potentially status.

Men's testosterone levels are known to increase in relationship to activities like individual or team competition (i.e. Trumble et al. 2012) and hunting (i.e. Trumble et al. 2013), and decrease alongside behaviors related to pair-bonding and fatherhood (i.e. Gettler et al. 2011, Gray et al. 2004). Based on these findings, I also expect changes in men's testosterone levels to vary depending on whom a man works with on any given day. Measures of Shodagor men's waking and evening testosterone levels will be used to

test the hypothesis that men's testosterone levels will increase at a higher rate on days when they work with other men, compared to days when they work alone or with their family. Testosterone should increase at the lowest rate on days when men work with their families, due to the down-regulating effect the presence of children have cross-culturally on men's testosterone levels. Controlling for factors like size of catch or amount of money earned, support for this hypothesis would suggest that fishing with other men creates a competitive environment, which results in increased levels of testosterone.

Measures of men's testosterone will also allow for a test between the provisioning hypothesis and the showoff hypothesis. A showoff model of Shodagor men's fishing would predict that men's testosterone should increase based on the signaling value of their catch. Men should show a higher increase in testosterone levels when they catch bigger, rarer fish, regardless of the amount of money they make from the fish. They will also spend a higher percentage of their income in ways that do not provision the family (i.e. buying tea for friends, cigarettes). A provisioning model would predict that men's hormonal profile will respond to the monetary value of the catch, but *not* the signaling value. Specifically, men's testosterone levels should increase when a catch has monetary value, regardless of the size or type of fish caught. Subsequently, a higher percentage of men's money earned should go to directly provision the family.

Much less is known about how women's testosterone levels respond to particular activities or circumstances. A few studies have found that women's testosterone levels increase with involvement in competitive sports (Bateup et al. 2002) and are higher when women engage in careers that involve more risk (Sapienza et al. 2009). In order to begin to understand the testosterone levels of Shodagor women, I will first compare the

increase from baseline of women who sell goods (the riskiest proposition for women, but also potentially the most rewarding), to women who fish with their families, and women who do not work outside the home. Previous findings predict that women who sell goods will show the greatest increase in testosterone throughout the day, with women who fish in the middle, and women who do not work showing the smallest change. Following this comparison, I will test the causal direction of change in testosterone for women by answering the following questions: Do women who sell goods have higher baseline testosterone levels than women who either fish or do not work? Or, do Shodagor women have similar baseline levels of testosterone, with major differences only seen after a day's activities? The first result would suggest that women with higher baseline testosterone are more likely to choose riskier economic pursuits, while the second result would suggest that it is the behavior of engaging in higher-risk work that causes testosterone levels to change temporarily.

Finally, this data will be used to test whether women's testosterone levels change in relationship to work partners, showing a pattern similar to men's. The lowest change in testosterone levels should be seen among women who work with their families. Very little is understood about how a woman's hormonal profile should change when she is working alongside other women, compared to working alone or working with her family. Understanding this relationship, especially as it compares to the findings for men, will help tease apart whether cooperation or competition is the driving force behind changes in testosterone levels for people who work in groups.

## **APPENDIX: Survey and Consent Documents**

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH  
Mohakhali, Dhaka- 1212  
UNIVERSITY OF MISSOURI  
Columbia, MO, USA

### **CONSENT FORM** **(Open-ended Interview)**

Protocol Number:

Protocol Title: **Shodagor Dissertation Project**

Name of ICDDR,B Principal Investigator: Nurul Alam

Name of University of Missouri Investigator: Kathrine Starkweather

Organization: HDSU, icddr,b; Bangladesh and University of Missouri, USA

Hello. I/we are from ICDDR,B, Dhaka, and have come here to collect information for a research project entitled “Shodagor Dissertation Project”. The purpose of this study is to learn things that no one has written about the Shodagor population living in Matlab, Bangladesh. Specifically, this study will get information about the way the Shodagor get food, what they do for work, how they travel, how often they travel, as well as information about parenting, marriage and family life from adult men and women living in different Shodagor communities. You are invited to participate in the study because you fit the criteria and can tell us about the Shodagor life and livelihood.

**Procedure:** If you accept you will be requested to answer some questions. The interview will be conducted in a place convenient to you and if you like, no one will be present during the interview. The interview will be recorded with the help of a voice recorder. This will be done to ensure that no valuable data is lost during the interview. We would like your permission to record the interview. The expected duration of the interview will be around 60 minutes. In addition to the interview, we will also be observing your daily activities and taking notes regarding these activities, however, this will not require much, if any, of your time.

**Risks:** The risk involved with the participation in this study is minimal and will not be any greater than what may be experienced in an everyday conversation. You may benefit from the opportunity to reflect upon your life and your culture. This research also has the potential to benefit the society by bringing about greater understanding of Shodagor economic and cultural practices and possibly policy reform that might help Shodagor people in Matlab.

**Confidentiality:** Your identity will remain completely confidential. Your identity will not be revealed in transcripts, written documents, or verbal presentations of the data. The following steps will be taken to protect your identity and confidentiality:

1. Consent forms will be separated from the data.
2. Only your ID number, and not your name, will appear in the electronic copy of the data and on any transcripts.
3. Interview notes will be kept in a locked cabinet in a locked office and all electronic versions of the data will be password protected.

4. Audio tapes will not include your name or directly identifying information and will be kept in a locked cabinet, in a locked office.

**Right not to participate and withdraw:** Your participation in the study is voluntary, and you are the sole authority to decide for or against your participation in this study. You will also be able to withdraw your participation any time during the study. Refusal to take part in or withdrawal from the study will involve no penalty for you or your family.

**Who to contact:** This proposal has been reviewed and approved by Research Review Committee and Ethical Review Committee at ICDDR,B. This proposal has also been reviewed and approved by the Campus Institutional Review Board at the University of Missouri, USA. Both committees are responsible for ensuring that research participants are protected from harm. For questions about your rights as a research subject you may contact either of the following:

ICDDR,B Ethical Review Committee, Mr. M.A. Salam Khan, Committee Coordination Secretariat, ICDDR,B, Mohakhali, Dhaka-1212, Bangladesh, Phone: 9886498 (direct) or 01711428989 (mobile).

University of Missouri Campus IRB, Office of Research, 483 McReynolds Hall, Columbia, MO 65211, USA. Phone: 1 (573) 882-9585. Email: [umcresearchcibr@missouri.edu](mailto:umcresearchcibr@missouri.edu).

If you have any general questions about the project you may ask those now or later. If you wish to ask questions later, you may contact the following: Dr. Nurul Alam, Health and Demographic Surveillance Unit, Public Health Sciences Division, icddr,b, Mohakhali, Dhaka 1212. Phone: 8810719, 8810024 or mobile: 01819438287. You may also contact the following investigators at the University of Missouri, Kathrine Starkweather at [kesc99@mail.missouri.edu](mailto:kesc99@mail.missouri.edu) or Dr. Mary Shenk at 1.206.383.6207 or [shenkm@missouri.edu](mailto:shenkm@missouri.edu)

If you agree to participate, please indicate that by putting your signature or your left thumb impression at the specified space below.

Thank you for your cooperation.

I have read/has been read to me the foregoing information. I have had the opportunity to ask questions about it and any question I have asked has been answered to my satisfaction. I consent voluntarily to participate in the study and to have my interview recorded. I understand that I have the right to refuse to answer individual questions, or to withdraw from the interview at any time without in any way affecting myself or my family.

\_\_\_\_\_  
Signature or left thumb impression of respondent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the interviewer

\_\_\_\_\_  
Date



INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH  
Mohakhali, Dhaka- 1212  
UNIVERSITY OF MISSOURI  
Columbia, MO, USA

Protocol Number:  
Protocol Title: Shodagor Dissertation Project  
Name of ICDDR,B Principal Investigator: Nurul Alam  
Name of University of Missouri Investigator: Kathrine Starkweather  
Organization: HDSU, ICDDR,B; Bangladesh and University of Missouri, USA

**Guidelines for Open-ended Interview**

**Personal Information**

ব্যক্তিগত তথ্যাবলী:

(explain: First, I will ask you some information about yourself.)

(বলুন: প্রথমে, আমি আপনার বিষয়ে কিছু তথ্য জানতে চাইবো)

ID#: \_\_\_\_\_

Respondent's Gender: Male  Female

তথ্যদাতার লিঙ্গ: পুরুষ  নারী

Respondent's Age: \_\_\_\_\_

তথ্যদাতার বয়স: -----

Respondent's Marital Status: -----

**Economics**

অর্থনীতি:

1. What do you do for work?

১। আপনি কি করেন?

2. Can you tell me what a typical working day is like for you? (i.e. What time do you start/finish, what do you do first, etc.)

২। সাধারণত আপনার কর্ম সম্পাদনের দিনগুলো কি, তা বলতে পারবেন? (যেমন, আপনি কখন কাজ শুরু করেন, কি দিয়ে শুরু করেন ইত্যাদি)

**Transition: Now, I will ask you to think about Shodagor people in this bohor.**

এবার আমি এই বহরে অবস্থিত সওদাগরদের সম্পর্কে কিছু সাধারণ তথ্যাদি জানতে চাইবো

3. What do most men in this bohor (group) do for work?

৩। এই বহরের পুরুষেরা সাধারণত কি কাজ করে?

**Probes:**

a) If they fish, where do men sell the fish they catch?

ক) তারা যদি মাছ ধরে তাহলে তা কোথায় বিক্রি করে?

b) Who do they sell to?

খ) কাদের কাছে বিক্রি করে?

- c) Do all men in this bohor sell to the same place/person?  
 গ) এই বহরের সবাই কি একই জায়গায়/ মানুষের কাছে বিক্রি করে?  
 d) How long does it take to reach the person or place the men sell to?  
 ঘ) যে জায়গা / মানুষের কাছে তারা বিক্রি করে তাদের কাছে পৌঁছাতে তার কত সময় লাগে?  
 e) How often do they sell their fish? (i.e. every day? Once a week?)  
 ঙ) তারা কখন কখন মাছ বিক্রি করে? (যেমন, প্রতিদিন? সপ্তাহে একবার?)

4. What do most women in this bohor do for work?

৪। বহরের বেশিরভাগ মহিলা কি কাজ করে?

**Probes:**

- a) If they sell goods, who do women sell goods to? (i.e. other women, men)  
 ক) মহিলারা কাদের কাছে বিক্রি করে? (যেমন, মহিলা, মহিলাদের জন্য পুরুষদের কাছে)  
 b) Where do women go to sell goods?  
 খ) মহিলারা দ্রব্যাদি কোথায় বিক্রি করে?  
 c) Do the women sell in the market or door-to-door?  
 গ) মহিলারা কি বাজারে বিক্রি করে না বাড়ি বাড়ি গিয়ে?  
 d) Name the places you usually go to sell the goods.  
 ঘ) আপনারা যেসব জায়গায় দ্রব্যাদি বিক্রি করেন তাদের নাম বলেন।  
 e) If so, how long does it take to travel to those places?  
 ঙ) তাহলে এইসব জায়গায় যেতে আপনার কত সময় লাগে?  
 f) Who do women buy these goods from?  
 চ) এই সব দ্রব্যাদি আপনারা কার কাছ থেকে কিনে আনেন?  
 g) If the husband buys the goods, who does he buy from?  
 ছ) যদি আপনার স্বামী এই সব দ্রব্যাদি কিনে আনেন সেক্ষেত্রে তিনি কার কাছ থেকে কিনে আনেন?

5. Does a woman work when she is pregnant or nursing?

৫। গর্ভবতী থাকাকালীন অথবা বাচ্চা লালন-পালন রত মহিলা কি কাজ করে?

**Probes:**

- a) If not, how long does she wait after she has the baby to return to work?  
 ক) যদি না হয়, তাহলে বাচ্চা জন্ম দেয়ার পর কাজে ফিরে যেতে তাকে কতদিন পর্যন্ত অপেক্ষা করতে হয়?  
 b) If so, does her work change in any way (i.e. does she stay closer to home, work fewer hours)?  
 খ) যদি হয় তাহলে তার কাজ কি কোনভাবে পরিবর্তিত হয়? (যেমন, তিনি কি ঘরের কাছাকাছি থাকেন বা কাজের সময়ের পরিধি কিছুটা পরিবর্তন হয়?)

6. Does a husband's work change when his wife is pregnant or nursing? (i.e. does he work more days, longer hours, does he travel more or less?)

৬। স্ত্রী গর্ভবতী থাকাকালীন বা শিশু লালন-পালন কালীন তার স্বামীর কাজ কি পরিবর্তিত হয়? (যেমন, তিনি বেশিদিন কাজ করে, বেশি সময় ধরে কাজ করে, তিনি কি বেশি দূরে ভ্রমণ করেন কম দূরে?)

a) If not, why not?

ক) না হলে, কেন না?

7. Where is the nearest market located?

- ৭) এখান থেকে সব চেয়ে কাছে কোন বাজার অবস্থিত?  
a) How long does it take to get there from here?  
ক) এখান থেকে যেতে কত সময় লাগে?

8. Do women usually go to the markets to buy food?

- ৮) মহিলারা কি সাধারণত খাবার কিনতে বাজারে যায়?  
a) If not, why not?  
ক) না হলে, কেন না?

9. Who buys most of the food and goods (i.e. clothes) for the family?

- ৯) পরিবারের জন্য খাবার এবং অন্যান্য দ্রব্যাদি (যেমন: কাপড়) সাধারণত কে কিনে আনে?

10. Who usually takes kids to the doctor?

- ১০) কে সাধারণত ছেলে-মেয়েদের ডাক্তারের কাছে নিয়ে যায়?

11. Do any of the families in this bohor own land?

- ১১) এই বহরের কোনো পরিবারের কি নিজস্ব জমি আছে?

**Probe:**

- a) If yes: So, they bought the land and do they pay taxes on it?  
ক) তাহলে, তারা জমি কিনেছে এবং সনলগ্ন সকল কর তারা প্রদান করে।

### **Economic Cooperation**

#### **অর্থনৈতিক সহযোগিতা**

12. Do you and your spouse ever go to work at the same time? Or does the wife stay home while the husband works and the husband stays home while the wife works?

- ১২) আপনি এবং আপনার স্বামী/ স্ত্রী কি কখনো একই সময়ে কাজে গিয়েছেন? নাকি স্ত্রী বাসায় থাকে যখন স্বামী কাজে যায় এবং স্ত্রী কাজে গেলে স্বামী বাসায় থাকে?

13. Do you and your spouse work together? (i.e. fish together, sell goods together)

- স্বামী এবং স্ত্রী কি কখনো একই সময়ে কাজ করে? (যেমন, একসাথে মাছ ধরেন, একসাথে দ্রব্যাদি বিক্রি করেন?)

14. What about other families in this bohor? Do husbands and wives go to work at the same time? Do husbands and wives do work together?

- এই বহরের অন্যান্য পরিবারগুলো কি করে? স্বামী স্ত্রী কি একই সময় কাজে যায়? স্বামী- স্ত্রী কি একই সাথে কাজ করে?

**For MEN:**

**পুরুষদের জন্য:**

15. Do you work (i.e. fish) with other men?

- ১৫) আপনি কি অন্য পুরুষদের সাথে কাজ (যেমন: মাছ ধরে) করে?  
a) If so, who?

- ক) হ্যাঁ হলে, কে?
- b) Do you and the other man/men cooperate (do you help each other)? Or do you do your own work nearby one another?
- খ) আপনি/আপনারা কি একে অপরকে সাহায্য-সহযোগিতা করেন?
- c) How do you split up the day's earnings?
- গ) এক দিনের আয় আপনারা কীভাবে ভাগভাগি করে নেন?
- d) Outside of work, do you cooperate with these men in any other way?
- ঘ) কাজের বাহিরেও কি আপনারা একে অপরকে অন্য কোন ভাবে সাহায্য করেন?

**For WOMEN:**

16. Do you ever go with other women to work (i.e. sell goods)?
- ১৭। আপনি কি কখনো অন্য কোন মহিলার সাথে দ্রব্যাদি বিক্রি করতে গিয়েছিলেন?
- a) If so, who?
- ক) তাহলে, কাদের সাথে?
- b) Do you and the other man/men cooperate (do you help each other)? Or do you do your own work nearby one another?
- খ) আপনি কি জানেন যে পুরুষেরা একে অপরকে সাহায্য করে কিনা? (আপনারা কি একে অপরকে সাহায্য করেন?) নাকি আপনারা একে অপরের আশেপাশে নিজেদের কাজ করেন?
- c) How do you split up the day's earnings?
- গ) এক দিনের আয় আপনারা কীভাবে ভাগা ভাগি করে নেন?
- d) Outside of work, do you cooperate with these men in any other way?
- ঘ) কাজ ছাড়াও কি অন্য কোন উপায়ে একে অপরকে সাহায্য করেন?

**Risk Management**

**দুর্যোগ ব্যবস্থাপনা**

17. Do you ever struggle to provide basic needs for your family?
- ১৯) আপনার পরিবারের মৌলিক চাহিদা (খাদ্য, বস্ত্র বাসস্থান, চিকিৎসা ও শিক্ষা) পূরণে কি আপনি কখনো সমস্যায় পড়েছেন?
18. What does your family do if you face hard times with low or no income?
- ২০) পারিবারিক দুঃসময় (অল্প আয়/ বিনা আয়ের সময়গুলো) আপনারা কীভাবে মোকাবেলা করেন?
- Probes:**
- a) Do you save money to protect against this?
- ক) মোকাবেলার জন্য কি আপনি সঞ্চয় করেন?
- b) Do you ever borrow money from other families or individuals?
- খ) অন্য কোনও পরিবার বা ব্যক্তির কাছ থেকে টাকা ধার নেয়?
- c) Who do you borrow from (i.e. relatives, sharder)?
- গ) কার কাছ থেকে ধার নেন? (যেমন: আত্মীয়, সর্দার)।
- d) Do other families or individuals ever share food or fish with you?
- ঘ) অন্য কোন ব্যক্তি বা পরিবার কি খাবার, মাছ দিয়ে আপনাকে সাহায্য করে?

- e) Who usually shares with you (i.e. relatives)?  
ঙ) কে সাধারণত সাহায্য করে? (যেমন: আত্মীয়)।

19. What about other Shodagor families you know? Do they struggle to provide? If so, what do they do?

২১) আপনার পরিচিত অন্যান্য সওদাগর পরিবার কি করে? তারাও কি দুঃসময়ের সম্মুখীন হয়? তাহলে, তখন তারা কি করে?

### **Parental Investment**

#### **For MEN:**

20. How much time do you spend (or *did* you spend if children are married adults) with your children on a normal day? (i.e. only night time after work, all day, etc.)

২২) সাধারণত আপনি আপনার সন্তানের সাথে কত সময় অতিবাহিত করেন (যদি বিবাহিত হয় তাহলে কত সময় অতিবাহিত করতেন?) (যেমন: শুধু রাতে কাজ থেকে ফিরার পর, দিনে, ইত্যাদি)।

- a) What about other Shodagor fathers you know? Are they similar to you?  
ক) অন্যান্য সওদাগর পরিবারের বাবারা কি করে? তারা কি আপনার- ই মত?

21. Are you ever away from home for more than 1 day (i.e. overnight)?

২৩) বাবারা কি কখনো কাজের জন্য এক দিনের বেশি (যেমন, রাতে বাড়ির বাহিরে) বাইরে থাকে?

- a) If so, does anyone help your wife with the children?  
ক) আপনার স্ত্রীকে কি সন্তান দেখাশোনার ক্ষেত্রে কেও সাহায্য করে?  
b) Who?  
খ) কে করে?

22. Do you ever take your children with you when you work?

২৪) কাজের সময় ভূমি কি তোমার সন্তানের সাথে নিয়ে যাও?

- a) If so, which children (i.e. only boys, only the oldest son, only older children)?  
ক) তাহলে কোন সন্তানকে? (যেমন: শুধু ছেলেদের, শুধু বড় ছেলেকে? শুধু বড় সন্তানদের?)  
b) Do the children help you do your work?  
খ) সন্তানরা কি আপনাকে সাহায্য করে?  
- How do they help?  
- কীভাবে সাহায্য করে?  
c) Do you teach the children how to fish?  
গ) আপনি কি তাদের মাছ ধরতে শিখান?

23. If you are ever away from home for any reason (i.e. working, visiting the market) who watches your kids? Please tell us all the people who help you.

২৫) আপনি কখনো কোনও কারণে বাড়ির বাহিরে (যেমন: বাড়ির বাহিরে, আত্মীয়ের বাড়িতে) থাকলে সন্তানের দেখাশোনা কে করে? যারা আপনাকে সাহায্য করে তাদের সম্পর্কে বলেন।

- a) What do they do to help?  
ক) সাহায্য করার জন্য তারা কি করে?

24. If your wife is ever away from home for any reason (i.e. working, visiting family) who helps you with your kids? Please tell us all the people who help you.

২৬) আপনার স্ত্রী কোনও কারণে বাড়ির বাহিরে (যেমনঃ কাজের জন্য, আত্মীয়ের বাড়িতে) থাকলে সন্তানের কে দেখাশোনা করে?

- a) What do they do to help?  
ক) তারা কি ধরণের সাহায্য করে?

**For WOMEN:**

25. How much time do you spend (or *did* you spend if children are married adults) with your children on a normal day? (i.e. only night time after work, all day, etc.)

২২) সাধারণত আপনি আপনার সন্তানের সাথে কত সময় অতিবাহিত করেন বা করতেন (যদি সন্তান বিবাহিত হয়ে থাকে)? (রাতে, কাজ থেকে ফিরার পর, সারাদিন, ইত্যাদি)

- a) Do/did you spend more time with some children than others? (i.e. you take younger kids with you to sell goods, but not older kids)  
ক) কারও সাথে বেশী সময় থাকেন এবং অন্যদের সাথে কম? (যেমনঃ আপনি আপনার ছোট সন্তানের আপনার সাথে কাজে নিয়ে যান, কিন্তু বড় সন্তানের নয়)  
b) What about other Shodagor mothers you know? Are they similar to you?  
খ) অন্যান্য মা রা কি করে? তারাও কি আপনার মত?

26. Are you ever away from home for more than 1 day (i.e. overnight)?

২৩) কাজের জন্য আপনি কি কখনো ১ দিনের বেশী বাড়ির বাহিরে থেকেছেন? (যেমনঃ সারা রাত)।

- a) If so, does anyone help your husband with the children?  
ক) সেক্ষেত্রে সন্তান দেখাশোনায় আপনার স্বামীকে কি কেউ সাহায্য করে?  
- Who?  
- কে?

27. Do you take your children with you when you work?

২৪) আপনি কি আপনার সন্তানের আপনার সাথে কাজে নিয়ে যান?

- a) If so, do you always take them, or are there only certain times of the year/days of the week when you take them?  
ক) তাহলে, কি সব সময় নিয়ে যান? নাকি বছরের/ মাসের/ সপ্তাহের কোনও নির্দিষ্ট সময় নিয়ে যান?  
b) Which children (i.e. nursing infants, only daughters, only younger children)?  
খ) কোন সন্তানের নিয়ে যান? (একদম ছোট বাচ্চা, শুধুমাত্র কন্যা সন্তানের, ছোট সন্তানের)।  
c) If so, do your children help you? Do other children help their mothers?  
গ) তাহলে, আপনার সন্তানরা কি আপনাকে সাহায্য করে? অন্যান্য সন্তানরাও কি তাদের মাদের সাহায্য করে?  
- How do they help?  
- কীভাবে সাহায্য করে?  
d) If your children come along, are you teaching them any skills?  
ঘ) আপনার সন্তানরা আপনার সাথে আসলে আপনি কি তাদের নানা বিষয় শিখা দেন?

28. If you are ever away from home for any reason (i.e. working, visiting family) who watches your kids? Please tell us all the people who help you.

২৫) আপনি যদি কোনও কারণে বাড়ির বাহিরে যান (যেমন: কাজের জন্য, আত্মীয়ের বাড়িতে) আপনার সন্তানের কে দেখাশোনা করে? তাদের সবার কথা বলেন যারা আপনাকে সাহায্য করে।

- a) What do they do to help?  
ক) সাহায্য করার জন্য তারা কি করে?

29. If your husband is ever away from home for any reason (i.e. working, visiting the market) who helps you with your kids? Please tell us all the people who help you.

২৬) আপনার স্বামী কোনও কারণে বাড়ির বাহিরে গেলে (যেমন: কাজে, আত্মীয়ের বাড়িতে) সন্তান দেখাশোনায় আপনাকে কে সাহায্য করে?

- a) What do they do to help? (i.e. hold your baby while you cook, let your kids play at their house, etc.)  
ক) তারা কি ধরনের সাহায্য করে? (যেমন: আপনার বাচ্চাকে কোলে রাখে যখন আপনি রান্না করেন, তাদের নিজেদের বাড়িতে খেলা করতে দেয়)

### **Marriage**

**Please tell us about your own marriage.**

আপনার বিয়ে সম্পর্কে আমাদের কিছু বলেন।

30. Was it a love marriage, or an arranged marriage?

৩১। আপনারা কি নিজেরা পছন্দ করে বিয়ে করেছেন নাকি আপনার পরিবার থেকে সিদ্ধান্ত নেয়া হয়েছে?

**Probes:**

If arranged:

যদি পরিবার থেকে সিদ্ধান্ত নেয়া হয়?

- a) If it was arranged, who arranged it? And how did they arrange it? (If there was a matchmaker, who was it?)

ক) পরিবারের পক্ষ থেকে বিয়ে ঠিক করা হলে, কে ঠিক করেছে?

- b) What role did your family members play in arranging your marriage? (i.e. father/mother/brother, etc.)

খ) আপনার পরিবেশের সদস্যরা কি ভূমিকা পালন করেছে আপনার বিয়েতে? ( বাবা/মা/ ভাই

ইত্যাদি)

- c) Did you participate in choosing your bride/groom?

গ) আপনি কি আপনার মতামত প্রকাশ করতে পেরেছেন?

31. How old were you and your spouse when you got married?

৩২। আপনার এবং আপনার স্বামী/ স্ত্রীর বয়স কত ছিল যখন আপনারা বিয়ে করেছেন?

32. Did you have a celebration?

৩৩। আপনারা কি কোনও অনুষ্ঠানের আয়োজন করেছিলেন?

**Probes:**

- a) If so, how many days was it?

ক) তাহলে, সেটা কত দিনের অনুষ্ঠান ছিল?

- b) Was there a feast?

খ) কোনও ভোজের কি আয়োজন করা হয়েছিল?

- c) Who paid for the feast?  
 গ) ভোজের জন্য টাকা কে দিয়েছে?  
 d) Where was it held?  
 ঘ) কোথায় হয়েছিল?  
 e) What kind of gifts did you get? (i.e. gold, jewelry, boat, money)  
 ঙ) কি ধরণের উপহার আপনি পেয়েছিলেন? (যেমন: স্বর্ণ, অলঙ্কার, নৌকা, টাকা)  
 f) Who gave the gifts?  
 চ) কে উপহার দিয়েছে?

33. After marriage, did you live near your family or your spouse's family? Why?

৩৪) বিয়ের পর আপনি কি আপনার পরিবারের কাছে থাকেন নাকি আপনার স্বামী/স্ত্রীর পরিবারের কাছে বসবাস করেন?

**If you have married sons or daughters, please tell us about those marriages also.**

আপনার কোনও ছেলে/মেয়ের বিয়ে হয়ে থাকলে তাদের বিয়ে সম্পর্কে আমাদের বলেন।

34. Was it a love marriage, or an arranged marriage?

৩৫) আপনারা কি নিজেরা পছন্দ করে বিয়ে করেছেন নাকি আপনার পরিবার থেকে সিদ্ধান্ত নেয়া হয়েছে?

**Probes:**

If arranged:

যদি পরিবার থেকে সিদ্ধান্ত নেয়া হয়?

- a) If it was arranged, who arranged it? And how did they arrange it? (If there was a matchmaker, who was it?)  
 ক) পরিবারের পক্ষ থেকে বিয়ে ঠিক করা হলে, কে ঠিক করেছে?  
 b) What role did your son/daughter's family members play in arranging the marriage?  
 খ) আপনার পরিবারের সদস্যরা কি ভূমিকা পালন করেছে তাদের বিয়েতে? (বাবা/মা/ ভাই ইত্যাদি)  
 c) Did your son or daughter participate in choosing the bride/groom?  
 গ) আপনার ছেলে/মেয়ে কি তাদের মতামত প্রকাশ করতে পেরেছেন?

35. How old was your son/daughter and his/her spouse when they got married?

৩৬) আপনার ছেলে/মেয়ের বয়স কত ছিল যখন তারা বিয়ে করেছেন?

36. Was there a marriage celebration?

৩৭) আপনারা কি কোনও অনুষ্ঠানের আয়োজন করেছিলেন?

**Probes:**

- a) If so, how many days was it?  
 ক) তাহলে, সেটা কত দিনের অনুষ্ঠান ছিল?  
 b) Was there a feast?  
 খ) কোনও ভোজের কি আয়োজন করা হয়েছিল?  
 c) Where was the feast held?  
 গ) কোথায় হয়েছিল?  
 d) Who paid for the feast?  
 ঘ) ভোজের জন্য টাকা কে দিয়েছে?  
 e) What kind of gifts were given? (i.e. gold, jewelry, boat, money)  
 ঙ) কি ধরণের উপহার আপনি পেয়েছিলেন? (যেমন: স্বর্ণ, অলঙ্কার, নৌকা, টাকা)  
 f) Who gave the gifts?



চ) কে উপহার দিয়েছে?

37. After marriage, did the couple live near the bride's family or the groom's family? Why?

৩৮) বিয়ের পর আপনি কি আপনার পরিবারের কাছে থাকেন নাকি আপনার স্বামী/ স্ত্রীর পরিবারের কাছে বসবাস করেন?

38. Do Shodagor children get any inheritance from their parents?

৪১) ছেলেমেয়েরা কি উত্তরাধিকার সূত্রে বাবা-মার কাছ থেকে কিছু পায়?

**Probes:**

a) If so, what do they inherit (i.e. boat, money, fishing nets, jewelry, other property, status in the group)?

ক) হ্যাঁ হলে, কি পায়? ( নৌকা, টাকা, মাছ ধরার জাল, অলঙ্কার, অন্যান্য সম্পত্তি, বহরের মধ্যে মর্যাদা)।

b) Do sons or daughters inherit?

খ) উত্তরাধিকার কারা? ছেলেরা?/ মেয়েরা?/ উভয়?।

c) Who do they inherit from?

গ) কাাদের কাছ থেকে উত্তরাধিকার সূত্রে তারা পায়?

**Now, please think about Shodagor families you know in Matlab.**

এখন, মতলবের অন্যান্য সওদাগর পরিবারের কথা চিন্তা করেন।

39. If a woman's husband dies, what does she do?

২৭) কোনও মহিলা বিধবা হলে তখন সে কি করে?

**Probes:**

a) Where does she live? (i.e. near her family, near her husband's family, alone)

ক) তখন সে কোথায় থাকে? (যেমন: তার পরিবারের সাথে? তার স্বামীর পরিবারের সাথে? একা?)

b) Who helps her with her children? (i.e. her family, her husband's family, other)

খ) সন্তান দেখাশোনায়ে তাকে কে সাহায্য করে? ( যেমন: তার পরিবার? তার স্বামীর পরিবার? একা?)

c) Will she find it difficult to provide for her family? Why?

গ) তার পরিবারকে দেখাশোনায়ে সে কি কোন সমস্যার সম্মুখীন হয়? কেন?

d) Is it common for a woman to get remarried after her husband dies?

ঘ) দ্বিতীয় বিবাহ কি মহিলাদের ক্ষেত্রেও একটি সাধারণ বিষয়?

40. Is a woman's situation different if her husband divorces or abandons her?

২৮) যদি কোনও মহিলার স্বামী তাকে ছেড়ে চলে যায় অথবা তালাক দেয় তবে সেক্ষেত্রে কি তার অবস্থার কোনও পরিবর্তন হয়?

**Probes:**

-How?

-কীভাবে?

-Why?

-কেন?

41. If a man's wife dies, what does he do?

২৯) কারও স্ত্রী মারা গেলে সেক্ষেত্রে পুরুষরা কি করে?

**Probes:**

a) Where does he live? (i.e. near his family, near his wife's family, alone)

ক) সে কোথায় বাস করে? (যেমনঃ তার পরিবারের সাথে? তার স্ত্রীর পরিবারের সাথে? একা?)

b) Who helps him with his children? (i.e. his family, his wife's family, other)

খ) সন্তান দেখাশোনায় তাকে কে সাহায্য করে? (যেমনঃ তার পরিবার? তার স্ত্রীর পরিবার?

একা?)

c) Will he find it difficult to provide for his family? Why?

গ) তার পরিবারকে দেখাশোনায় সে কি কোন সমস্যার সম্মুখীন হয়? কেন?

d) Is it common for a man to get remarried after his wife dies?

ঘ) স্ত্রী মারা গেলে স্বামীর দ্বিতীয় বিবাহ কি একটি সাধারণ বিষয়?

42. Is a man's situation different if his wife divorces or abandons him?

৩০) পুরুষের অবস্থা কি মহিলাদের থেকে ভিন্ন হয় যদি তার স্ত্রী তাকে ছেড়ে চলে যায়?

**Probes:**

- How?

- কীভাবে?

- Why?

- কেন?

a) Do you know anyone whose wife has left him? Tell me about that situation.

ক) আপনি কি এমন কাউকে চিনেন যার স্ত্রী তাকে ছেড়ে চলে গেছে? আমাকে তার অবস্থার

কথা বলুন।

### **Movement & Residence**

গতিবিধি এবং বাসস্থানঃ

43. Do all of the families in this bohor stay near this place all year or do they move to different places?

৪২) এই বছরের সকল পরিবার সারা বছরই কি কাছাকাছি থাকে (স্থানের নাম উল্লেখ করুন) নাকি তারা বিভিন্ন স্থানে যায়?

a) If they move, where do they go?

ক) যদি তারা যায়, তারা কোথায় যায়?

b) What are some of the reasons a family would move?

খ) একটি পরিবার সাধারণত কি কি কারণে স্থান পরিবর্তন করে?

44. What about your family?

৪৩) আপনার পরিবারের কথা বলেন।

a) Do you move?

ক) আপনি কি কখনো স্থান পরিবর্তন করেন?

b) How many times do you move in 1 year?

খ) এক বছরে আপনারা কত বার স্থান পরিবর্তন করেন অথবা অন্য জায়গায় যান?

c) Where do you go?

গ) আপনারা কোথায় যান?

- d) WHY do you move to those places?  
 ঘ) আপনি ঐসব স্থানে কেন যান?  
 e) Do you always move to the same places at the same times of year?  
 ঙ) বছরের একটি নির্দিষ্ট সময় কি আপনারা একটি নির্দিষ্ট স্থানে যান?  
 f) Do you move with other families?  
 চ) আপনি কি অন্যান্য পরিবারের সাথে স্থান পরিবর্তন করেন?
45. Do any of the families in this bohor move together at the same time and go to the same place?  
 ৪৪) এই বছরের অন্য পরিবার কি একসাথে একই সময়ে একটি নির্দিষ্ট স্থানে যান?  
 a) If so, who usually moves together?  
 ক) সে রকম হলে, কারা স্থান পরিবর্তন করে?  
 b) Why do they move together?  
 খ) কারা কারা এক সাথে স্থান পরিবর্তন করে?  
 c) If many families move together, how do they decide WHERE and WHEN to go?  
 গ) অনেক গুলো পরিবার এক সাথে স্থান পরিবর্তন করলে তারা কীভাবে সিদ্ধান্ত গ্রহণ করে?
46. What is the farthest place your family has traveled in the last 2 years?  
 ৪২) গত ২ বছরে সবচেয়ে কতদূর আপনার পরিবার ভ্রমণ করেছে?  
 a) How long did it take you to get there?  
 ক) ঐ স্থানে পৌঁছাতে কত সময় লেগেছিল?  
 b) Why did you go there?  
 খ) আপনারা সেখানে কেন গিয়েছিলেন?

#### **Hierarchy & Political Organization**

47. Is there a leader who makes decisions for this group?  
 ৪৬) এই বছরে কি কোনও সর্দার আছে যে সিদ্ধান্ত গ্রহণ করে?  
 a) If so, who is the leader?  
 ক) কে সেই সর্দার?  
 b) Where does he/she live?  
 খ) তিনি কোথায় বাস করেন?  
 c) What kinds of decisions does this person make for the group? (i.e. when to move, where to move, other)  
 গ) বছরের জন্য কি ধরণের সিদ্ধান্ত তিনি গ্রহণ করেন?  
 d) What else does the leader do for the group besides make decisions?  
 ঘ) এছাড়াও তিনি র কি কি ভূমিকা পালন করেন?  
 e) How was the leader chosen?  
 ঙ) আপনারা সর্দার কীভাবে নির্বাচন করেন?  
 f) Does the leader of the group ever change?  
 চ) সর্দার কি কখনো পরিবর্তন হয়?
48. Do people in this group ever make decisions together without the leader?  
 ৪৭) এই বছরের সকলে মিলে সর্দারকে ছাড়া কি কোনও সিদ্ধান্ত গ্রহণ করেছে?  
 a) What kinds of things do they make decisions about?  
 ক) কি ধরণের সিদ্ধান্ত তারা গ্রহণ করেছে?  
 b) How are decisions made?  
 খ) তারা কীভাবে সিদ্ধান্ত গ্রহণ করেছে?

49. Can you tell me about the last time multiple families in this group made a decision together?

৪৮) শেষ কবে বহু পরিবার মিলে একটি সিদ্ধান্ত গ্রহণ করেছে?

a) What happened?

ক) কি হয়েছিল?

b) What was the decision about?

খ) সিদ্ধান্ত কি বিষয় ছিল?

c) How did the families come to agree on an action?

গ) সকল পরিবার কীভাবে একত্রে মিলিত হল?

50. If a particular family is unhappy about a group decision, what can they do?

৪৯) কোনও পরিবার যদি সিদ্ধান্ত মেনে না নিতে চায় তখন তারা কি করে?

51. Are some women in this group considered higher status than other women?

৫০) এই গোত্রের কোন মহিলাদের কি অন্য মহিলাদের তুলনায় সামাজিক পদমর্যাদায় উচ্চতর অবস্থানে গণ্য করা হয়?

a) Why?

ক) কেন?

b) Who are they?

খ) তারা কারা?

52. Are some men in this group considered higher status than other men?

৫১) এই গোত্রের কোন পুরুষদের কি অন্য পুরুষদের তুলনায় সামাজিক পদমর্যাদায় উচ্চতর অবস্থানে গণ্য করা হয়?

a) Why?

ক) কেন?

b) Who are they?

খ) তারা কারা?

53. Are some families in this group considered higher status than other families?

৫২) কোনও বিশেষ পরিবার কি অন্য পরিবারের থেকে উচ্চ অবস্থানে আছে?

a) Why?

ক) কেন?

b) Who are they?

খ) তারা কারা?

54. Do the families in this bohor think of yourselves as a part of a separate community? (i.e. separate from other Shodagor groups, separate from non-Shodagor families?)

৫৩) আপনারা সবাই কি নিজেকে একটি ভিন্ন সম্প্রদায়ের অংশ বলে মনে করেন? (যেমন, সওদাগর গোত্র থেকে আলাদা, স্থলে বসবাসরত মানুষদের থেকে আলাদা)

**Can you tell us where other Shodagor groups live in Matlab?**

আপনি কি বলতে পারেন মতলব আর কোনও সউদাগর বহর আছে কিনা?

**Charmukundi, Kazir Bazar, Nayerga, Amirabad? Others?**

চরমুকুন্দি, খামির বাজার, নায়ের গাঁ, আমিরাবাদ? অন্যান্য?

**Is there anything that we talked about that you would like to tell me more about or anything I did not ask that you would like to add/to tell me?**

আমরা যা ডিস্কাস করেছি তার বাহিরে কি আপনারা কিছু বলতে চান?

**Thank you for your time and thank you for talking with us today.**

আপনাকে অনেক ধন্যবাদ আপনার মূল্যবান সময় আমাদের দেয়ার জন্য।

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH  
Mohakhali, Dhaka- 1212  
UNIVERSITY OF MISSOURI  
Columbia, MO, USA

**CONSENT FORM**  
**(Questionnaire Interview and Anthropometric Measures)**

Protocol Number:

Protocol Title: Shodagor Dissertation Project

Name of ICDDR,B Principal Investigator: Nurul Alam

Name of University of Missouri Investigator: Kathrine Starkweather

Organization: HDSU, icddr,b; Bangladesh and University of Missouri, USA

Hello. I/we are from ICDDR,B, Dhaka, and have come here to collect information for a research project entitled “Shodagor Dissertation Project”. The purpose of this study is to learn things that no one has written about the Shodagor population living in Matlab, Bangladesh. Specifically, this study will get information about type of work the Shodagor do, their health status, nutrition status, education, living situation, travel, parenting practices, family formation and marriage from adult men and women living in different Shodagor communities. You are invited to participate in the study because you fit the criteria and can tell us about your own experiences and the Shodagor way of life.

**Procedure:** If you accept, first you will be requested to answer some questions on two different occasions over the next year. The interviews will be conducted in a place convenient to you and if you like, no one will be present during the interviews. The expected duration of the first interview will be around 60 minutes. Some parts of this interview will be repeated again several months later, in order to understand the differences between the Shodagor way of life during the rainy season and the dry season. The second interview will be much shorter and last approximately 30 minutes.

You and any children or dependents you have will also be asked to allow us to take some measurements. We will measure 3 different things: 1) weight, 2) height, and 3) upper arm circumference. Weight will be measured using a scale that you will stand on for a few seconds, while height and upper arm circumference will be measured using a cloth tape measurer. All 3 of these measurements will be very quick and will take less than 5 minutes to complete per person. In addition to the interview, we will also be observing your daily activities and taking notes regarding these activities however, this will require little to none of your time.

**Risks:** The risk involved with the participation in the interview portion of this study is minimal and will not be any greater than what may be experienced in an everyday conversation. The risk involved with collecting anthropometric measures will also be minimal; it will not cause any physical discomfort. The procedure will be very brief, not at all harmful, and non-invasive. You may benefit from the opportunity to reflect upon your life and your culture. This research also has the potential to benefit the society by bringing about greater understanding of Shodagor

subsistence and cultural practices as well as health and nutritional practices and possibly policy reform that might help Shodagor people in Matlab.

**Confidentiality:** Your identity will remain completely confidential. Your identity will not be revealed in transcripts, written documents, or verbal presentations of the data. The following steps will be taken to protect your identity and confidentiality:

1. Consent forms will be separated from the data.
2. Only your ID number, and not your name, will appear on the questionnaire form.
3. Questionnaire forms and notes will be kept in a locked cabinet in a locked office and all electronic versions of the data will be password protected.

**Right not to participate and withdraw:** Your participation in the study is voluntary, and you are the sole authority to decide for or against your participation in this study, as well as that of any of your children or dependents. You will also be able to withdraw your participation or your children's/dependents' participation any time during the study. Refusal to take part in or withdrawal from the study will involve no penalty for you or your family.

**Who to contact:** This proposal has been reviewed by Research Review Committee and Ethical Review Committee at ICDDR,B. This proposal has also been reviewed and by the Campus Institutional Review Board at the University of Missouri, USA. Both committees are responsible for ensuring that research participants are protected from harm. For questions about your rights as a research subject you may contact either of the following:

ICDDR,B Ethical Review Committee, Mr. M.A. Salam Khan, Committee Coordination Secretariat, ICDDR,B, Mohakhali, Dhaka-1212, Bangladesh, Phone: 9886498 (direct) or 01711428989 (mobile).

University of Missouri Campus IRB, Office of Research, 483 McReynolds Hall, Columbia, MO 65211, USA. Phone: 1 (573) 882-9585. Email: [umcresearchcirb@missouri.edu](mailto:umcresearchcirb@missouri.edu).

Principle Investigator: Ms. Kathrine Starkweather, Email: [kesc99@mail.missouri.edu](mailto:kesc99@mail.missouri.edu), Phone: TBD

Advisor: Dr. Mary K. Shenk, Email: [shenkm@missouri.edu](mailto:shenkm@missouri.edu), Phone: 1-206-383-6207

If you have any general questions about the project you may ask those now or later. If you wish to ask questions later, you may contact the following: Dr. Nurul Alam, Health and Demographic Surveillance Unit, Public Health Sciences Division, icddr,b, Mohakhali, Dhaka 1212. Phone: 8810719, 8810024 or mobile: 01819438287.

If you agree to participate in some or all parts of this research study, please indicate that by first check-marking next to the appropriate explanations, then by putting your signature or your left thumb impression at the specified space below.

Thank you for your cooperation.

I have read/has been read to me the foregoing information. I have had the opportunity to ask questions about it and any question I have asked has been answered to my satisfaction. I consent voluntarily to participate in the study, indicated by the lines I have check-marked below. I understand that I have the right to refuse to answer individual questions, or to withdraw from the interview at any time without in any way affecting myself or my family.

Please check next to the applicable statements.

I agree to let my child(ren) participate in your research study.

I do not agree to let my child(ren) participate in your research study.

I agree to participate in your research study.

I do not agree to participate in your research study.

\_\_\_\_\_  
Signature or left thumb impression of respondent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the interviewer

\_\_\_\_\_  
Date



INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH  
Mohakhali, Dhaka- 1212

**CHILD ASSENT FORM**  
**(Anthropometric Measures)**

Protocol Number:

Protocol Title: **Shodagor Dissertation Project**

Name of ICDDR,B Principal Investigator: Nurul Alam

Name of University of Missouri Investigator: Kathrine Starkweather

Organization: HDSU, icddr,b; Bangladesh and University of Missouri, USA

Hello. I/we are from ICDDR,B and we are doing a research study about Shodagor people's lives. If it is ok with you, we would like to measure your height, weight, and the size of your upper arm. It will not take very long and will not hurt at all. You can say no to being in the study if you don't want to participate, even if your parents say it is ok for you to be in the study. You can also stop any time you want. Do you have any questions? Would you like to participate?

**INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH**  
**Mohakhali, Dhaka- 1212**  
**UNIVERSITY OF MISSOURI**  
**Columbia, MO, USA**

Protocol Number:  
Protocol Title: Shodagor Dissertation Project  
Name of ICDDR,B Principal Investigator: Nurul Alam  
Name of University of Missouri Investigator: Kathrine Starkweather  
Organization: HDSU, ICDDR,B; Bangladesh and University of Missouri, USA

**Life History Interview**

**INDIVIDUAL CHARACTERISTICS**

1. Respondent's Gender:  Male  Female  
উত্তরদাতার লিঙ্গ পুরুষ মহিলা
2. Respondent's Age: \_\_\_\_\_  
উত্তরদাতার বয়স
3. Religion:  Muslim  Hindu  Christian  Other \_\_\_\_\_  
ধর্ম ইসলাম হিন্দু খৃস্টান অন্যান্য
4. Education: Years/Level (শিক্ষা) \_\_\_\_\_  
Type (ধরণ) \_\_\_\_\_
5. Respondent's Marital Status:  Single  Married (husband and wife present)  Married (Husband/wife working away from home)  
উত্তরদাতার বৈবাহিক অবস্থা অবিবাহিত বিবাহিত (স্বামী/স্ত্রী বর্তমান) বিবাহিত (স্বামী/স্ত্রী বাড়ির বাহিরে কাজ করে)
- Married (Husband/wife left)  Widowed  Divorced  Other (explain: \_\_\_\_\_)  
বিবাহিত (স্বামী/স্ত্রী চলে গেছে) বিধবা তালকপ্রাপ্ত অন্যান্য

**RESPONDENT'S MARRIAGE(S)**

Question #	6	7	8a	8b	8c	9	10	11	12a	12b
Marriage # বিবাহ #	Respondent's Age at Marriage  উত্তরদাতার বিবাহের সময় বয়স	Spouse's Age at Marriage  বিবাহের সময় স্বামী/স্ত্রীর বয়স	Marriage Ended? 0 = no 1 = yes  বিয়ে কি ভেঙ্গে গেছে? ১= না ২= হ্যাঁ	If ended, duration of marriage (in years)  ভেঙ্গে গেলে বিয়ের বয়স কত দিন ছিল? (বছরে)	Reason for ending 1=death 2=divorce 3=abandonment 4=other (explain)  ভেঙ্গে গেলে কেন? ১=মারা গেছে ২=ভালোক ৩=ছেড়ে চলে গেছে ৪=অন্যান্য	Marriage synchrony 1 = monogamy 2 = polygamy  বিবাহের ধরণ ১= একক বিবাহ ২= বহু বিবাহ	Type of marriage 1=arranged 2=love 3=arr/love  বিবাহের ধরণ ১= আয়োজিত ২=ভালবাসা ৩= আয়োজিত/ভালবাসা	Who arranged the marriage? (list all, primary 1 <sup>st</sup> )  কে আয়োজন করেছে? (লিস্ট করুন, প্রথমে প্রাথমিক)	Is spouse a relative? 0 = no 1 = yes আপনার স্বামী/ স্ত্রী  কি আপনার আত্মীয়? ০= না ১= হ্যাঁ	If so, type of relative.  তাইলে, কি ধরণের আত্মীয়?

	13	14	15	16a	16b	17
Marriage # বিবাহ #	Was spouse Shodagor when you met? 0 = no 1 = yes আপনার স্বামী/ স্ত্রী কি সওদাগর ছিল যখন আপনারা বিয়ে করেন? ০=না ১= হ্যাঁ	Did spouse live on a boat before marriage? 0 = no 1 = yes আপনার স্বামী/ স্ত্রী কি বিয়ের আগেও নৌকায় থাকত? ০=না ১= হ্যাঁ	Did you live on a boat before marriage? 0 = no 1 = yes আপনি কি বিয়ের আগে নৌকায় থাকতেন? ০=না ১= হ্যাঁ	How long did it take to move between husband's natal home and wife's natal home? (Hours/ minutes) আপনার বাড়ি এবং আপনার স্বামী/ স্ত্রীর বাড়ির দূরত্ব কত?	Mode of transportation 1 = boat 2 = rickshaw 3 = CNG 4 = bus যাতায়াতের মাধ্যম ১=নৌকা ২=রিকশা ৩= সি এন জি ৪= বাস	Right after marriage, where did you live? 1 = near wife's family 2 = near husband's family 3 = neither 4 = other (explain) আপনার বিয়ের পরপর আপনি কোথায় ছিলেন? ১= স্ত্রীর বাড়ির কাছে? ২= স্বামীর বাড়ির কাছে ৩= কনট্রি নয় ৪= অন্যান্য (উল্লেখ মক্ফন)

18	19	20	21	22	23	
Marriage # বিবাহ	Feast Amount (in taka) ভোজের খরচ (টাকায়)	Who paid for feast? 1=husband's family 2=wife's family 3=both paid equal amounts 4=other (explain) (ভোজের খরচ কে দিয়েছে?) ১= স্বামীর পরিবার ২= স্ত্রীর পরিবার ৩= দুই পরিবার সমান ৪= অন্যান্য	Gift amount from Husband's Family (in taka) স্বামীর পরিবার থেকে কি পরিমাণ উপহার পেয়েছেন? (টাকায়)	Gift amount from Wife's Family (in taka) স্ত্রীর পরিবার থেকে কি পরিমাণ উপহার পেয়েছেন? (টাকায়)	Amount of Gold or Silver given by Husband's family B = Bhor A = Anna R = Rotti স্বামীর পরিবার থেকে প্রাপ্ত স্বর্ণ/ রুপার পরিমাণ B= vor A= আনা R= রটি	Amount of gold or silver given by wife's family B = Bhor A = Anna R = Rotti স্ত্রীর পরিবার থেকে প্রাপ্ত স্বর্ণ/ রুপার পরিমাণ B= vor A= আনা R= রটি
					G S	
					G S	
					G S	
					G S	
					G S	

**FAMILY CHARACTERISTICS** পরিবারিক বৈশিষ্ট্য

24. How many boats (choi nouka) do you own? \_\_\_\_\_  
আপনার কতগুলো ছই নৌকা আছে?

25. How many people live on this/these boat(s) now? \_\_\_\_\_  
নৌকায় (গুলায়) এখন কত জন লোক থাকে?

Relative আত্মীয়	26 Age (age at death/years since death) মৃত্যুকালীন বয়স/কত বছর হল মারা গেছে?	27 # of marriages বিবাহের সংখ্যা	28 Marriage Synchrony 1=monogamy 2=polygamy বিবাহের ধরণ ১= একক বিবাহ ২= বহু বিবাহ	29 Age at marriage বিবাহের সময় বয়স	30 Years /Level of Education লেখাপড়া কতটুকু?	31a/b #sons / #daughters ever born এখন পর্যন্ত কতজন ছেলে/মেয়ে জন্ম হয়েছে	32a/b #sons/ #daughter still living কতজন ছেলে/মেয়ে বেঁচে আছে
Husband's Father স্বামীর বাবা							
Husband's Mother স্বামীর মা							
Wife's Father স্ত্রীর বাবা							
Wife's Mother স্ত্রীর মা							
Spouse 1 ১ম স্বামী/স্ত্রী							
Spouse 2 ২ম স্বামী/স্ত্রী							
Spouse 3 ৩ম স্বামী/স্ত্রী							
Spouse 4 ৪র্থ স্বামী/স্ত্রী							

Relative আত্মীয়	33 Where does he/she live now? এখন সে কোথায় থাকে?	34a How long does it take to get there from here? (Hours/min) এখান থেকে আত্মীয়ের বাড়িতে যেতে কত সময় লাগে?	34b Mode of transport 1=boat 2=rickshaw 3=CNG 4=bus যোগাযোগের মাধ্যম ১= নৌকা ৩= সি এন জি ২= রিক্সা ৪= বাস	35 Does he/she live on a boat? 0=no 1=yes উনিও কি নৌকায় থাকে? ০= না ১= হ্যাঁ	36a Does he/she live in the same place all year? 0=no 1=yes তারা কি বছরের সব সময় একই জায়গায় থাকে? ০= না ১= হ্যাঁ	36b If no # movements / year না হলে, # গতিবিধি/বছর
Husband's Father স্বামীর বাবা						
Husband's Mother স্বামীর মা						
Wife's Father স্ত্রীর বাবা						
Wife's Mother স্ত্রীর মা						
Spouse 1 ১ম স্বামী/ স্ত্রী						
Spouse 2 ২য় স্বামী/ স্ত্রী						
Spouse 3 ৩য় স্বামী/ স্ত্রী						
Spouse 4 ৪র্থ স্বামী/ স্ত্রী						

Occupation categories (most from 2005 HDSS)	
0=jobless	19=professional (doctor, engineer)
1=fishing	20=student
2= salesperson/merchant	21=semi professional (teacher, nurse)
3=housewife	22=local government
4=repairman	23=CNG driver
5= day labor	24=rickshawallah
6=catle/chicken/duck	25=agriculture (own land)
7=handicraft	26=agriculture (share crops)
8=tailoring work	
9=business	
10=service	
11=pension	
12=remittance (in country)	
13=remittance (other country)	
14=food for work	
15=old age/desitute allowance/NGD	
16=house or shop rent	
17=other (specify)	
18= land mortgage/lease/rent	

Occupation categories (most from 2005 HDSS)	
পেশার ধরন (2005 HDSS)	
০= বেকার	১৭= অলাভা (উল্লেখ করুন)
১= মৎস্য জীবী	১৮= জমি ইজারা দেয়া
২= বিক্রোতা/ ব্যবসায়ী	১৯= পেশা জীবী ( ডাক্তার, ইঞ্জিনিয়ার)
৩= গৃহিণী	
৪= মেরামতকারী	২০= ঘাত্র/ ঘাত্রি
৫= দিন মজুর	২১= আধা পেশা জীবী ( শিক্ষক, মাদ)
৬= গর/ মুদি/ হাঁস	২২= স্বামী/ মরকার
৭= যন্ত্র পিত	২৩= সি এন জি চালক
৮= দর্জি	২৪= রিক্সা চালক
৯= ব্যবসা	২৫= কৃষি জীবী ( নিজের জমি)
১০= চাকুরী	২৬= কৃষি জীবী ( বর্গ জমি)
১১= পেনশন	
১২= বৈদেশিক মুদ্রা (দেশের মধ্যে)	
১৩= বৈদেশিক মুদ্রা (দেশের বাহিরে)	
১৪= কাজের বিনিময়ে খাদ্য	
১৫= ব্যবস্ ডাক্তার/ এন জি ডি	
১৬= ঘর/ দকান ভাড়া	

**SIBLINGS** ভাই বোন

	37	38	39	40	41	42	43	44
Sibling Birth Order (mark an 'R' next to respondent's number) Circle M for male, F for female ভাই বোন ক্রম অনুসারে (অংশগ্রহণকারীর পাশে R লিখতে হবে ) বৃত্তাকার করুন পুরুষ হলে M মহিলা হলে F	Age (age at death/years since death) মৃত্যুকালীন বয়স/ কত বছর হল মারা গেছে	Relationship to Respondent 1=full sib 2=half sib 3=cousin 4=other distant relative 5=unrelated to R (explain) উত্তরদাতার সাথে সম্পর্ক ১= ভাই বোন ২= সৎ ভাই বোন ৩= খালত/চাচাত/ সামাত/দুগাত ভাই বোন ৪= দূরের আত্মীয় ৫= অনাত্মীয়	Years of education শিক্ষার স্তর	Marital Status 0 = single 1 = married 2 = widowed 3 = divorced / abandoned বৈবাহিক অবস্থা ০= অবিবাহিত ১= বিবাহিত ২= বিধবা ৩= তলাক প্রার/ ছেড়ে চলে গেছে	# of marriages বিবাহের সংখ্যা	Marriage Synchrony 1 = monogamy 2 = polygamy বিবাহের ধরণ ১= একক বিবাহ ২= বহু বিবাহ	Age at marriage বিবাহের সময় বয়স	Type of marriage 1=arranged 2=love 3=arr/love কি ধরনের বিয়ে ১= আয়োজিত ২= ভালবাসা ৩= আয়োজিত/ভালবাসা
1	M F							
2	M F							
3	M F							
4	M F							
5	M F							
6	M F							

	45	46	47	48a	48b	49	50	51
Sibling Birth Order ভাই বোন ক্রম অনুসারে	Primary occupation (see pg. 4 for list) প্রাথমিক পেশা	Where does he/she live now? এখন সে কোথায় থাকে?	Does he/she live on a boat? 0=no 1=yes সে কি নৌকায় থাকে? ০=না ১= হ্যাঁ	Does he/she live in the same place all year? 0=no 1=yes ভারা কি বছরের সব সময় একই জায়গায় থাকে? ০=না ১= হ্যাঁ	If not # movements / year না হলে, গতিবিধির সংখ্যা	#sons / #daughters ever born # ছেলে / # মেয়ে এ পর্যন্ত জন্ম নেয়া	#sons / #daughters still living # ছেলে/ # মেয়ে এখন পর্যন্ত বেঁচে আছে	Age of oldest son / age of oldest daughter সব চেয়ে বড় ছেলে/মেয়ের বয়স বেঁচে আছে
1								
2								
3								
4								
5								
6								

**CHILDREN (please list all children who lived past age 3)** ছেলেমেয়ে (দয়া করে ৩ বছরের বেশী বেঁচে থাকা সব ছেলেমেয়েদের একটি লিস্ট তৈরি করুন)

	52	53	54	55	56	57	58	59
Birth Order Circle M for male, F for female বয়সক্রম বুত্রকোর ক্রম পুরুষ হলে M মহিলা হলে F	Age (age at death)/years since death) মৃত্যুকালীন বয়স/ মারা গেছে কত দিন হয়?	Relationship of child to respondent 1=biological 2=adopted 3=step-child 4=biological child from other marriage উত্তরাধিকার সাথে বাচ্চার সম্পর্ক ১= নিজের সন্তান ২= পালক ৩= মৎ ৪= আগের স্বামী/স্ত্রীর ঘনোর	Years of education শিক্ষার স্বর	Marital Status 0 = single 1 = married 2 = widowed 3 = divorced / abandoned বৈবাহিক অবস্থা ০= অবিবাহিত ১= বিবাহিত ২= বিধবা ৩= তলাক প্রাপ্ত/ ছেড়ে চলে গেছে	# of marriages বিবাহের সংখ্যা	Marriage Synchrony 1=monogamy 2=polygamy বিবাহের ধরণ ১= একক বিবাহ ২= বহু বিবাহ	Age at marriage বিবাহ কালীন বয়স	Type of marriage 1=arranged 2=love 3=arr/love কি ধরনের বিয়ে ১= আয়োজিত ২= ভালবাসা ৩= আয়োজিত/ ভালবাসা
1	M F							
2	M F							
3	M F							
4	M F							
5	M F							
6	M F							

	60	61	62	63	64a	64b	65	66	67
Child's Birth Order বাচ্চার বয়সক্রম	Child's Primary Occupation (see pg. 4 for list) বাচ্চার প্রাথমিক পেশা	Spouse's Primary Occupation (see pg. 4 for list) স্বামী/ স্ত্রীর প্রাথমিক পেশা	Where does he/she live now? সে এখন কোথায় থাকে?	Does he/she live on a boat? 0=no 1=yes সেও কি নৌকায় থাকে? ০= না ১= হ্যাঁ	Does he/she live in the same place all year? 0=no 1=yes সে কি বছরের সব সময় একই জায়গায় থাকে? ০= না ১= হ্যাঁ	# movements / year # গতি বিধি/ বছর	#sons / #daughters ever born # ছেলে/ মেয়ে এখন পর্যন্ত জন্মেছে।	#sons / #daughters still living # ছেলে/ মেয়ে এখন বেঁচে আছে।	Age of oldest son / age of oldest daughter সব চেয়ে বড় ছেলে/মেয়ের বয়স
1									
2									
3									
4									
5									
6									

	68	69	70	71	72	73
Child's Birth Order বাচ্চের বয়সক্রম	Feast Amount (in taka) ভোজের খরচ (টাকায়)	Who paid for feast? 1=husband's family 2=wife's family 3=both paid equal amounts 4=other (explain)  খরচ কে প্রদান করেছে ১= স্বামীর পরিবার ২= স্ত্রীর পরিবার ৩= উভয় সম পরিমাণ	Gift amount from Husband's Family (in taka) স্বামীর পরিবার থেকে প্রাপ্ত উৎসর্গ (টাকায়)	Gift amount from Wife's Family (in taka) স্ত্রীর পরিবার থেকে প্রাপ্ত উৎসর্গ (টাকায়)	Amount of Gold or Silver given by Husband's family B = Bhoori A = Anna R = Roti  স্বামীর পরিবার থেকে দেয় স্বর্ণ/ রুপার পরিমাণ B = ভুরি A = আনা R = রটি	Amount of gold or silver given by wife's family B = Bhoori A = Anna R = Roti  স্ত্রীর পরিবার থেকে দেয় স্বর্ণ/ রুপার পরিমাণ B = ভুরি A = আনা R = রটি
1					G S	G S
2					G S	G S
3					G S	G S
4					G S	G S
5					G S	G S
6					G S	G S

Please list all additional adult family members (natal and marital) living in this bohor:  
বহুরে বয়স্ক রক্ত সর্কল আত্মীয়ের (বাবার/ স্বপ্তর বাড়ির দিকে) একটি তালিকা তৈরি করুন:

Relationship to Respondent উত্তরদাতার সাথে সম্পর্ক	#sons / #daughters living in this bohor বহুরে বসবাসরত # ছেলে/ # মেয়ে	#sons / #daughters ever born এই পর্শর জন্ম নেয়ে #ছেলে/ #মেয়ে



**MOVEMENT** গতিবিধি

74. How many times per year do you (and your family) usually move to a different bohor? \_\_\_\_\_  
 প্রতি বছর কত বার আপনি (আপনার পরিবার) অন্য বহরে স্থান পরিবর্তন করেন?

76. Does your family currently own a homestead?  yes  no  
 আপনার পরিবারের কি এখন নিজস্ব বাড়ি আছে?  হ্যাঁ  না

75. How many times did you move last year? \_\_\_\_\_  
 গত বছর কতবার স্থান পরিবর্তন করেছেন?

76a. Where is the home located?  
 আপনার বাড়ি কোথায় অবস্থিত?

76b. Are you currently living in the home?  yes  no  
 বর্তমানে কি আপনি বাড়িতে বাস করেন?  হ্যাঁ  না

Describe your family's movements in the last year starting with the most recent and working backwards: আপনার পরিবারের গতিবিধি উল্লেখ করুন (এখন থেকে শুরু করে পিছনের ক্রম অনুযায়ী)

Movement # # গতিবিধি	77 Month/time of year মাস/ বছরে নির্দিষ্ট সময়	78 Name of the place you moved to পরিবর্তিত স্থানের নাম	79 Location of that place 1=inside Matlab thana 2=in Chandpur district 3=outside of Chandpur 4=to a home on the land স্থান টি কোথায়? ১= মতলব থানার ভিতরে ২= চাঁদপুর জেলার অধিনে ৩= চাঁদপুর থানার বাইরে ৪= জমির উপরে একটি বাড়িতে	80a How long does it take you to get there from here? (Hours/min) এখান থেকে সেখানে যেতে কত সময় লাগে? (ঘণ্টা/ মিনিট)	80b Mode of transport 1=boat 2=rickshaw 3=CNG 4=bus পরিবহন ব্যবস্থা ১= নৌকা ২= রিক্সা ৩= সি এন জি ৪= বাস	81 Reason for movement স্থান পরিবর্তনের কারণ	82 List all relatives in this place (see list below) এই স্থানে বসবাসরত আত্মীয়ের তালিকা তৈরি করুন ( তালিকা নিম্নে উল্লেখ করা আছে)
1							
2							
3							
4							

1=R's adult children; 2=R's siblings; 3=spouse's siblings; 4=R's parents; 5=spouse's parents; 6=R's extended family; 7=spouse's extended family; 8=other; 9=none of the above  
 ১= R এর প্রাপ্যবয়স্ক সন্তান; ২= R এর ভাইবোন; ৩= R এর স্বামী/স্ত্রীর ভাই বোন; ৪= R এর বাবা-মা; ৫= স্বামী/ স্ত্রীর বাবা-মা; ৬= R এর আত্মীয়; ৭= স্বামী/ স্ত্রীর আত্মীয়; ৮= অন্যান্য; ৯= কোনটিই নয়।

83. Please list ALL bohors you have EVER lived in:  
 দয়া করে এ ব্যবত কাল পর্যন্ত আপনি যে কয়েকটি বহর ভ্রমণ করেছেন তার একটি তালিকা তৈরি করুন:

83a. Before marriage (বিয়ের আগে) \_\_\_\_\_  
 83b. After marriage (বিয়ের পর) \_\_\_\_\_

**ECONOMIC STRATEGIES**

অর্থনৈতিক পরিচালনার দক্ষতা

	84a Primary Occupation প্রাথমিক পেশা	84b Secondary Occupation সেবিক পেশা	84c Other Occupations (list all) অন্যান্য পেশা ( তালিকা করুন )
Relationship দাম্পত্য			
Respondent উত্তরদাতা			
Spouse স্বামী/ স্ত্রী			
Father বাবা			
Mother মা			
Father-in-law শুশুর			
Mother-in-law শাশুড়ি			

Occupations: (see pg. 4 for more) পেশা
0=unemployed ০= বেকার
1 = fisherman/woman মৎস্যজীবী
2=salesperson (who sells products) বিক্রেতা ( দ্রব্যাদি বিক্রি করে)
3=rickshaw puller রিকশাচালক
4=repairman/woman মেরামত কারী
5=housewife গৃহিণী
6=other (explain) অন্যান্য ( উল্লেখ করুন)

**Answer for the RESPONDENT:** অংশগ্রহণকারীর উত্তর:

	85a	85b	85c	85d	85e	85f
	Yesterday OR the last day you worked গতকাল/ শেষ কবে কাজ করেছেন	Last week গত সপ্তাহ	Last month গত মাস	Last year গত বছর	On a regular day last rainy season গত বর্ষা মউসুমে একটি সাধারণ দিন	On a regular day last dry season গত শুষ্ক মউসুমে একটি সাধারণ দিন
How much money did you make? কত টাকা আয় করেন?						
On a normal day, how many hours did you work? একটি সাধারণ দিনে কত ঘণ্টা কাজ করেন?						
How many days per week do you usually work? সপ্তাহে কত দিন কাজ করেন?						

**Answer for respondent's SPOUSE:** উত্তরদাতার স্বামী/ স্ত্রীর উত্তর

	86a	86b	86c	86d	86e	86f
	Yesterday OR the last day you worked গতকাল/ শেষ কবে কাজ করেছেন	Last week গত সপ্তাহ	Last month গত মাস	Last year গত বছর	On a regular day last rainy season গত বর্ষা মউসুমে একটি সাধারণ দিন	On a regular day last dry season গত শুষ্ক মউসুমে একটি সাধারণ দিন
How much money did your spouse make? স্বামী/ স্ত্রী কত টাকা আয় করেন?						
On a normal day, how many hours did he/she work? একটি সাধারণ দিনে কত ঘণ্টা কাজ করে?						
How many days per week did he/she usually work? সপ্তাহে কত দিন কাজ করে?						

**If respondent fishes:** উত্তরদাতা যদি মৎস্যজীবী হয়ে থাকেন:

87. How many fish do you catch on an average day (either number of fish or kg's of fish)?

একটি সাধারণ দিনে আপনি কতগুলো মাছ ধরেন? (মাছের সংখ্যা/ কেজিতে)

87a. During the rainy season \_\_\_\_\_  
বর্ষা মৌসুমে

87b. During the dry season \_\_\_\_\_  
শুষ্ক মৌসুমে

87c. Last week \_\_\_\_\_  
গত সপ্তাহে

88. How many fish did you catch yesterday / the last day you worked? \_\_\_\_\_

গত কাল/ শেষ কাজের দিনে আপনি কতগুলো মাছ ধরেছেন?

89. How many fish **can** you catch in one day (i.e. what is the maximum amount you could catch)?

এক দিনে আপনি সর্বচ্চ কতগুলো মাছ ধরতে পারেন? (যেমন: সর্বচ্চ কি পরিমাণ মাছ ধরতে পারেন)?

89a. During the rainy season \_\_\_\_\_  
বর্ষা মৌসুমে

89b. During the dry season \_\_\_\_\_  
শুষ্ক মৌসুমে

90. If you catch the maximum amount, how much money **could** you make if you sold all of these fish?

মাছ বিক্রি করে আপনি সর্বচ্চ কি পরিমাণ আয় করেন?

90a. During the rainy season \_\_\_\_\_  
বর্ষা মৌসুমে

90b. During the dry season \_\_\_\_\_  
শুষ্ক মৌসুমে

91. Do you and/or your spouse sell all of the fish you catch?  yes  no

আপনি এবং আপনার স্বামী/ স্ত্রী কি সব মাছ বিক্রি করে দেন?  হ্যাঁ  না

92. How much of your catch do you eat? \_\_\_\_\_

আপনি যা ধরেন তার কত টুকু খান?

93. When you/your wife is pregnant, do you/does she continue to work?  yes  no

আপনি/ আপনার স্ত্রীর গর্ভবতী থাকাকালীন সময়ে কি আপনি/ আপনার স্ত্রী কাজ করেন?  হ্যাঁ  না

**Sharing** অংশ ভাগ

94. Do you ALWAYS work alone?  yes  no

আপনি কি সবসময় একা কাজ করেন?  হ্যাঁ  না

95. If no, please check all of the people you work with throughout the year.

না হলে যাদের সাথে কাজ করেন তাদের কে টিক দিন

- |  |   |   |  |  |  |   |   |
|--|---|---|--|--|--|---|---|
| <input type="checkbox"/> Spouse<br>স্বামী/ স্ত্রী                                      | <input type="checkbox"/> Brother(s)<br>ভাই(দের)                   | <input type="checkbox"/> Sister(s)<br>বন(দের)   | <input type="checkbox"/> Male Cousin(s)<br>ছেলে(কাজিন) | <input type="checkbox"/> Female Cousin(s)<br>মেয়ে(কাজিন)                          | <input type="checkbox"/> Father<br>বাবা                                | <input type="checkbox"/> Mother<br>মা   | <input type="checkbox"/> Son(s)<br>ছেলে(রা) |
| <input type="checkbox"/> Daughter(s)<br>মেয়ে(রা)                                      | <input type="checkbox"/> Brother(s)-in-law<br>স্বামী/ স্ত্রীর ভাই | <input type="checkbox"/> Sister(s)-in-law<br>স্বামী/ স্ত্রীর বোন                      | <input type="checkbox"/> Father-in-law<br>স্বস্তর      | <input type="checkbox"/> Mother-in-law<br>শাশুড়ি                                  | <input type="checkbox"/> Other male relatives<br>অন্যান্য ছেলে আত্মীয় | <input type="checkbox"/> Other female relatives<br>অন্যান্য মেয়ে আত্মীয়         |   |
| <input type="checkbox"/> Other female in-laws<br>অন্যান্য স্বস্তর বাড়ির আত্মীয়(ছেলে) |   | <input type="checkbox"/> Other male in-laws<br>অন্যান্য স্বস্তর বাড়ির আত্মীয়(মেয়ে) |  | <input type="checkbox"/> Unrelated men(i.e. friends)<br>অনাত্মীয় পুরুষ(খে; বন্ধু) |  | <input type="checkbox"/> Unrelated women(i.e. friends)<br>অনাত্মীয় মহিলা (বন্ধু) |   |

If 'other' explain:  
অন্যান্য আরও থাকলে উল্লেখ করুন

96. If you fish, do you share any of your catch with people you work with?  yes  no

আপনি কি কখনো আপনার মাছ অন্য কারও সাথে ভাগাভাগি করেছেন?  হ্যাঁ  না

96a. If so, how do you split up your catch? \_\_\_\_\_  
তমসে, কীভাবে ভাগাভাগি করেছেন?

97. Do you share any of your income with people you work with?  yes  no  
 আপনি যা আয় করেন তার কিছু অংশ কি আপনার সাথে যারা কাজ করে তাদের সাথে ভাগাভাগি করেন?  
 97a. If so, how do you split up your income? \_\_\_\_\_  
 তাহলে, কীভাবে ভাগা ভাগি করেন?
98. Do you ever share your catch or income with anyone you didn't work with that day?  yes  no  
 কাজ করেন নাই এমন কারও সাথে কি কখনো মাছ ভাগাভাগি করেছেন?  
 98a. If so, list all of the people you share with: \_\_\_\_\_  
 তাহলে, তাদের একটি তালিকা তৈরি করুন:  
 98b. Why do you share with these people? \_\_\_\_\_  
 আপনি কেন তাদের সাথে ভাগাভাগি করেন?  
 98c. How much do you share with them usually? \_\_\_\_\_  
 সাধারণত কি পরিমাণ তাদের সাথে ভাগাভাগি করেন?
99. Last time your family was short on money, what did you do? \_\_\_\_\_  
 শেষ ফসল আপনার পরিবার টাকার স্বল্পতায় ছিলেন, তখন তা উত্তরলের জন্য কি করেছিলেন?  
 99a. If you received help from someone, who did you get help from? \_\_\_\_\_  
 আপনি যদি কারও কাছ থেকে সাহায্য শিবে থাকেন তাহলে সেটা কে?  
 99b. How did they help you? (i.e. give you food, buy clothes for the kids, give you money)  
 তারা আপনাকে কীভাবে সাহায্য করেছিল? (খাদ্য দিবে, কাপড়ের জন্য বস্ত্র কিনে দিবে, টাকা দিবে)  
 99c. Do you also help them sometimes?  yes  no  
 আপনিও কি তাদের কখনো সাহায্য করেছিলেন?  
 99d. If so, how do you help them? \_\_\_\_\_  
 তাহলে কীভাবে সাহায্য করেছিলেন?
100. How often has your family been short on money in the last year? \_\_\_\_\_  
 কতদিন পরপর আপনার পরিবার আর্থিক অক্ষমতার সম্মুখীন হয়?

**Income use** আয়ের প্ৰয়োগ

101. Whose income is used to buy the following items for the family? (check the appropriate boxes)  
 কার আয় থেকে নিম্নোক্ত দ্রব্যাদি পরিবারের জন্য কেনা হয়? (প্রযোজনীয় তথ্য গুলো লক্ষ করুন)

Item দ্রব্যাদি	Husband's Income স্বামীর আয়	Wife's Income স্ত্রীর আয়	Item দ্রব্যাদি	Husband's Income স্বামীর আয়	Wife's Income স্ত্রীর আয়
Food খাদ্য			Doctor bills ডাক্তারের খরচ		
Clothes বস্ত্র			Children's education ছেলেমেয়ের শিক্ষাপত্র		
Household items গৃহস্থালির দ্রব্য			Fishing equipment মাছ ধরার বস্ত্র		
Repairs on the boat(s) নৌকা(গুলোর) মেরামত			Products to sell বিক্রয়ের দ্রব্যাদি		

Other (অন্যান্য) \_\_\_\_\_

102. What else does your family use the HUSBAND'S income to buy? \_\_\_\_\_  
 স্বামীর আয় দিয়ে আপনার পরিবার আর কি করে?  
 103. What else does your family use the WIFE'S income to buy? \_\_\_\_\_  
 স্ত্রীর আয় দিয়ে আপনার পরিবার আর কি করে?

**Decision-making** সিদ্ধান্ত গ্রহন

104. Who usually makes decisions about the following: (check the appropriate boxes)

আপনার পরিবারে সাধারণত কে সিদ্ধান্ত গ্রহণ করে? (নিম্নে উপস্থাপিত সঠিক বাস্তব টিক দিন)

	Husband স্বামী	Wife স্ত্রী		Husband স্বামী	Wife স্ত্রী
When to shift to a new place যখন কোলও নতুন জায়গায় স্থান পরিবর্তন করতে হয়			Spending money on household items		
Where to shift the family কোথায় স্থান পরিবর্তন করতে হবে			Spending money on new fishing equipment নতুন মাছ ধরার যন্ত্র কেনা হবে কি না		
Whether the wife works or not স্ত্রী কাজ করবে কিনা			Spending money on boat repairs নৌকা মেরামতে কত টাকা খরচ হবে		
Spending money on food খাবারে কত টাকা খরচ হবে			Whether or not kids go to the doctor when they are sick অসুস্থ হলে ডাক্তারের কাছে যেমা হবে কি না		
Spending money on clothes বস্ত্রে কত টাকা খরচ হবে			Whether kids go to school or not বাচ্চারা স্কুলে যাবে কি না		

**PARENTING** সন্তান লালন পালন

105. Who spends the most time parenting your children?  
সন্তান লালনপালনে সবচেয়ে বেশী কে সময় দেয়?

mother মা  father বাবা  other অন্যান্য \_\_\_\_\_

106. Does anyone aside from you or your spouse help with the children? আপনি বা আপনার স্বামী/ স্ত্রী ছাড়া র কেও কি লালন পালনে সাহায্য করে?

	106a	106b	106c	106d	106e
Relationship to Child সদস্যদের সাথে সম্পর্ক	Help? 0=no 1=yes সাহায্য ০= না ১= হ্যাঁ	Does he/she have young children? 0=no 1=yes জার কি কোনও সন্তান আছে? ০= না ১= হ্যাঁ	Number of children under 18 living in his/her household ১৮ বছরের নিচে কজন সন্তান তার সাথে বাস করে?	Does he/she watch other people's children, too? নে কি অন্যান্য মানুষের শেলেমেবন্ডেরও দেখাশোনা করে	Do you ever watch his/her children? 0=no 1=yes আপনিও কি তার শেলেমেবন্ডের দেখাশোনা করে রাখেন?
Maternal Grandmother মামী					
Maternal Grandfather মামা					
Paternal Grandmother দাদী					
Paternal Grandfather দাদা					
Maternal Aunt থালু					
Maternal Uncle মামা					
Paternal Aunt তুতু					
Paternal Uncle চাচা					
Older Sister বড় বোন					
Younger Sister ছোট বোন					
Older Brother বড় ভাই					
Younger Brother ছোট ভাই					
Other relative (specify) অন্যান্য আত্মীয় (উল্লেখ করুন)					
Other relative (specify) অন্যান্য আত্মীয় (উল্লেখ করুন)					
Non-relative (specify) অন্যায়ীয় উল্লেখ করুন					

107. On an average day, who watches your children when you are working?  
একটি সাধারণ দিনে কে সন্তানদের দেখাশোনা করে?

- 107a. Usually (সাধারণত) \_\_\_\_\_  
 107b. Rainy season (বর্ষা মৌসুমে) \_\_\_\_\_  
 107c. Dry season (শুষ্ক মৌসুমে) \_\_\_\_\_  
 107d. Last week (গত সপ্তাহে) \_\_\_\_\_  
 107e. Yesterday / last day you worked  
 গতকাল/ শেষ কবে আপনি কাজ করেছেন

108. On an average day, who watches your children when your spouse is working?  
একটি সাধারণ দিনে আপনার ছেলে মেয়েদের কে দেখাশোনা করে যখন আপনার স্বামী/ স্ত্রী কাজ করেন?

- 107a. Usually (সাধারণত) \_\_\_\_\_  
 107b. Rainy season (বর্ষা মৌসুমে) \_\_\_\_\_  
 107c. Dry season (শুষ্ক মৌসুমে) \_\_\_\_\_  
 107d. Last week (গত সপ্তাহে) \_\_\_\_\_  
 107e. Yesterday / last day you worked  
 গতকাল/ শেষ কবে আপনি কাজ করেছেন

109. Please list all people who have provided for each child in the following way:  
স্বারা সন্তানের নিম্নে উল্লিখিত চর্যাচি প্রদান করে তাদের একটি তালিকা প্রকাশ করুন।

	Child 1 সন্তান: ১	Child 2 সন্তান: ২	Child 3 সন্তান: ৩	Child 4 সন্তান: ৪	Child 5 সন্তান: ৫	Child 6 সন্তান: ৬
Giving food খাদ্য						
Giving clothes বস্ত্র						
Giving other items (like books, school supplies) অন্যান্য চর্যাচি (বইখাতা)						
Giving small gifts/treats উপহার সামগ্রী						
Helping arrange marriage বিয়ে দেয়ার ক্ষেত্রে সাহায্য						
Paying for marriage বিয়েতে পরচ বহন						
Paying for education শিক্ষার পরচ বহন						
Teaching information প্রতীতি ইতিহাস						
Teaching skills (i.e. cooking, fishing, sewing, selling goods, "driving" a boat) কাজে দক্ষতা শিখানো ( রান্না, ফেলাই, মাছ ধরা, চর্যা বিক্রি করা, নৌকা চালানো)						
Buying clothes বস্ত্র কেনা						
Giving inheritance উত্তরাধিকার						
Telling family stories পরিবারের ইতিহাস জানানো						
Other (explain) অন্যান্য ( উল্লেখ করুন)						

- List of providers:  
 1=Mother  
মা  
 2=Father  
পাpa  
 3=Maternal grandmother  
মামী  
 4=Maternal grandfather  
নানা  
 5=Paternal grandmother  
দাদী  
 6=Paternal grandfather  
দাদা  
 7=Maternal Aunt  
খালা  
 8=Maternal Uncle  
খামা  
 9=Paternal Aunt  
ফুপু  
 10=Paternal Uncle  
চাচা  
 11=Sister  
বোন  
 12=Brother  
ভাই  
 13=Other relative (specify)  
অন্যান্য আয়ীয়ে (উল্লেখ করুন)  
 14=Non-relative (specify)  
অনায়ীয়ে (উল্লেখ করুন)

**HEALTH** স্বাস্থ্য

110. When someone in your family gets sick, does he/she see a doctor?  
 আপনার পরিবারের কেউ অসুস্থ হলে গেল জাকে কি ডাক্তারের কাছে গিয়ে যাওয়া হয়?  yes হ্যাঁ  no না  
 110a. If so, where is the doctor located?  
 তাহলে, ডাক্তার কোথায় থাকে? \_\_\_\_\_  
 110b. How long does it take to get there from here?  
 এখান থেকে যেতে কত সময় লাগে? \_\_\_\_\_
111. Do you and your spouse visit the same doctor if you get sick?  
 আপনি বা আপনার স্ত্রী/স্বামী কি একই ডাক্তারের কাছে যান?  yes হ্যাঁ  no না
112. Do all of your children visit the same doctor if they get sick?  
 আপনার খেল সবারও একই ডাক্তারের কাছে যান?  yes হ্যাঁ  no না  
 112a. Please describe any differences.  
 কোনও পার্থক্য থাকলে উল্লেখ করুন \_\_\_\_\_
113. Where do you get your drinking water from? (please check all that apply)  
 খাবার পানি কখা থেকে সংগ্রহ করা হয়? টিক দিন।  river নদী  tubewell ট্যাপকল  market বাজার  other (explain) \_\_\_\_\_  
 113a. If you get any of your drinking water from the river, what purification system do you use? (check all that apply)  
 আপনারা নদী থেকে পানি নিলে, পরিশোধনের জন্য কি করেন? (টিক দিন)  
 boiling ফুটানো  adding something to the water পানিতে কিছু মিশানো  electric purification system বৈদ্যুতিক পরিশোধন উপায়  none কোনটি নয়  other (explain) \_\_\_\_\_
- Please tell me about your family's health:  
 আপনার পরিবারের সদস্যদের স্বাস্থ্য সম্পর্কে বলুন:

	114	115	116	117
	# of sicknesses in the last year গত বছরে কতবার অসুস্থ হয়ে	# of doctor visits in the last year গত বছরে কতবার ডাক্তারের কাছে গিয়েছে	Amount spent last year on doctor visits for this person: এই ব্যক্তির জন্য গত টাকা খরচ করেছে	# of serious life-threatening illnesses or injuries in lifetime জীবনের জন্য হুমকি এমদ অসুস্থ কতবার হয়েছে
You আপনি				
Your spouse স্বামী/ স্ত্রী				
Child 1 সন্তান ১				
Child 2 সন্তান ২				
Child 3 সন্তান ৩				
Child 4 সন্তান ৪				
Child 5 সন্তান ৫				
Child 6 সন্তান ৬				
Others (list) অন্যান্য (ডালিকা)				



**For WOMEN ONLY** শুধু মাত্র মহিলাদের জন্য

At the time of each pregnancy: (please list for every pregnancy and birth)

গর্ভবতী থাকা কালীন সময় ( অনুগ্রহ করে একটি তালিকা করুন )

118	119	120	121	122
Pregnancy # কতবার সন্তান সন্তান হয়েছেন	Where did you live? 1=near wife's family 2=near husband's family 3=other (please specify)  আপনি কোথায় ছিলেন? ১= আপনার বাবার বাড়ি ২= স্বপ্তর/ স্বামীর বাড়ি ৩= অন্যান্য (উল্লেখ করুন)	Who was living in that bohor? (list all) 1=wife's mother 2=wife's father 3=husband's mother 4=husband's father  বহরে কে কে থাকত? ১= মা ২= বাবা ৩= স্বপ্তর ৪= শশুড়ি	Result of the pregnancy 1=miscarriage 2=stillbirth 3=live birth  কি হয়েছিল ১= গর্ভপাত ২= মৃত সন্তান ৩= জীবিত সন্তান	Result of every live birth 1=lived past age 3 2=lived 3 years 3=lived 2 years 4=lived 1 year 5=lived less than 6 m  জীবিত সন্তান জন্মের পর: ১= ৩ বছরের অধিক বেঁচেছে ২= ৩ বছর বেঁচেছে ৩= ২ বছর বেঁচেছে ৪= ১ বছর বেঁচেছে ৫= ৬ মাসের কম বেঁচেছে
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

122. For every live birth, please list everyone who helped after the birth and how they helped you:  
 জীবিত সন্তান প্রসবের ক্ষেত্রে, কে কে বাচ্চা লালন পালনে সাহায্য করেছে, তার একটি তালিকা করুন:

Child # (indicate sex) # সন্তান (লিঙ্গ) M=male (ছেলে) F=female (মেয়ে)	Helpers (see list) সাহায্যকারী (তালিকা দেখুন)	How he/she helped (see list) কীভাবে সাহায্য করে (তালিকা দেখুন)	Child # (indicate sex) # সন্তান (লিঙ্গ) M=male (ছেলে) F=female (মেয়ে)	Helpers (see list) সাহায্যকারী (তালিকা দেখুন)	How he/she helped (see list) কীভাবে সাহায্য করে (তালিকা দেখুন)
1 _____			5 _____		
2 _____			6 _____		
3 _____			7 _____		
4 _____			8 _____		

**Helpers:**  
 1=husband/ স্বামী  
 2=mother/ মা  
 3=mother-in-law/ শাশুড়ি  
 4=sister/ বোন  
 5=sister-in-law/স্বামীর বোন  
 6=daughter/ বোন  
 7=son/ ছেলে  
 8=maternal aunt/ খালা  
 9=paternal aunt/ ছুপু  
 10=husband's aunt/ স্বামীর ছুপু/ খালা  
 11=no one helped/ কেউ না  
 12=other (specify)/ অন্যদ্বারা/ উল্লেখ করুন

**Helping activities:**  
 কি ধরনের সাহায্য  
 1=helped you care for the infant/ যেটি বাচ্চার লালন পালন  
 2=helped you care for your other children/ বড় বাচ্চাদের লালন পালন  
 3=provided food for you and your children/ আপনার এবং আপনার বাচ্চাদের খাবার দেয়া  
 4=provided money for your family/ আপনার পরিবারকে আর্থিক সহায়তা  
 5=helped you with household chores/ আপনার স্বামীকে গৃহস্থটির কাজে সাহায্য করা  
 6=gave you advice on caring for your infant/ যেটি বাচ্চার বেপারে উন্নতসে দিয়ে সাহায্য করা

123. Do you/your husband use contraception?  yes  no  
 আপনি/ আপনার স্বামী জন্ম নিয়ন্ত্রণ পদ্ধতি ব্যবহার করেন?  হ্যাঁ  না

123a. When did you first use it?  
 সব চেয়ে প্রথম কবে ব্যবহার করেন?

123b. How long did you use/have you been using it?  
 কতদিন ধরে আপনি এইগুলো ব্যবহার করেন?

123c. If so, what method (i.e. condom)?  
 তাহলে, ক ব্যবহার করেন? (কনডম)  
 condoms  pill  IUD  tubal ligation  withdrawal  other \_\_\_\_\_  
 কনডম পিল আইইউডি টিউবাল লাইগেশন প্রত্যাহার অন্যান্য

123d. What is the purpose of using the contraceptive?  
 কী উদ্দেশ্যে ব্যবহার করেন?  
 Stopping  delaying  spacing  
 বন্ধ করে দেয়া বিলম্ব কিছু সময় পর

**Breastfeeding** বাচ্চাকে দুধ খাওয়ানো:  
 How long (in months or years) did you breastfeed each child? (please list ALL children you ever breastfed)  
 বাচ্চাকে কত বছর পর্যন্ত দুধ খাইয়েছেন? (ডাপিকা জেরি করুন)

Child # সন্তানের সংখ্যা	124 Gender 1=male 2=female লিঙ্গ ১= ম্বেলে ২= মেয়ে	125 Number of months or years exclusively breastfed শুধু মাত্র বুকের দুধ খাইয়েছেন (মাস/বছর)	126 Number of months or years breastfed with supplemental food given বুকের দুধের সাথে অন্যান্য খাবারও খাওয়ান ( মাস/ বছর)	127 Food used to supplement during weaning দুধ ছাড়ানোর সময় কি খাবার দিতেন	128 Age child was fully weaned কত বছর বয়সে সম্পূর্ণ দুধ খাওয়া বন্ধে দিয়েছে?
1					
2					
3					
4					
5					
6					
7					
8					

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH  
Matlab, Dhaka- 2014

CONSENT FORM

Protocol Number:

Protocol Title: **Shodagor Dissertation Project**

Name of ICDDR,B Principal Investigator: Nurul Alam

Name of University of Missouri Investigator: Kathrine Starkweather

Organizations: ICDDR,B; Bangladesh and University of Missouri, USA

**Purpose of the research**

Hello. I/we are from ICDDR,B and have come here to collect information for a research project entitled "Shodagor Dissertation Project". The purpose of this study is to learn things that, as far as we know, no one has written about the Shodagor population living in Matlab. Specifically, this small part of the larger study will get information about parenting practices of men and women living in different Shodagor communities in Matlab who have children under the age of 5.

**Why invited to participate in the study?**

You are invited to participate in the study because you fit the criteria: you are a mother or father living in a Shodagor community in Matlab with at least one child under the age of 5.

**Methods and procedure (What is expected from the study participants?)**

If you agree to participate, I (Kathrine) will do some observation of you and other people watching your child/children (only those under the age of 5). I will visit you a maximum of 2 times per week for 8 weeks over the next 3 months. Each time I visit, I will sit in my own boat, in a place where I can easily see your boat. I will observe and write down all the interactions you and other people have with your child continuously for 10 minutes. After that, I will rest for 20 minutes, then begin another 10 minute observation period. I will stay no more than 2 hours on each visit, for a total of 4 observation periods per family per visit. This will result in no more than 40 minutes of observation per visit. You will not be required to do anything. I will observe quietly and will not interfere with your daily activities.

**Risks and benefits**

The risk involved with the participation in this study is minimal and will not be any greater than what may be experienced in everyday life. While you may not benefit directly from participation in this study, you may benefit as a member of your community as understanding the parenting practices within a community can lead to programs or interventions that might help Shodagor people in Matlab. Specifically, this study will contribute to knowledge of how working mothers manage childcare, who helps the mother and father watch their children when both parents are working, and how mothers and fathers work together to take care of their children, among other things.

**Privacy, anonymity and confidentiality**

We will take every precaution to minimize any potential risks to you. Your identity will remain completely confidential. Your identity will not be revealed in written documents or verbal presentations of this data. The following steps will be taken to protect your identity and confidentiality:

1. Consent forms will be separated from the data.
2. Only your ID number will appear on any documents with data on them.
3. All notes will be kept in a locked cabinet in a locked office and all electronic versions of the data will be password protected.

**Future use of information**

In case of sharing the data of this study by other researchers, anonymous data will be supplied.

**Right not to participate and withdraw**

Your participation in the study is voluntary, and you are the sole authority to decide whether to participate. You can also withdraw your participation any time during the study. Refusal to take part in or withdrawal from the study will involve no penalty for you or your family.

**Who to contact**

This proposal has been reviewed by the Research Review Committee and Ethical Review Committee at ICDDR,B. They are responsible for ensuring that research participants are protected from harm. For questions about your rights as a research subject you may contact the following:

ICDDR,B Ethical Review Committee, Mr. M.A. Salam Khan, Committee Coordination Secretariat, ICDDR,B, Mohakhali, Dhaka-1212, Bangladesh, Phone: 9886498 (direct) or 01711428989 (mobile).

University of Missouri Campus IRB, Office of Research, 483 McReynolds Hall, Columbia, MO 65211, USA. Phone: 1 (573) 882-9585. Email: [umcresearchcirb@missouri.edu](mailto:umcresearchcirb@missouri.edu).

Principle Investigator: Ms. Kathrine Starkweather, Email: [kesc99@mail.missouri.edu](mailto:kesc99@mail.missouri.edu), Phone: 01747573076

Advisor: Dr. Mary K. Shenk, Email: [shenkm@missouri.edu](mailto:shenkm@missouri.edu), Phone: 1-206-383-6207

If you have any general questions about the project you may ask those now or later. If you wish to ask questions later, you may contact Dr. Nurul Alam, Centre for Population, Urbanization and Climate Change, ICDDR,B, Mohakhali, Dhaka 1212. Phone: 9827041, 9827042 or mobile: 01819438287.

If you agree to participate, please indicate that by putting your signature or left thumb impression on the specified space below.

Thank you for your cooperation.

I have read/has been read to me the foregoing information. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate in the study. I understand that I have the right to withdraw from the study at any time without in any way affecting myself or my family.

\_\_\_\_\_  
Signature or left thumb impression of respondent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of researcher

\_\_\_\_\_  
Date

**INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH**  
**Mohakhali, Dhaka- 1212**  
**UNIVERSITY OF MISSOURI**  
**Columbia, MO, USA**

ID #: \_\_\_\_\_

Protocol Number: PR-14016  
 Protocol Title: Shodagor Dissertation Project  
 Name of ICDDR,B Principal Investigator: Nurul Alam  
 Name of University of Missouri Investigator: Kathrine Starkweather  
 Organization: HDSU, ICDDR,B, Bangladesh and University of Missouri, USA

Date of Interview: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Checked by: \_\_\_\_\_  
 Date Checked: \_\_\_\_\_

Respondent's Gender: \_\_\_\_\_  
 উত্তরদাতার লিঙ্গ

PLEASE LIST ALL PEOPLE CURRENTLY LIVING IN THIS HOUSEHOLD বরতমানে এই বাড়িতে বসবাসরত মানুষের একটি তালিকা তৈরি করুনঃ

Relationship to Respondent উত্তরদাতার সাথে সম্পর্ক	Age বয়স
Respondent (উত্তরদাতা)	

**ECONOMIC STRATEGIES**  
 অর্থনৈতিক পরিকল্পনা

Relationship সম্পর্ক	Rainy Season Primary Occupation বর্ষা মৌসুমে প্রধান পেশা	Dry Season Primary Occupation শুকনা মৌসুমে প্রধান পেশা	Other Occupations (list all) অন্যান্য পেশা (তালিকা তৈরি করুন)
Husband স্বামী			
Wife স্ত্রী			
Husband's Father স্বামীর বাবা			
Husband's Mother স্বামীর মা			
Wife's Father স্ত্রীর বাবা			
Wife's Mother স্ত্রীর মা			

Occupations:
0 = unemployed বেকার
1 = fisherman/woman মৎস্যজীবী
2=salesperson (who sells products) বিক্রেতা
3=rickshaw puller রিকশাওয়ালা
4=repairman/woman সেয়ারমতকারী
5=housewife পুঁহিণী
6=Shordar সর্দার
7=other (explain)

**Selling Goods** দ্রব্যাদি বিক্রয়ের ক্ষেত্রে

Do you ever pay for the entire basket of goods upfront?

আপনি কি কখনো পুরো ঝুড়ি অর্থের জন্য টাকা দিয়েছেন ?

If so, how many times in the last month have you paid for full basket upfront? \_\_\_\_\_

How many times in the last year? \_\_\_\_\_

গত মাসে কতবার?

গত বছরে কতবার?

Answer for Respondent on LAST 3 DAYS WORKED ALONE: উত্তরদাতার ক্ষেত্রে শেষ ৩ দিন যখন তিনি একা কাজ করেনঃ

Which day was it? কোন দিন আপনি একা কাজ করেছেন?			
How long did it take you to travel to the location where you worked? আপনি যেখানে কাজ করেন সেখানে যেতে আপনার কত সময় লেগেছে?			
How much money did you make (total)? আপনি মোট কত টাকা আয় করেন?			
How much did you give back to the mahajan? মহাজনকে কত টাকা ফেরত দিতে হয়?			
How much did you save to pay the mahajan for your next basket? পরবর্তী ঝুড়ি অর্থের ক্ষেত্রে মহাজনকে টাকা ফেরত দেয়ার জন্য আপনি কত টাকা জমান ?			
Total Profit মোট লাভ			
How much did you spend for travel? যাতায়াতের জন্য আপনি কত টাকা খরচ করেন?			
How much did you spend buying food to eat that day? সেই দিন আপনি খাবারের জন্য কত টাকা ব্যয় করেছেন?			
Total left over মোট উচ্চিষ্ট			

Answer for Respondent on LAST 3 DAYS WORKED WITH OTHER ADULTS: উত্তরদাতা গত ৩ দিন প্রাপ্তবয়স্ক অন্য কারো সাথে কাজ করলেঃ

Which day was it? দিনটি কবে ছিল?			
List all the people you worked with যাদের সাথে কাজ করেছেন তাদের একটি তালিকা তৈরি করুন			
How long did it take you to travel to the location where you worked? যেখানে কাজ করেন সেখানে যেতে কত সময় লাগে?			
How much money did you make (total)? আপনি মোট কত টাকা আয় করেন?(মোট)			
How much did you give back to the mahajan? মহাজনকে কত টাকা ফেরত দিতে হয়?			
How much did you save to pay the mahajan for your next basket? পরবর্তী ঝুড়ি অর্থের ক্ষেত্রে মহাজনকে টাকা ফেরত দেয়ার জন্য আপনি কত টাকা জমান ?			
Total Profit মোট লাভ			
How much did you spend for travel? যাতায়াতের জন্য কত টাকা খরচ করতে হয়?			
How much did you spend buying food to eat that day? সেই দিন আপনি খাবারের জন্য কত টাকা ব্যয় করেছেন?			
Total left over মোট উচ্চিষ্ট			

Answer for Respondent on LAST 3 DAYS WORKED WHEN YOU TOOK YOUR CHILDREN ALONG: গত ৩ দিনের জন্য উত্তরদাতার ক্ষেত্রে যখন আপনি আপনার সন্তানদের আপনার সাথে কাজে নিয়ে যান:

Which day was it? দিনটি কবে ছিল?			
List all the children you took with you যাদের সাথে কাজ করেছেন তাদের একটি তালিকা তৈরি করুন			
How long did it take you to travel to the location where you worked? যেখানে কাজ করেন সেখানে যেতে কত সময় লাগে?			
How much money did you make (total)? আপনি কত টাকা আয় করেন(মোট)?			
How much did you give back to the mahajan? মহাজনকে কত টাকা ফেরত দিতে হয়?			
How much did you save to pay the mahajan for your next basket? পরবর্তী মুক্তি দ্রব্যের ক্ষেত্রে মহাজনকে টাকা ফেরত দেয়ার জন্য আপনি কত টাকা জমান ?			
Total Profit নেট লাভ			
How much did you spend for travel? যাতায়াতের জন্য কত টাকা খরচ করতে হয়?			
How much did you spend buying food to eat that day? সেই দিন আপনি খাবারের জন্য কত টাকা ব্যয় করেছেন?			
Total left over নেট উচ্চিষ্ট			

**Fishing** মাছ ধরার ক্ষেত্রে

What method of fishing do you use? During the rainy season \_\_\_\_\_ During the dry season \_\_\_\_\_  
আপনি কন পদ্ধতিতে মাছ ধরেন? বর্ষা মৌসুমে \_\_\_\_\_ শুষ্ক মৌসুমে \_\_\_\_\_

Answer for Respondent on LAST 3 DAYS WORKED WHEN YOU WORKED ALONE: উত্তরদাতার ক্ষেত্রে যখন গত ৩ দিন আপনি একা কাজ করেন:

Which day was it? দিনটি কবে ছিল?			
How long did it take you to travel to the place you caught fish? আপনি যেখানে মাছ ধরেন সেখানে পৌঁছাতে আপনার কত সময় লেগেছে?			
What fishing method did you use? আপনি কোন পদ্ধতিতে মাছ ধরেন?			
How many KGs of fish did you catch? কত কেজি মাছ আপনি ধরেছেন?			
How many KGs did you give to someone else? কত কেজি মাছ আপনি অন্য কাউকে দিয়েছেন?			
Who did you give the fish to? কাকে আপনি মাছ দিয়েছেন?			
How many KGs of fish did you sell? কত কেজি মাছ আপনি বিক্রি করে দিয়েছেন?			
How much taka did you make from selling the fish? আপনি মাছ বিক্রি করে কত টাকা পেয়েছেন?			
How much taka did you give to someone else? কত টাকা আপনি অন্য মানুষকে দিয়েছেন ?			
Who did you give taka to? কাকে টাকা দিয়েছেন?			
Total Profit নেট লাভ			
How much did you spend for travel? যাতায়াতে কত টাকা খরচ করেছেন?			
How much did you spend for food? খাবারের জন্য আপনি কত টাকা খরচ করেছেন?			
Total left over নেট উচ্চিষ্ট			





Answer for Respondent on LAST 3 DAYS WORKED WHEN YOU WORKED WITH YOUR CHILDREN (18 and under OR unmarried, living at home): পত ৩ দিন উত্তরগাতা যখন তার সন্তানদের সাথে কাজ করেন (১৮ বছর এবং ১৮ বছরের নিচে অস্বাধীন বাসায় থাকে):

Which day was it? এটা কোন দিন ছিল?			
List all the people who worked with you যাদের সাথে কাজ করেছেন তাদের একটি তালিকা তৈরি করুন			
How long did it take you to travel to the place you caught fish? আপনি যেখানে মাছ ধরেন সেখানে পৌঁছাতে আপনার কত সময় লেগেছে?			
What fishing method did you use? আপনি কোন পদ্ধতিতে মাছ ধরতেন?			
How many KGs of fish did you catch? কত কেজি মাছ আপনি ধরেছেন?			
How many KGs did you give to someone else? কত কেজি মাছ আপনি অন্য কাউকে দিয়েছেন?			
Who did you give the fish to? কাকে আপনি মাছ দিয়েছেন?			
How many KGs of fish did you sell? কত কেজি মাছ আপনি বিক্রি করে দিয়েছেন?			
How much taka did you make from selling the fish? আপনি মাছ বিক্রি করে কত টাকা পেয়েছেন?			
How much taka did you give to someone else? কত টাকা আপনি অন্য মানুষকে দিয়েছেন?			
Who did you give taka to? কাকে টাকা দিয়েছেন?			
Total Profit মোট লাভ			
How much did you spend for travel? যাতায়াতে কত টাকা খরচ করেছেন?			
How much did you spend for food? খাবারের জন্য আপনি কত টাকা খরচ করেছেন?			
Total left over মোট উচ্চিষ্ট			

Answer for Respondent on LAST 3 DAYS WORKED WHEN YOU WORKED WITH YOUR SPOUSE AND CHILDREN: উত্তরগাতার কেবল যখন পত ৩ দিন আপনি আপনার সান্নি/ স্ত্রীর সাথে কাজ করেছেন:

Which day was it? এটা কোন দিন ছিল?			
List all the people who were with you যাদের সাথে কাজ করেছেন তাদের একটি তালিকা তৈরি করুন			
How long did it take you to travel to the place you caught fish? আপনি যেখানে মাছ ধরেন সেখানে পৌঁছাতে আপনার কত সময় লেগেছে?			
What fishing method did you use? আপনি কোন পদ্ধতিতে মাছ ধরতেন?			
How many KGs of fish did you catch? কত কেজি মাছ আপনি ধরেছেন?			
How many KGs did you give to someone else? কত কেজি মাছ আপনি অন্য কাউকে দিয়েছেন?			
Who did you give the fish to? কাকে আপনি মাছ দিয়েছেন?			
How many KGs of fish did you sell? কত কেজি মাছ আপনি বিক্রি করে দিয়েছেন?			
How much taka did you make from selling the fish? আপনি মাছ বিক্রি করে কত টাকা পেয়েছেন?			
How much taka did you give to someone else? কত টাকা আপনি অন্য মানুষকে দিয়েছেন?			
Who did you give taka to? কাকে টাকা দিয়েছেন?			
Total Profit মোট লাভ			
How much did you spend for travel? যাতায়াতে কত টাকা খরচ করেছেন?			
How much did you spend for food? খাবারের জন্য আপনি কত টাকা খরচ করেছেন?			
Total left over মোট উচ্চিষ্ট			

Answer for Respondent on LAST 3 DAYS WORKED WHEN YOU WORKED WITH YOUR CHILDREN AND OTHER ADULTS (not your spouse):  
 উত্তরসহকারী প্ৰশ্নের পত ৩ দিন আপনি যখন আপনার সন্তান ও অন্যান্য প্রাপ্তবয়স্ক ব্যক্তির সাথে (ধর্মী/ স্ত্রী ব্যতীত) কাজ করেন:

Which day was it? এটা কোন দিন ছিল?			
List all the people who were with you যাদের সাথে কাজ করেছেন তাদের একটি তালিকা তৈরি করুন			
How long did it take you to travel to the place you caught fish? আপনি যেখানে মাছ ধরেন সেখানে পৌঁছাতে আপনার কত সময় পেয়েছে?			
What fishing method did you use? আপনি কোন পদ্ধতিতে মাছ ধরেন?			
How many KGs of fish did you catch? কত কেজি মাছ আপনি ধরেছেন?			
How many KGs did you give to someone else? কত কেজি মাছ আপনি অন্য কাউকে দিয়েছেন?			
Who did you give the fish to? কাকে আপনি মাছ দিয়েছেন?			
How many KGs of fish did you sell? কত কেজি মাছ আপনি বিক্রি করে দিয়েছেন?			
How much taka did you make from selling the fish? আপনি মাছ বিক্রি করে কত টাকা পেয়েছেন?			
How much taka did you give to someone else? কত টাকা আপনি অন্য কাউকে দিয়েছেন?			
Who did you give taka to? কাকে টাকা দিয়েছেন?			
Total Profit মোট লাভ			
How much did you spend for travel? যাওয়ার জন্যে কত টাকা খরচ করেছেন?			
How much did you spend for food? খাবারের জন্যে আপনি কত টাকা খরচ করেছেন?			
Total net over মোট উচ্চত্ব			

**PARENTING** সন্তান লালন পালন

Number of children \_\_\_\_\_  
 সন্তানের সংখ্যা

Please list ALL adults you lived with during childhood:  
 আপনি শিশুরে যে সকল প্রাপ্ত বয়স্ক মানুষের সাথে ছিলেন তার একটি তালিকা তৈরি করুন:

Age 10 and younger ১০ বছর এবং তার থেকে ছোট	Age 10-18 বয়স ১০-১৮

Please list ALL adults that each of your children have lived with during childhood:

বেসকল প্রাপ্ত বয়স্ক মানুষের সাথে আপনার সন্তান শৈশবে ছিল তার একটি তালিকা তৈরি করুন:

Child সন্তান	Age 10 and younger ১০ বছর এবং তার থেকে ছোট	Age 10-18 বয়স ১০-১৮

Please list all children NOT YOUR OWN who have ever lived with you: \_\_\_\_\_  
 নিজের সন্তান ছাড়া অন্য কারো সন্তান আপনার সাথে কখনো থাকলে তার একটি তালিকা তৈরি করুন

For each live birth, please answer the following about the MOTHER's experience:

প্রত্যেক জীবিত সন্তান প্রসবের ক্ষেত্রে মাতৃ অভিজ্ঞতা উল্লেখ করুন:

Child সন্তান	Where did you/your wife give birth? আপনি/আপনার স্ত্রী কোথায় সন্তান প্রসব করেছেন?	Who helped with the birth (i.e. labor and delivery)? কে সাহায্য করেছেন? (সন্তান প্রসবের ক্ষেত্রে)	How soon after birth did you/your wife return to work? সন্তান জন্ম দানের কতদিন পর আপনি/আপনার স্ত্রী কাজে ফেরত গেছেন?	What type of work did you/she do? আপনি/আপনার স্ত্রী কি ধরনের কাজ করতেন?	Did you/she take the baby along? সন্তান কে কি সাথে নিয়ে জান/যেত?	If not, who watched the baby? না হলে বাচ্চার দেখাশোনা কে করত?

Please answer the following for the LAST 3 DAYS THE MOTHER WORKED. দয়া করে উত্তর দিন। গত ৩ দিন যখন মা কাজ করে

Who watched each child?  
প্রত্যেক সন্তানকে কে দেখে?

Child বাচ্চা	Day 1 দিন ১	Day 2 দিন ২	Day 3 দিন ৩

Who cooked for / fed each child?  
বাচ্চার জন্য কে রান্না করে/ খাওয়ায়?

Child বাচ্চা	Day 1 দিন ১	Day 2 দিন ২	Day 3 দিন ৩

**HOUSEHOLD INVENTORY** ঘরের আসবাবপত্র

How many chot nouka do you own? \_\_\_\_\_ আপনাদের কতগুলো ছোট নৌকা আছে?  
 How many homes do you own? \_\_\_\_\_ আপনাদের কতগুলো বাড়ি আছে?  
 What is your home made of? \_\_\_\_\_ আপনার বাড়ি কি দিয়ে তৈরি?  
 1 = earth/mud; 2 = cement/tiles; 3 = tin; 4 = thatch/straw/leaves; 5 = scrap materials/sack/polythene; 6 = wood; 7 = bamboo; 8 = other (specify)  
 ১= মাটি; ২= সিমেন্ট/টাইলস; ৩= তিন; ৪= ধড়/শরকুতা; ৫= অস্বচ্ছিত দ্রব্য/বস্তা/পলিথিন; ৬= কাঠ; ৭= বাঁশ; ৮= অন্যান্য(উল্লেখ করুন)

Fuel used for cooking fire: \_\_\_\_\_ রান্নার জন্য ব্যবহৃত জ্বালানি  
 Number of rooms in your home: \_\_\_\_\_ ঘরের কামড়া সংখ্যা  
 Size of boat (in cm): \_\_\_\_\_ নৌকার দৈর্ঘ্য (সেটিমিটার)

Please answer the following:

Amount of agricultural land owned নিজস্ব কৃষি জমির পরিমাণ	Number of mobile phones মোবাইল ফোন আছে
Have lantern? Yes/no লণ্টন আছে হ্যাঁ/না	Have dining table? খাবার টেবিল আছে
Have quilt/blanket? Yes/no কথা / লেপ আছে হ্যাঁ / না	Have showcase/mirrah? সোফেস/ আলমারি আছে
Have mattress? Yes/no জামিন আছে হ্যাঁ /না	Have electricity? বিদ্যুৎ আছে
Have bed stand? (khat/chowki) বাঁত/ চৌকি আছে	Have electric fan? বিদ্যুতিক পাখা আছে
Have chair/table? ছেয়ার/ টেবিল আছে	Own radio? ওজন রেডিও আছে
Have rickshaw? রিক্সা আছে	Own television? টেলিভিশন আছে
Own bicycle? বাইক/সাইকেল আছে	Have solar panel? সৌর বিদ্যুৎ আছে
Number of fishing boats মাছ ধরার নৌকা আছে	Number of chickens / ducks মুরগি/ ছাগলের সংখ্যা
Number of other country boats অন্যান্য ছোট নৌকার সংখ্যা	Number of cows / goats গরু/ ছাগলের সংখ্যা
Number of motor boats ইঞ্জিন চালিত নৌকার সংখ্যা	Own a shop? নিজস্ব দোকান আছে
Number of cooking pots রান্না করার সরঞ্জামের সংখ্যা	Number of fishing nets মাছ ধরার জালের সংখ্যা

## REFERENCES

- Adair, L.A. & B.M. Popkin (1992). Prolonged lactation contributes to depletion of maternal energy reserves in Filipino women. *The Journal of Nutrition*, 122, 1643-1655.
- Adair, L.A. & D.K. Guilkey (1997). Age-specific determinants of stunting in Filipino children. *The Journal of Nutrition*, 127, 314-320.
- Ahmed, N. (1962). The Laua Community. In J.E. Owen (Ed.), *Sociology in East Pakistan*. Dhaka, Bangladesh: Dhaka University Press.
- Ahmed, S.M., A. Adams, A.M.R. Chowdhury, & A. Bhuiya (1998). Chronic energy deficiency in women from rural Bangladesh: Some socioeconomic determinants. *Journal of Biosocial Science*, 30, 349-358.
- Allal, N., R. Sear, A.M. Prentice, & R. Mace (2004). An evolutionary model of stature, age at first birth and reproductive success in Gambian women. *Proceedings of the Royal Society B: Biological Sciences*, 271, 465-470.
- Alom, J., M.A. Quddus, & M.A. Islam (2012). Nutritional status of under-five children in Bangladesh: A multilevel analysis. *Journal of Biosocial Science*, 44, 525-535.
- Amin, S. (1997). The Poverty-Purdah Trap in Rural Bangladesh: Implications for Women's Roles in the Family. *Development and Change*, 28, 213-233.
- Amin, S. (1998). Family Structure and Change in Rural Bangladesh. *Population Studies*, 52, 201-213.
- Amin, S., & M. Cain (1997). "The rise of dowry in Bangladesh." In G.W. Jones, R.M. Douglas, J.C. Caldwell, and R.M. D'Souza (Eds.), *The Continuing Demographic Transition* (pp. 290–306). Oxford, England: Clarendon Press.

- Aslam, M. & G. Gandhi Kingdon (2012). Parental education and child health – understanding the pathways of impact on Pakistan. *World Development*, 40, 2014-2032.
- Aziz, K.M.A. (1979). *Kinship in Bangladesh*. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh.
- Balk, D. (1997). Change comes slowly for women in rural Bangladesh. *Asia-Pacific Population & Policy*, 41, 1-4.
- Bangladesh Bureau of Statistics (2010). “Area, population, household, and household characteristics.” *The Statistical Yearbook of Bangladesh – 2010*  
(<http://www.bbs.gov.bd/PageWebMenuContent.aspx?MenuKey=230>)
- Becker, G.S. (1985). Human capital, effort, and the sexual division of labor. *Journal of Labor Economics*, 3, 33.
- Becker, S., R.E. Black, & K.H. Brown (1991). Relative effects of diarrhea, fever, and dietary energy intake on weight gain in rural Bangladeshi children. *The American Journal of Clinical Nutrition*, 53, 1499-1503.
- Behrens, C.A. (1992). Labor specialization and the formation of markets for food in a Shipibo subsistence economy. *Human Ecology*, 20, 435-462.
- Behrman, J.R. & A.B. Deolalikar (1988). Health and nutrition. In H. Chenery and T. Srinivasan (Eds.) *Handbook of Development Economics*, p. 631-711. Amsterdam: North-Holland.



- Bhutta, Z.A., T. Ahmed, R.E. Black, S. Cousens, K. Dewey, E. Giugliani, ...M. Shekar. (2008). What works? Interventions for maternal and child undernutrition and survival. *The Lancet*, 371, 417-440.
- Bird, R. (1999). Cooperation and conflict: The behavioral ecology of the sexual division of labor. *Evolutionary Anthropology*, 8, 65-75.
- Black, E.R., C.G. Victora, S.P. Walker, Z.A. Bhutta, P. Christian, M. de Onis, ... R. Uauy (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*, 382, 427-451.
- Black, E.R., H.K. Brown, & S. Becker (1984). Malnutrition is a determining factor in diarrheal duration, but not incidence, among young children in a longitudinal study in rural Bangladesh. *American Journal of Clinical Nutrition*, 37, 87-94.
- Blackwell, D.L., M.D. Hayward, & E.M. Crimmins (2001). Does childhood health affect chronic morbidity in later life? *Social Science & Medicine*, 52, 1269-1284.
- Bliege Bird, R. (2007). Fishing and the sexual division of labor among the Meriam. *American Anthropologist* 109:442-451.
- Bliege Bird, R. & B.F. Coddling (2015). The sexual division(s) of labor. In R. Scott & S. Kosslyn (Eds.) *Emerging Trends in the Social and Behavioral Sciences* (pp. 1-16). John Wiley & Sons, Inc.
- Bliege Bird, R. and D.W. Bird (2008). Why women hunt: Risk and contemporary foraging in a Western Desert Aboriginal community. *Current Anthropology*, 49, 655-693.

- Bliege Bird, R., E.A. Smith, & D.W. Bird (2001). The hunting handicap: Costly signaling in male foraging strategies. *Behavioral Ecology and Sociobiology*, 50, 9-19.
- Bloss, E., F. Wainaina, & R.C. Bailey (2004). Prevalance and predictors of underweight, stunting, and wasting among children aged 5 and under in western Kenya. *Journal of Tropical Pediatrics*, 50, 260-270.
- Blumberg, R.L., M.R. Estrada de Batres, & J. Xuya Cuxil (1994). Women's work, wealth, and family survival strategy: The impact of Guatemala's ALCOSA agribusiness project. In E.N. Chow and C.W. Berheide (Eds.) *Women, the Family, and Policy: A Global Perspective*.
- Brown J.K. (1970). A Note on the Division of Labor by Sex. *American Anthropologist*, 72, 1073–1078.
- Bureau of Labor Statistics (2014). Labor Force Statistics from the Current Population Survey. Retrieved January 14, 2016, from <http://www.bls.gov/cps/cpsaat11.htm>
- Burton, M.L. & D.R. White (1984). Sexual division of labor in agriculture. *American Anthropologist*, 86, 568-583.
- Buss, D. M. (1984). Marital assortment for personality dispositions: Assessment with three different data sources. *Behavior Genetics*, 14, 111–123.
- Chen, L.C., A. Chowdhury, and S.L. Huffman (1980). *American Journal of Clinical Nutrition*, 33, 1836-1845.
- Chen, Y. & H. Li (2009). Mother's education and child health: Is there a nurturing effect? *Journal of Health Economics*, 28, 413-426.

- Chowdhury, A.M.R., A. Bhuiya, S. Mahmud, A.K.M. Abdus Salam, & F. Karim (2003). Immunization divide: Who do get vaccinated in Bangladesh? *Journal of Health and Population Nutrition*, 21, 193-204.
- Codding, B. F., Bliege Bird, R. & Bird, D.W. (2011). Provisioning offspring and others: Risk-energy trade-offs and gender differences in hunter-gatherer foraging strategies. *Proceedings of the Royal Society B: Biological Sciences*, 278, 2502-2509.
- Cole, T.J. (1990). The LMS method for constructing normalized growth standards. *European Journal of Clinical Nutrition* 44, 45–60.
- Cole, T.J. & J.M. Parkin (1977). Infection and its effect on the growth of young children: A comparison of The Gambia and Uganda. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 71, 196-198.
- Dahlberg F. (1983) *Woman the gatherer*. Yale University Press.
- de Onis, M., A.W. Onyango, E. Borghi, A. Siyam, C. Nishida, & J. Siekmann (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization*, 85, 660-667.
- de Onis, M., A.W. Onyango, E. Borghi, A. Siyam, M. Blossner, & C. Lutter (2012). Worldwide implementation of the WHO child growth standards. *Public Health Nutrition*, 15, 1603-1610.
- Demment, M.W., M.M. Young, & R.L. Sensenig (2003). Providing micronutrients through food-based solutions: A key to human and national development. *The Journal of Nutrition*, 133, 3879S-3885S.

- Doucet, A. & L. Merla (2007). Stay-at-home-fathering: A strategy for balancing work and home in Canadian and Belgian families. *Community, Work, and Family*, 10, 455-473.
- Ember, C. R. (1975). Residential variation among hunter-gatherers. *Cross-Cultural Research*, 10(3), 199-227.
- Engeland, A., T. Bjorge, R.M. Selmer, & A. Tverdal (2003). Height and body mass index in relation to total mortality. *Epidemiology*, 14, 293-299.
- Engle, Patrice L. (1991). Maternal work and child-care strategies in Peri-urban Guatemala: Nutritional effects. *Child Development*, 62, 954-965.
- Fawzi, W.W., M.G. Herrera, P. Nestel, A. El Amin, & K.A. Mohamed (1998). A longitudinal study of prolonged breastfeeding in relation to child undernutrition. *International Journal of Epidemiology*, 27, 255-260.
- Folbre, N. (1986). Hearts and spades: Paradigms of household economics. *World Development*, 14, 245-255.
- Forman, M.R., G.L. Hundt, H.W. Berendes, K. Abu-Saad, L. Zangwill, D. Chang, ... , B.I. Graubard (1995). Undernutrition among Bedouin Arab children: a follow-up of the Bedouin Infant Feeding Study. *The American Journal of Clinical Nutrition*, 61, 495-500.
- Fortes, M. (1958). Introduction. In: *The Developmental Cycle in Domestic Groups*. Jack Goody, (Ed.) Cambridge Papers in Social Anthropology (pp. 1-14), Cambridge, England: The University Press,
- Foster, A.D. (1995). Prices, credit markets and child growth in low-income rural areas. *The Economic Journal*, 105, 551-570.

- Fox, R. (1967). *Kinship and marriage: An anthropological perspective*. Cambridge University Press.
- Geary, D. C. (2000). Evolution and proximate expression of human paternal investment. *Psychological Bulletin*, 126, 55-77.
- Goodman M.J., Griffin P.B., Estioko-Griffin A.A., & Goodman, M. J., et al. (1985). "Menarche, pregnancy, birth spacing and menopause among the Agta women foragers of Cagayan Province, Luzon, the Philippines." *Annals of human biology*, 12, 169-177.
- Guldan, G.S., M.F. Zeitlin, A.S. Beiser, C.M. Super, S.N. Gershoff, & S. Datta (1993). Maternal education and child feeding practices in rural Bangladesh. *Social Science & Medicine*, 36, 925-935.
- Gunnell, D., G. Davey Smith, A.R. Ness, & S. Frankel (2000). The effects of dietary supplementation on growth and adult mortality: A re-analysis and follow-up of a pre-war study. *Public Health*, 114, 109-116.
- Gurven M. & Hill K. (2009). Why do men hunt? A reevaluation of "man the hunter" and the sexual division of labor. *Current anthropology*, 50, 51.
- Gurven, M., A.V. Jaeggi, C. von Rueden, P.L. Hooper, & H. Kaplan (2015). Does market integration buffer risk, erode traditional sharing practices and increase inequality? A test among Bolivian forager-farmers. *Human Ecology*, 43, 515-530.
- Gurven, M., J. Winking, H. Kaplan, C. von Rueden, & L. McAllister (2009). A bioeconomic approach to marriage and the sexual division of labor. *Human Nature*, 20, 151-183.

- Guyer, J. (1980). *Household budgets and women's incomes*. African Studies Center Working Paper 28. Boston: Boston University.
- Guyer, J. & P. Peters (1987). Introduction. Special issue on Conceptualizing the household: Issues of theory and policy in Africa. *Development and Change*, 18, 197-213.
- Haddad, L., H. Alderman, S. Appleton, L. Song, & Y. Yohannes (2003). Reducing child malnutrition: How far does income growth take us? *World Bank Economic Review*, 17, 107-131.
- Haddad, L., J. Hoddinott, & H. Alderman (1997). *Intrahousehold resource allocation in developing countries: Models, methods, and policy*. Baltimore: The Johns Hopkins University Press.
- Hadfield, J.D. (2010). Mcmc methods for multi-response generalized linear mixed models: the MCMCglmm R package. *Journal of Statistical Software*, 33, 1–22.
- Hagen, E.H., R.B. Hames, N.M. Craig, M.T. Lauer, & M.E. Price (2001). Parental investment and child health in a Yanomamo village suffering short-term food stress. *Journal of Biosocial Sciences*, 33, 503-528.
- Hames, R.B. (1979). A comparison of the efficiencies of the shotgun and the bow in neotropical forest hunting. *Human Ecology*, 7, 219-252.
- Hames, R.B. (1988). The allocation of parental care among the Ye'kwana. In L. Betzig, M. Borgerhoff-Mulder, & P. Turke (eds.) *Human Reproductive Behavior* (pp. 237-251). Cambridge, MA: Cambridge University Press.

- Hames, R.B. (1992). Variation in paternal care among the Yanomamo. In B. Hewlett (Ed.) *Father-child relations: Cultural and biosocial contexts* (pp. 85-110). Hawthorne, NY: Aldine de Gruyter.
- Hames, R. B. & P. Draper (2004). Women's work, child care, and helpers-at-the-nest in a hunter-gatherer society. *Human Nature*, 15, 319-341.
- Harkness, S. & C.M. Super (1992). The cultural foundations of fathers' roles: Evidence from Kenya and the United States. In Hewlett BS (Ed.) *Father-child relations: cultural and biosocial context* (pp. 191-212). New York: Aldine de Gruyter.
- Hawkes, K. (1990). Why do men hunt? Some benefits for risky strategies. In E.A. Cashdan (Ed.) *Risk and uncertainty in tribal and peasant economies*. Boulder, CO: Westview Press.
- Hawkes, K. (1991). Showing off: Tests of an hypothesis about men's foraging goals. *Ethology and Sociobiology*, 12, 29-54.
- Hawkes, K., A.R. Rogers, & E.L. Charnov (1995). The male's dilemma: Increased offspring production is more paternity to steal. *Evolutionary Ecology*, 9, 662-677.
- Hesketh, T., J.D. Qu, & A. Tomkin (2003). Health effects of family size: Cross-sectional survey in Chinese adolescents. *Archives of Disease in Childhood*, 886, 467-471.
- Hewlett, B.S. (1991). *Intimate fathers: The nature and context of Aka pygmy paternal infant care*. Ann Arbor, MI: University of Michigan Press.
- Hewlett, B.S. (1992). Husband-wife reciprocity and the father-infant relationship among Aka pygmies. In B.S. Hewlett BS (Ed.) *Father-child relations: cultural and biosocial context* (pp. 153-176). New York: Aldine de Gruyter.

- Hewlett, B.S. & M.E. Lamb (2005). *Hunter-gatherer childhoods: Evolutionary, developmental, and cultural perspectives*. New Brunswick, NJ: Transaction Publishers.
- Hill, K. (1988). Macronutrient modifications of optimal foraging theory: An approach using indifference curves applied to some modern foragers. *Human Ecology*, 16, 157–197.
- Hill, K. & H. Kaplan (1993). Why Do Male Foragers Hunt and Share Food? *Current Anthropology*, 34, 701-706.
- Hinde, K. & L.A. Milligan (2011). Primate milk: Proximate mechanisms and ultimate perspectives. *Evolutionary Anthropology Issues and News Review*, 20, 9-23.
- Hoddinott, J. & L. Haddad (1991). Household expenditures, child anthropometric status and the intrahousehold division of income: Evidence from the Cote d'Ivoire. Discussion Paper #155 given at Research Program in Development Studies, Woodrow Wilson School, Princeton University.
- Hofer, T. & B. Messerli (1997). *Floods in Bangladesh: History, dynamics, and rethinking the role of the Himalayas*. United Nations University Press: Tokyo.
- Hrdy, S. (1992). Fitness tradeoffs in the history and evolution of delegated mothering with special reference to wet-nursing. *Ethology and Sociobiology* 13, 409-442.
- Hrdy, S. (2009). *Mothers and Others: The evolutionary origins of mutual understanding*. Cambridge, MA: Belknap Press.



- Hurtado A.M., K. Hill, I. Hurtado, & H. Kaplan (1992). Trade-offs between female food acquisition and child care among Hiwi and Ache foragers. *Human Nature*, 3, 185–216.
- Hurtado, A.M., K. Hawkes, K. Hill, & H. Kaplan (1985). Female subsistence strategies among Ache hunter-gatherers of Eastern Paraguay. *Human Ecology*, 13, 1-28.
- International Centre for Diarrheal Disease Research, Bangladesh (ICDDR,B) (2014). *Health and Demographic Surveillance System – Matlab*. Dhaka, Bangladesh.
- Ivanoff, J., Cholmeley, F.N., & Ivanoff, P. (1997). *Moken: sea-gypsies of the Andaman Sea, post-war chronicles*. White Lotus Press.
- Ivey, P.K. (1993). Life-history theory perspectives on allocaretaking strategies among Efe foragers of the Ituri Forest of Zaire. PhD dissertation, University of New Mexico, Albuquerque, NM.
- Ivey, P.K. (2000). Cooperative reproduction in Ituri Forest hunter-gatherers: Who cares for Efe infants? *Current Anthropology*, 41, 856–866.
- Jochim, M.A. (1988). Optimal foraging and the division of labor. *American Anthropologist*, 90, 130-136.
- Joshi, S. & T.P. Schultz (2007). Family planning as an investment in development: Evaluation of a program's consequences in Matlab, Bangladesh. *Yale University Economic Growth Center Discussion Paper*, 951.
- Judge, D.S., K.A. Sanders, N. Reghupathy, P.C. Amaral, & L.H. Schmitt (2012). Family influences on long-term and short-term child growth in Ossu area, Timor Leste. In *New Research on Timor-Leste* (pp. 233-241). Hawthorn: Swinburne Press.

- Kaplan, H. S., P.L. Hooper, & M. Gurven (2009). The evolutionary and ecological roots of human social organization. *Philosophical Transactions of the Royal Society, B*, 364, 3289-3299.
- Kaplan, H. & K. Hill (1985). Food sharing among Ache foragers: Tests of explanatory hypotheses. *Current Anthropology*, 26, 223-246.
- Kaplan, H., K. Hill, & A.M. Hurtado (1990). Risk, foraging and food sharing among the Ache. In Cashdan E. (Ed.) *Risk and uncertainty in tribal and peasant economies* (pp. 107-144). Boulder, CO: Westview.
- Kaplan, H., K. Hill, J. Lancaster, & A.M. Hurtado (2000). A theory of human life history evolution: Diet, intelligence, and longevity. *Evolutionary Anthropology Issues News and Reviews*, 9, 156–185.
- Kelly, R. (1995). *The foraging spectrum: diversity in hunter-gatherer lifeways*. Washington D.C.: Smithsonian Institution Press.
- Konner, M. (2005). Hunter-gatherer infancy and childhood: the !Kung and others. In B.S. Hewlett and M.E. Lamb (Eds.) *Hunter-gatherer childhoods* (pp. 19-64). New Brunswick, NJ: Aldine.
- Kramer, K. (2004). Reconsidering the cost of childbearing: the timing of children's helping behavior across the life cycle of Maya families. *Research in Economic Anthropology* 23, 335-353.
- Kramer, K. (2010). Cooperative breeding and its significance to the demographic success of humans. *Annual Review of Anthropology*, 39, 417-436.

- Kramer, K.L., A. Veile, & E. Otarola-Castillo (2016). Sibling competition and growth tradeoffs. Biological vs. statistical significance. *PloS ONE*, 11.3: e0150126.
- Krishna, A., J. Oh, J. Lee, H. Lee, J.M. Perkins, J. Heo, Y.S. Ro, & S.V. Subramanian (2015). Short-term and long-term associations between household wealth and physical growth: A cross-comparative analysis of children from four low- and middle-income countries. *Global Health Action*, 8, 1-13.
- Kruuk, L.E.B. (2004). Estimating genetic parameters in natural populations using the “animal model”. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 359, 873–890.
- Lamb, M. E., J.H. Pleck, E.L. Chamov, & J.A. Levine (1985). Paternal behavior in humans. *American Zoologist*, 25, 883-894.
- Lancaster, J.B. (1978). Carrying and sharing in human evolution. *Human Nature*, 1, 82-89.
- Lancaster, J.B. & Lancaster, C.S. (1983) Parental Investment: The Hominid Adaptation. In D. Ortner, (Ed.) *How Humans Adapt: A Biocultural Odyssey*, Proceedings of the Seventh International Smithsonian Symposium. Smithsonian Institution. Washington, p. 33-66.
- Lancaster, J.B. & Lancaster, C.S. (1987). The watershed: Change in parental-investment and family-formation strategies in the course of human evolution. In *Parenting across the lifespan: Biosocial dimensions* (pp. 187-205).
- Latshaw, B.A. (2011). Is fatherhood a full-time job? Mixed methods insights into measuring stay-at-home fatherhood. *Fathering*, 9, 125-149.
- Lee, R. & I. DeVore (1968). *Man the hunter*. Chicago: Aldine-Atherton.

- Lee, R. B. (1968). What hunters do for a living, or how to make out on scarce resources. In: R.B. Lee & I. DeVore (Eds.) *Man the hunter* (pp. 30-48). Chicago: Aldine.
- Lee, R.B. (1979). *The !Kung San: Men, women, and work in a foraging society*. Cambridge University Press.
- Lim, S.S., T. Vos, A.D. Flaxman, G. Danaei, K. Shibuya, H. Adair-Rohani, M. Amann, ... M. Ezzati (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*, 380, 2224-2260.
- Lovejoy, C.O. (1981). The origin of man. *Science*, 211, 341-350.
- Macgregor, S., B.K. Cornes, N.G. Martin, & P.M. Visscher (2006). Bias, precision and heritability of self-reported and clinically measured height in Australian twins. *Human Genetics*, 120, 571-580.
- Maes, H.H.M., M.C. Neale, & L.J. Eaves (1997). Genetic and environmental factors in relative body weight and human adiposity. *Behavior Genetics*, 27, 325-351.
- Malinowski, B. (1913). *The family among the Australian aborigines*. London: University of London Press.
- Mani, S. (2014). Socioeconomic determinants of child health: Empirical evidence from Indonesia. *Journal of the East Asian Economic Association*, 28, 81-104.
- Marlowe, F.W. (1999a). Male care and mating effort among Hadza foragers. *Behavioral Ecology and Sociobiology*, 46, 57-64.

- Marlowe, F.W. (1999b). Showoffs or Providers? The Parenting Effort of Hadza Men. *Evolution and Human Behavior*, 20, 391–404.
- Marlowe, F.W. (2000). Paternal investment and the human mating system. *Behavioural Processes* 51, 45-61.
- Marlowe, F.W. (2001). Male contribution to diet and female reproductive success among foragers. *Current Anthropology* 42, 755-760.
- Marlowe, F.W. (2003). A critical period for provisioning by Hadza men.: Implications for pair bonding. *Evolution and Human Behavior*, 24, 217–229.
- Marlowe, F.W. (2007). Hunting and gathering: The human sexual division of foraging labor. *Cross Cultural Research* 41, 170-195.
- Marquis, G.S., J-P Habicht, C.F. Lanata, R.E. Black, & K.M. Rasmussen (1997). Breast milk or animal-product foods improve linear growth of Peruvian toddlers consuming marginal diets. *American Journal of Clinical Nutrition*, 66, 1102-1109.
- Martin (2012). Genetic and environmental contributions to weight, height, and BMI from birth to 19 years of age: An international study of over 12,000 twin pairs. *PLoS ONE*, 7: e30153. doi: 10.1371/journal.pone.0030153.
- Martorell, R., H.L. Delgado, V. Valverde, & R.E. Klein (1981). Maternal stature, fertility and infant mortality. *Human Biology*, 53, 303-312.
- Mattison, S.M., K. Wander, & K. Hinde (2015). Breastfeeding over two years is associated with longer birth intervals, but not measures of growth or health,

- among children in Kilimanjaro, TZ. *American Journal of Human Biology*, 27, 807-815.
- McDade, T.W. & C.M. Worthman (1998). The weanling's dilemma reconsidered: A biocultural analysis of breastfeeding ecology. *Journal of Developmental Behavioral Pediatrics*, 19, 286-299.
- McDade, T.W., M.W. Metzger, L. Chyu, G.J. Duncan, C. Garfield, & E.K. Adam (2014). Long-term effects of birth weight and breastfeeding duration on inflammation in early adulthood. *Proceedings of the Royal Society B: Biological Sciences*, 281.
- Meehan, C. L. (2009). Maternal time allocation in two cooperative childrearing societies. *Human Nature*, 20, 375-393.
- Meehan, C.L. (2005). The effects of residential locality on parental and alloparental investment among the Aka foragers of the Central African Republic. *Human Nature*, 16, 58-80.
- Milgram, B.L. (2001) Situating handicraft market women in Ifugao, Upland Philippines: a case for multiplicity. In J.L. Seligmann (Ed), *Women traders in cross-cultural perspective: Meditating identities, marketing wares* (pp. 129-160). Stanford University Press.
- Milgram, B.L. (personal communication).
- Motarjemi, Y., F. Kaferstein, G. Moy, & F. Quevedo (1993). Contaminated weaning food: a major risk factor for diarrhoea and associated malnutrition. *Bulletin of the World Health Organization*, 71, 79-92.

- Munroe, R. L. & Munroe, R. H. (1992). Fathers in children's environments: A four culture study. In B.S. Hewlett (Ed.) *Father-child relations: cultural and biosocial context* (pp. 213-229). New York: Aldine de Gruyter.
- Murdock, G.P. (1949). *Social Structure*. New York: MacMillian
- Murdock, G.P. (1960). The universality of the nuclear family. In N.W. Bell & E.F. Vogel (Eds.) *A modern introduction to the family: New York and London* (pp. 37-44). New York: Free Press.
- Nahar, B., T. Ahmed, K.H. Brown, & M.I. Hossain (2010). Risk factors associated with severe underweight among young children reporting to a diarrhoea treatment facility in Bangladesh. *Journal of Health and Population Nutrition*, 28, 476.
- Nakagawa, S. & H. Scheilzeth (2013). A general and simple method for obtaining R<sup>2</sup> from generalized linear mixed effects models. *Methods in Ecological Evolution*, 4, 133–142.
- Nan, C., B. Guo, C. Warner, T. Fowler, T. Barrett, D. Boomsma, ... M. Zeegers (2012). Heritability of body mass index in pre-adolescence, young adulthood and late adulthood. *European Journal of Epidemiology*, 27, 247-253.
- Nandy, S., M. Irving, D. Gordon, S.V. Subramanian, & G.D. Smith (2005). Poverty, child undernutrition and morbidity: New evidence from India. *Bulletin of the World Health Organization*, 83, 210-215.
- Noss, A.J. & B.S. Hewlett (2001). The contexts of female hunting in Central Africa. *American Anthropologist*, 103, 1024-1040.
- Novak, J. J. (1993). *Bangladesh: Reflections on the Water*. Indiana University Press: Bloomington, IN.

- O'Connell, J. F., K. Hawkes and N.G. Blurton Jones. 1991. Hunting income patterns among the Hadza: Big game, common goods, foraging goals and the evolution of the human diet. *Philosophical Transactions: Biological Sciences*, 334, 243-250.
- O'Connell, J. F., & K. Hawkes (1981). Alawara plant use and optimal foraging theory. In B. Winterhalder and E. A. Smith, (Eds.) *Hunter-gatherer foraging strategies: Ethnographic and archaeological analyses* (pp. 99-125). Chicago: University of Chicago Press.
- Oddy, W.H. (2001). Breastfeeding protects against illness and infection in infants and children: a review of the evidence. *Breastfeeding Review*, 9, 11-18.
- Onyango, A.W., S.A. Esrey, & M.S. Kramer (1999). Continued breastfeeding and child growth in the second year of life: A prospective cohort study in western Kenya. *The Lancet*, 354, 2041-2045.
- Pate, D. (1986). The effects of drought on Ngatatjara plant use: An evaluation of optimal foraging theory. *Human Ecology*, 14, 95-115.
- Pelto, G.H., J. Urgello, L.H. Allen, A. Chavez, H. Martinez, L. Meneses, C. Capacchione, & J. Backstrand (1995). Household size, food intake, and anthropometric status of school-age children in a highland Mexican area. *Social Science & Medicine*, 33, 1135-1140.
- Perry, G. (in press). Alloparental care and assistance in a normatively patrilocal society. *Current Anthropology*.
- Persson, L.A., S. Arifeen, E.C. Ekstrom, K.M. Rasmussen, E.A. Frongillo, & Md. Yunus (2012). Effects of prenatal micronutrient and early food supplementation on maternal hemoglobin, birth weight, and infant mortality among children in



- Bangladesh: The MINIMat randomized trial. *The Journal of the American Medical Association*, 307, 2050-2059.
- Phipps, Shelley A. and Burton, Peter S. (1998). What's mine is yours? The influence of male and female incomes on patterns of household expenditure. *Economica*. **65**: 599-613.
- Prader, A. (1978). Catch-up growth. *Postgraduate Medical Journal*, 54 Suppl 1, 133-146.
- Prentice, A.M., C.J.K. Spaajj, G.R. Goldberg, S.D. Poppitt, J.M.A. van Raajj, M. Totton, D. Swann, & A.E. Black (1996). Energy requirements of pregnant and lactating women. *European Journal of Clinical Nutrition*, 50, 82-111.
- Quinlan, R. J., & Quinlan, M. B. (2008). Human lactation, pair-bonds, and alloparents. *Human Nature*, 19, 87-102.
- Quinlan, R. J., Quinlan, M. B., & Flinn, M. V. (2003). Parental investment and age at weaning in a Caribbean village. *Evolution and Human Behavior*, 24, 1-16.
- R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org/>
- Rahman, A. & S. Chowdhury (2007). Determinants of chronic malnutrition among preschool children in Bangladesh. *Journal of Biosocial Science*, 39, 161-173.
- Rahman, A., S. Chowdhury, & D. Hossain (2009). Acute malnutrition in Bangladeshi children: levels and determinants. *Asia-Pacific Journal of Public Health*, 21, 294-302.
- Raley, S., S.M. Bianchi, & W. Wang (2012). When do fathers care? Mothers' economic contribution and fathers' involvement in child care. *American Journal of Sociology*, 117, 1422-1459.

- Ricci, J.A. & S. Becker. (1996). Risk factors for wasting and stunting among children in Metro Cebu, Philippines. *American Journal of Clinical Nutrition*, 63, 966-975.
- Rieger, M. & S.K. Trommlerova (2016). Age-specific correlates of child growth. *Demography*, 53, 241-267.
- Rigby, R.A. and Stasinopoulos D.M. (2005). Generalized additive models for location, scale and shape. *Applied Statistics*, 54, 507-554.
- Rivera, J.A., R. Martorell, M.T. Ruel, J-P Habicht, & J.D. Haas (1995). Nutritional supplementation during the preschool years influences body size and composition of Guatemalan adolescents. *The Journal of Nutrition*, 125, 1068S-1077S.
- Roberts, D.F., W.Z. Billewicz, & I.A. McGregor (1978). Heritability of stature in a West African population. *Annals of Human Genetics*, 42, 15-24.
- Robinson, M.R., G. Hemani, C. Medina-Gomez, M. Mezzavilla, T. Esko, K. Shakhbazov, ... , P.M. Visscher (2015). Population genetic differentiation of height and body mass index across Europe. *Nature Genetics*, 47, 1357-1362.
- Rouf, Kazi Abdur (2011). Grameen Bank women borrowers' familial and community relationships development in patriarchal Bangladesh. *International Journal of Research Studies in Psychology*. 1, 17-26.
- Rowland, M.G.M., T.J. Cole, & R.G. Whitehead (1977). A quantitative study into the role of infection in determining nutritional status in Gambian village children. *British Journal of Nutrition*, 37, 441-450.

- Roy, B.S., M.Z. Rahman, & M.A. Kashem (2009). Farmers' perception of the effect of IPM towards sustainable crop production. *Bangladesh Journal of Extension Education*, 21, 35- 41.
- Rushing, C. & L. Powell (2015). Family dynamics of the stay-at-home father and working mother relationship. *American Journal of Men's Health*, 9, 410-420.
- Sather, C. (1997). *The Bajau Laut: Adaptation, history, and fate in a maritime fishing society of South-eastern Sabah*. Oxford University Press, USA.
- Schousboe, K., G. Willemsen, K.O. Kyvik, J. Mortensen, D.I. Boomsma, B.K. Cornes, ... J.R. Harris (2012). Sex differences in heritability of BMI: A comparative study of results from twin studies in eight countries. *Twin Research*, 6, 409-421.
- Sear R. & R. Mace (2008) Who keeps children alive? A review of the effects of kin on child survival. *Evolution and Human Behavior*, 29, 1–18.
- Sear, R., N. Allal, & R. Mace (2004). Height, marriage and reproductive success in Gambian women. *Research in Economic Anthropology*, 23, 203-224.
- Seligmann, L.J. (2001). *Women traders in cross-cultural perspective: Meditating identities, marketing wares*. Stanford University Press.
- Semba, R.D., S. de Pee, K. Sun, M. Sari, N. Akhter, & M.W. Bloem (2008). Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: A cross-sectional study. *The Lancet*, 371, 322-328.
- Silventoinen, K. (2003). Determinants of variation in adult body-height. *Journal of Biosocial Science*, 35, 263-285.

- Silventoinen, K., J. Kaprio, E. Lahelma, R.J. Viken, & R.J. Rose (2001). Sex differences in genetics and environmental factors contributing to body-height. *Twin Research*, 4, 25-29.
- Silventoinen, K., S. Sammalisto, M. Perola, D.I. Boomsma, B.K. Cornes, C. Davis, ... , J. Kaprio (2003). Heritability of adult body height: a comparative study of twin cohorts in eight countries. *Twin Research*, 6, 399-408.
- Smith E.A. & R. Bliege Bird (2000). Turtle hunting and tombstone opening: Public generosity as costly signaling. *Evolution and Human Behavior*, 21, 245-261.
- Starkweather, K.E. (in press). Shodagor family strategies: Balancing work and family on the water. *Human Nature*.
- Starkweather, K.E. & Ahsan, M.H. (in prep). Effects of household traits and heritable variation on Shodagor health.
- Stephens, D.W., & Krebs, J.R. (1986). *Foraging theory*. Princeton, NJ: Princeton University Press.
- Stulp, G., S. Verhulst, T.V. Pollet, & A.P. Buunk (2012). The effect of female height on reproductive success is negative in Western populations, but more variable in non-Western populations. *American Journal of Human Biology*, 24, 486-494.
- Thomas, D., J. Strauss, & M.H. Henriques (1990). Child survival, height for age and household characteristics in Brazil. *Journal of Development Economics*, 33, 197-234.
- Timus I.M. & L. Lush (1995). Intra-urban differentials in child health. *Health Transition Review*, 5, 163-190.

- Trivers R. (1972). Parental investment and sexual selection. In B. Campbell (Ed.) *Sexual selection and the descent of man 1871–1971* (pp. 136-179). Chicago: Aldine de Gruyter.
- Truswell, S. (2012). Protein-energy malnutrition. In J. Mann and A.S. Truswell (Eds.) *Essentials of Human Nutrition*. Oxford: Oxford University Press, p. 289-298.
- Tucker, B., J. Tombo, P. Hajasoa, C. Nagnisaha, V.R. Lahitoka, & C. Zahtsy (2013). Beyond mean and variance: Economic risk versus perceived risk of farming, foraging, and fishing activities in Southwestern Madagascar. *Human Ecology*, 41, 393-407.
- Underwood, B. (1999). Micronutrient deficiencies as a public health problem in developing countries and effectiveness of supplementation, fortification, and nutrition education programs: Is there a role for agriculture? International Rice Research Institute-hosted International Food Policy Research Institute Workshop. Symposium, Oct 5-7, 1999.
- UNICEF (2009). *Bangladesh Health and Injury Survey*. Dhaka, Bangladesh.
- Van den Berghe. P.L. (1990). *Human family systems: An evolutionary view*. Waveland Press.
- Visscher, P.M. (2008). Sizing up human height variation. *Nature Genetics*, 40, 489-490.
- Visscher, P.M., W.G. Hill, & N.R. Wray (2008). Heritability in the genomics era – concepts and misconceptions. *Nature Reviews Genetics*, 9, 255-266.
- von Rueden, C. (2011). The acquisition of social status by males in small-scale human societies. *Doctoral dissertation*. University of California, Santa Barbara.

- WHO (1995). Physical status: The use of and interpretation of anthropometry, Report of a WHO Expert Committee.
- WHO (2001). The optimal duration of exclusive breastfeeding, Report of an Expert Consultation, Geneva, Switzerland, 28-30 March, 2001.
- Winking, J., Gurven, M., Kaplan, H., & Stieglitz, J. (2009). The goals of direct paternal care among a South Amerindian population. *American Journal of Physical Anthropology*, 139, 295-304.
- Winterhalder, B. (1981). Foraging strategies in the boreal environment: An analysis of Cree hunting and gathering. In *Hunter-gatherer foraging strategies: Ethnographic and archaeological analyses*, B. Winterhalder and E. A. Smith, (Eds.) Chicago: University of Chicago Press, 66-98.
- Winterhalder, B. (1990). Open field, common pot: Harvest variability and risk avoidance in agricultural and foraging societies. In E. Cashdan (Ed.) *Risk and Uncertainty in Tribal and Peasant Economies* (pp. 67-87). Boulder, CO: Westview Press.
- World Cultures* (Vol. 15) (2005). [Data file]. LaJolla, CA: World Cultures.
- Xia, C., C. Amador, J. Huffman, H. Trochet, A. Campbell, D. Porteous, ... C.S. Haley (2016). Pedigree- and SNP-associated genetics and recent environment are the major contributors to anthropometric and cardiometabolic trait variation. *PLoS Genetics*, 12, doi: 10.1371/journal.pgen.1005804
- Yang, J., A. Bakshi, Z. Zhu, G. Hemani, A.A.E. Vinkhuyzen, S.H. Lee, ... , P.M. Visscher (2015). Genetic variance estimation with imputed variants finds

negligible missing heritability for human height and body mass index. *Nature Genetics*, 47, 1114-1120.

Yellen, J.E. (1990). The transformation of the Kalahari !Kung. *Scientific American*, 262, 96-105.

Ziyatdinov, et al. (2016). solarius: an R interface to SOLAR for variance component analysis in pedigrees, *Bioinformatics*.

## VITA

Kathrine Starkweather researches parental investment, subsistence strategies, and other aspects of human behavior among the Shodagor of Bangladesh. Her research interests span cultural, demographic, and evolutionary anthropology and include marriage, parental investment, subsistence strategies, household and group economics, the influence of the ecology on all aspects of human behavior, and the evolutionary fitness outcomes of these behaviors. Kathrine has presented her research at the American Anthropological Association's Evolutionary Anthropology Society's conferences, the Human Behavior and Evolution Society's meetings, and the American Association of Physical Anthropologists meeting. She has published in the journal *Human Nature* on polyandry, father absence, and Shodagor family strategies, coauthored a book chapter on sex ratios in Bangladesh, and received funding for research from the Wenner-Gren Foundation and the National Science Foundation.

Kathrine will continue research among the Shodagor as a postdoctoral fellow at the Max Planck Institute for Evolutionary Anthropology. Contact Kathrine Starkweather at [kstarkweather8@gmail.com](mailto:kstarkweather8@gmail.com).