



# Individual and Population Perspectives on Sexual and Reproductive Health in Low and Middle Income Countries

## Citation

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INDIVIDUAL AND POPULATION PERSPECTIVES ON SEXUAL AND REPRODUCTIVE HEALTH IN LOW  
AND MIDDLE INCOME COUNTRIES

Jewel Gausman

A Dissertation Submitted to the Faculty of

The Harvard T.H. Chan School of Public Health

in Partial Fulfillment of the Requirements

for the Degree of *Doctor of Science*

in the *Department of Social and Behavioral Sciences*

Harvard University

Boston, Massachusetts.

Date

*May 2017*

INDIVIDUAL AND POPULATION PERSPECTIVES ON SEXUAL AND REPRODUCTIVE HEALTH IN LOW  
AND MIDDLE INCOME COUNTRIES

Abstract

This dissertation consists of three papers that explore the social determinants of several sexual and reproductive health outcomes in low and middle income countries. Together, these three papers employ a range of quantitative and qualitative methodologies, and exploit unique datasets to reveal new insight into these topics.

The first study presents the results of a qualitative study conducted in Monrovia, Liberia among boys and girls aged 15-17 years living in two urban slums in Monrovia, Liberia. The purpose of this study is to better understand how intrapersonal, interpersonal, family and community factors that shape adolescents' risk for early sexual initiation and pregnancy or fatherhood. The results of the study point toward the need to elicit youth participation in order to develop an understanding of risk environment that adolescents face, and to the importance of up-stream interventions to improve health outcomes among this vulnerable population.

The second paper uses multilevel analysis to explore the residual variance in early adolescent childbearing across 44 low and middle income countries using nationally-representative data. Examining the ecological influences on health outcomes is an area of emerging importance in social science and global health research. This paper is the first to use this approach to quantify the variance in adolescent childbearing at the community and country-level. The results indicate that higher-level social, political, and economic determinants at the country and community levels may influence adolescent childbearing.

The third paper in this series explores a chronically understudied area of critical importance to women’s health in low and middle income countries – perinatal mental health. By using data from Ethiopia, India and Vietnam, the results of this paper provide a cross-country comparative perspective that highlights both the heterogeneity and similarities observed. This paper is one of the few papers to explore how socioeconomic adversity, including economic disadvantage and exposure to stressful life events during the prenatal period, relates to the presence of common perinatal mental disorders. While the underlying causes of socioeconomic adversity may be difficult to modify through intervention, this paper examines the potential role of social capital as a way to foster resilience.

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## ***Acknowledgements***

*This dissertation would not have been possible without the support of my wonderful committee: Dr. S Bryn Austin and Dr. Ana Langer, as well as the support of my advisor, Dr. SV Subramanian.*

*I would also like to thank my colleagues and mentors at the Harvard TH Chan School of Public Health for all their support along the way. Also, I would like to thank my colleagues in Liberia for their tireless work, effort, and guidance. Finally, I would like to thank my family, my friends, and most importantly, my husband, Nicholas Wexler.*

## ***Paper 1***

### ***Clustered risk: A youth-focused, youth-led approach to developing an ecological understanding of sexual behavior among adolescents in two urban slums in Monrovia, Liberia.***

*Jewel Gausman, Danielle Lloyd, Thomas Kallon, SV Subramanian, Ana Langer, S. Bryn Austin*

#### **Abstract**

##### *Background*

The age at sexual debut represents a marked point of transition in a young person's life. With the age of sexual debut decreasing globally, many young people face this transition before they have the ability to cope with the consequences. Liberia's history of violence conflict, Ebola outbreak, and widespread poverty have caused youth, and particularly young women, to experience high levels of early sexual debut and childbearing. The purpose of this study is to examine how psychosocial factors and interpersonal relations at the individual level converge with the broader social and physical environment to form an ecological understanding risk environment that encourages young girls and boys to participate in sexual activity in two urban slums in Monrovia, Liberia.

##### *Methods*

Fifty-three adolescents aged 15-17 years were recruited to participate in a series of three sequential focus group sessions (27 males and 26 females) to participate in a concept mapping exercise. Concept mapping is a participatory research method that uses both qualitative data collection methods and quantitative analytical tools. Data were generated through a four-step process including 1) generating initial questions in order to encourage group discussion, 2) brainstorming of factors that contribute to adolescent pregnancy, 3) sorting and rating factors

into meaningful clusters, and 4) discussing/interpreting results to confirm cluster groupings and labels using a visual display.

### *Results*

Final cluster maps indicate a variety of positive and negative factors that the participants perceive to be related to (or protective against) early sexual activity by youth in their communities, including parental pressure to participate in sex, transactional sex, family status, goals and aspirations, and poverty. The youth also describe how psychosocial, interpersonal, family, and community factors interact with economic, political, and social forces to normalize a culture of sexual violence. Additionally, the positive effects of social institutions such as family and schools, is diluted by the overwhelming context of poverty. Third, there are prominent gender-related differences in how the broader social and economic forces shape the sexual and reproductive health of young boys and girls.

### *Conclusions*

This study uses an innovative qualitative method to highlight the importance of the risk environment that shapes adolescent sexuality in urban slums. The results of this study highlight the importance of interventions designed to harness the social, political, and economic determinants that shape youth sexual and reproductive health in positive, rather than harmful, ways.

## Introduction

Adolescence is a time in which the complicated nature of sexuality emerges yet most countries in sub-Saharan Africa have limited capacity to provide adequate sexual and reproductive health services to youth. The services that do exist tend to focus primarily on the immediate goals of preventing unwanted pregnancy and disease, and rarely address the adolescent's evolving sexuality and the complex structure of the interrelated social and economic pressures that youth must balance as they make decisions about their evolving sexual behavior. Normative sex roles, social position, and power can undermine an adolescent's ability to exercise agency in sexual encounters and negotiate safer sexual behavior, all of which may be patterned by gender. Decisions surrounding sexual behavior often reflect a desire to strike a balance between individual identity and social expectations (Kinsman, 2000; Ampofo, 2001).

The age at sexual debut represents a marked point of transition in a young person's life. With the age of sexual debut decreasing globally, many young people face this transition before they have the ability to cope with the consequences. In many low and middle income countries, the younger the adolescent, the less likely they are to have had access to informational resources that would enable them to protect themselves against health risks such as pregnancy or STIs [1]. Concerns over the consensual nature of an adolescent's first sexual experience also become magnified as age decreases; a recent study raises questions about the physiological and cognitive maturity of adolescents less than 15 years of age that may jeopardize their ability to engage consensually in most sexual transactions and reproductive behaviors [2]. For many young people in the developing world, the decision to have sex is not always their own decision to make; rather, it is a question as to whether they are coerced into sexual activity by another individual or by the

structural violence of poverty.

Syndemics theory emphasizes how oppressive social, political, and economic forces become entangled with health problems to produce a multiplicative interaction that exposes a community to concentrated clusters of disease [3]. In turn, the collective experience of disease compounds and changes the social environment. In the case of adolescent sexual behavior, factors at all levels, including biological, social, economic, and geographical intertwine to create a web of influence that reinforces existing behaviors and normalizes new ones. While the majority of existing research on the determinants of sexual debut and sexual behavior among adolescents focuses on individual-level factors, such as one's own socioeconomic position or psychosocial attributes, a body of literature is emerging that highlights the association between the multiple levels of context in which youth are embedded and their reproductive health outcomes.

Through the lens of syndemics theory, sex-specific biology and gender interact with the contextual environment, often disproportionately disadvantaging young women in particular. During adolescence, the process of biological maturation is often incongruent with social maturation [4]. Puberty represents a time when sex-specific biological change diverges between young men and women and when hegemonic gender norms are reinforced by powerful social and economic forces [5]. Young women may be encouraged to partner with older men who are more sexually experienced, while young men are encouraged to prove their masculinity through early sexual contact [6]. Such differences often put young women at increased risk of pregnancy, STIs and violent sexual encounters. The societal response to sex-specific biological change during puberty also serves to disadvantage young girls. For example, the lack of adequate facilities,

supplies, and gender sensitivity often found in schools in LMICs creates a difficult environment for young girls who are transitioning through puberty [7]. Many girls drop out of school once they begin menstruating and as a result, become even more vulnerable to negative sexual exposure [8].

Gender-related differences also often dictate discriminatory access to resources, power, and education [9]. In much of the world, men embody a model of masculinity characterized by male dominance, and may feel threatened by women's independence – be it social, economic, or related to sexuality [10, 11]. Social expectations may negatively influence a woman's ability to effectively navigate the underlying power structure within a relationship in order to negotiate with their sexual partners [11]. At the community level, several studies have found that the construction of male and female identities is often reinforced within the school setting by allotting boys and girls different opportunity and status [12]. Aggressive male behavior is normalized, while women are taught to be obedient and tolerant of inappropriate sexual conduct [13]. Despite the increased awareness of the damaging role that inequitable gender norms plays with regard to women's health, only recently have studies been designed to measure gender-based relational dynamics and sexual expectations in order to attempt to identify and influence these norms [10].

Finally, several studies have begun to examine the role of macro-level structural factors that operate within the community environment and serve to influence the sexual and reproductive health of both young boys and girls. Poverty in the community may limit the availability of positive recreational opportunities for all youth, especially young girls, thereby increasing the likelihood of risky sexual experiences [14]. A qualitative cross-country comparison

of youth in Baltimore, Johannesburg, Shanghai and Ibadan found that adolescents identified a complex interaction between their social and physical environments and their reproductive health status. Vacant homes and the lack of recreation facilities were cited as being influential among young girls, while boys focused on the role of drugs and violence [15]. Other studies in low and middle income countries have identified the importance of community-level factors on adolescent sexual behavior, notably poverty. A multilevel study in South Africa found that community-level poverty is a predictor of risky sexual behavior, including age at first sex [16]. Burns and Snow also identified structural poverty and its impact on the built environment, as manifest by the inequitable and exclusionary distribution of basic services, is significant in its contribution to risky sexual behavior among adolescents, such as condom use and the number of partners [17].

#### *Adolescent Sexual Behavior in Liberia*

In the West African country of Liberia, a devastating history of war, the recent Ebola outbreak, and widespread, extreme poverty are undoubtedly root causes of the poor reproductive health status of young women in Liberia. Traditional family and community support structures have eroded during the decades of violence and many of today's youth were orphaned or have only one surviving parent, thus making the transition through adolescence even more difficult (The Population Council, 2009). In this environment, more girls tend to experience first sex in early adolescence than boys. The most recent 2013 Demographic and Health Survey in Liberia estimates that among Liberian adolescent girls currently between the ages of 15-19, 23.3 percent had sex before the age of 15 compared to only 8.9 percent among adolescent boys [18]. Compared to other West African countries, the percentage of girls experiencing sexual debut

before the age of 15 is relatively high, as compared to 13% in Benin, 8% in Ghana, 20% in Guinea, 15% in Nigeria, 9% in Senegal, and 22% in Sierra Leone [19]. Adolescent girls with no education and those in the poorest wealth quintiles experience sexual initiation nearly one year before their better educated and wealthier counterparts [18].

Few studies to date have examined the determinants of sexual debut among Liberian youth. The studies that do exist highlight a situation in which sexual activity among youth is commonplace, and where youth frequently engage in transactional sex and experience forced sexual encounters. One study, using data collected from 1,119 young people (571 males and 548 females) aged 14 – 25 years from locations in Montserrado County reinforce the contention that sexual debut before the age of 15 is common [20-22]. McCarreher et al. found that 56% of females and 47% of males reported that they initiated sexual activity before the age of 15, and 71% of females and 56% of males reported that they had received money or a gift for sex [22]. Additionally, the authors found that 20% of females and 6% males reported that their first sexual encounter was forced. Using the same data, Okigbo et al. found that transactional sex was very common (72%) within the study population; that engagement in transactional sex was inversely associated with education; and those reporting no earned income, longer duration of sexual activity, early sexual debut, history of sexual violence, and multiple sexual partnerships were associated with increased odds of participating in transactional sex [21]. Another study using data from an HIV prevention intervention study among 13-19 year olds in Monrovia found that the majority of sexually experienced respondents (66%) reported sexual initiation between the ages of 15–17. Of these, 27% were 11 to 14 years of age and 7% were 10 years of age or younger at first intercourse [23].



### *Specific Aims*

The purpose of this study is to examine, from the perspective of the youth themselves, how psychosocial factors and interpersonal relations at the individual level converge with the broader social and physical environment in which they are embedded to form an ecological understanding of the multilayered risk environment that operates to encourage young girls and boys to participate in sexual activity, while capturing how gender interacts with factors at each of these levels. This study focuses on three different levels in the social and physical environment: 1) intrapersonal and psychosocial factors, 2) the role of the family and other interpersonal relationships, and 3) the overall community structure.

The focus of this study will be on youth from Monrovia's urban slums. As youth living in these communities represent some of the most vulnerable and disadvantaged, this study provides much-needed evidence by giving these adolescents a voice to share their lived experiences and will provide important insight for programs designed to support youth in these communities to improve their own sexual and reproductive health outcomes. Two slums were selected that diverge culturally and historically in order to document potential differences that may exist between the two different slum contexts.

Finally, the methods used in this study will demonstrate the value of an innovative and participatory approach to data collection, known as concept mapping, in order to engage youth in elucidating their own perceptions of their risk environment. Concept mapping, developed by Trochim, is a structured conceptualization process that results in the development of a conceptual framework for how a group views a particular topic through inductive and structured group data collection processes [24]. The resulting data are then analyzed using hierarchical

cluster analysis which produce illustrative cluster maps depicting relationships between ideas [25].

Other studies have used concept mapping as an effective, participatory methodology to engage adolescents in abstract concepts, but this will be the first study known by the authors to date that has used it among adolescents in sub-Saharan Africa. One study used concept mapping to explore the community and social support needs of sexual minority youth in order to better develop support mechanisms and culturally relevant services [26]. Another study in Lima, Peru engaged 63 15–17 year olds from a low-income community near Lima in order to better understand the pathways that relate to their sexuality and sexual behavior [27]. By using this underutilized approach, this study will add to the literature on this methodology's use and relevance among adolescents, but will also generate important results for future intervention designed for Liberia's most vulnerable, urban youth. Concept mapping has been used in other settings to examine the effect of both the social and physical environment on reproductive health outcomes.

## **Methodology**

### *Data Collection*

This study was conducted in two urban slums in Monrovia, Liberia (referred to as Slum A and Slum B to ensure that participants remain anonymous). The two slums included in this study were purposefully selected because of their contextual diversity. Slum A is a one of the largest slums in Monrovia. It is very densely populated, characterized by sprawling shantytowns and located in a heavily urbanized environment, with an estimated population size of 75,000. Slum A was very heavily affected by the recent Ebola outbreak, which exacerbated the existence of a

deep distrust of state actors resulting from the civil war and subsequent failure of many of Liberia's institutions. Slum B is located on the outskirts of Monrovia's urban center with a population of approximately 25,000-35,000. While Slum B is characterized by widespread poverty, it is much less densely populated than Slum A, has wide streets and is nestled in a swamp, making it seem somewhat rural. Slum B was mostly settled by ex-combatants from the war.

Fifty-three adolescents aged 15-17 years were recruited to participate in a series of three sequential focus group sessions. Twenty-seven males and 26 females were sampled by convenience. In Slum A, participants were recruited from a neighborhood near a local health center and in Slum B, participants were recruited from a cooperating school. Ethical review of this study and protection of human subjects was provided by the Institutional Review Board at the Harvard T.H. Chan School of Public Health's Office of Human Research Administration and the University of Liberia (UL) Institutional Review Board (IRB). Parental consent was obtained for all study participants.

Over the course of three 1.5 hour sessions (each spaced approximately 2 days apart), study participants were asked to participate in a concept mapping exercise. Concept mapping is a participatory research method that uses both qualitative data collection methods (such as brainstorming and pile sorting) and quantitative analytical tools (such as hierarchical cluster analysis). To elicit the data, a four-step process was used that involved participants in 1) generating initial questions in order to encourage group discussion, 2) brainstorming of factors that contribute to adolescent pregnancy, 3) sorting and rating factors into meaningful clusters, and 4) discussing/interpreting results to confirm cluster groupings and labels using a visual

display. Each session was separated by participant gender, comprised of 5-8 participants, and led by a trained local facilitator of the same sex familiar with reproductive health issues. Each session was recorded and transcribed, and facilitators took copious notes on a poster-board so that all participants could see.

In the first session, participants were asked to brainstorm a set of factors at the individual, family/interpersonal and community levels that they believed to either encourage or discourage their participation in sexual activity. These factors were then distilled to reduce duplication and recorded onto note cards for a pile sorting activity during the second session [28]. During the second session, each focus group was divided into small groups or pairs of participants. Participants were given the task of placing the items into piles based on the item's similarity to other items. The participants then generated labels for each pile of items. Once the sorting was complete, each participant was asked to individually rank each item in importance (on a scale of 1 (not important) to 4 (very important) with regard to their decision to begin participation in sexual activity via pen and paper survey. In the final session, consensus was built around cluster names and pile content by presenting the concept clusters to the entire focus group. Participatory techniques were integrated in the final session, including a role-playing exercise, to enable participants to discuss the ways in which clusters influenced their sexual experience. Throughout the three sessions, emphasis was placed on having in-depth conversations that were guided by the group activities. Upon completion of all three focus groups, each participant was given 5 USD to compensate them for their time. The facilitator guide that was used during each of the focus group discussions can be found in Appendix 1.

### *Data Analysis*

Once each group finished sorting, the original labels generated by participants were retained with each of the items placed into the piles, and emergent themes were identified and a final hierarchical analysis using multidimensional scaling was performed to reach convergence. The analysis process occurred according to multiple steps as outlined by Kane and Trochim [29]. First, participants' responses were encoded into binary similarity matrices and were summed to create a combined matrix. A distance matrix (using Euclidian distances) was then calculated from the combined matrix.

Multidimensional scaling uses the distances between items (representing the degree of similarity between items) from the distance matrix and iteratively places them in a spatial configuration according to a specified number of dimensions. Scree plots and Shepard plots were used to determine the final number of dimensions to best represent the data on each map, thus minimizing stress and maximizing interpretability. Stress is the key diagnostic criteria used in multidimensional scaling and measures the degree to which the distances on the final map are discrepant to the values in the distance matrix. It is generally desirable to have a stress value of 0.10 or lower [30]. Scree plots plot the stress value against the dimensionality of the solution. Shepard plots take individual pairs of items and plots their dissimilarity on the x-axis and the distance on the map on the y-axis, while the line represents a regression line of the optimal distances [31]. Little spread indicates a better fit of the solution. Once the final number of dimensions was determined, items were grouped into clusters using a dendrogram. Once the number of dimensions was determined, a dendrogram of the relationships between all items was created to determine the final cluster groupings. In the dendograms, items that are nested together are more similar to each other [32]. The dendograms are then examined to determine

the final number of clusters that best represents the content of the focus group discussions. The analysis was performed using the R statistical package *Vegan* [33]. Separate concept maps were generated for each of the two study locations and by participant gender to offer a comparative perspective.

Finally, using the distance matrix from the final cluster solution, cluster maps were generated for boys and girls within each community. Within each map, a label indicating each individual item brainstormed by the participants is connected to its corresponding point on the map. Each item's location on the map is determined based on its similarity to the other items, so that the distance between any two points represents the degree of similarity between two corresponding items. Each item on the map is also grouped into a cluster that represents the high level conceptual sphere to which the item belongs. Clusters are color-coded and the corresponding points are enclosed in a convex hull drawn around each cluster grouping. The colors on the map correspond with the cluster names provided in the legend. Diagnostic plots, including scree plots, Shepard plots, and final cluster dendograms that were used to generate each cluster map can be found in Appendix 2.

## **Results**

### *Description of Participants*

**Error! Reference source not found..1** presents the background social and demographic characteristics by participants' sex. On average, most participants were around 15 years of age. Boys were slightly older than girls. The vast majority were enrolled in school (more than 95% across both sexes) and lived with both biological parents. In Slum A, 12 boys and 14 girls participated in the study and in Slum B, 15 boys and 12 girls participated in the study.

Table 1. 1: Participants Background Characteristics by Sex

Characteristics	Male (n=27)	Female (n=26)
Age in years (mean)	15.73	15.4
Currently enrolled in school (%)	96.3%	95.5%
Currently lives with: (%)		
Both biological parents	50.0%	59.1%
Mother Only	25.0%	22.7%
Father Only	0.0%	4.6%
Guardian	25.0%	13.6%

### Cluster Maps

The final cluster maps can be found in Figures 1.1-1.4. The maps are presented individually for boys and girls from each slum community. The final cluster map for Boys in Slum A contains 23 items and was generated using a three-dimensional solution (stress = 0.07). The map contains 7 clusters: 1) exposure to sex, 2) fear of negative repercussions, 3) community influence, 4) family pressure to have sex, 5) family status, 6) future goals and aspirations, 7) perceptions of girls (**Error! Reference source not found..1**). For boys in Slum B, the final point map contains 36 items, which was also generated using a three-dimensional solution (stress=0.04). The final solution presented contains 7 clusters: 1) family status, 2) individual determination, 3) community dynamics, 4) biological changes, 5) peer pressure, 6) parental control, and 7) family pressure (Figure 1.2). The point map for girls in Slum A includes 40 items and was generated according to two dimensions (stress=0.07). The final solution includes 6 clusters: 1) respect for one's self, 2) understanding of consequences, 3) positive encouragement, 4) sex pressure, 5) poverty, and 6) community influence (Figure 1.3). Finally, for girls in Slum B,

the final point map contains 42 items and was generated along two dimensions (stress=0.05). The final solution includes 6 clusters: 1) individual motivation, 2) good advice from role models, 3) sex pressure, 4) little positive encouragement, 5) poverty, and 6) dangerous community influences (Figure 1.4).



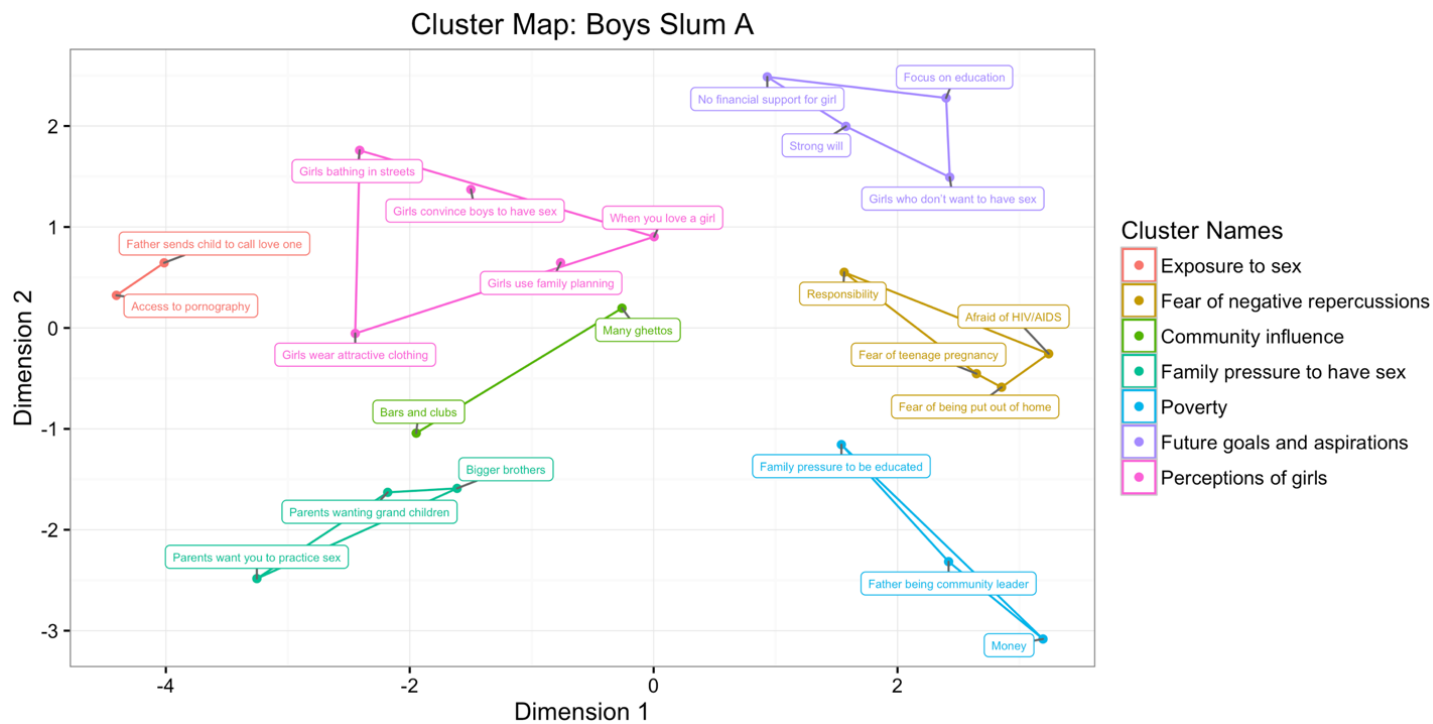


Figure 1. 1: Final Cluster Map Boys, Slum A

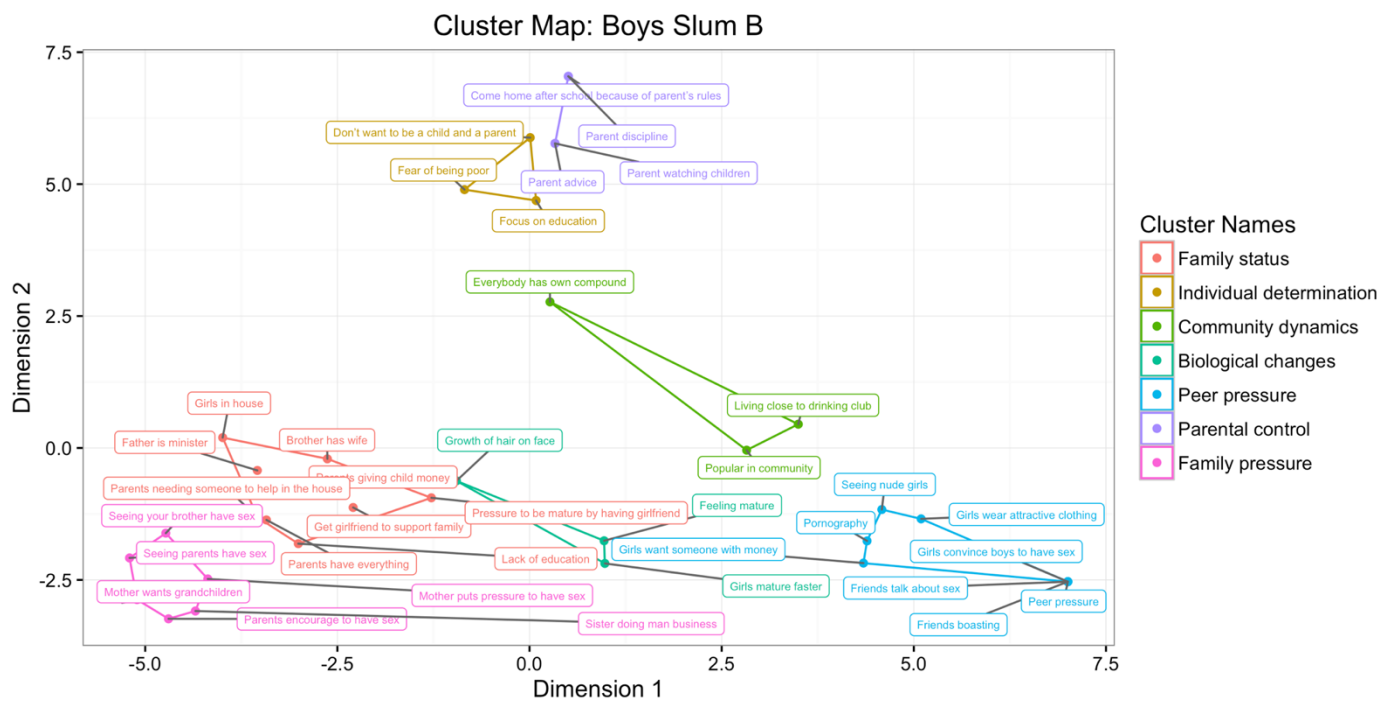


Figure 1. 2 Final Cluster Map Boys, Slum B

Cluster Map: Girls Slum A

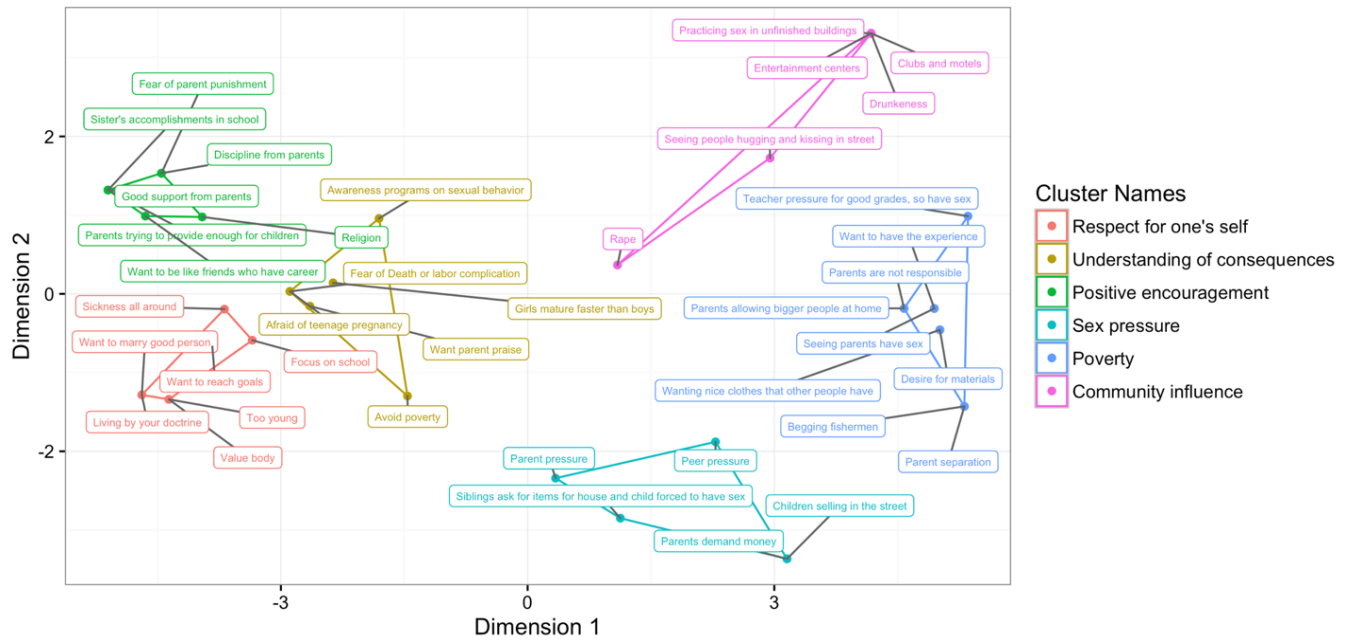


Figure 1.3: Final Cluster Map Girls, Slum A

Cluster Map: Girls Slum B

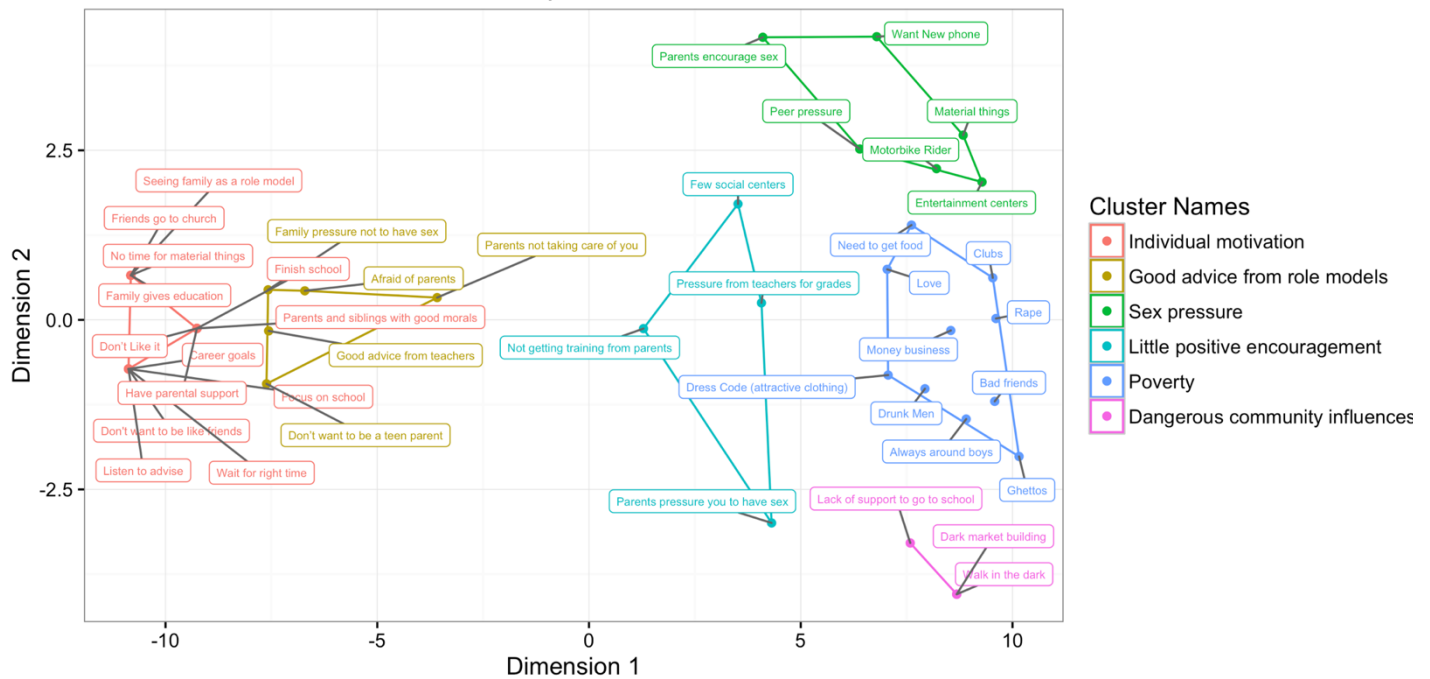


Figure 1.4 Final Cluster Map Girls, Slum B

### *Intrapersonal and Psychosocial Factors*

Intrapersonal and psychosocial factors emerged as influential in all four groups. The items that constitute the concepts of “future goals and aspirations” (boys in Slum A), “individual determination” (boys in Slum B), “respect for one’s self” (girls in Slum A), and “individual motivation” (girls in Slum B) all share similar threads and focus on the influence of one’s personal attributes. For example, the desire to obtain an education and pursue future career goals, coupled with having a strong, personal character, were thought to steer young people away from participating in sexual activity. Additionally, fears over the potential negative consequences of sexual activity emerged, such as fears of pregnancy complications, HIV/AIDS, and being thrust into continued poverty, were frequently associated as part of the intrapersonal context. While these items were combined into one concept among girls and boys in Slum B, participants in Slum A saw such fears as a separate, but proximate, construct. One boy in Slum A described how the need to take individual responsibility combined with the anticipated economic repercussions of having a child influences his participation in sexual activity:

*It have to do with my age, not having sex, because I am determined, let's say focus[ed] on education, my fear [of being] poor in the future. So I prefer keeping myself than to put myself into calamity...in the sense that my daddy still buying me shoes, then you tell me that if I go out and pregnant somebody daughter, you think my daddy will be able to buy me shoes? The money he using to buy me shoes, he will end all taking it to buy pampers for my children. –Boy, Slum A*

Girls also expressed similar sentiments. As one girl in Slum B explained:

*When you small and get pregnant, your parents will give you to that man to get marry to you and then the man do not have [money], you will suffer, so I will stay from sex and achieve my goals.—Girl, Slum B*

In Slum A, one girl explained the connection between her fears childbirth resulting in either death or destitution:

*If [I were to] go have sex, [I] will get pregnant and ...my womb will not be able to hold that child. Maybe I will go deliver and [it] will either lead me to death [or] if I born [a child], I won't have anything.—Girl, Slum A*

#### *Interpersonal and Family Factors*

Boys and girls from both slum communities identified several concepts that influenced their sexual behavior at the interpersonal level – primarily relating to families and peers; many of which operate in divergent directions. Parental support emerged as a prominent factor among both boys and girls in both slums that served to prevent them from engaging in sexual activity. Most participants described parental discipline as the primary deterrent. Parental support emerged in the concepts of “positive encouragement” among girls in Slum A, and “good advice from role models” and “individual motivation” among girls in Slum B. “Parental control” is a discrete concept among boys in Slum B; however, no similar discussion of parental control emerged among boys in Slum A.

While parental support was thought to deter sexual activity, parental pressure to participate in sexual activity was pervasive among all groups, by way of pressure to participate in transactional sex (among girls) or as pressure to begin having their own family or to assert their masculinity (among boys). As is illustrated in the concept maps, under the concepts of “sex pressure” (girls, Slum A) and “little positive encouragement” (girls, Slum B) girls described receiving pressure from their parents and their siblings to have sex in order to satisfy demands on them for money, food, and other household items. A girl from Slum B describes parental pressure to use sexuality in order to obtain food, “some of the parents can send you on the street and tell you to go look for food outside.” Similarly, a girl in Slum A explains:

*Parents will see their friend[’s] children bringing money in their house and doing thing[s] for her parent, so she will tell her children say, “every day you in this house doing nothing, go and follow your friend and bring things,” then her mother will pressure her. – Girl, Slum A*

The pressure that boys described receiving in both slums from parents and siblings is encapsulated within the two clusters entitled “family pressure” in each map. The nature of the pressure that boys face is substantially different from that faced by girls. Boys in both communities described feeling pressure to provide their parents with grandchildren, and finding a girlfriend who can help out with household chores:

*Parents are forcing their children saying, “I am getting old. I need a grandchild to help me,” and the child still fifteen, to help me in the process. If I died, the grandchild will take over... Boy, Slum B*

*When [your mother] send you to wash and you don't want to wash, they will say, "my man you hurry up and bring your girlfriend, so they can be washing our clothes and be cooking for us," so some of those things can encourage us to go and look for the girl... Boy, Slum*

*B.*

For boys, family pressure to have sex is also heightened by presence of sexual activity in the house. Boys in Slum A identified "exposure to sex" as a separate construct, while boys in Slum B thought of it as an aspect that is intrinsic to family pressure they experience. In both groups, participants described one-room houses or otherwise very tight living quarters, and as a result, many indicated that they are regularly exposed to their parents' and siblings' sexual behavior. Boys also described being tasked with fetching their fathers' girlfriends. These influences served to pique young boys' curiosity about sex, while also increasing their desire to conform to gender norms and expectations relating to their own sexual behavior.

*Parents send their under age children to go and call their girlfriend or boyfriend in the house. So, I will say if my father can call me to go call big woman like that, so myself too, I will say, let me call my little girl... Boy, Slum B*

*When we go on the beach and when we see our big brother kissing their girlfriend, we will say let me go look for girls on the side too.*

*Boy, Slum A.*

## *Community Influences*

Items that correspond to persistent poverty and dangerous community characteristics were identified by both boys and girls in both slums as being factors that are more permissive towards sexual activity. Girls in both slums identified poverty and community influence as discrete concepts that capture diverse influences. In Slum A, the items that girls identified to be related to poverty include attributes of the family environment, such as being exposed to sexual activity at home or the home environment being dangerous because of the presence of older men, pressure from teachers, desire for material things, and the need to get food. The girls identified sexual exploitation by teachers as a product of poverty, in that if they fail out of school, they will not be able to provide for their family in the future. Additionally, many of them described poverty being at the root of the pressure they receive from their family to engage in transactional sex. In particular, many girls described what they considered to be a common scenario in their community where young girls are told by their parents to get fish to feed the family, but they aren't given any money. As one girl in Slum A states, "when you go buy fish, [the fisherman] will ask you for your number because every day he giving you free fish," thus, the girl will be expected to have sex with the fisherman for payment for the fish. Girls in Slum B identified many of the same items in the concepts of "dangerous community influences" and "poverty," however, the concept of "sex pressure" also includes many elements that relate to both community influence and poverty.

*Some of the children's parents can't pay their school fees [and] they don't have no support. If they don't do man business, they will not be able to pay their school fee. –Girl, Slum B*

Many girls discussed leveraging their sexuality as a means to obtain desired material goods. For example, a girl in Slum A described, peer pressure as “seeing your friends with new things, and you want it at all costs.” Another girl in slum B explains:

*If my parents are on divorce and I have so many friends who wear new thing every day, and I complain to my parents to buy the same cloth my friends are wearing, they will beg you and tell you that they don't have money, you should manage with what you get, [but] I will find all means to get it...--Girl, Slum B*

For boys, the items that form the clusters of *family status and family pressure* in Slum B and *poverty* in Slum A constitute a similar, but complex set of influences that both encourage and discourage sexual activity. In Slum B, the concepts of family status and family pressure were both intertwined with community poverty and economic standing. Participants indicated that boys from relatively wealthy families were thought to be more attractive to girls because of their ability to provide material and financial support to a girl, while boys from poor families were thought to be less appealing. In Slum B, one boy described how being in poverty reduced his confidence in approaching girls:

*It can discourage me to have sex because if I see a girl passing and I say in my heart that this girl is beautiful, but when I look at myself I will say, I do not even have food to eat in my house and my parent do not have any money. It will discourage you. You will not want to approach any girl. You will be a secret admirer because of your*



*poverty background... you will be afraid to approach her. –Boy,  
Slum B*

Conversely, many boys described relative affluence as a reason young boys feel pressure to participate in sexual activity. One boy in Slum A describes:

*When your father come from work he will give you huge amount of money and say take your school fees from there and take the balance want. Sometimes when the girls them see, you they will be calling your name. –Boy, Slum A*

Additionally, having money increased the confidence that young boys felt in their interactions with girls. For example, one boy in Slum B explains:

*My parents having big generator, and on Sunday we put the big speaker outside. The children can come there and we be dancing every night, because I know that my mother have it, I will act like big boy and be bluffing... Boy, Slum B*

### *Cluster Importance*

Table 2 presents the average importance of the items that comprise each cluster with regard to the item's importance in terms of the participant's own engagement in sexual activity (scores ranging from 1 (not important) to 4 (very important)). The cluster importance rankings among girls were fairly consistent among participants in Slum A and Slum B. "Respect for one's self" and "individual motivation" were the most important clusters in both slums, and "positive encouragement" and "good advice from role models" was ranked second in importance. In both communities, sex pressure, community influences, and poverty were considered to be only

somewhat important to the participants, although their relative importance was different between the two slums. For boys, substantial differences were found in terms of the relative importance ascribed to each cluster between the two communities. In Slum A, boys thought poverty and parent pressure to have sex were the most important concepts. In Slum B, however, parental control and individual determination were the most important, while parental pressure was one of the clusters assigned the lowest score.

Table 1.2: Mean Cluster Importance

Boys Slum A		Boys Slum B	
Cluster Name	Mean Item Importance (n=12)	Cluster Name	Mean Item Importance (n=15)
Poverty	2.64	Parental Control	2.76
Family Pressure to Have Sex	2.24	Individual Determination	2.44
Fear of Negative Repercussions	2.19	Community Dynamics	2.29
Future Goals and Aspirations	2.18	Family Status	2.14
Exposure to sex	1.97	Peer Pressure	2.01
Perceptions of Girls	1.94	Family Pressure	1.99
Community Influence	1.46	Biological Changes	1.98
Girls Slum A		Girls Slum B	
Cluster Name	Mean Item Importance (n=14)	Cluster Name	Mean Item Importance (n=12)
Respect for One's Self	2.95	Individual Motivation	2.73
Positive Encouragement	2.66	Good Advice from Role Models	2.42
Understanding Consequences	2.23	Dangerous Community Influences	1.55
Sex Pressure	1.59	Sex Pressure	1.5
Poverty	1.4	Little Positive Encouragement	1.19
Community Influence	1.25	Poverty	1.14

## **Discussion**

This study highlights that the physical and social challenges that exist in urban slums represent a unique risk environment for adolescents. Young women living in such conditions survive at the margins between intersecting dimensions of discrimination, vulnerability, deprivation, and violence, where the transition to adulthood is saddled with an array of adverse sexual and reproductive behaviors and consequences, such as rape, transactional sex, and maternal complications. The clustering of poor sexual and reproductive health outcomes among adolescents has been documented in slum environments in sub-Saharan Africa. In these studies, adolescents in urban slums in sub-Saharan Africa face earlier sexual debut, higher rates of unwanted pregnancies, higher fertility, and worse maternal and child health outcomes than youth living outside of slums [34-36].

Invoking syndemics theory to interpret the risk environment described in this study's results emphasizes the role of interacting influences, including biological, individual and social factors that are described by youth, and how they compound to magnify the adverse health outcomes experienced by youth in these communities. Using this theory as a guide, this study highlights three salient findings pertinent to understanding the risk environment that leads to poor adolescent sexual and reproductive health outcomes for young men and women in Liberia's urban slums. The first is that there is a mutual interaction between the economic, political, and social forces that serve to normalize a culture of sexual violence that influences sexual decision-making among youth. The second is that the effect of institutions that are often considered protective, such as family and schools, is diluted by the overwhelming context of poverty. Third,

there are prominent gender-related differences in how the broader social and economic forces shape the sexual and reproductive health of young boys and girls.

The concentrated social disadvantage experienced in urban slums has been theorized to erode protective social structures that positively influence youth behavior, allowing for normative change that makes what may have once been considered deviant behavior, such as early sexual debut, to become accepted and even promoted within the community [37-39]. The findings of this study support this hypothesis, in that for many youth, for both boys and girls, using sexuality as a way to respond to the underlying pressures of poverty, despite one's own personal desire to either abstain or participate in sexual behavior, has become normalized and promoted within the community environment.

The participants of this study embody the structural violence of the ever-present poverty in their daily lives through their sexuality, which has been exacerbated by intergenerational exposure to violence, war and oppression. During the Liberian Civil War, the collapse of social order and the governing institutions led to the normalization of violence across both the social and political domains [40]. The use of rape as a weapon during the war was widespread. One study estimates that more than 90% of women experienced sexual violence during the conflict [41]. Today, violence is woven into the context of daily life, and with the strain placed on Liberian society after the recent Ebola crisis, there may be another layer added to the cross-generational cycle of violence and poverty experienced by the children of Liberians who survived the war. According to a recent population-based survey, nationwide, 42.5% of women and 24.2% of men report that they believe wife-beating to be justified [18], and 94 percent of children report experiencing violence when being disciplined [42]. This study adds that sexual violence, as

manifest through the pressure placed on youth to leverage their sexuality for economic gain combined with the experience of rape in their communities, in many ways, has become socially sanctioned.

The issue of sexual violence in Liberia highlights how social, political, and economic forces interact to magnify health problems. Studies have found that while Liberians tend to believe that sexual assault is a crime, they reserve the word “rape” for only the most extreme offenses, but many continue to believe that women either invite rape through their behavior, or that they use accusations of rape as means to enact revenge or to gain some sort of political or economic leverage against another party [43, 44]. While there is a predominant perception that the political and legal environment that fails to adequately address acts of sexual violence, many Liberians also believe that only most extreme rape cases should be prosecuted [44].

Additionally, this study adds to the findings of previous studies that have documented the pervasive participation in transactional sex among Liberian youth. Similar to what was described by the young women in this study, a qualitative study conducted by Atwood and colleagues found that young Liberian women described being encouraged by their families to leverage their sexuality to engage in the economy through sex, and young women have little agency in negotiating the terms of sexual encounters (Atwood, 2011), while a recent vulnerability assessment conducted in Monrovia indicated that transactional sex was considered to be socially acceptable for young girls [45]. Additionally, this study adds to the discourse by documenting how young men’s attitudes towards women are shaped by the high prevalence of transactional sex. The results of this study clearly articulate that while young women realize that the consequences of engaging in sexual activity may destroy the ability to achieve future aspirations,

they often use sex as a means to meet immediate needs despite the potential repercussions.

The Liberian youth in this study describe a context in which the protective benefits of social structures, such as the family and school, seem to erode under the influence of poverty and instead, operate as drivers of early exposure to sexual activity. The way in which these forces operate seems also appear to be gender-specific. While both young men and women indicated that even though families can exert a protective effect on their sexual and reproductive health, family influence was also characterized by neglect, abuse, and sexual pressure that differed between boys and girls. Boys described being pressured by their family and peers to have sex in order to assert their masculinity and to contribute economically to the household by getting a girlfriend and having children. The pressure that young women faced from their family was also economically driven, but instead, pertained to the use of sex to meet the family's immediate financial needs.

Both young men and women in the study identified ambition to stay in school as a protective factor; however, again the role of education in shaping adolescent sexual behavior diverges according to gender. Young boys believed that staying in school provided them with incentive to avoid sexual behavior because of its promise of upward mobility and an economic future. While young girls also described the same ambition as boys, for some, that ambition ultimately translated into participation in transactional sex for higher grades and school fees.

Finally, other attributes of the built environment consistent with poverty, such as alcohol establishments, informal gathering places for youth, and dilapidated buildings described by study participants, all combine to create an environment conducive to early entry into sexual activity. For young women, these structures seemed to heighten the risk of unwanted sexual encounters,

while for young men, they were places that were difficult to navigate as a result of social pressure encouraging of male sexual dominance. In many of these places, both young men and young women described how the background exposure to sex in these places interacted with the biological change during adolescence. Young boys described how the presence of pornography and seeing individuals engage in sexual activity in many of these places heightened their emerging sexual curiosity; however, they also seem to blame young women for fostering a permissive sexual environment that almost forces them into becoming sexually active. Young women group these same places in their community as being consistent with a high-risk environment for sexual assault and rape.

In terms of interventions, syndemics theory points towards the development of multidimensional efforts that not only focus on individual and psychosocial factors, but also large scale community dynamics that create the conditions for the combined consequences. In this case, coupling interventions that build motivation, target relationships within the family, and encourage more robust livelihood interventions to improve economic empowerment may help to enable young boys and girls to enter into sexual activity on their own terms, and offer a more holistic approach to improving adolescent sexual and reproductive health overall in these communities.

### **Limitations**

The results of this study should be interpreted with some caution, as this is a qualitative study designed to provide an in-depth examination of the factors that contribute to sexual debut among the study participants. Given that the sample of participants is not representative of all slum dwellers in Monrovia, the factors elucidated as part of this process may not describe the

experience of all Liberian slum-dwelling youth. As indicated in the participant demographics, the majority of participants in this study were in school and lived with their biological parents. Orphaned and out-of-school youth represent prominent populations within these slum communities and the factors that contribute to engagement in sexual behavior among those populations may be different than the factors described in this study.

While great care was taken to ensure that youth were honest and comfortable in each focus group, the sharing of minority opinions could have been discouraged in the group environment, thus the results of this study could disproportionately represent the most confident and outspoken youth. Additionally, even though all data were collected by trained, Liberian facilitators, it is possible that given the sensitive nature of these topics, youth may have been embarrassed during the discussions because of the presence of the adult facilitator. However, given that many participants appeared to share personal anecdotes about their lives throughout the discussion, any social desirability bias is likely limited.

## **Conclusion**

This study highlights the importance of defining the risk environment that shapes adolescent sexuality in urban slums to incorporate multiple levels, spanning from the intrapersonal to the macro socioeconomic forces that operate at the community level and beyond. As the global health community has recently begun to focus its attention to improving the lives of those living in urban slums, this study implores interventions designed to target youth in these communities to harness the social, political, and economic determinants to influence adolescent sexuality in positive, rather than harmful, ways.



## Appendix 1: Facilitator Discussion Guides

### Focus Group 1: Brainstorming and warm-up

Focus group 1 will begin after verbal informed assent is given taken from everyone in the group. No names will be asked or recorded, but individual code names will be recorded (as selected by each participant to use for the duration of the study) so that we can track attendance at later groups.

Everyone should receive a copy of the informed consent form to keep.

Once everyone is settled in the room, the facilitator will begin by explaining to participants that their participation in this is entirely voluntary. Participants can leave at any time, and while we would like them to be truthful in their responses, they should not feel pressured at any time to contribute. Additionally, participants should not feel obligated to provide any information about themselves directly if they do not feel comfortable sharing, as we are primarily asking about community-level factors in their neighborhoods rather than on their personal stories.

Additionally, participants will be reminded that all information will remain confidential. While we may use the data for a publication, we will not link any personally identifiable information to their responses so no one will know that they participated in the study or what they said. Also, all of the participants should keep everything said a secret to respect the privacy of the other participants. No one should share anything that is discussed, nor the names of the other participants, with anyone outside of the group.

**\*\*\*\*\*REMEMBER TO START THE TAPE RECORDER!!!!\*\*\*\*\***

#### Activity 1:

Ask group to brainstorm discussion ground rules. While ground rules generated will be unique to the group, be respectful of everyone in the group, be quiet when someone else is talking, don't use your cell phone during the discussion, don't judge anyone or make anyone feel uncomfortable).

Start by giving an introduction: Say that we are familiar with the reproductive health situation that many of you face. We are interested in learning more about why some adolescents participate in sexual behavior or become pregnant (or become fathers) at a young age while others do not. We are also trying to learn about what we can do about it within your families and your communities to help improve the situation.

1) Begin with brainstorming activity. Write the responses on a large sheet of paper. Have one sheet of paper for individual factors, family factors, and community factors.

*Let's start by thinking about individual level factors. When we talk about individual level factors, we mean characteristics and attributes of individuals, of you and your friends, that influence their decision to participate in sexual behavior. For example, if we were to ask you about an individual level factor to better understand why someone does well in school, it could be because they are motivated.*

*Think about your girl (or boy) friends who have begun to participate in sexual behavior. I am going to ask you to brainstorm some individual characteristics that cause people to want to begin sexual activity at your age, or prevent them from wanting to engage in sexual activity and I will write down what you say on this piece of paper. [note: probe on these factors if they are not clear, or you think that you could get good discussion]*

***What are some individual factors that cause your friends to decide to have sex at your age?***

***What are some individual factors that cause your friends to decide NOT to have sex at your age?***

***Question for discussion: What do you think are some differences between boys and girls in terms of their decision to have sex at a young age?***

*Now we are going to move onto talking about your parent and family. This time, think about what factors within your family cause you or your friends to decide to have sex or not. [write the responses on a new sheet of paper for all to see and separate it into enabling factors and preventive factors]*

***What aspects of the family environment that make it easy for people your age to start having sex [probe: parents, siblings, etc.]***

***What are some aspects of the family environment that make it more difficult?***

*Now, for the last level, we are going to think about the community environment and how that influences your or your friends' decision to participate in sexual behavior. Now, feel free to think about the social environment, for example, are there community leaders that influence your friends decisions? Are there organizations in your community the influence the decision? You can also think about the physical environment. For example, what about empty buildings or dark streets at night?*

***What aspects of the community environment that make it easy for people your age to start having sex [probe: organizations, leaders.]***

***What are some aspects of the community environment that make it more difficult?***

***For discussion: Do adolescents in all neighborhoods in West Point/Peace Island have the same sexual behaviors? Do some of these factors differ across neighborhoods? Why? {if you need***

***to generate conversation, you can ask: What are the different neighborhoods in your community?]***

Activity 2: Before the session ends, everyone will receive a sheet of paper so with two additional questions on it. They will be asked to generate a list of items associated with each question anonymously, should they want to contribute. After the meeting, they can turn in their sheet of paper, if they would like.

The questions will be: 1) Why do some young/men women in your community become pregnant or become fathers? 2) What are some of the consequences, both good and bad, engaging in getting pregnant or becoming a father for a young man/woman?

### **Focus Group 2: Brainstorming of factors that contribute to adolescent pregnancy**

Once everyone is settled in the room, the facilitator will begin by explaining to participants that their participation in this is entirely voluntary. Participants can leave at any time, and while we would like them to be truthful in their responses, they should not feel pressured at any time to contribute. Additionally, participants should not feel obligated to provide any information about themselves directly if they do not feel comfortable sharing, as we are primarily asking about community-level factors in their neighborhoods rather than on their personal stories.

Additionally, participants will be reminded that all information will remain confidential. While we may use the data for a publication, we will not link any personally identifiable information to their responses so no one will know that they participated in the study or what they said. Also, all of the participants should keep everything said a secret to respect the privacy of the other participants. No one should share anything that is discussed, nor the names of the other participants, with anyone outside of the group.

Please remember that you should try not to share any information that could identify yourself or other individuals. We want to make sure that your participation remains a secret.

This session will begin with brief reminders of the ground rules generated in the previous session (ie be respectful, turn off cell phones, etc), any additions to the ground rules, and a reminder of participant confidentiality.

### Activity 1:

In this session participants will sort and rate the items generated in the brainstorming sessions. Each item from the first session will be printed on a separate index card. A complete set of cards will be given to participants to work in small groups of 2-3. Participants will be asked to put the cards into piles that make sense to them, and once complete, create a name to describe each pile.

For the second activity, each participant will receive a list of the factors that were brainstormed for 2 of the outcomes. Each participant will be asked to rate on a scale of 1-5 (1 not important, 5 very important) the importance of each item with regard to the question. For example, the question could be “How important is [contraceptive use] when you envision reproductive health. Please rate this item between 1 (not important) and 5 (very important)?”

After this session, the research team will take the piles and lists generated in the focus groups and conduct analysis to determine the composition of clusters and relative importance of certain items. The analysis will be done according to the questions posed on the first day. Individual ratings will be entered into a spreadsheet and summed for each item. The overall distribution will be used to place the items into categories of importance.

### **Focus Group Session 3: Data analysis and interpretation**

Once everyone is settled in the room, the facilitator will begin by explaining to participants that their participation in this is entirely voluntary. Participants can leave at any time, and while we would like them to be truthful in their responses, they should not feel pressured at any time to contribute. Additionally, participants should not feel obligated to provide any information about themselves directly if they do not feel comfortable sharing, as we are primarily asking about community-level factors in their neighborhoods rather than on their personal stories.

Additionally, participants will be reminded that all information will remain confidential. While we may use the data for a publication, we will not link any personally identifiable information to their responses so no one will know that they participated in the study or what they said. Also, all of the participants should keep everything said a secret to respect the privacy of the other participants. No one should share anything that is discussed, nor the names of the other participants, with anyone outside of the group.

Please remember that you should try not to share any information that could identify yourself or other individuals. We want to make sure that your participation remains a secret.

This session will begin with brief reminders of the ground rules generated in the previous session (ie be respectful, turn off cell phones, etc), any additions to the ground rules, and a reminder of participant confidentiality.

The goal of this session is to review the results of the first two sessions and discussion.

Activity 1: In the first activity, the facilitator will share aggregated sorted and rated data from the previous sessions.

Activity 2: The second activity will consist of interpretation. Groups will be given 15 minutes and asked to work in groups of 2-3 in order to discuss and prepare and present role-plays that demonstrate a situation represented by one of the clusters on the cluster map.

As the role-plays will be generated from the discussion during the focus groups, it is impossible to know exactly what scenario the participants will want to discuss in advance, however, an example role play scenario is as follows:

*Example Scenario:* Cluster name - physical Barriers to obtaining health services. A young woman would like to go to the clinic to receive contraception, but she doesn't know where to go. Act out how she will address this situation. Who will she go to for information?

After each role play, all session participants discussed whether the content and outcome presented was a realistic representation of what would actually happen to adolescents they know and how they might modify what was presented, when relevant.

Activity 3: After the role plays, discussion will focus on the pathways that may result in sexual activity.

Participants will select clusters of items that were generated in previous sessions in order to arrange them into a decision-making pathway that leads to the outcome of sexual activity and/or accessing health services.

The research team will collect items from this session to create a final cluster map of items.

#### **Focus Group 4: Final Presentation and discussion**

Once everyone is settled in the room, the facilitator will begin by explaining to participants that their participation in this is entirely voluntary. Participants can leave at any time, and while we would like them to be truthful in their responses, they should not feel pressured at any time to contribute. Additionally, participants should not feel obligated to provide any information about themselves directly if they do not feel comfortable sharing, as we are primarily asking about community-level factors in their neighborhoods rather than on their personal stories.

Additionally, participants will be reminded that all information will remain confidential. While we may use the data for a publication, we will not link any personally identifiable information to their responses so no one will know that they participated in the study or what they said. Also, all of the participants should keep everything said a secret to respect the privacy of the other participants. No one should share anything that is discussed, nor the names of the other participants, with anyone outside of the group.

Please remember that you should try not to share any information that could identify yourself or other individuals. We want to make sure that your participation remains a secret.

This session will begin with brief reminders of the ground rules generated in the previous session (ie be respectful, turn off cell phones, etc), any additions to the ground rules, and a reminder of participant confidentiality.

The final map generated by researchers will be presented to each group for discussion and confirmation. This map will be hand drawn on a large easel sheet and attached to the wall. It will contain information generated from all the previous sessions.

Additional questions and discussion will be generated. Discussion will focus on the following questions:

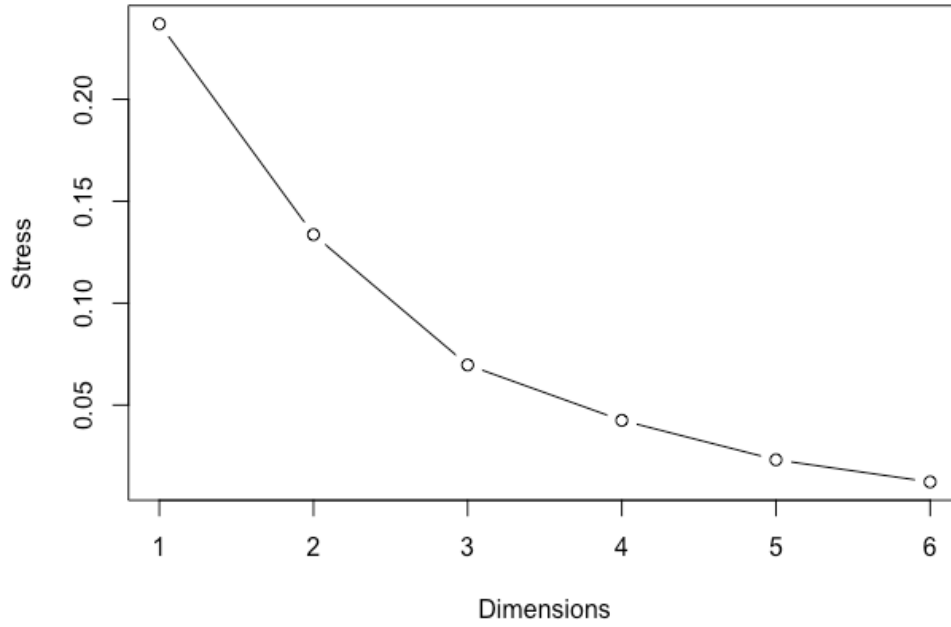
In thinking about the youth in your community, how can programs hoping to improve the reproductive health of youth and prevent girls from becoming pregnant do a better job of reaching youth?

Before we close for the day, if any of you would like to receive more information on the reproductive health services in your neighborhood, there are many options. Locally, you can go to [local government or NGO service provider] to get additional information.

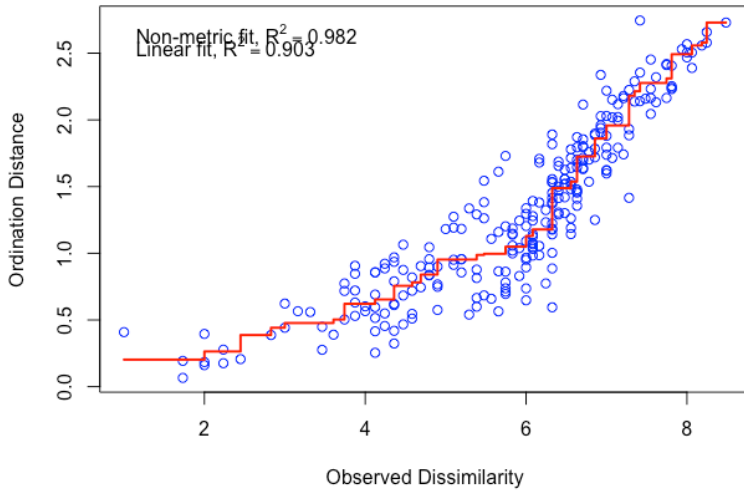
Thank you, and wrap up. Distribute compensation.

## Appendix 2: Diagnostic Plots

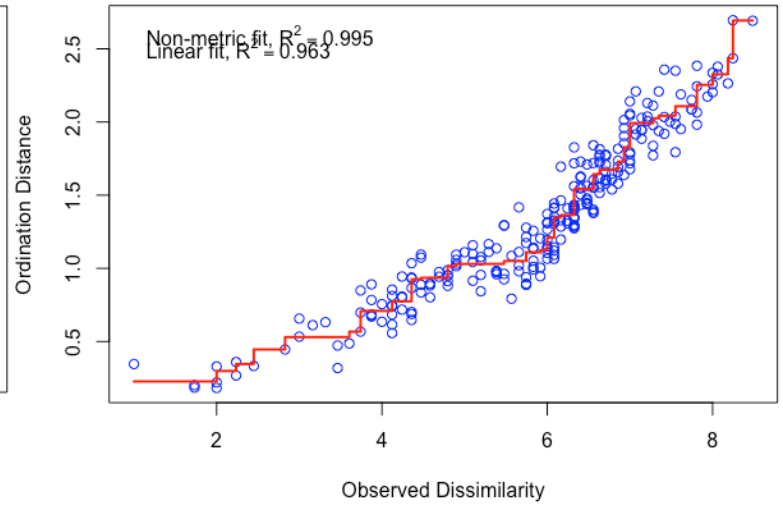
### Scree Plot Boys Slum A



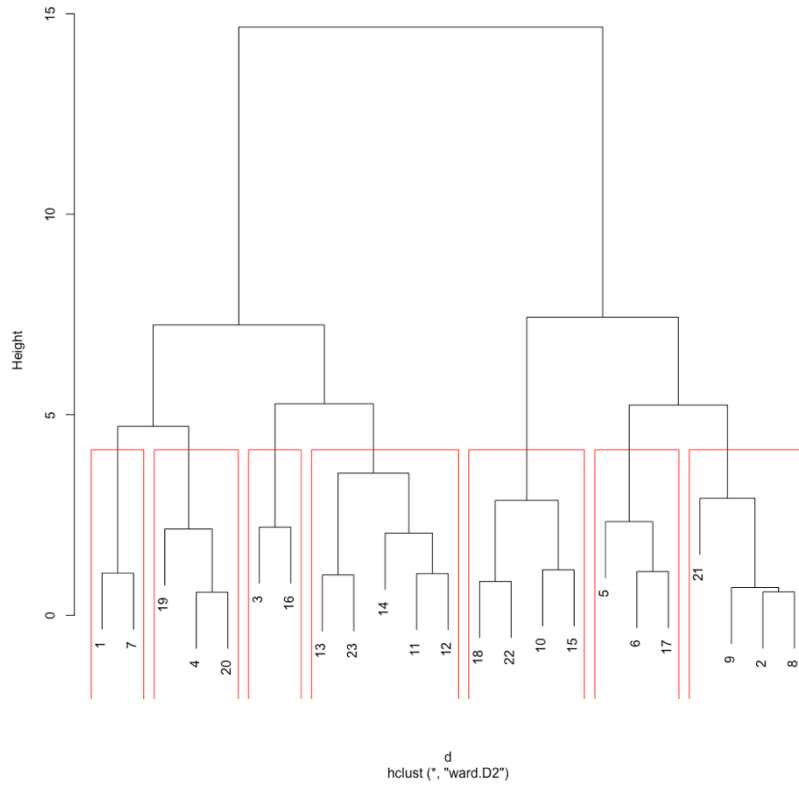
### Sheperd Plot Boys Slum A 2 Dimensions



### Sheperd Plot Boys Slum A 3 Dimensions

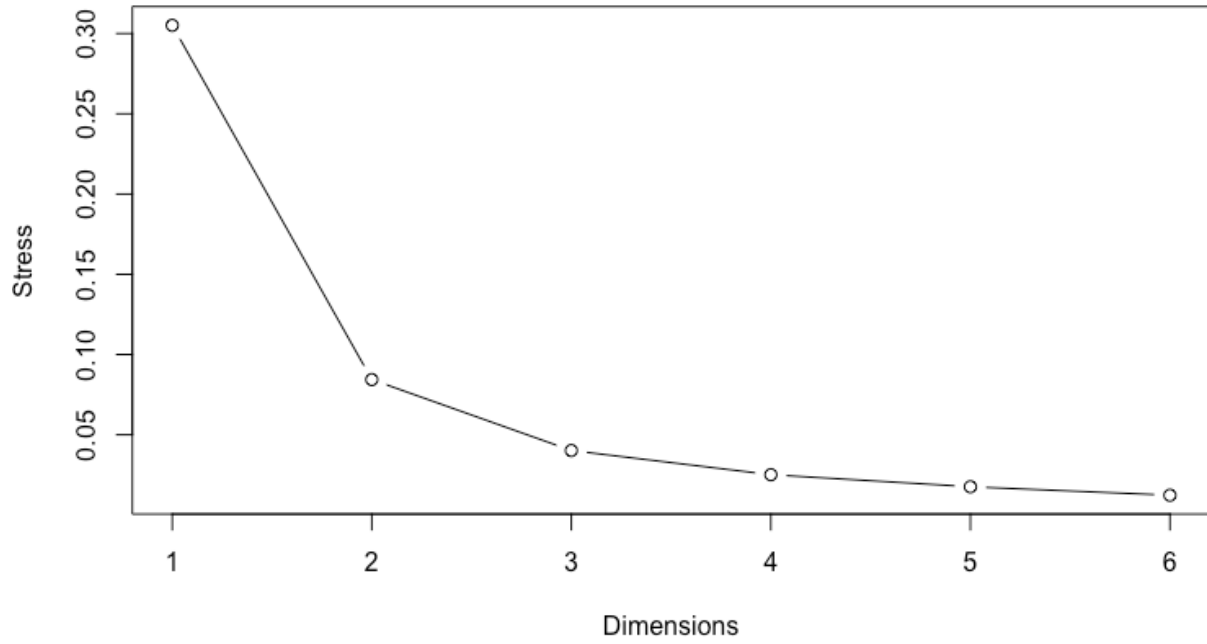


Cluster Dendrogram: Boys Slum A

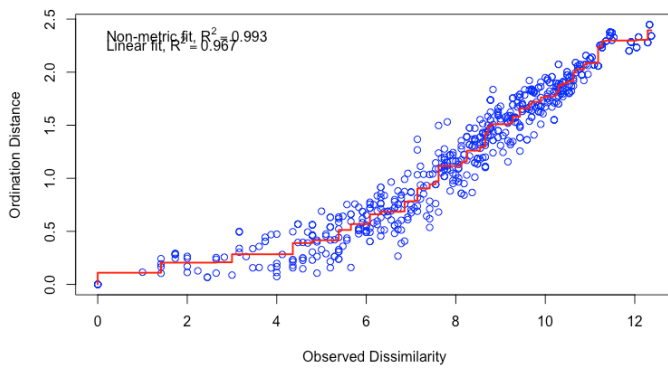




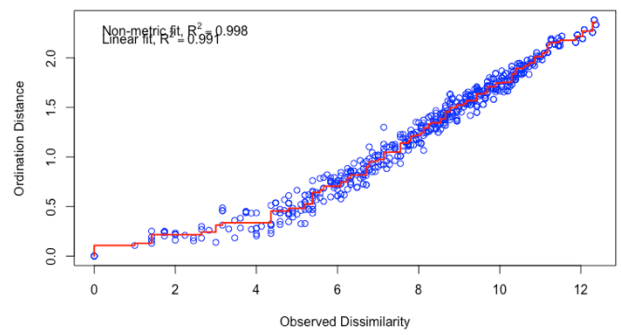
### Scree Plot Boys Slum B



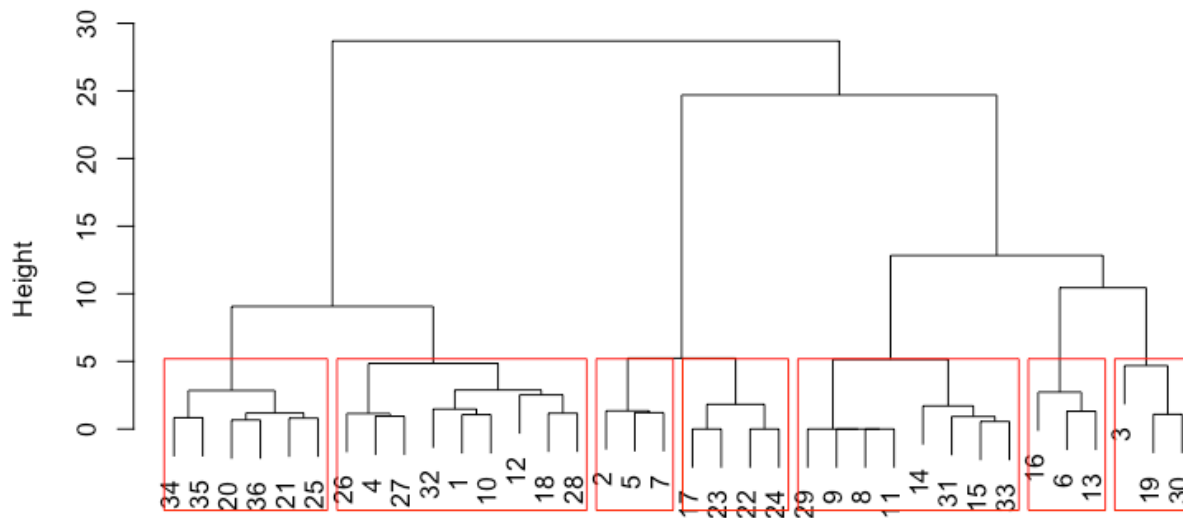
Sheperd Plot Boys Slum B  
2 Dimensions



Sheperd Plot Boys Slum B  
3 Dimensions

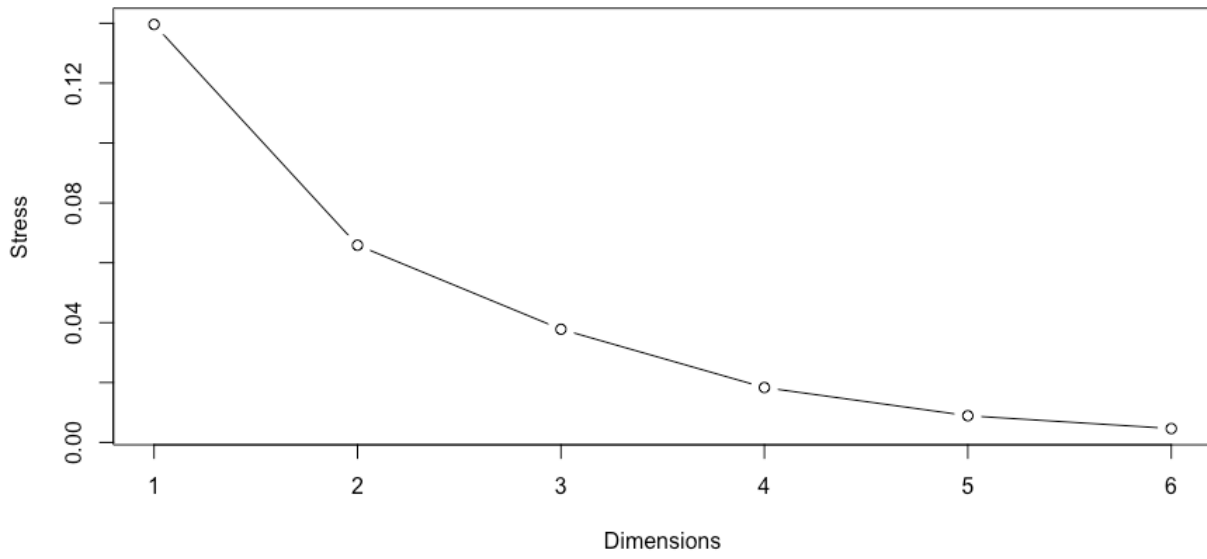


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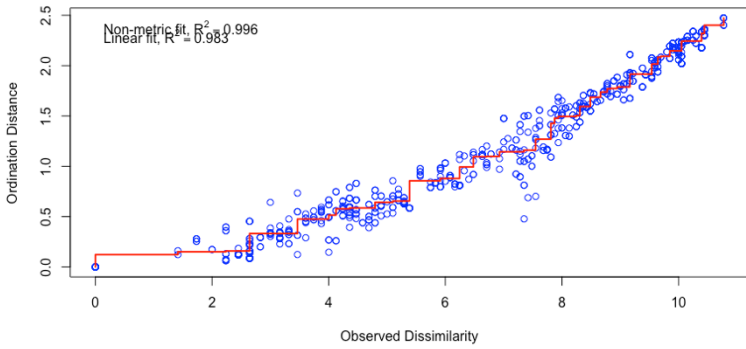


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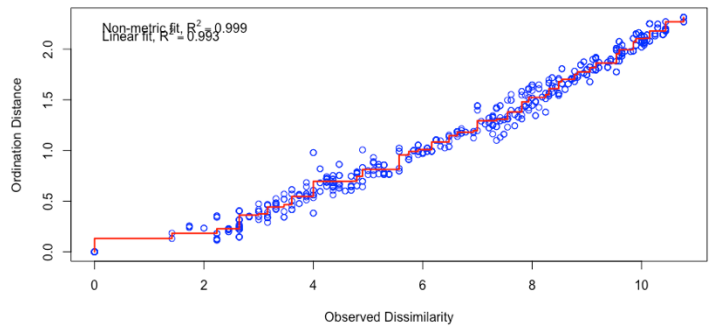
### Scree Plot Girls Slum A



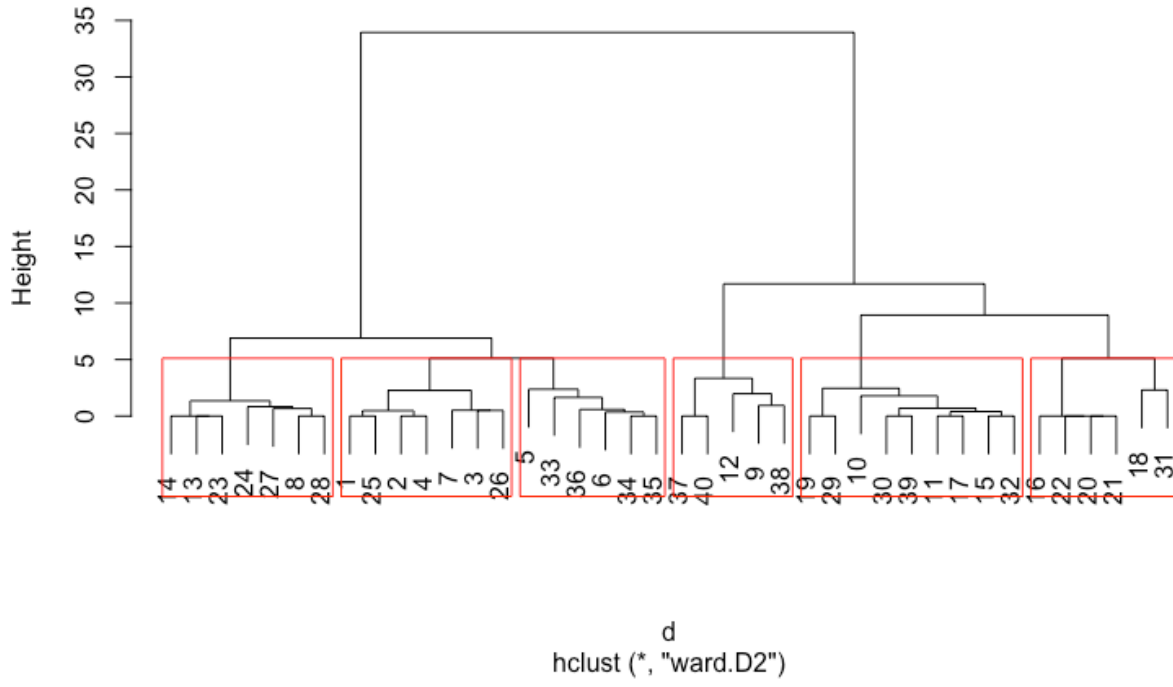
#### Sheperd Plot Girls Slum A 2 Dimensions



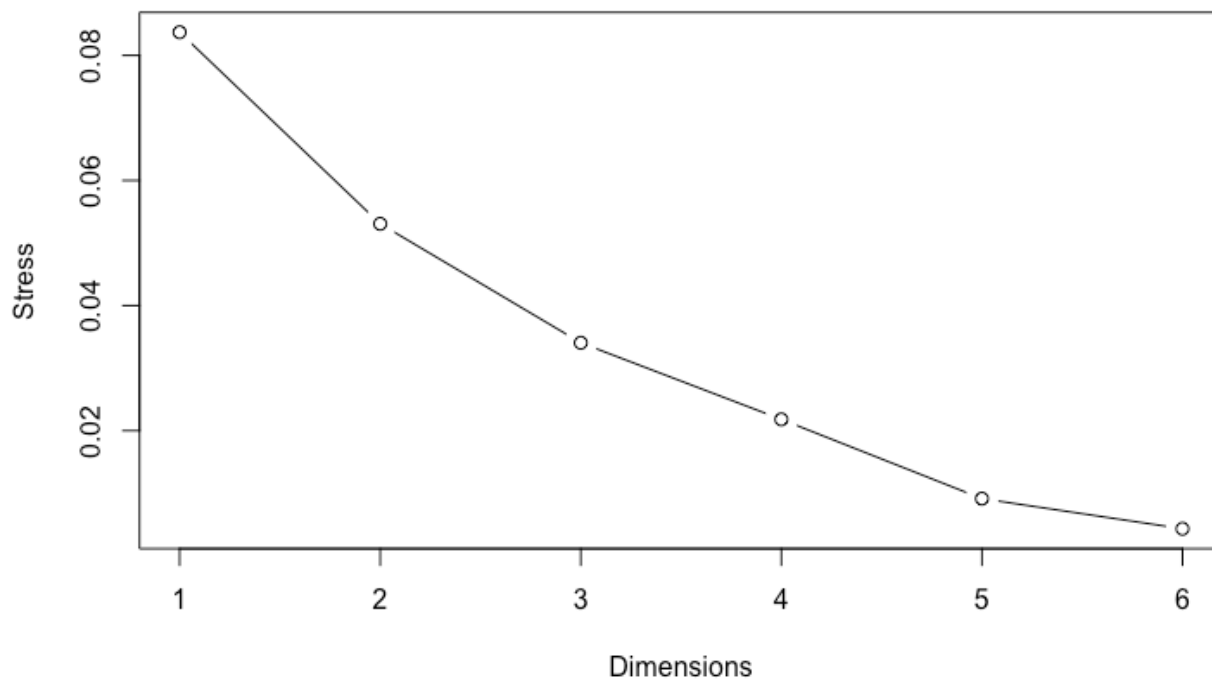
#### Sheperd Plot Girls Slum A 3 Dimensions



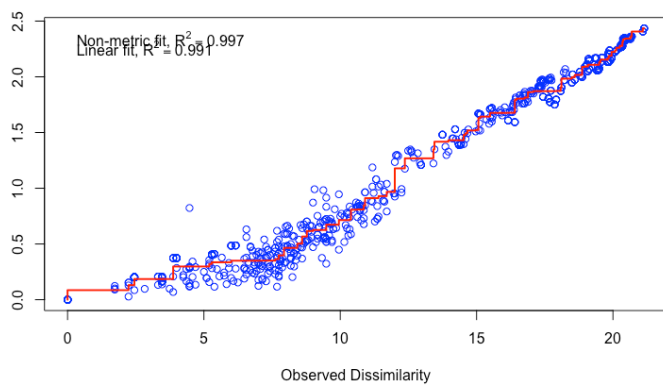
### Cluster Dendrogram: Girls Slum A



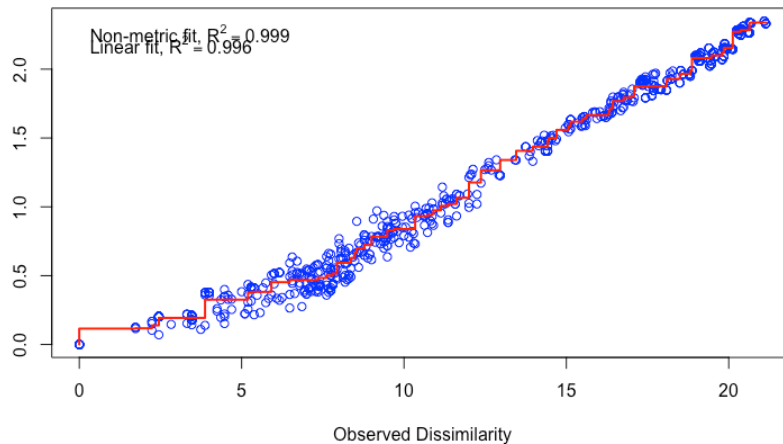
### Scree Plot Girls Slum B



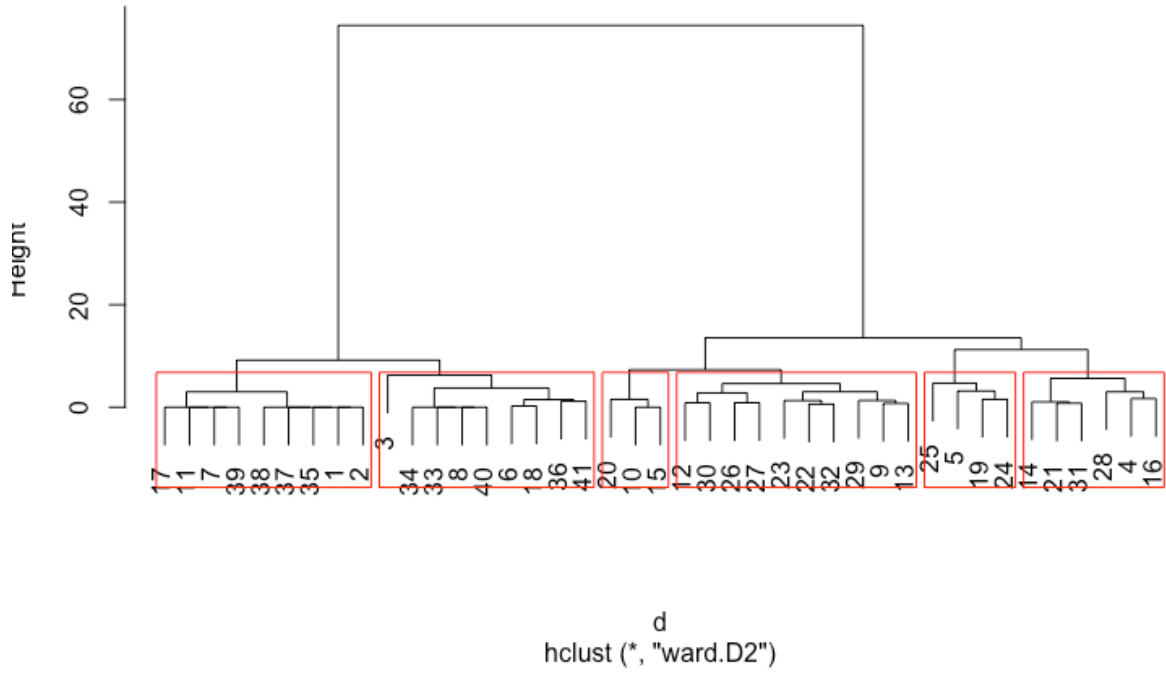
Sheperd Plot Girls Slum B  
2 Dimensions



Sheperd Plot Girls Slum B  
3 Dimensions



### Cluster Dendogram: Girls Slum B



## *Paper 2*

### ***Individual and Population Perspectives on Childbearing During Early Adolescence: A Multilevel Approach Examining 33,822 Communities in 44 Low and Middle Income Countries***

*Jewel Gausman, Ana Langer, S. Bryn Austin, SV Subramanian*

#### **Abstract**

##### *Background*

Recent research in low and middle income countries (LMICs) calls for a deeper examination into how the context in which one lives influences their sexual and reproductive health outcomes. This study seeks to describe the social and ecological variation in early adolescent pregnancy at the community and country levels in 44 LMICs by 1) examining the role of individual-level social disadvantage, 2) exploring the ecological influence of context by estimating the residual variation at both the country and community-level after accounting for individual level factors, and 3) assessing whether the ecological effect varies according to individual-level socioeconomic status.

##### *Methods*

We use nationally representative data from 33,822 communities in 44 LMICs to employ multilevel modeling techniques to examine the variation in adolescent pregnancy at the individual, community, and country levels.

##### *Results*

We find that individual-level socioeconomic disadvantage, as measured by household wealth and education, is an important predictor of early adolescent childbearing globally. Additionally, we find that after adjusting for individual-level characteristics, there remains

significant residual variance apportioned to both the community and country-levels. The individual-level covariates in the model explain 46.4% of the total variance at the community-level and 21.3% of the total variance found at the country-level. Finally, for the poorest wealth tertile, the residual variance apportioned to the community-level is estimated at 43.5%, while for the richest wealth tertile reduces to 32.6%. Across countries, we find substantial heterogeneity in the variance observed at the community-level.

### *Conclusions*

Our results highlight the complexity in understanding the determinants that shape adolescent sexual and reproductive health, and point to the need for a continued focus on multi-level interventions that include both individual and population-perspectives. As this paper represents a first attempt to explore the variation in early adolescent pregnancy attributable to the community and country context, more research is needed to identify the mechanisms through which the macro-level context influences adolescent sexual and reproductive health outcomes.



## Background

The global burden of adolescent pregnancy is unequally distributed, and is striated by social and economic inequities that shape youth's future trajectories into adulthood. In most high income countries, adolescent pregnancy has declined over the last 25 years [46]; however, 90 percent of pregnancies that occur to adolescent women between the ages of 15-19 occur in low and middle income countries [47]. Limited data exist on the pregnancies that occur to women during early adolescence. Recent estimates from 44 low and middle income countries indicate that approximately 2.5 million births occur to women between the ages of 12-15 years of age, with 35-50% of these occurring to girls less than 15 years of age [48].

Women who become pregnant during early adolescence may face a disproportionate burden of poor maternal health outcomes. Only recently have studies examined the risks of maternal mortality among adolescents disaggregated by age [49]. One study using data from 38 countries found that girls aged 15 to 19 are 28% more likely to die as a result of childbirth than women aged 20-24 years, but women under the age of 14 years were found to be five times more likely to die as a result of childbirth than women in their twenties [50]. Another study using data from 14 countries in Latin American found that women aged less than 16 years have four times the risk of maternal mortality than women aged 20-24 years [51]. The health implications of pregnancy during early adolescence extend beyond the mother to affect the health of the child. A recent study in the United States found a strong inverse relationship between maternal age and the risk of infant mortality, very low birthweight, and pre-term delivery for women who give birth below the age of 16 years; however, in this study, the rate of adverse health outcomes seemed to stabilize after the age of 16 years [52].

Going beyond the physical ramifications of early pregnancy, the economic and social consequences associated with adolescent childbearing may have a lasting impact throughout a young woman's life. For many young women, pregnancy outside of wedlock may result in stigmatization, while adolescent motherhood may limit educational and economic potential [53]. Additionally, in many resource poor settings, young women who become pregnant before they are physically mature may be at an increased risk of developing an obstetric fistula, and the consequences of which, including social isolation and poverty, can be devastating [54-57].

In many low and middle income countries, data are often not available for women who become pregnant during early adolescence [48]. For older adolescents, however, the global geographic disparities are significant. Some estimates indicate that 15-19 years olds in sub-Saharan Africa face more than a 70-fold increase in maternal mortality when compared to countries with greater resources [58]. Similarly, unsafe abortion exhibits a similar gradient: 25% of all unsafe abortions occur to women aged 15-19 years in sub-Saharan Africa compared to 8 percent in Asia and 14.3 percent in Latin America [59]. Such disparities bring the interactions between human biology and the surrounding social, policy and economic context into sharp focus. The fact that adverse pregnancy outcomes among adolescents tend to be concentrated among the most disadvantaged populations represents a social injustice [51, 60-62].

Research on social disparities in adolescent childbearing is beginning to show that individual-level attributes (such as those related to biology, race, ethnicity, and socioeconomic status) and the characteristics of one's community context may influence adolescent reproductive health outcomes. One study conducted in three countries in East Africa found that adolescent pregnancy, particularly for women under the age of 16 years, was significantly

associated with educational status and household-level poverty [63]. Other studies have begun to examine spatial disparities in adolescent pregnancy and sexual behavior that may be partially rooted in socioeconomic disadvantage at the community-level, such as through harmful social norms and practices [64-67], and further exacerbated by the inequitable and exclusionary distribution of basic services [16, 17]. For example, in Kenya and Uganda, one study found the level of poverty, women's autonomy, and child marriage at the community-level may be related to higher levels of early adolescent pregnancy [64]. In the United States, a few studies have found that ecological-level variables, including the proportion of individuals within a community that have completed grade 9 [68], average community income [68], and the availability of reproductive health services [69] may influence the rate of adolescent pregnancy. Additionally, the findings of one study suggest that a combined measure of community disadvantage (as measured by overall unemployment, average educational level, and proportion of individuals living in poverty) is not only associated with adolescent pregnancy, but that community disadvantage may have a stronger impact on adolescent pregnancy in communities located within the southern United States than those in other regions, as well as those in urban areas [70]. Taken together, these studies suggest that higher-level social, political, and economic forces may manifest in striking sexual and reproductive health disparities between adolescents, and that population-based interventions that target modifiable, higher-level determinants may offer an effective intervention strategy.

As there remains limited research in understanding the geographic disparities in pregnancy during adolescence, especially under the age of 16 years, this study seeks to describe the social and ecological variation in early adolescent pregnancy at the community and country

levels across a wide range of low and middle income countries. The first aim of this study is to describe the variation observed in pregnancy during early adolescence according to individual-level socioeconomic factors. In order to then explore the ecological influence of context, the second aim of this study is to examine the residual variation at both the country and community-levels after accounting for individual-level factors. After adjusting for individual-level factors, the residual variance apportioned to these levels provides an indication of whether higher-level ecological determinants present within the contextual environment may influence early adolescent childbearing, over and above the individual-level attributes. Finally, as a third aim, we explore whether the ecological effect varies according to individual-level socioeconomic status. To the best of our knowledge, this is the first attempt to provide estimates of the potential contribution of country and community-level factors to early adolescent pregnancy.

## **Methods**

### *Data*

Data for this analysis were obtained from the Demographic and Health Surveys (DHS) which are nationally representative, cross-sectional household surveys that have been conducted regularly in more than 85 countries since 1984, and are funded largely by the US Agency for International Development. DHS surveys are designed to collect data on a range of indicators related to socioeconomic status, demographic characteristics, and reproductive, maternal and child health [71, 72]. In each country, surveys are designed according to a multi-stage cluster design stratified by urban/rural locality and large administrative units, such as states or regions. In the first stage, primary sampling units (PSUs) are selected within the country specific-strata utilizing a probability-proportional-to-size technique that results in each PSU having an equal

probability of being selected. PSUs are discrete geographic units, typically obtained from national census enumeration units, that cover the entire country geographically [72]. In the second stage, all households within a selected PSU are enumerated through field visits, and the sample of households included in the survey is selected with equal systematic probability yielding a national sample that is typically between 5000 to 30,000 households [73].

#### *Study Population and Sample Size*

In our study, we use data obtained from the latest DHS for all women aged 15-30 years from 44 countries. Countries were included in this study if they had a DHS conducted since 2005 and were located in Latin America, Africa, or Asia. While bias resulting from maternal recall of birth histories has been found to be minimal [74], only women aged under 30 at the time of the survey were included in the analysis in order to limit the recall period. Women who were missing data on the outcome variable or other key covariates of interest were excluded from the analysis (n = 47,675), amounting to 11.9% of the sample being excluded (Figure 1).

#### *Outcome*

The outcome is a binary variable indicating whether or not a woman gave birth to a child while she was under the age of 16 years. Sixteen years of age was selected as the cut-off given that previous research indicates that women under this age may have a higher risk of poor health outcomes than older adolescents [52, 60, 61]. This variable was derived from the woman's self-reported birth history ascertained at the time of the survey. Age of first birth was derived by subtracting the year of the woman's first birth from the woman's current age.

#### *Primary and Secondary Exposures*

The primary exposure of interest in this analysis is the community environment to which the woman was exposed. We operationalize the concept of community to correspond to the PSU in which a woman resides. The use of the PSU as a means to define community in this study is consistent with other studies that use DHS data to investigate the role of community influence on reproductive health-related outcomes [75-78]. PSUs generally correspond to geographically discrete villages in rural areas and relatively homogenous blocks in urban areas that capture the geographic, socioeconomic, and demographic environment that comprise a community [79-82].

We consider variables relevant to socioeconomic status to be a secondary exposure of interest in order to describe variation in adolescent childbearing. We are particularly interested in the effects of household wealth and educational attainment. Household wealth was constructed using a weighted score of household assets [83]. Educational attainment is categorized according to whether the woman reports having no education, some formal education, or secondary or higher education.

### *Covariates*

The covariates considered in the analysis include standard variables that are thought to confound the relationship between exposure to the community environment and adolescent pregnancy. We consider confounding variables to be those that are a prior common cause of both the exposure and the outcome [84]. As a result, we adjust for the woman's age at the time of the survey, place of residence (rural/urban) and religion (Christian, Muslim, or Other). Age is included in all baseline models as it would adjust for temporal changes that occur within communities over time.

### *Analysis*

We employ multilevel modeling techniques to examine variation in adolescent pregnancy at the individual, community, and country-level levels [85]. We began by estimating a series of four-level global models that used pooled data from all 44 countries, adjusting first for age and then for other confounding variables. While variation apportioned to the household-level is not of primary interest, we include it to ensure that the variation observed at the community-level or country-level is not being driven by variation between households. The four-level model is specified in equation (1) where  $y_{ijkl}$  is log odds of a woman  $i$  in household  $j$  in community  $k$  in country  $l$  giving birth to a child under the age of 16 years; and  $\beta$  represents a vector of regression coefficients associated with the individual-level variables  $X_{ijkl}$  included in the model. Using the same underlying statistical model, we then estimated the individual contribution of each covariate of interest in explaining the variance attributable to the community and country levels relative to the baseline age-adjusted model.

$$\log\left(\frac{\pi_{ijkl}}{1 - \pi_{ijkl}}\right) = y_{ijk} = \beta_0 + \beta X_{ijkl} + (f_{0l} + v_{0kl} + u_{0jk} + e_{ijkl}) \quad (1)$$

To describe the proportion of residual variance attributable to each level of the model, we used variance estimates of the random effects at the community and country-level ( $\sigma_{v0}^2$  and  $\sigma_{u0}^2$ ) obtained from the model to calculate the variance partition coefficient (VPC) [85]. We estimate the VPC using the latent variable approach by which we assume the individual-level variance,  $\sigma_e^2$ , to equal that of a standard logistic distribution with a variance of  $\pi^2/3$  [86, 87]. Using these estimates, we then calculate the proportion of the total variance apportioned to the community and country levels by the addition of each individual covariate using the age-adjusted model as the baseline.

The model specified above assumes that the effects of the covariates in the model are

fixed across communities. We extend the model above to include a random component to allow the effect of wealth to vary randomly across communities. This enables us to examine whether the community-level variance is a function of an individual's wealth. To do this, we add a random error term for wealth at the community-level  $j$  as specified in Equation 2 below. We examine Bayesian DIC statistics to compare the model with and without a random component for wealth.

$$\log\left(\frac{\pi_{ijk}}{1 - \pi_{ijk}}\right) = y_{ijk} = \beta_0 + \beta_1 X_{ijk} + \beta_2 Wealth_{ijk} + (v_{0k} + u_{0jk} + u_{2j}x_{jk} + e_{ijk}) \quad (2)$$

In order to explore the variance structure within individual countries, we then estimated three separate two-level logistic regression models for each of the 44 countries included in the analysis by following the same approach as described above, where the baseline model adjusts for age, and the second model includes confounding variables. For each model, we calculated the VPC using estimates of the random effects in order to examine the variance attributable to the community-level within each country. This approach enabled us to compare the residual variance at the community-level within each country after adjusting for the individual-level covariates of interest. Wald tests and the 95% credible intervals<sup>1</sup> were used to determine whether the variance estimates are statistically significant from the value 0. Using these estimates, we then calculated the proportion of variance apportioned to the community level after the inclusion of the covariates in the model.

Because likelihood-based estimates of the random effects tend to be biased downward when using multilevel binary logistic regression, we used Bayesian Monte Carlo Markov Chain (MCMC) methods to estimate our final model [88]. We implemented a three-step procedure to

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<sup>1</sup> Note: Credible intervals are used in Bayesian statistics and are analogous to 95% confidence intervals estimated in likelihood-based models; however, they differ with regard to the assumptions made about nuisance parameters.



estimate all regression models where we used Marginal Quasi-Likelihood Methods (MQL) followed by Penalized Quasi-Likelihood Methods (PQL) to obtain starting values before estimating the final model using MCMC methods [89]. For all analysis, we used Stata 14 [90] and MLwiN v2.28 [91, 92]. Graphics were produced using the statistical software R [93].

## Results

The final sample used in this analysis consists of 398,332 women from the 44 countries included in our analysis (Figure 2.1). Within each country, the mean sample size includes 18,662 women (ranging from 2,137 to 62,645) from 33,822 communities (Table 2.1). The mean sample size per community is 15 women, ranging from 1 to 58.

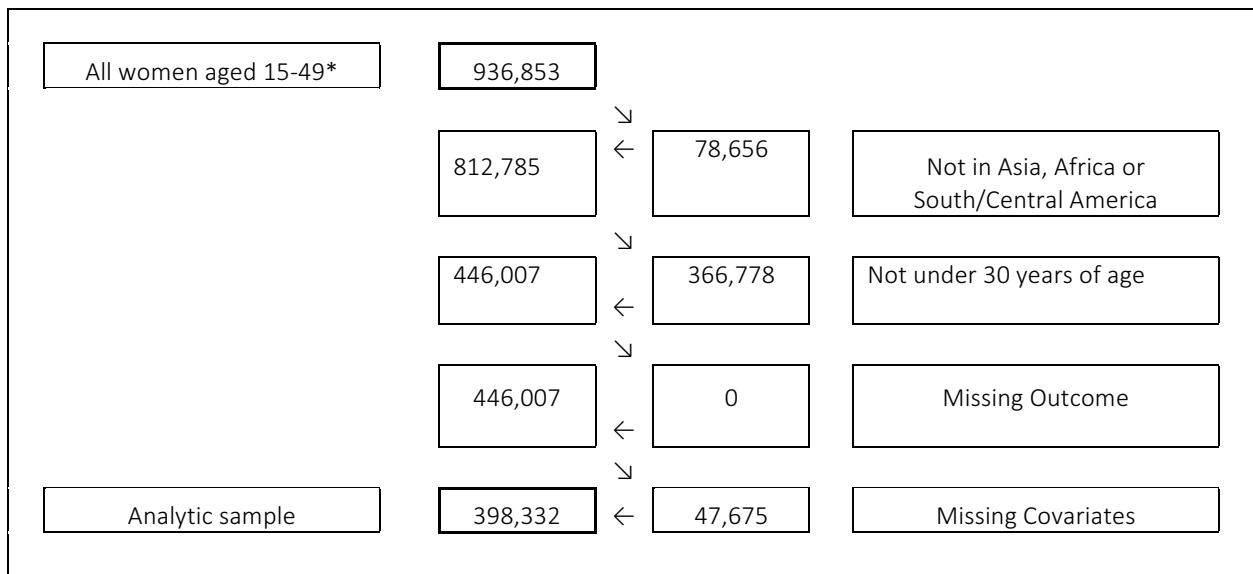


Figure 2. 1: Detailed Flowchart of Final Sample Size Used in Analysis According to Observations Missing

\* Obtained from all DHSs conducted since 2005

Table 2.1: Descriptive Statistics of Survey Information and Early Adolescent Fertility by Key Sociodemographic Characteristics According to Country

Country Name	Survey Year	Communities (n)	Women Under the Age of 30 (n)	Women who Gave Birth Under Age 16* (n)	Proportion of Women who Gave Birth Under Age 16* (%) (95% CI)*§	Rural Residence*§		Lowest Wealth Quintile*§		No Formal Education*§	
						% of Sample	% of U16 Births	% of Sample	% of U16 Births	% of Sample	% of U16 Births
Bangladesh	2014	599	7,203	1,639	24.00 (21.86, 26.28)	72.19 (67.40, 76.53)	78.36 (72.70, 83.12)	19.42 (17.02, 22.07)	31.05 (26.24, 36.30)	11.04 (9.23, 13.14)	18.86 (14.39, 24.32)
Benin	2011-12	750	7,924	881	10.23 (9.30, 11.24)	50.74 (46.58, 54.89)	70.25 (65.11, 74.92)	14.66 (13.04, 16.44)	26.06 (22.43, 30.05)	48.10 (45.75, 50.46)	84.11 (81.01, 86.79)
Bolivia	2008	994	8,209	474	5.36 (4.75, 6.04)	31.19 (27.83, 34.75)	46.55 (39.59, 53.65)	13.06 (11.24, 15.12)	25.27 (19.98, 31.42)	1.20 (0.92, 1.56)	3.46 (1.82, 6.48)
Burkina Faso	2010	573	8,131	495	6.42 (5.64, 7.30)	68.35 (63.17, 73.11)	87.94 (83.77, 91.15)	15.04 (13.26, 17.02)	25.90 (21.11, 31.33)	64.47 (61.34, 67.48)	89.86 (86.46, 92.48)
Burundi	2012	376	5,531	141	2.36 (1.91, 2.90)	88.42 (85.09, 91.08)	81.80 (72.00, 88.70)	19.69 (17.74, 21.79)	28.69 (20.78, 38.17)	32.89 (30.58, 35.29)	51.95 (41.74, 61.99)
Cambodia	2014	611	8,493	103	1.01 (0.78, 1.30)	79.64 (75.36, 83.34)	89.56 (80.99, 94.53)	16.10 (14.07, 18.36)	29.81 (20.05, 41.83)	6.13 (5.32, 7.06)	28.42 (19.37, 39.62)
Cameroon	2011	578	8,198	1,024	11.81 (10.65, 13.07)	43.67 (38.89, 48.57)	65.07 (58.62, 71.01)	15.05 (12.34, 18.23)	31.25 (25.40, 37.76)	15.69 (13.06, 18.73)	41.51 (35.47, 47.82)
Chad	2014-15	624	9,019	2,075	22.72 (21.31, 24.19)	74.83 (70.20, 78.96)	81.63 (77.13, 85.41)	18.36 (16.55, 20.32)	21.11 (18.33, 24.20)	53.78 (50.38, 57.14)	67.84 (64.23, 71.25)
Colombia	2010	4840	25,135	1,650	5.32 (4.94, 5.72)	21.93 (20.42, 23.51)	33.35 (29.59, 37.34)	18.25 (17.01, 19.57)	33.83 (30.48, 37.35)	0.60 (0.50, 0.72)	3.19 (2.26, 4.47)
Congo, Dem. Rep.	2013-14	536	9,792	1,016	9.19 (8.24, 10.23)	59.85 (53.42, 65.95)	72.54 (65.58, 78.55)	18.00 (15.71, 20.54)	27.85 (23.57, 32.58)	11.89 (10.12, 13.92)	20.69 (17.08, 24.83)

Congo, Rep.	2011-12	384	4,982	613	10.09	29.09	38.45	14.82	22.41	4.28	6.26
					(9.03, 11.24)	(23.94, 34.83)	(30.94, 46.55)	(12.11, 18.02)	(17.56, 28.15)	(3.52, 5.19)	(4.40, 8.83)
Cote d'Ivoire	2011-12	351	4,975	622	12.38	43.74	62.08	15.40	23.81	48.07	67.37
					(10.97, 13.93)	(37.03, 50.69)	(53.35, 70.09)	(12.27, 19.14)	(18.28, 30.39)	(44.76, 51.40)	(61.95, 72.36)
Dominican Republic	2013	523	4,358	352	7.44	24.00	28.26	16.98	31.22	0.95	2.18
					(6.51, 8.50)	(18.98, 29.86)	(21.11, 36.72)	(14.86, 19.32)	(24.88, 38.35)	(0.68, 1.33)	(1.15, 4.11)
Ethiopia	2011	596	9,266	829	8.13	73.32	83.96	16.23	23.91	35.86	67.59
					(7.23, 9.14)	(67.11, 78.73)	(75.75, 89.77)	(14.05, 18.67)	(19.34, 29.17)	(32.90, 38.93)	(61.24, 73.35)
Gabon	2012	327	3,892	553	11.71	10.15	14.30	13.40	21.07	3.58	6.58
					(9.96, 13.72)	(7.37, 13.83)	(10.09, 19.87)	(10.66, 16.71)	(16.10, 27.07)	(2.53, 5.05)	(3.33, 12.61)
Ghana	2014	427	4,381	211	4.87	45.79	59.34	16.22	23.90	10.87	27.68
					(4.00, 5.91)	(39.85, 51.85)	(46.98, 70.62)	(13.19, 19.78)	(17.79, 31.31)	(8.84, 13.31)	(20.34, 36.46)
Guinea	2012	300	4,620	848	18.57	58.95	78.15	16.15	22.47	54.23	77.14
					(16.76, 20.53)	(51.78, 65.76)	(71.93, 83.32)	(13.28, 19.50)	(18.20, 27.42)	(50.16, 58.25)	(72.98, 80.82)
Guyana	2009	321	2,137	130	5.61	71.93	88.30	16.70	47.53	1.15	3.21
					(4.28, 7.32)	(65.20, 77.80)	(77.75, 94.22)	(13.70, 20.21)	(33.85, 61.59)	(0.71, 1.87)	(1.29, 7.77)
Haiti	2012	445	7,562	289	3.56	52.18	59.26	14.71	19.78	4.87	14.42
					(3.04, 4.17)	(46.15, 58.14)	(49.91, 68.00)	(12.35, 17.43)	(14.97, 25.67)	(4.00, 5.92)	(10.18, 20.03)
Honduras	2011-12	1146	11,488	890	7.17	45.22	58.82	15.82	28.65	1.87	5.49
					(6.59, 7.80)	(41.63, 48.87)	(53.28, 64.14)	(14.26, 17.51)	(24.95, 32.67)	(1.59, 2.20)	(4.04, 7.42)
India	2005-6	3849	62,645	3,532	7.55	67.01	81.97	16.92	33.73	29.02	66.08
					(7.16, 7.96)	(64.88, 69.07)	(79.39, 84.29)	(15.96, 17.92)	(31.45, 36.08)	(27.86, 30.21)	(63.83, 68.26)
Indonesia	2012	1831	19,972	406	1.63	46.65	70.71	17.22	42.22	1.23	8.40
					(1.39, 1.91)	(43.27, 50.06)	(61.98, 78.15)	(15.79, 18.76)	(34.74, 50.06)	(0.97, 1.56)	(4.94, 13.94)
Kenya	2014	1590	15,607	1,403	7.74	56.45	65.20	15.01	27.63	5.14	14.57
					(7.14, 8.38)	(52.67, 60.15)	(60.38, 69.73)	(13.51, 16.64)	(24.18, 31.37)	(4.46, 5.91)	(12.07, 17.49)
Lesotho	2014	399	3,455	84	2.22	64.44	72.72	14.71	23.98	0.33	1.76

					(1.72, 2.87)	(57.68, 70.68)	(57.68, 83.90)	(12.26, 17.55)	(15.43, 35.30)	(0.17, 0.63)	(0.26, 11.14)
Liberia	2013	322	4,157	647	13.08	35.36	46.43	15.45	22.22	19.51	34.88
					(11.58, 14.74)	(28.51, 42.87)	(38.42, 54.64)	(12.35, 19.15)	(17.63, 27.59)	(16.95, 22.35)	(29.66, 40.48)
Malawi	2015-16	849	12,004	1,157	9.23	79.56	86.56	18.12	22.85	6.88	18.20
					(8.44, 10.09)	(75.45, 83.14)	(82.32, 89.90)	(16.62, 19.72)	(20.00, 25.97)	(6.03, 7.84)	(15.13, 21.74)
Mali	2012-13	413	5,196	1,072	21.46	72.73	82.51	17.62	20.27	67.90	81.11
					(19.80, 23.21)	(67.58, 77.34)	(77.85, 86.37)	(15.19, 20.33)	(16.87, 24.15)	(64.68, 70.97)	(77.68, 84.12)
Mozambique	2011	610	6,580	913	14.68	62.86	67.17	17.83	18.93	21.97	28.87
					(13.54, 15.89)	(58.12, 67.37)	(60.61, 73.11)	(15.42, 20.53)	(15.10, 23.47)	(19.88, 24.22)	(24.83, 33.27)
Namibia	2013	542	4,463	220	3.94	43.35	53.81	14.62	24.10	2.29	8.77
					(3.35, 4.62)	(37.96, 48.90)	(44.68, 62.70)	(12.25, 17.35)	(17.58, 32.09)	(1.81, 2.89)	(5.52, 13.66)
Nepal	2011	289	6,517	249	4.20	85.29	87.97	15.47	17.78	21.64	56.63
					(3.50, 5.04)	(81.27, 88.56)	(82.19, 92.06)	(12.46, 19.05)	(12.86, 24.06)	(18.12, 25.63)	(46.90, 65.88)
Niger	2012	476	5,452	1,028	21.45	79.46	90.41	17.18	19.80	73.97	90.80
					(19.80, 23.20)	(75.22, 83.14)	(86.57, 93.23)	(15.08, 19.51)	(16.72, 23.27)	(71.22, 76.54)	(88.50, 92.68)
Nigeria	2013	896	19,586	2,121	11.38	57.44	80.68	16.75	34.31	32.35	68.01
					(10.44, 12.40)	(53.32, 61.45)	(76.39, 84.35)	(14.50, 19.27)	(30.21, 38.65)	(29.18, 35.69)	(63.82, 71.92)
Pakistan	2012	498	5,338	276	4.05	70.29	75.99	21.36	32.41	48.57	75.24
					(3.38, 4.85)	(64.46, 75.53)	(67.35, 82.93)	(17.13, 26.31)	(24.00, 42.13)	(44.79, 52.37)	(66.78, 82.12)
Peru	2012	1423	10,302	484	3.70	24.52	45.52	14.66	30.91	0.52	2.72
					(3.24, 4.21)	(21.83, 27.42)	(38.66, 52.55)	(12.95, 16.54)	(25.30, 37.16)	(0.36, 0.74)	(1.10, 6.58)
Philippines	2013	799	7,835	129	1.53	45.49	56.57	14.89	40.83	0.60	5.58
					(1.28, 1.83)	(41.65, 49.39)	(46.77, 65.88)	(13.27, 16.68)	(32.04, 50.26)	(0.43, 0.86)	(2.50, 11.97)
Rwanda	2013-15	492	7,251	64	0.83	79.01	67.04	17.73	30.34	4.90	17.34
					(0.63, 1.10)	(74.73, 82.73)	(52.93, 78.63)	(16.13, 19.46)	(19.09, 44.57)	(4.27, 5.62)	(9.21, 30.27)
Senegal	2015	200	4,586	331	5.58	45.02	70.63	16.18	35.50	39.66	73.34

					(4.44, 6.98)	(35.28, 55.16)	(55.49, 82.27)	(12.25, 21.05)	(26.56, 45.58)	(34.30, 45.29)	(66.97, 78.87)
Sierra Leone	2013	435	8,025	1,200	15.51	60.21	72.70	16.94	22.99	39.02	64.13
					(14.29, 16.83)	(53.77, 66.32)	(66.15, 78.40)	(14.46, 19.75)	(18.95, 27.58)	(36.23, 41.88)	(60.38, 67.71)
Swaziland	2006-7	272	2,634	179	6.63	74.82	78.46	15.49	25.15	4.32	18.19
					(5.60, 7.84)	(68.88, 79.95)	(69.26, 85.48)	(12.92, 18.47)	(18.34, 33.46)	(3.48, 5.36)	(13.15, 24.60)
Tanzania	2010	475	4,984	272	6.74	68.36	72.67	14.39	24.35	14.90	40.40
					(5.66, 8.02)	(62.24, 73.90)	(60.14, 82.41)	(12.44, 16.59)	(18.20, 31.77)	(12.85, 17.22)	(32.12, 49.27)
Togo	2013-14	330	4,400	259	5.40	50.61	69.70	14.96	20.94	18.97	43.30
					(4.67, 6.24)	(44.45, 56.76)	(60.91, 77.24)	(12.39, 17.96)	(15.63, 27.47)	(16.53, 21.67)	(35.67, 51.25)
Uganda	2011	404	4,623	530	11.86	77.56	79.66	16.26	22.34	5.91	12.09
					(10.62, 13.22)	(72.33, 82.04)	(72.85, 85.10)	(13.98, 18.83)	(17.44, 28.16)	(4.86, 7.16)	(8.75, 16.48)
Zambia	2013-14	721	8,225	682	7.83	50.30	60.27	16.37	24.51	5.00	12.72
					(7.13, 8.59)	(45.43, 55.16)	(53.86, 66.35)	(14.49, 18.45)	(20.60, 28.90)	(4.33, 5.78)	(10.11, 15.90)
Zimbabwe	2010-11	406	4,902	195	4.10	58.69	75.22	15.53	30.28	0.51	3.36
					(3.42, 4.90)	(53.02, 64.14)	(63.73, 83.98)	(13.37, 17.98)	(22.55, 39.32)	(0.33, 0.77)	(1.52, 7.25)
<b>Total</b>	<b>2005-16</b>	<b>33,822</b>	<b>398,332</b>	<b>32,268</b>	<b>8.21</b>	<b>56.6</b>	<b>71.47</b>	<b>16.51</b>	<b>27.34</b>	<b>19.73</b>	<b>45.41</b>
					<b>(8.05, 8.38)</b>	<b>(55.85, 57.33)</b>	<b>(70.46, 72.46)</b>	<b>(16.17, 16.87)</b>	<b>(26.49, 28.21)</b>	<b>(19.31, 20.16)</b>	<b>(44.49, 46.34)</b>

\*Calculated among women aged under 30 at the time of the survey

§ Weighted for Survey Design

Across the countries included in the analysis, we find that there is substantial variation in the percentages of women who report having given birth under the age of 16 years (Table 2.1). Rwanda has the lowest proportion of women who have given birth under the age of 16 years (0.83%) while Bangladesh has the highest, with 24%. In nearly all countries included in the analysis, women with no formal educational background, those who live in rural areas, and those who are from households that fall into the lowest wealth quintile represent a disproportionate percentage of women who gave birth under the age of 16 years.

The results of our four-level model (Table 2.2) suggest that socioeconomic factors have a significant effect on the odds that a woman will have given birth before the age of 16 years. Wealth has a protective effect on the odds of adolescent childbearing in Model 2. Women from households that fall into the richest quintile have 0.468 (95% CI: 0.44, 0.50) times the odds of early adolescent childbearing as compared to women in the lowest wealth quintile; while women who have completed secondary or higher education have 0.19 (95% CI: 0.18, 0.20) times the odds of adolescent childbearing compared to women who have no formal education.

Table 1.2: Odds Ratios and Random Variance Parameters Obtained for the 4-Level Pooled Regression Analysis of Early Adolescent Childbearing (Under 16 years of Age) Across 44 Countries

Covariates	Odds Ratios and 95% CI	
	Model 1 <sup>1</sup>	Model 2 <sup>2</sup>
Cons	0.029**** (0.026, 0.032)	0.093**** (0.078, 0.109)
Age (ref: <18)		
18-22	2.47**** (2.357, 2.571)	2.416**** (2.320, 2.514)
23-25	3.272**** (3.142, 3.411)	2.727**** (2.608, 2.842)
Wealth Quintile (ref: Poorest)		
Poorer		0.926**** (0.893, 0.963)
Middle		0.809**** (0.777, 0.843)
Richer		0.688**** (0.657, 0.719)
Richest		0.468**** (0.443, 0.495)
Place of Residence (ref: urban)		
Rural		0.980 (0.945, 1.016)
Educational Attainment (ref: No Formal Education)		
Some formal Education		0.659**** (0.636, 0.684)
Secondary or Higher		0.192**** (0.184, 0.201)
Religion (ref: Christian)		
Muslim		1.143**** (1.090, 1.199)
Other		1.105**** (1.047, 1.161)
<b>Random Variance Parameters</b>	<b>Mean (95% CI)</b>	<b>Mean (95% CI)</b>
Country Level	0.790 (0.510, 1.210)	0.622 (0.402, 0.965)
Community Level	0.629 (0.597, 0.663)	0.337 (0.312, 0.361)
Household Level	0.000 (0.000, 0.000)	0.000 (0.000, 0.000)

<sup>1</sup> Model adjusted for woman's current age

<sup>2</sup> Covariate Adjusted Model: Age, Wealth Quintile, Educational Level, Rural/Urban Residence, and Religion

<sup>3</sup> Covariate and Mediator Adjusted Model: Age, Wealth Quintile, Educational Level, Rural/Urban Residence, Religion, Married before age 16 and Sex before age 16

\* p<0.05; \*\* p<0.01; \*\*\* p<0.001; \*\*\*\* p<0.0001

In Model 2, the random variance parameters estimated at the country and community-levels remain significant after including individual-level factors (Table 2.3). Table 2.3 presents a decomposition of the random variance at the country and community-level. It shows both the residual variance at the country and community-levels after taking into account individual-level factors, while also presenting the individual contribution of each covariate to the higher-level variance structure in comparison to the age-adjusted model. Overall, we see that after including the individual-level covariates in Model 2, 7.9% and 14.6% of the variance apportioned to the community-level and country-level remains unexplained, respectively, while the individual covariates included in the model account for 46.2% of the total variance at the community-level and 21.3% of the total variance found at the country-level. Taken individually, wealth and educational attainment explain a substantial proportion of residual variance at the community level. Wealth accounts for 36.3% of the total community-level variance, while educational attainment accounts for 44.4%. At the country level, wealth accounts for 3.3% of the total variance, while educational attainment accounts for 21.7% of the total variance. At the country level, adjusting for place of residence actually increases the variance apportioned to the country-level, suggesting that it was being underestimated in the age-adjusted model. The other demographic covariates included in Model 2 absorb a relatively small amount of the variance apportioned to the community-level individually.



Table 2.3: Proportion of Variance in Early Adolescent Childbearing (Under 16 Years of Age) Apportioned to the Community and Country Levels by Individual Covariates Using Data from 44 Countries

Covariates	Residual Variance		Variance Partition		% Variance Explained	
	Community	Country	Community	Country	Community	Country
Age Adjusted Model (Baseline Model)	0.629 (0.597, 0.663)	0.790 (0.510, 1.210)	0.134	0.168		
Wealth Quintile	0.401 (0.379, 0.423)	0.764 (0.503, 1.148)	0.090	0.171	36.25%	3.29%
Place of Residence (urban/rural)	0.511 (0.481, 0.539)	0.813 (0.525, 1.262)	0.111	0.176	18.76%	-2.91%
Religion	0.584 (0.555, 0.614)	0.737 (0.479, 1.118)	0.127	0.160	7.15%	6.71%
Educational Attainment	0.350 (0.326, 0.377)	0.619 (0.403, 0.947)	0.082	0.145	44.36%	21.65%
<b>Model 2<sup>1</sup></b>	0.337 (0.312, 0.361)	0.622 (0.402, 0.965)	0.079	0.146	46.42%	21.27%

<sup>1</sup> Covariate Adjusted Model: Age, Wealth Quintile, Educational Level, Rural/Urban Residence, and Religion

Figure 2.2 presents the results of the three-level model allowing for a random level wealth component at the community-level and adjusting for individual-level characteristics. In this model, we see that the residual variance at the community-level is highest for the poorest wealth tertile and then decreases as wealth increases. For the poorest wealth tertile, the residual variance apportioned to the community-level is estimated at 43.5%, while for the richest wealth tertile reduces to 32.6%. After examination of the DIC to assess model fit, the model that includes the random community-level component for wealth is superior to the models without the inclusion of a random component for wealth.

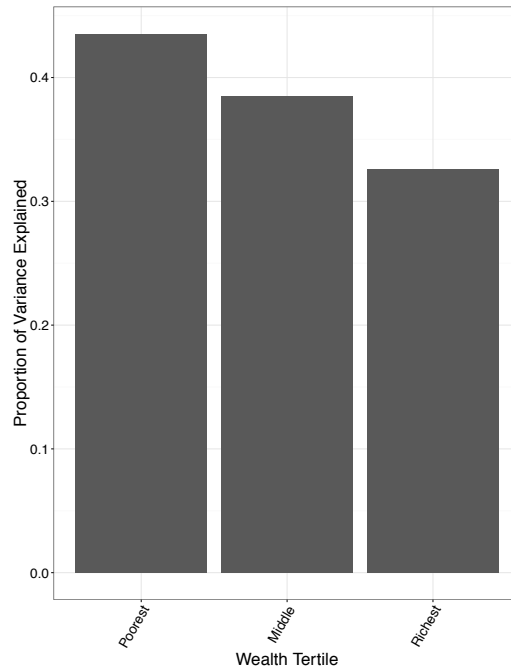


Figure 2.2: Proportion of Residual Variance in Early Adolescent Childbearing (Under 16 Years of Age) Apportioned to the Community-level Variance by Wealth Tertile in Multivariable Adjusted Models (Age, Wealth Quintile, Educational Level, Rural/Urban Residence, and Religion)

Table 2.4 displays the proportion of residual variance at the community-level estimated by the VPC by country after adjusting for age, demographic characteristics and mediating variables. An examination of the results of Model 2 shows that there is considerable variation by country in the amount of unexplained variation that remains at the community-level after adjusting for individual factors. In more than half of the countries included in the analysis (26 out of 44), the unexplained variance at the community-level remains significant after adjustment for individual level variables. Rwanda has the largest percent of unexplained variance at the community-level (30.0%), followed by Bolivia (19.6%) and Burundi (15.0%). The Philippines and the Republic of Congo have the least, with 0.1% and 0.2%, respectively. Figure 2.3 shows that there remains significant variation across countries in the proportion of variance attributed to the community-level by the inclusion of the predictors in Model 2. The proportion of variance

apportioned to the community-level that is explained by individual factors in the multivariable adjusted model (Model 2) ranges from -45.8% in Lesotho to 99.3% in Cambodia. The individual variables included in Model 2 explained less than 50% of the community-level variance in 19 countries, while in Lesotho, Rwanda, Uganda and Republic of Congo (Brazzaville), the proportion of variance explained by individual covariates that is apportioned to the community-level decreased with the addition of the variables in Model 2.

Table 2.4: Variance Partition and Percent Unexplained Variance at the Community-level by Country in Early Adolescent Childbearing (Under the Age of 16 years) for Age-Adjusted and Multivariable Adjusted 2-Level Logistic Regression Analysis

Country Name	Model 1 <sup>1</sup>		Model 2 <sup>2</sup>	
	Variance Estimate	% Unexplained Community-Level Variance	Variance Estimate	% Unexplained Community-Level Variance
Bangladesh	0.353**** (0.255 0.467)	9.70	0.245**** (0.157 0.345)	6.93
Benin	0.883**** (0.675 1.145)	21.16	0.375**** (0.242 0.531)	10.24
Bolivia	1.219**** (0.918 1.635)	27.04	0.802**** (0.508 1.119)	19.60
Burkina Faso	0.953**** (0.663 1.262)	22.46	0.523**** (0.326 0.764)	13.71
Burundi	0.815**** (0.443 1.340)	19.86	0.580* (0.160 1.275)	15.00
Cambodia	1.159**** (0.586 1.913)	26.05	0.008 (0.002 0.018)	0.24
Cameroon	0.759**** (0.574 0.975)	18.74	0.253*** (0.115 0.397)	7.14
Chad	0.446**** (0.345 0.561)	11.93	0.340**** (0.255 0.441)	9.38
Colombia	0.870**** (0.718 1.077)	20.91	0.168 (0.047 0.519)	4.87
Congo, Dem. Rep.	0.371**** (0.242 0.523)	10.13	0.231**** (0.135 0.346)	6.56
Congo, Rep.	0.007 (0.001 0.036)	0.22	0.007 (0.001 0.029)	0.23
Cote d'Ivoire	0.451**** (0.287 0.651)	12.04	0.187* (0.064 0.368)	5.38
Dominican Republic	0.030 (0.001 0.166)	0.89	0.010 (0.001 0.028)	0.29
Ethiopia	0.627**** (0.449 0.828)	16.01	0.341**** (0.192 0.494)	9.40
Gabon	0.101 (0.013 0.272)	2.98	0.095 (0.019 0.234)	2.81

Ghana	0.660** (0.352 1.200)	16.71	0.448* (0.176 0.878)	11.99
Guinea	0.563**** (0.394 0.769)	14.61	0.181** (0.081 0.307)	5.22
Guyana	0.439 (0.109 1.095)	11.77	0.346 (0.011 1.005)	9.52
Haiti	0.272* (0.090 0.543)	7.63	0.008 (0.002 0.020)	0.24
Honduras	0.313**** (0.184 0.474)	8.69	0.148 (0.010 0.289)	4.31
India	1.253**** (1.117 1.402)	27.58	0.521**** (0.442 0.610)	13.68
Indonesia	1.480**** (1.126 1.945)	31.03	0.385* (0.128 0.720)	10.47
Kenya	0.587**** (0.451 0.751)	15.13	0.287**** (0.181 0.403)	8.02
Lesotho	0.080**** (0.001 0.586)	2.38	0.117 (0.006 0.320)	3.43
Liberia	0.057 (0.007 0.166)	1.71	0.021 (0.002 0.114)	0.64
Malawi	0.416**** (0.285 0.550)	11.22	0.328**** (0.227 0.456)	9.06
Mali	0.298**** (0.184 0.428)	8.29	0.099 (0.011 0.211)	2.92
Mozambique	0.211**** (0.106 0.356)	6.04	0.044 (0.005 0.182)	1.32
Namibia	0.828**** (0.433 1.305)	20.10	0.191* (0.050 0.360)	5.47
Nepal	0.356** (0.124 0.653)	9.76	0.203 (0.024 0.478)	5.82
Niger	0.670**** (0.493 0.879)	16.93	0.320**** (0.197 0.475)	8.86
Nigeria	1.340**** (1.099 1.601)	28.95	0.290**** (0.212 0.386)	8.10
Pakistan	0.619**** (0.353 0.952)	15.83	0.573** (0.228 0.991)	14.84
Peru	0.997**** (0.686 1.342)	23.26	0.485** (0.118 0.807)	12.86
Philippines	0.007 (0.001 0.024)	0.22	0.002 (0.000 0.006)	0.06

Rwanda	<b>1.052*</b> (0.230 1.947)	<b>24.23</b>	<b>1.408**</b> (0.619 2.640)	<b>29.97</b>
Senegal	<b>0.762****</b> (0.440 1.167)	<b>18.81</b>	0.214 (0.052 0.483)	6.11
Sierra Leone	<b>0.308****</b> (0.196 0.433)	<b>8.57</b>	<b>0.131**</b> (0.052 0.221)	<b>3.82</b>
Swaziland	<b>0.341*</b> (0.069 0.767)	<b>9.39</b>	<b>0.304*</b> (0.080 0.653)	<b>8.46</b>
Tanzania	<b>0.740****</b> (0.428 1.138)	<b>18.36</b>	<b>0.432*</b> (0.174 0.829)	<b>11.60</b>
Togo	<b>0.405**</b> (0.158 0.683)	<b>10.97</b>	0.110 (0.002 0.297)	3.22
Uganda	0.429 (0.223 0.658)	11.53	<b>0.478***</b> (0.259 0.754)	<b>12.68</b>
Zambia	<b>0.196**</b> (0.067 0.356)	<b>5.61</b>	0.126 (0.020 0.346)	3.70
Zimbabwe	<b>0.821***</b> (0.424 1.373)	<b>19.97</b>	0.122 (0.007 0.273)	3.57

<sup>1</sup> Model adjusted for woman's current age

<sup>2</sup> Covariate Adjusted Model: Age, Wealth Quintile, Educational Level, Rural/Urban Residence, and Religion

\* p<0.05; \*\* p<0.01; \*\*\* p<0.001; \*\*\*\* p<0.0001

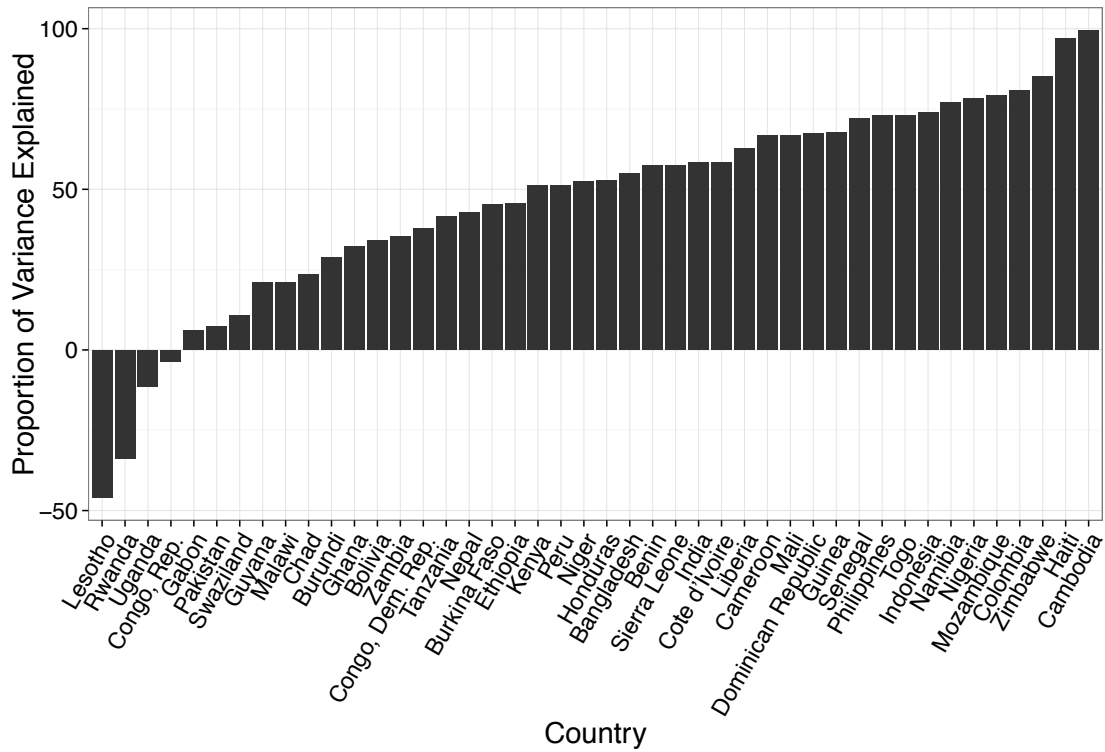


Figure 2.3: Proportion of Total Variance in Early Adolescent Childbearing Explained at the Community Level in Models Adjusted for Individual Characteristics

## Discussion

This study has three salient findings that help to elucidate the degree to which individual, community, and country-level factors may influence early adolescent childbearing. First, we find that individual-level determinants reflective of socioeconomic disadvantage are associated with early adolescent childbearing, including wealth and education. Second, after accounting for individual-level factors, there remains significant residual variance at both the country and community-level indicating that context may also play an important role in influencing childbearing among early adolescents. Finally, our results suggest that individual-level socioeconomic disadvantage may interact with the contextual environment at the community-level, so that the poorest women may be more affected by their community environment than richer women.

The results of this paper indicate that globally women who are the most socioeconomically disadvantaged are most likely to give birth during early adolescence. Our results support the findings of previous studies that suggest that socioeconomic disadvantage negatively impacts adolescent sexual and reproductive health outcomes [94]. While more research is needed to elucidate the mechanisms through which social disadvantage operates to place young women at an increased risk of poor sexual and reproductive health outcomes [95], the results of several previous studies suggest several potential pathways. Young women from disadvantaged backgrounds often have lower levels of knowledge about how to protect themselves from unintended pregnancy and they also may have limited access to health services [96]. Poverty and socioeconomic disadvantage may also increase early adolescent childbearing



by putting young women at increased risk of child marriage [97], sexual violence [98], and transactional sex [99].

The limited reduction in residual variance at the country-level that we observe after including individual-level covariates in the model suggests that very little of the variation in early adolescent pregnancy between countries is a result of the characteristics of the individuals who live there. Additionally, our results show significant heterogeneity across countries by region. Among the 20 countries that have the highest proportion of women who have given birth under the age of 16 years, all of them except for Bangladesh are located in Africa. These results support the findings of Neal and colleagues who find a disproportionate burden of early adolescent pregnancies in Africa, but also find considerable country-level heterogeneity in early adolescent birth rates within regions [48, 100]. For example, while the majority of countries in West Africa have very high levels of childbearing among early adolescents, Togo and Burkina Faso appear to be outliers within the region. Rwanda and Burundi also have very low birth rates among adolescents in this age group relative to the other countries in close proximity. More research should explore the cross-regional heterogeneity, as there may be programmatic lessons to be learned at the country-level that could improve health outcomes for adolescent women.

Our results highlight that very little of the variance apportioned to the country-level is explained by individual-level factors (21.3%). To date, there is very little research that explores the macro-level determinants for the large variation in adolescent childbearing that exists between countries in the developing world. Factors related to the macro socioeconomic and political context, such differences in wealth, income inequality, gender inequality, and the pace of economic development between countries may influence some of the variation we observe in

early adolescent pregnancy at the country-level [101, 102]. To this point, the results of an ecological analysis using data from 27 LMICs suggest that a country's score on the Gender Development Index is negatively associated with the prevalence of adolescent childbearing [102]. Increasing the availability of educational and economic opportunities for young girls and supporting a national legal environment that outlaws child marriage and punishes the perpetrators of sexual assault are two potential pathways by which gender equitable development at the national level may reduce adolescent childbearing [95]. Finally, national variation in laws, policies and guidelines that pertain to adolescent sexual and reproductive health, such as access to abortion, contraception, and other health services for adolescents [103], sexual education in schools [104], and the availability of an appropriate range of contraceptive methods [105] may also explain some of the variation in early adolescent childbearing that we observe between countries, and could be an important area for future intervention. Future studies that seek to examine the extent to which country-level differences in policy, laws, and characteristics of the health system account for country-level variance may help to advocate for the importance of more a more-supportive policy environment, and could have important programmatic implications to reduce the burden of early adolescent pregnancy.

The findings of our study also have important implications at the community-level. While the inclusion of individual-level factors reduces the variance observed at the community-level to a greater degree than at the country-level, the ecological effect of communities remains significant. The results of the country-specific models indicate that influence of determinants at the community-level may vary across countries, noting the substantial heterogeneity in the residual variance apportioned to the community-level after including individual-level factors. In

the countries where the majority of the community variance was explained by the inclusion of individual level covariates, our findings suggest that individuals who share similar socioeconomic and demographic characteristics may be clustered together. In these countries, interventions that seek to specifically target the most socioeconomically disadvantaged may benefit from geographically targeted interventions designed to reach the most vulnerable. However, in 26 out of 44 countries included in our analysis, the residual community-level variance remains significant after adjustment for individual factors. In these countries, attributes of the community context over and above the characteristics of the people who live there may be associated with early adolescent pregnancy.

The considerable variation that we observe at the community-level contributes to an emerging body of literature that calls for the examination of community-level determinants as a target for interventions in order to influence adolescent reproductive health outcomes [64, 105-107]. A few studies have documented an association between area-level socioeconomic disadvantage and adolescent childbearing [64, 108]. More socioeconomically disadvantaged communities, for example, may have limited access to the health system, few educational resources to keep young women in school, and a more dilapidated physical environment that lacks safe recreation spaces for young women [109-111]. Additionally, adolescents living in impoverished communities may be less incentivized to delay childbearing because of poor quality schools and limited employment potential [68, 70, 112, 113]. Similarly, a multilevel analysis using data from Brazil suggests that income inequality at the community-level as measured by the Gini coefficient is associated with adolescent pregnancy rates [114], potentially by way of lowering adolescents' perceptions of future economic advancement [115].

While ecological economic factors at the community-level, such as poverty and inequality, may be difficult to change through intervention, the community's social environment represent a more modifiable target for interventions to reduce early adolescent childbearing. For example, social capital within communities may have the potential to buffer the impact of other forms of socioeconomic deprivation and increase the resilience of youth living in disadvantaged areas [116, 117]. An ecological analysis of state-level social capital and adolescent childbearing in the United States found that differences in social capital at the state level may explain differences in adolescent pregnancy rates [118]. Mechanistically, decreased social capital at the community level may influence adolescent childbearing by causing adolescents to feel disconnected, disruptions in protective information flow, or it may lead to exclusionary social policies that either fail to provide adequate health services for youth, or limit economic incentives to delay childbearing [119, 120]. A community's degree of collective efficacy, or its ability to mobilize its resources in order to accomplish shared goals, has been found to be associated with delays in sexual debut among adolescents [121], as such communities may be more able to advocate for improved policies in the domains of education and health services.

With regard to the interaction between individual socioeconomic status and community context, the fact that we see the highest proportion of unexplained community-level variance among the poorest wealth tertiles suggests that community context may matter the most for the poorest populations with regard to early adolescent pregnancy. This finding suggests that the poorest women in many low and middle income countries may face increased difficulty in overcoming the barriers that make navigation of the health system or accessing educational programs difficult when compared to wealthier women. Therefore, population-level

interventions may be effective at reducing early adolescent pregnancy among the most socioeconomically disadvantaged populations. This finding is the first of its kind that the authors are aware of, and more research should be conducted to examine whether this finding extends to other measures of socioeconomic status, such as education and women's empowerment, and whether similar results are found across individual regions and countries.

### **Limitations**

Our study should be interpreted in light of several limitations. The most important of which is that this study does not seek to identify the specific ecological mechanisms that may explain the variance observed at the country and community-level, but rather the goal of this study is to provide some initial evidence to indicate that higher-level forces may operate to influence early adolescent childbearing. Identifying the potential influence of these higher-level determinants represents an important area for future research.

Additionally, this study faces some limitations with regard to the data used in this analysis. First, given the nature of the questions asked in the Demographic and Health Surveys, we examine only births among adolescents, and not pregnancies. If more disadvantaged women are more likely to have pregnancies that do not result in a live birth [122], we could potentially find stronger associations between socioeconomic position and adolescent pregnancy than those observed with using birth as an outcome. Secondly, we rely on self-reported data to ascertain the age of the woman at her first birth. While we attempt to limit recall bias by only including women under the age of 30 at the time of the survey, we cannot verify the woman's actual age. Even though previous research has found that women's recall of child's birthdates tends to be fairly accurate, we expect that any misclassification is non-differential and would not serve to

bias the results. Finally, we assume that a woman's geographic location and socioeconomic status at the time of the survey reflects her status at the time of her first birth; however, both of these factors may change over time.

## **Conclusions**

To our knowledge, this study is the first attempt to quantify the variance in early childbearing to the community and country levels and more research needs to be done to explore the mechanisms through which adolescent pregnancy is influenced by higher-level forces. Our study contributes to the growing body of literature gives credence to the notion that adolescent health is strongly influenced by macro socioeconomic and political forces [107]. The interplay between individual attributes and higher-level factors that vary within and across countries and communities highlights the complexity involved in developing an understanding the determinants that shape adolescent sexual and reproductive health, and point to the need for a continued focus on multi-level interventions that include both individual and population-perspective in bringing about improved outcomes.

### ***Paper 3***

## ***The Relationship between Socioeconomic Disadvantage and Adversity, Common Mental Disorders During the Perinatal Period, and Social Capital in Three Low and Middle Income Countries***

*Jewel Gausman, S. Bryn Austin, SV Subramanian, Ana Langer*

### **Abstract**

#### *Background*

Common Perinatal Mental Disorders (CPMDs) are becoming increasingly recognized as health priorities in low and middle income countries. Studies suggest that the onset of perinatal depression is exacerbated by socioeconomic adversity, including poverty, exposure to adverse life events, and other types of social disadvantage; however, a majority of these studies have been conducted in high income countries. Social capital may have the potential to play a role in buffering the impact of exposure to adversity on the development of CPMDs. This paper examines the relationship between socioeconomic adversity, social capital and CPMDs by using a cross-country comparative perspective focused on three LMICs.

#### *Methods*

We use data from 5,482 women from Ethiopia, India, and Peru from the 2002 round of the Young Lives Survey. Logistic regression analysis is used to examine the association between exposure to socioeconomic disadvantage, including adverse life events (shocks), and the prevalence of CPMDs in women between 6 months and 1.5 years post-partum. Additionally, explore the potential for effect modification by social capital.

#### **Results**

Overall, the percentage of women with probable CPMD are similar in Ethiopia (32.64%) and in India (30.5%), while much lower in Vietnam (21.12%). In Ethiopia, the odds of CPMD among women who experienced 2 or more adverse events was estimated at 1.82 (95 CI: 1.39 – 2.41);  $p < 0.01$ ), while in Vietnam, the odds that a woman would experience CPMD was estimated at 3.68 (95% CI: 2.66 - 5.10;  $p < 0.01$ ) among women who experienced 2 or more adverse events, compared to 2.23 (95% CI: 1.67- 2.98;  $p < 0.01$ ) among women who experienced 1 adverse event. Perceived inequality and having serious household debt were both found to be significantly associated with CPMD across all countries after in adjusted models. Finally, social capital modifies the effect of being exposed to a shock on the odds of developing CPMD in Ethiopia, but not in India or Vietnam.

### *Conclusions*

This study provides evidence that social disadvantage and adversity put women at increased risk for the development of CPMDs in three LMICs. The findings point towards social capital being a potential intervention strategy that may improve maternal mental health outcomes in the face of adversity.



## Introduction

Depression, anxiety, and other common perinatal mental disorders (CPMDs) have begun to emerge as global health priorities [123]. The inclusion of mental health within the Sustainable Development Goals [123], and the growing recognition that women's health should encompass a holistic range of health issues [54, 124], has highlighted the importance of addressing CPMDs in low and middle income countries (LMICs). The prevalence of perinatal depression in high income countries (HICs) is estimated to be between 10-15% [125]. In LMICs, data on prevalence of CPMDs remains limited [123]. A recent systematic review of CPMDs in LMICs included 13 studies from 17 countries and estimated an average prevalence of 15.9% [126], ranging from 4.3% in Nepal [127] to 59.5% in India [128]. While the results of these studies indicate that CPMDs may be higher in LMICs than in HICs [125], methodological considerations may have resulted in an underestimate of the true measure [126].

The development of CPMDs can have lifelong consequences for women, their children and their families [129, 130]. Studies show that women suffering from perinatal depression are estimated to have a 25% increased risk of developing major depression later in life following a single episode of perinatal depression [54, 131]. Robust evidence generated over the last several decades has also revealed myriad biological, cognitive, social consequences that affect infant and child development and well-being [132-134]. In LMICs, the outcomes of perinatal depression may be particularly severe, where studies show that this condition is associated with malnutrition, stunting, diarrheal disease, and poor immunization coverage [126].

The determinants of perinatal depression reflect a complex interaction between biological, social, and environmental factors. Biological change during the perinatal period may result in increased sensitivity to external stress, thereby increasing a woman's vulnerability to developing CPMDs [130, 135]. Studies in both HIC and LMICs suggest that the onset of perinatal depression is exacerbated by socioeconomic adversity. Socioeconomic adversity includes a broad range of harmful or unfavorable experiences that have social or economic origins, which may be associated with poor living conditions, lack of resources, incurrence of debt, etc. [136, 137]. In many countries, women suffering from poverty or financial hardship have been found to suffer from higher rates of CPMDs than wealthier or more financially stable women [126, 138-147]. Chronic poverty, material deprivation, and low socioeconomic status is consistently associated with CPMDs [138, 141, 148-153], while relative disadvantage [154] and household debt [155] may also increase a woman's vulnerability.

Socioeconomic adversity also includes the exposure to stressful life events, or shocks, that are frequently defined as an event that negatively influences the way a household typically lives [156]. Research on shocks typically focuses on both the effect of a single shock, such as death of a family member, independent of other events as well as the additive accumulation of multiple negative events over time [156, 157]. While research has long documented a relationship between exposure to adverse life events and the onset of major depressive disorder [158, 159], including some studies in LMICs [160, 161], a small, but growing, body of literature examines the association between exposure to shocks and CPMDs. A vast majority of these studies have been conducted in HICs [162-166]. A study in Sweden that asked post-partum women whether they experienced 10 stressful life events, such as family events (including illness, divorce, and death)

and economic events (such as unemployment) in the 12 months prior to giving birth found that women who experienced two or more adverse events had 3.7 times the odds of having postpartum depression [167]. A study in Nepal found that women 5-10 weeks postpartum who experienced a stressful life event in the previous year had 4.6 times the odds of postnatal depression compared to women who had not [127]. Another study conducted among 162 women in Nigeria found an association between CPMD and exposure to marital and family-related adverse events [138]. The research in this domain remains limited in LMICs, and the authors are not aware of any studies that decompose the association between life events and CPMDs with regard to the type of adversity encountered.

Identifying mechanisms that foster resilience in order to improve health outcomes in the face of adversity has been a significant focus of research [168]. Resilience is a multidimensional construct that is shaped by social processes [169], and the mechanisms that foster resilience are embedded in the social ecology of a community [169-172]. Social capital may be one dimension through which the community social environment contributes to the individual coping response [173, 174]. Generally, at the individual-level, social capital can be defined as a resource that is generated through social connections [175]. In other words, it is one of the ways in which often intangible investments in social relationships generate tangible results by way of community assets such as knowledge-sharing, voluntarism, and policies that benefit the members of the community. More specifically, cognitive social capital (CSC) is a type of social capital that refers to an individual's perceptions of the values, attitudes and beliefs that produce cooperative behavior and norms of reciprocity in their community [176, 177]. CSC may reduce the negative effects of stressful life events on mental health by increasing an individual's sense of belonging

in the community, self-esteem, and supportive resources [178]. Social support is a construct related to, but distinct from, social capital. Social support typically refers to the support provided through an individual's strong network ties, which are often categorized into emotional, instrumental, appraisal, and informational [179].

Several studies conducted in HICs, and to a lesser extent in LMICs, have established an association between an individual's level of social support and CPMDs, but very few focus on social capital [175, 180]. In HICs, social support seems to be protective against the development of CPMDs [163, 181-184]. Research in the United Kingdom found that depression at 8 week post-partum was related to an individual's degree of social support [149], while a study conducted in Denmark found that social isolation was associated with post-partum depression [185]. With regard to social capital, a woman's assessment of social capital in her community was found to be associated with perinatal depression, prior to adjusting for the level of self-reported stress, but after adjusting for stress, the relationship was no longer significant [186]. The association between social support and CPMDs in LMICs is less consistent. Research in China and Ethiopia suggests that higher levels of social support may protect against CPMDs [184, 187, 188]. An analysis using data from four LMICs, however, found that CSC, but not social support, reduced the odds of CPMDs across all study countries, thereby suggesting that the role of social capital may be more universally protective than that of social support in these settings [189].

Conceptual models that relate to stress, coping, and depressive symptoms suggest both a direct and an interactive effect of the social environment on mental health outcomes, by which social factors may be independently protective, but may also serve to buffer the harmful effects of adversity [190]. Following this framework, individuals who report high levels of adversity and

stress, but have a supportive community environment, would have better mental health outcomes than those without the same degree of supportive social infrastructure [191]. A few studies have found support for this hypothesis in terms of major depressive disorder [192, 193]; however, this proposition has not been extensively examined as it relates to CPMDs. One study examining the potential for social support to buffer the mental health effect of stressful life events among mothers of young children did not find evidence for an interactive effect [191].

The purpose of this paper is to examine the relationship between socioeconomic disadvantage, social capital and the presence of CPMDs by using a cross-country comparative perspective focused on three LMICs. Specifically, this paper will 1) examine the association between socioeconomic adversity and CPMDs, 2) decompose the association between the type of adversity suffered, including family, economic, crime, and environmental shocks, and CPMDs and 3) examine the potential for social capital to mediate the association between adversity and CPMDs, thus pointing toward intervention strategies.

## **Data and Methods**

### *Data Collection and Study Design*

The data used in this study were part of the Young Lives Study that has collected data on 12,000 children and their caregivers since 2002 in Ethiopia, India, Peru, and Vietnam.<sup>2</sup> The study was designed with the goal of investigating the changing nature of childhood poverty from early childhood through entry into adulthood [194]. The countries included in the study were selected from a short-list of 25 countries that were purposively sampled in order to represent the major

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<sup>2</sup> The data collected on CPMDs in Peru were not released.

regions of the world. The final countries were chosen, in part, because of their ability to carry out the project.

The sampling strategy employed by the Young Lives Study is based on a cluster design in which 20 clusters were selected in each country and 100 children were sampled in each site. Cluster selection was non-random and largely based on the cluster's overall poverty status and the desire to capture the full diversity of living experiences found in each country. Each country arrived at their final selection of clusters based on an independent process [195-198]. Once the clusters were selected, the individual households within each of them were randomly selected [199]. In each cluster, 100 households were selected to comprise the younger cohort and 50 were selected for the older one [199]. This study uses data collected from the younger cohort in 2002 during the first round of the survey, when the reference child was aged between 6 and 18 months. All women with complete data on all of the study variables were included in the study.

#### *Outcome variable*

The presence of common mental disorders (CPMD) was recorded using the 20-Question Self-Reporting Scale (SRQ-20) which was developed and validated by the World Health Organization [200]. Data on CPMDs were collected when the mother was between 6 and 18 months post-partum. This study uses a cut-off score of 8, meaning that the woman is considered to be a case of probable CPMD if she answers positively to 8 of the 20 questions [200-203]. Studies have found this tool to be appropriate, valid and reliable for finding probable cases of CPMD, most commonly depression and anxiety, across a wide range of LMICs [204]. The SRQ-20 is capable of capturing the multidimensionality of CPMD by reflecting a diversity in symptomatology [205]. While there is some variation in the number and content of factors across

countries/settings, the SRQ-20 frequently has been found to consist of a somatic factor including physical symptoms (such as headaches, loss of appetite, poor sleep etc.), a negative affect factor including symptoms relating to the cognitive domain (such as unhappiness, difficulty thinking clearly, loss of pleasure, etc.), and a factor relating to feelings of anxiety and worthlessness (such as crying frequently, or feeling frightened) [202, 205-211]. The SRQ-20 has been validated in and used to detect CPMD in several LMICs [207, 212-217], including Vietnam [202, 218-220], Ethiopia [203, 221-224], and India [201, 225-228]. Several studies have used the SRQ-20 to specifically examine the presence of perinatal CPMD across a range of countries and settings [189, 229-236].

#### *Exposures of Interest*

The exposure of interest focuses on socioeconomic adversity during the perinatal period, including measures that relate to economic hardship, debt, and other socioeconomic vulnerabilities, as well as the experience of specific adverse life events (shocks). Other variables of interest include whether the mother is the head of household (coded as 1 yes, 0 for no), whether the household receives remittances from any outside source (coded as 1 yes, 0 for no), whether the household has serious debt (coded as 1 yes, 0 for no), how the respondent views the socioeconomic status of her household compared to others in her community (1 for better off, 2 for similar, and 3 for worse off) [154]. Remittances are payments from individuals connected with the household who have migrated elsewhere that may have a short-term impact on the financial resources available to the household [237, 238]. Wealth was measured based on a composite, asset based measure that incorporates values from: 1) a housing quality index, which is the simple average of materials used for housing construction and the number of persons per room, 2) a consumer durables index, which is the scaled sum of ownership of a set

of consumer durables, and 3) a services index, which is the average of basic household utility services, such as water, electricity, toilet and fuel [239].

Exposure to shocks is assessed by examining whether a woman reported having experienced an economic-related shock (death of livestock, loss of a job/source of income/family enterprise, or decrease in food availability), an environmental-related shock (crop failure or a natural disaster), a family-related shock (divorce or separation, birth of a new household member, enrollment of a child in school, death/reduction of household member(s), severe illness or injury, or move/migration), or crime-related shock (theft of crops/livestock or being the victim of another crime) in the 12 months before childbirth. Women were asked about shocks that they considered to be important, and that negatively impacted the economic welfare of their household. A summary variable was created based on the cumulative exposure to any of the above shocks categorized according to whether the woman reported experiencing 0 events, 1 event, or 2 or more events based on the distribution of the variable across countries as well as the literature [167, 240].

Effect modification was assessed by examining a woman's CSC. The level of CSC was assessed by asking the woman questions regarding trust, social harmony, perceived fairness, and sense of belonging [241]. This variable was developed using the Short Social Capital Assessment Tool (SASCAT) [242], which was specifically designed for use in low income countries and which has been validated in Peru and Vietnam [243]. In this study, CSC was categorized into low (positive responses to 2 or fewer questions) or high (positive responses to 3 or 4 questions) [189].

#### *Other Covariates*



The other covariates in this study include potential confounding variables that may act as prior common causes of both socioeconomic adversity and CPMD. These variables include place of residence (rural/urban) [244], maternal age, marital/cohabitation status (living with partner, married but living apart from partner, single, or divorced/separated/widowed) [151], maternal education status (completed primary school or not) [141], maternal literacy, time living in the community, member of religious/ethnic majority [245], woman's/partner's employment status [152], and household composition (number of children under 5 years, number children between 5-15 years, and number of individuals older than the age of 16 years).

### *Statistical Analysis*

Logistic regression models were used to examine the whether the variables related to socioeconomic adversity were associated with the presence of CPMD. Unadjusted, univariate models were first fit for each variable of interest followed by adjusted models that included all theoretical confounding variables. To ensure that the variables related to socioeconomic adversity are not measuring the same underlying construct, variance inflation factors (VIFs) were calculated for each variable in the covariate-adjusted models to examine the potential for multicollinearity [246].

Further logistic regression analysis was conducted to analyze the association between the type of adverse life event suffered (environmental, economic, family, and crime events), CSC, and CPMD. This was done by first fitting an unadjusted model for each type of shock. In a second partially adjusted model, the model was fit including all potential confounding covariates. Finally, in the third, fully adjusted model, indicator variables for all of the types of shocks were included

in the model simultaneously in order to assess their independent associations. Finally, interaction terms were generated to assess whether the association between CPMD and exposure to shocks is modified by a woman's level of CSC and added to the final model.

As the data for this study were generated by a cluster-based sampling strategy at the community level, individual residuals may be correlated among individuals residing in the community, thus leading to incorrect inference. As a result, this study uses robust standard errors to obtain an estimate of variance that accounts for the within cluster correlation across observations [247, 248]. All models are stratified according to country. Estimates of the regression coefficients were exponentiated to convert them to odds ratios [249]. Estimates were considered to be significant if the p-value was less than 0.05. Data management and analysis was conducted using Stata version 14.0 [90] and the graphics were produced using the statistical package R *ggplot2* [250].

## **Results**

The final sample consists of 5,482 women (n=1,771 in Ethiopia, n=1,850 in India, and n=1,861 in Vietnam). Four hundred and seventeen women were dropped because of missing data. In all, 2.80% of women were missing data on the exposure variables and covariates included in the study (7.30% in Ethiopia, 1.25% in India, and 0.10% in Vietnam) and 4.31% of women were missing data on the outcome variable (1.29% in Ethiopia, 5.50% in India, and 5.96% in Vietnam). No patterning was found according to the individuals who were missing data, and any missing data are assumed to be missing completely at random. The percent of participants who were missing data on specific variables ranged from 0% to 5.6% across countries.

Overall, the percentage of women with probable CPMD are similar in Ethiopia (32.64%) and in India (30.5%), while much lower in Vietnam (21.12%). Figure 3.1 highlights the considerable variation in symptomology as assessed with the SRQ-20 in each country. Table 3.1 presents the distribution of CPMD by country and according to socioeconomic and demographic variables included in the study. Generally, women with probable CPMD tend to have experienced more adverse events, have more debt, be from poorer households, while also being less educated. Overall, women experienced 1.18 shocks on average in the 12 months prior to childbirth, with an average of 1.89 shocks in Ethiopia (range: 0-10 shocks), 1.08 shocks in India (range 0-15 shocks), and 0.61 shocks in Vietnam (range 0-5 shocks). In all countries on average, women with probable CPMD experienced a larger number of shocks than those who are considered to be a non-case. While women with CPMD tend to perceive their households as worse off than others in their community, the distribution of perceptions of inequality are notably different in India than in Ethiopia and Vietnam. In Ethiopia and Vietnam, 33.9% and 42.2% of the total sample perceives their household has being worse off compared to others in their community, while in India, only 2.2% of the total sample considers themselves as being worse off than other households.

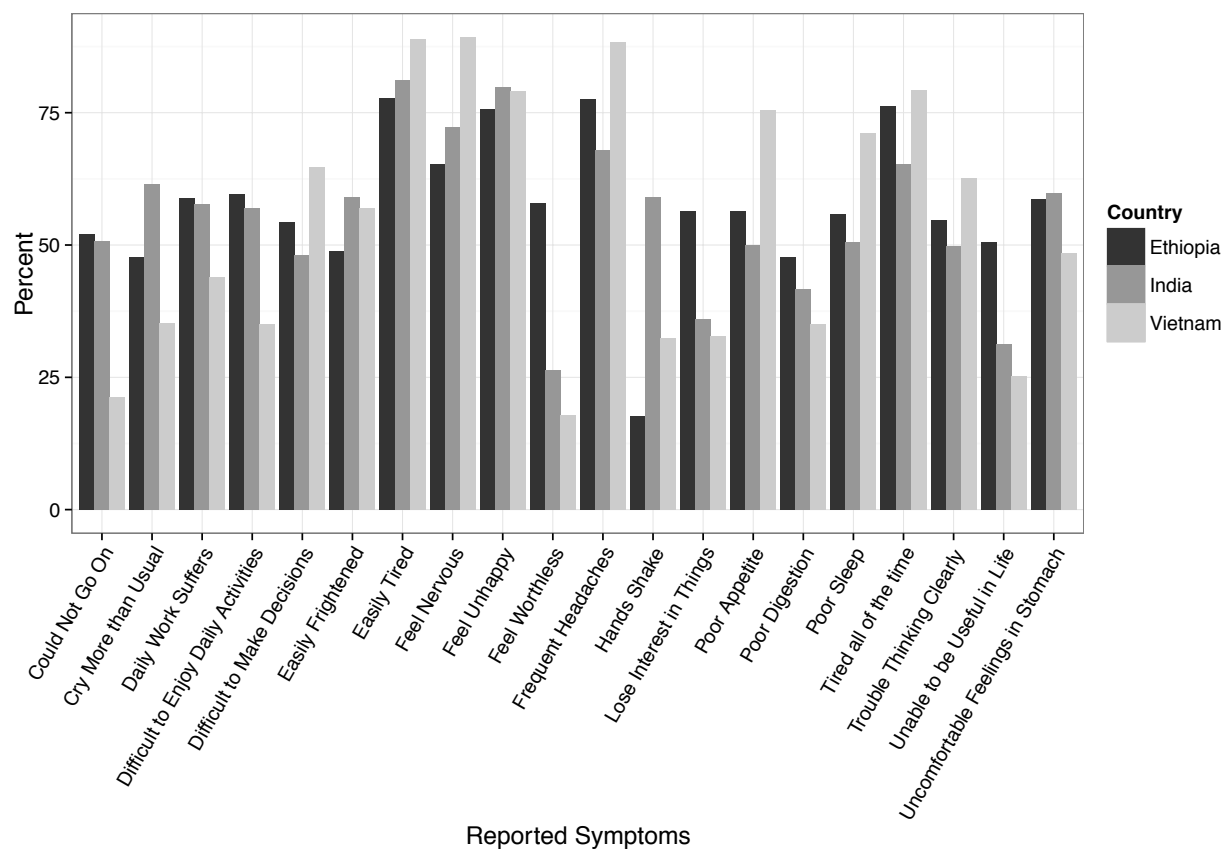


Figure 3.1: Proportion of Respondents Reporting Specific Symptoms of Common Perinatal Mental Disorders in Ethiopia, India, and Vietnam as assessed by the Self-Reporting Questionnaire-20.

Table 3.1: Sample Characteristics in Ethiopia, India, and Vietnam Comparing Probable Cases of Common Perinatal Mental Disorders (CPMD) to non-cases by Study Variables

Sample Characteristics	Country								
	Ethiopia			India			Vietnam		
	Non CPMD Case n= 1,192	CPMD Case n=578	Total n=1,771	Non CPMD Case n=1,294	CPMD Case n=556	Total n=1,850	Non CPMD Case n=1,468	CPMD Case n=393	Total n=1,864
<b>Exposure to Adversity</b>									
<i>Number of Adverse Events (Shocks) in Year Before Birth</i>									
0 Events	419 (35.1)	122 (21.1)	541 (30.5)	789 (61)	250 (45)	1039 (56.2)	938 (63.9)	136 (34.6)	1074 (57.7)
1 Event	195 (16.3)	80 (13.8)	275 (15.5)	125 (9.7)	93 (16.7)	218 (11.8)	356 (24.3)	141 (35.9)	497 (26.7)
2+ Events	579 (48.5)	376 (65.1)	955 (53.9)	380 (29.4)	213 (38.3)	593 (32.1)	174 (11.9)	116 (29.5)	290 (15.6)
<i>Mother is head of household</i>									
No	1097 (92)	502 (86.9)	1599 (90.3)	1288 (99.5)	548 (98.6)	1836 (99.2)	1392 (94.8)	358 (91.1)	1750 (94)
Yes	96 (8)	76 (13.1)	172 (9.7)	6 (0.5)	8 (1.4)	14 (0.8)	76 (5.2)	35 (8.9)	111 (6)
<i>Household Receives Remittances</i>									
No	808 (67.7)	327 (56.6)	1135 (64.1)	922 (71.3)	417 (75)	1339 (72.4)	414 (28.2)	120 (30.5)	534 (28.7)
Yes	385 (32.3)	251 (43.4)	636 (35.9)	372 (28.7)	139 (25)	511 (27.6)	1054 (71.8)	273 (69.5)	1327 (71.3)
<i>Household has serious debt</i>									
No	879 (73.7)	345 (59.7)	1224 (69.1)	700 (54.1)	226 (40.6)	926 (50.1)	775 (52.8)	143 (36.4)	918 (49.3)
Yes	314 (26.3)	233 (40.3)	547 (30.9)	594 (45.9)	330 (59.4)	924 (49.9)	693 (47.2)	250 (63.6)	943 (50.7)
<i>Household compared to others</i>									
Better off	185 (15.5)	52 (9)	237 (13.4)	283 (21.9)	81 (14.6)	364 (19.7)	58 (4)	3 (0.8)	61 (3.3)

Similar	681 (57.1)	253 (43.8)	934 (52.7)	993 (76.7)	453 (81.5)	1446 (78.2)	869 (59.2)	145 (36.9)	1014 (54.5)
Worse off	327 (27.4)	273 (47.2)	600 (33.9)	18 (1.4)	22 (4)	40 (2.2)	541 (36.9)	245 (62.3)	786 (42.2)
<i>Wealth Quintile</i>									
Poorest	234 (20)	116 (20.57)	350 (20.18)	232 (18.34)	136 (25.37)	368 (20.43)	287 (19.59)	86 (21.99)	373 (20.1)
Poorer	219 (18.72)	108 (19.15)	327 (18.86)	206 (16.28)	149 (27.8)	355 (19.71)	302 (20.61)	74 (18.93)	376 (20.26)
Middle	234 (20)	95 (16.84)	329 (18.97)	241 (19.05)	109 (20.34)	350 (19.43)	255 (17.41)	104 (26.6)	359 (19.34)
Rich	228 (19.49)	134 (23.76)	362 (20.88)	262 (20.71)	97 (18.1)	359 (19.93)	310 (21.16)	70 (17.9)	380 (20.47)
Richer	255 (21.79)	111 (19.68)	366 (21.11)	324 (25.61)	45 (8.4)	369 (20.49)	311 (21.23)	57 (14.58)	368 (19.83)
<b>Social Capital</b>									
<i>Level of Cognitive Social Capital</i>									
Low	4 (0.34)	9 (1.56)	13 (0.73)	2 (0.15)	0 (0.00)	2 (0.11)	4 (0.27)	2 (0.51)	6 (0.32)
Medium	95 (7.96)	86 (14.88)	181 (10.22)	56 (4.33)	34 (6.12)	90 (90.47)	104 (7.08)	63 (16.03)	167 (8.97)
High	1084 (90.86)	475 (82.18)	1559 (88.03)	1211 (93.59)	503 (90.47)	1714 (92.56)	1358 (93.51)	326 (82.95)	1684 (90.49)
<b>Demographic Variables</b>									
<i>Mother's Educational Level</i>									
No	912 (76.4)	461 (79.8)	1373 (77.5)	704 (54.4)	397 (71.4)	1101 (59.5)	389 (26.5)	118 (30)	507 (27.2)
Yes	281 (23.6)	117 (20.2)	398 (22.5)	590 (45.6)	159 (28.6)	749 (40.5)	1079 (73.5)	275 (70)	1354 (72.8)
<i>Mother can read a newspaper in any language</i>									
Easily	357 (29.9)	155 (26.8)	512 (28.9)	514 (39.7)	159 (28.6)	673 (36.4)	1192 (81.2)	296 (75.3)	1488 (80)
With Difficulty	146 (12.2)	72 (12.5)	218 (12.3)	95 (7.3)	35 (6.3)	130 (7)	95 (6.5)	36 (9.2)	131 (7)
Not at all	690 (57.8)	351 (60.7)	1041 (58.8)	685 (52.9)	362 (65.1)	1047 (56.6)	181 (12.3)	61 (15.5)	242 (13)
<i>Member of Ethnic Majority</i>									
No	946 (79.3)	457 (79.1)	1403 (79.2)	995 (76.9)	459 (82.6)	1454 (78.6)	216 (14.7)	51 (13)	267 (14.3)
Yes	247 (20.7)	121 (20.9)	368 (20.8)	299 (23.1)	97 (17.4)	396 (21.4)	1252 (85.3)	342 (87)	1594 (85.7)
<i>Member of Religious Majority</i>									

No	379 (31.8)	165 (28.5)	544 (30.7)	163 (12.6)	69 (12.4)	232 (12.5)	260 (17.7)	67 (17)	327 (17.6)
Yes	814 (68.2)	413 (71.5)	1227 (69.3)	1131 (87.4)	487 (87.6)	1618 (87.5)	1208 (82.3)	326 (83)	1534 (82.4)
<i>Place of Residence</i>									
Urban	416 (34.9)	221 (38.2)	637 (36)	381 (29.4)	91 (16.4)	472 (25.5)	284 (19.3)	86 (21.9)	370 (19.9)
Rural	777 (65.1)	357 (61.8)	1134 (64)	913 (70.6)	465 (83.6)	1378 (74.5)	1184 (80.7)	307 (78.1)	1491 (80.1)
<i>Mother's Age (years)</i>									
Less than 18	22 (1.8)	12 (2.1)	34 (1.9)	22 (1.7)	9 (1.6)	31 (1.7)	11 (0.7)	1 (0.3)	12 (0.6)
18-24	381 (31.9)	168 (29.1)	549 (31)	762 (58.9)	313 (56.3)	1075 (58.1)	567 (38.6)	140 (35.6)	707 (38)
25-34	612 (51.3)	273 (47.2)	885 (50)	475 (36.7)	205 (36.9)	680 (36.8)	719 (49)	196 (49.9)	915 (49.2)
35 +	14.9 (1193)	21.6 (578)	17.1 (1771)	2.7 (1294)	5.2 (556)	3.5 (1850)	11.6 (1468)	14.2 (393)	12.2 (1861)
<i>Time lived in Community (years)</i>									
Less than 1	53 (4.4)	34 (5.9)	87 (4.9)	63 (4.9)	23 (4.1)	86 (4.6)	19 (1.3)	6 (1.5)	25 (1.3)
1 - 5	239 (20)	88 (15.2)	327 (18.5)	583 (45.1)	184 (33.1)	767 (41.5)	341 (23.2)	97 (24.7)	438 (23.5)
5+	901 (75.5)	456 (78.9)	1357 (76.6)	648 (50.1)	349 (62.8)	997 (53.9)	1108 (75.5)	290 (73.8)	1398 (75.1)
<i>Marital/Cohabitation Status*</i>									
Single	20 (1.7)	17 (2.9)	37 (2.1)	2 (0.2)	1 (0.2)	3 (0.2)	3 (0.2)	3 (0.8)	6 (0.3)
Married Cohab	1042 (87.3)	462 (79.9)	1504 (84.9)	1262 (97.5)	545 (98)	1807 (97.7)	1438 (98)	368 (93.6)	1806 (97)
Married Apart	16 (1.3)	10 (1.7)	26 (1.5)	26 (2)	6 (1.1)	32 (1.7)	8 (0.5)	2 (0.5)	10 (0.5)
Separated	115 (9.6)	89 (15.4)	204 (11.5)	4 (0.3)	4 (0.7)	8 (0.4)	19 (1.3)	20 (5.1)	39 (2.1)
<i>Number of Children Under 5 years in Household</i>									
1 Child	647 (54.2)	319 (55.2)	966 (54.5)	1050 (81.1)	428 (77)	1478 (79.9)	1134 (77.2)	285 (72.5)	1419 (76.2)
2-3 Children	538 (45.1)	252 (43.6)	790 (44.6)	235 (18.2)	118 (21.2)	353 (19.1)	330 (22.5)	108 (27.5)	438 (23.5)
3+ children	1 (0.1)	1 (0.2)	2 (0.1)	2 (0.2)	4 (0.7)	6 (0.3)	2 (0.1)	0 (0)	2 (0.1)

<i>Number of Children between the ages of 5-15 years in Household</i>									
0 children	325 (27.2)	130 (22.5)	455 (25.7)	777 (60)	284 (51.1)	1061 (57.4)	782 (53.3)	220 (56)	1002 (53.8)
1-2 Children	544 (45.6)	241 (41.7)	785 (44.3)	435 (33.6)	223 (40.1)	658 (35.6)	607 (41.3)	156 (39.7)	763 (41)
2+ children	317 (26.6)	201 (34.8)	518 (29.2)	75 (5.8)	43 (7.7)	118 (6.4)	77 (5.2)	17 (4.3)	94 (5.1)
<i>Number of Individuals aged 16+ years in the Household</i>									
1 Adult	58 (4.9)	45 (7.8)	103 (5.8)	2 (0.2)	4 (0.7)	6 (0.3)	0.2 (842)	1.8 (268)	0.5 (1110)
2 Adults	769 (64.5)	322 (55.7)	1091 (61.6)	531 (41)	262 (47.1)	793 (42.9)	57.4 (621)	68.2 (118)	59.6 (739)
3+ Adults	359 (30.1)	205 (35.5)	564 (31.8)	754 (58.3)	284 (51.1)	1038 (56.1)	42.3 (2)	30 (0)	39.7 (2)
<i>Mother had at least one economic activity in last year</i>									
No	545 (45.7)	225 (38.9)	770 (43.5)	706 (54.6)	221 (39.7)	927 (50.1)	90 (6.1)	36 (9.2)	126 (6.8)
Yes	648 (54.3)	353 (61.1)	1001 (56.5)	588 (45.4)	335 (60.3)	923 (49.9)	1378 (93.9)	357 (90.8)	1735 (93.2)
<i>Partner had at least one economic activity in last year</i>									
No	47 (3.9)	31 (5.4)	78 (4.4)	72 (5.6)	26 (4.7)	98 (5.3)	18 (1.2)	6 (1.5)	24 (1.3)
Yes	1146 (96.1)	547 (94.6)	1693 (95.6)	1222 (94.4)	530 (95.3)	1752 (94.7)	1450 (98.8)	387 (98.5)	1837 (98.7)
<i>Parity</i>									
1 Child	271 (22.72)	113 (19.55)	384 (21.68)	519 (40.11)	173 (31.12)	692 (37.41)	662 (45.1)	159 (40.46)	821 (44.12)
2 Children	239 (20.03)	96 (16.61)	335 (18.92)	500 (38.64)	205 (36.87)	705 (38.11)	527 (35.9)	137 (34.86)	664 (35.68)
2-4 children	346 (29)	152 (26.3)	498 (28.12)	236 (18.24)	143 (25.72)	379 (20.49)	233 (15.87)	81 (20.61)	314 (16.87)
5+ children	337 (28.25)	217 (37.54)	554 (31.28)	3.01 (39)	6.29 (35)	4 (74)	3.13 (46)	4.07 (16)	3.33 (62)
* Marital categories include Single, Married Cohabiting, Married but not cohabiting, and Separated/Divorced/Widowed									



Table 3.2 presents the univariate and multivariable adjusted logistic regression results for the variables related to socioeconomic adversity. In the adjusted models, there was little evidence for collinearity among representing socioeconomic variation (variance inflation factors ranged between 1.02 and 1.11). Having serious household debt remains a significant factor associated with CPMD across all countries, with very little attenuation after adjustment for socioeconomic and demographic characteristics. Additionally, there is a strong association between perceived inequality and CPMD. In all countries, women who view their family as being worse off than others in their community have more than two times the odds of CPMD than women in households who view themselves as being better off than others in their community. The magnitude is most pronounced in Vietnam, with women who consider themselves being worse off than others in their community having nearly a four-fold increase in the odds of CPMD in the adjusted model. With regard to wealth, there does not appear to be a prominent pattern that emerges with regard to household wealth and the odds of CPMD. Only a weak negative association between household wealth and CPMD appears in India whereby wealth appears to have a protective effect against CPMD only in the richest wealth quintiles. Interestingly, the receipt of remittances by the household, after adjusting for other covariates, seems to be associated with increased odds of CPMD (OR: 1.42; 95% CI: 1.14 – 1.79;  $p < 0.01$ ) in Ethiopia whereas the receipt of remittances does not appear to be associated with CPMD in India or Vietnam. After adjusting for other covariates, we do not find evidence that the mother being the head of the household is associated with the odds of CPMD.

Table 3.2: Odds Ratios Obtained from Unadjusted and Multivariable Adjusted Logistic Regression of a Woman Having a Probable Case of a Common Perinatal Mental Health Disorder on Variables Associated with Socioeconomic Adversity in Ethiopia, India and Vietnam

	Ethiopia		India		Vietnam	
	Univariate OR (95% CI)	Multivariable OR (95% CI) <sup>1</sup>	Univariate OR (95% CI)	Multivariable OR (95% CI) <sup>1</sup>	Univariate OR (95% CI)	Multivariable OR (95% CI) <sup>1</sup>
<b>Number of adverse events (Shocks) in year before birth</b>						
<i>0 Events</i>	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]
<i>1 Event</i>	1.41** (1.014 - 1.958)	1.317 (0.924 - 1.875)	2.35*** (1.733 - 3.182)	1.723*** (1.230 - 2.415)	2.73*** (2.095 - 3.562)	2.23*** (1.672 - 2.983)
<i>2+ Events</i>	2.23*** (1.755 - 2.835)	1.83*** (1.385 - 2.414)	1.77*** (1.420 - 2.204)	1.23 (0.925 - 1.637)	4.60*** (3.420 - 6.182)	3.68*** (2.658 - 5.088)
<b>Mother is head of household</b>						
<i>No</i>	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]
<i>Yes</i>	1.73*** (1.257 - 2.380)	1.229 (0.682 - 2.216)	3.13** (1.082 - 9.077)	3.23 (0.865 - 11.86)	1.79*** (1.180 - 2.717)	1.266 (0.773 - 2.073)
<b>Household Receives Remittances</b>						
<i>No</i>	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]
<i>Yes</i>	1.61*** (1.313 - 1.976)	1.43*** (1.137 - 1.794)	0.826 (0.659 - 1.036)	0.80 (0.627 - 1.022)	0.894 (0.701 - 1.139)	0.966 (0.738 - 1.265)
<b>Household has serious debt</b>						
<i>No</i>	1.0	1.0	1.0	1.0	1.0	1.0

Yes	[ref] 1.89*** (1.532 - 2.333)	[ref] 1.60*** (1.269 - 2.029)	[ref] 1.72*** (1.407 - 2.105)	[ref] 1.35** (1.053 - 1.726)	[ref] 1.96*** (1.554 - 2.460)	[ref] 1.46*** (1.124 - 1.902)
<b>Household compared to others</b>						
<i>Better off</i>	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]
<i>Similar</i>	1.322 (0.941 - 1.857)	1.233 (0.867 - 1.752)	1.59*** (1.216 - 2.090)	1.24 (0.923 - 1.677)	3.226 (0.997 - 10.44)	2.1 (0.609 - 7.205)
<i>Worse off</i>	2.97*** (2.099 - 4.203)	2.49*** (1.720 - 3.602)	4.27*** (2.185 - 8.347)	2.87*** (1.384 - 5.965)	8.76*** (2.716 - 28.23)	3.98** (1.153 - 13.71)
<b>Wealth Quintile</b>						
<i>Poorest</i>	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]	1.0 [ref]
<i>Poorer</i>	0.961 (0.699 - 1.321)	0.941 (0.665 - 1.332)	1.192 (0.888 - 1.599)	1.18 (0.865 - 1.615)	0.81 (0.574 - 1.154)	0.82 (0.553 - 1.220)
<i>Middle</i>	0.803 (0.581 - 1.111)	0.746 (0.514 - 1.084)	0.745 (0.549 - 1.011)	0.74 (0.535 - 1.017)	1.36 (0.973 - 1.886)	1.50** (1.005 - 2.224)
<i>Richer</i>	1.182 (0.870 - 1.605)	1.11 (0.724 - 1.704)	0.61*** (0.447 - 0.831)	0.65** (0.450 - 0.931)	0.75 (0.527 - 1.068)	0.896 (0.582 - 1.380)
<i>Richest</i>	0.839 (0.614 - 1.148)	1.053 (0.630 - 1.761)	0.24*** (0.166 - 0.345)	0.28*** (0.169 - 0.460)	0.62*** (0.428 - 0.896)	0.602 (0.346 - 1.048)

\*\*\* p<0.01, \*\* p<0.05

<sup>1</sup>Adjusted for all variables shown as well as maternal employment, partner employment, ethnicity, religion, urban/rural residence, household size (number of children under 5, children aged 5-15, and adults over the age of 16, maternal age, length of time living in community, and marital/cohabitation status

The number of adverse events remained significant after adjusting for all socioeconomic and demographic variables. In Ethiopia and Vietnam, the results of our adjusted models suggest that there is strong positive relationship between the number of adverse events that a woman experienced and the odds that she will suffer from CPMD. In Ethiopia, the odds of CPMD among women who experienced 2 or more events was estimated at 1.82 (95 CI: 1.39 – 2.41;  $p < 0.01$ ), compared to the reference group, while in Vietnam, the odds that a woman would experience CPMD was estimated at 3.68 (95% CI: 2.66 - 5.10;  $p < 0.01$ ) among women who experienced 2 or more adverse events, compared to 2.23 (95% CI: 1.67- 2.98;  $p < 0.01$ ) among women who experienced 1 adverse event. Additionally, we conducted a sensitivity analysis, in which we fit a model that included the number of adverse events as a continuous variable (not shown). We find that for each additional shock experienced, a woman has 1.26 (95% CI: 1.17, 1.35;  $p < 0.01$ ) times the odds in Ethiopia, 1.07 (95% CI: 0.99, 1.15;  $p = 0.08$ ) times the odds in India, and 1.80 (95% CI: 1.57, 2.06;  $p < 0.01$ ) times the odds in Vietnam of being a probable case of CPMD.

Figure 3.2 presents the distribution of the type of shock according to country and probable CPMD status. The chart illustrates that a larger percentage of women with probable CPMD have experienced each type of shock than women who are not a probable case. The percentage of women experiencing each type of shock is highest in Ethiopia, followed by India and Vietnam for all but family shocks. In all countries, exposure to shocks related to crime is much less common than the other types of shocks.

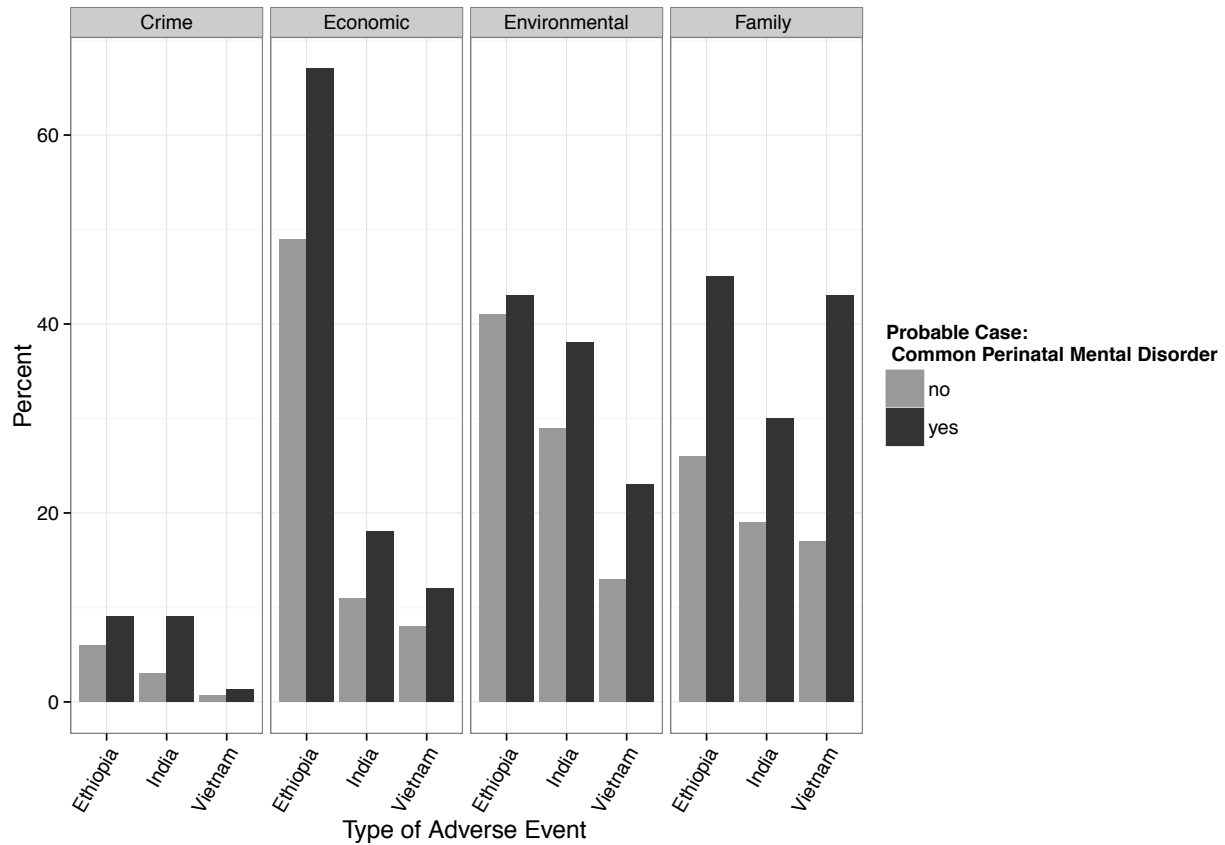


Figure 3.2: Distribution of the Type of Adverse Event (Shock) Experienced by Women in the 12 Months Prior to Giving Birth in Ethiopia, India, and Vietnam According to Common Perinatal Mental Disorder (CPMD) Status

The results presented in Table 3.3 highlight the relative importance of each type of adverse event (environmental, economic, family, and crime) in relation to CPMD. In unadjusted models, nearly all categories of adverse events are significantly associated with CPMD (except for environmental shocks in Ethiopia and crime shocks in Vietnam). In the fully adjusted models, exposure to family shocks remains consistently significant across all countries with odds ratios of 1.86 (95% CI: 1.38 – 2.56;  $p < 0.01$ ), 1.52 (95% CI: 1.05 – 2.21;  $p < 0.05$ ), and 1.89 (95% CI: 1.88 – 2.86,  $p < 0.01$ ), in Ethiopia, India and Vietnam respectively. In Ethiopia, economic shocks are also significantly associated with probable CPMD after adjustment (OR: 1.62; 95% CI: 1.08 – 2.42;

p<0.05), while in India, both economic shocks (OR: 1.52; 95% CI: 1.05 – 2.21; p<0.05) and crime shocks (OR: 2.44; 95% CI: 1.44 – 4.17; p<0.01) are associated with probable CPMD.

Table 3.2: Odds Ratios Obtained from Unadjusted, Partially Adjusted, and Fully Adjusted Multivariable Logistic Regression Analysis Decomposing the Association between Adverse Life Events and Presence of CPMD by Type of Shock Experienced in the 12 Months Prior to Giving Birth in Ethiopia, India, and Vietnam

Ethiopia			
	Unadjusted OR (95% CI)	Partially Adjusted OR <sup>1</sup> (95% CI)	Fully Adjusted OR <sup>2</sup> (95% CI)
Environmental Shock	1.063 (0.869 - 1.300)	0.676 (0.556 - 0.821)***	0.857 (0.606 - 1.213)
Economic Shock	1.986(1.617 - 2.440)***	1.020 (0.842 - 1.234)	1.621 (1.076 - 2.442)**
Family Shock	2.408(1.953 - 2.968)***	1.748 (1.473 - 2.074)***	1.876(1.375 - 2.558)***
Crime Shock	1.671 (1.138 - 2.453)***	1.530 (1.142 - 2.051)***	1.491 (0.958 - 2.320)
India			
	Unadjusted OR (95% CI)	Partially Adjusted OR <sup>1</sup> (95% CI)	Fully Adjusted OR <sup>2</sup> (95% CI)
Environmental Shock	1.443 (1.170 - 1.779)***	0.660 (0.540 - 0.807)***	1.061 (0.718 - 1.568)
Economic Shock	1.852(1.403 - 2.444)***	0.960 (0.787 - 1.170)	1.539 (1.072 - 2.210)**
Family Shock	1.832 (1.457 - 2.303)***	1.732 (1.457 - 2.060)***	1.519(1.046 - 2.208)**
Crime Shock	2.681 (1.773 - 4.054)***	1.189 (0.869 - 1.628)	2.437 (1.435 - 4.136)***
Vietnam			
	Unadjusted OR (95% CI)	Partially Adjusted OR <sup>1</sup> (95% CI)	Fully Adjusted OR <sup>2</sup> (95% CI)
Environmental Shock	1.944 (1.472 - 2.568)***	0.660 (0.540 - 0.807)***	1.103 (0.695 - 1.750)
Economic Shock	1.507 (1.047 - 2.169)**	0.960 (0.787 - 1.170)	0.811 (0.506 - 1.298)
Family Shock	1.507 (1.047 - 2.169)***	1.732 (1.457 - 2.060)***	1.885 (1.241 - 2.864)***
Crime Shock	1.507 (1.047 - 2.169)	1.189 (0.869 - 1.628)	0.889 (0.266 - 2.964)

\*\*\* p<0.01, \*\* p<0.05

<sup>1</sup>Adjusted for all variables shown as well as maternal employment, partner employment, ethnicity, religion, urban/rural residence, household size (number of children under 5, children aged 5-15, and adults over the age of 16, maternal age, length of time living in community, and marital/cohabitation status

<sup>2</sup>Adjusted for all variables in the partially adjusted model and type of shock

The stratified results that include the interaction term for CSC are presented in Table 3.4. For all countries, we find that a high level of social capital is protective against CPMD (results not shown). Once the interaction term is included in the model, the only interaction term that reaches significance is in Ethiopia. These results suggest that in Ethiopia, high levels of social capital are protective against CPMD, as there is evidence for qualitative effect modification (the p-value for the interaction term is 0.05). The results indicate that among women with a degree of CSC those who experience two or more adverse events have 0.83 (95% CI: 0.50, 1.36) times the odds of experiencing CPMD compared to women who have experienced less than two adverse events. Similarly, we see that women who have low levels of social capital and have had two or more adverse events have 3.17 (05% CI: 0.82, 12.31) times the odds of CPMD when compared to similar women who had less than two adverse events.

*Table 3.4: Stratified Odds Ratios Obtained from Multivariable Logistic Regression Analysis to Assess Interaction Between Social Capital Level and Experience of Adverse Life Events on the Presence of CPMD in Ethiopia, India, and Vietnam Comparing the Odds Ratios for Women with High Versus Low Levels of Social Capital*

<b>Country</b>	<b>High Social Capital (OR 2 vs 0 events)</b>	<b>Low Social Capital (OR 2 vs 0 events)</b>	<b>P-value for Interaction</b>
Ethiopia	0.83 (0.50, 1.36)	3.17 (0.82, 12.31)	0.05
India	1.34 (0.84, 2.12)	1.10 (0.04, 31.11)	0.60
Vietnam	1.22 (0.77, 1.91)	6.65 (1.06, 41.79)	0.43

## **Discussion**

This study highlights several important factors related to socioeconomic adversity and CPMDs in LMICs. First, this study provides evidence that in all three study countries, socioeconomic adversity has a strong and independent effect on the odds of having a probable case of CPMD. Second, while there is considerable variation by country in the types of adverse



events faced by a woman during the pre-natal period that are most strongly associated with CPMD, the association between CPMD and being exposed to a family shock is consistent across all three countries. Finally, the results of this study provide evidence that social capital may serve as a buffer between exposure to adversity and CPMD, although there is some heterogeneity across countries.

This study indicates that socioeconomic disadvantage operates according to multiple dimensions in order to increase a woman's risk for developing CPMD, which is consistent with the growing body of literature from LMICs that shows that CPMD is patterned according to socioeconomic disadvantage and adversity. Of note, in our study, household debt and a mother's perceptions of inequality with regard to how she views her household in relation to other households within the community both have a particularly powerful effect after adjusting for other factors related to socioeconomic adversity. Few studies have examined the relationship between household debt and CPMDs [155, 251]; however, the insidious role that debt can play in undermining economic stability within a household may be particularly important for women and families living at the edge of poverty, especially those with a young child. Additionally, very few studies have examined the role of socioeconomic inequality on CPMD. While in our study, we are unable to determine whether perceptions of inequality pre-date the development of a CPMD or whether having the CPMD causes a woman to feel that she is worse off than others in her community, our results support the results of another study that found that relative socioeconomic advantage, even among the poor, seems to provide a protective effect on maternal mental health [126]. This may represent an important direction for future research on the association between inequality and CPMDs. These results indicate that policies designed to

improve the economic stability and wellbeing of financially vulnerable women may have significant mental health impacts [148].

Our study failed to find a consistent association between household wealth and CPMD with the only clear association between wealth and CPMDs occurring in India. While a majority of the literature on this topic from both HICs and LMICs finds household wealth to exert a protective effect on CPMDs [138, 141, 148-153], the data used in this study were obtained from a sampling strategy that intended to over-represent the most socioeconomically disadvantaged households [194]. As a result of the characteristics of the sample, there may not have been enough wealthy households included in the study in order to be able to detect a protective effect.

We find several important results with regard to the exposure to adverse events and CPDMs. Notably, their number appears to exert a cumulative effect of the risk of CPMD in Ethiopia and Vietnam, as women who experienced two or more shocks in the 12 months prior to giving birth have significantly higher odds of having CPMD than women who experienced no shocks, and in Ethiopia and Vietnam, we also see a significant association between each additional shock a woman is exposed to and her odds of being a probable case of CPMD in the model that incorporated the number of events as a continuous variable. In situations with multiple shocks, the occurrence of different types of adverse events may be related, thus causing them to occur in conjunction with one another [240]. For example, a household's exposure to a crime may be related to the death of a family member. Studies using data from Young Lives report that households that report facing multiple adversities, often face them in rapid succession [252]. Consistent with this finding, in our study, few households experienced only one shock. Women in households that experience more shocks within a short period of time may find it more difficult

to recover and cope with the changes to household well-being. Another study using the same dataset found that households typically respond to shocks by eating less and reducing household assets [252] – both of which may negatively affect maternal mental health.

Both the consistency of our results and the heterogeneity in effect that is observed across countries with regard to the different types of adverse events that have the strongest influence on CPMD have important implications. The consistency in the effect of family shocks indicates that household disruptions and changes may be devastating to mothers in the perinatal period, and they may be an important population to target in interventions strategies. Studies in HICs have found that mothers rely on coping resources from within their close interpersonal relationships [165]. In the intergenerational households that are found throughout many LMICs, women may find these supportive resources from the individuals within their household environment. For households that experience paternal death or illness in Ethiopia, India, and Vietnam, household members rate it as the most severe event that they experience with regard to their household's well-being [240]. A qualitative study in Malawi found that post-partum women considered the inability to rely on their partners or other family members for financial or emotional support during the perinatal period as a risk factor for the development of CPMDs [253]. Unlike in Ethiopia and Vietnam, in India, being exposed to a crime-related shock during the pre-natal period is highly associated with perinatal depression, despite the relatively low prevalence of such shocks. While the underlying mechanisms through which these types of shocks affect CPMD are unclear, one study in South Africa suggests that being exposed to such a shock may serve to erode trust in a tumultuous community environment [251].

Finally, this study demonstrates that CSC has the potential to buffer the impact of exposure to adversity on CPMD. This is the only study that we know of to demonstrate this effect; however, we found evidence for this result only in Ethiopia. There may be several reasons for the heterogeneity observed between countries. The economic literature on adverse events differentiates between common shocks, defined as those that affect everyone within a community, and individual shocks, defined as those that only affect an individual [157]. A study that examined community exposure to shocks by aggregating household shock data from a later wave of the Young Lives found that when shocks occurred in Ethiopia, they were more likely to affect a large proportion of other individuals within their community than in the other study countries [240]. As the measure of social capital that we use in this study focuses on an individual's perception of their communities with regard to trust, social harmony, perceived fairness, and their sense of belonging, perhaps CSC is particularly well-suited to help women cope with the shared nature of the shocks experienced in Ethiopia. Women who are caring for young children in the home may rely extensively on resources available in their community for support [186]. Taking this a step further, another potential reason for the differences in the interaction between adverse events and social capital observed across countries may be related to the type of social capital that we included in our analysis. Perhaps other types of social capital, such as structural social capital, would emerge as being important for other settings that are exposed more often to other types of individual-based shocks [189, 241]. Structural social capital is somewhat similar to the concept of social support, and refers to the behavioral component of social capital, such as participation within groups and social institutions within a community, [179] which may also be associated with mental health outcomes [176].

This study should be interpreted in light of several limitations, of which several pertain to the data used in this analysis. While this study uses data from a community-based sample, thus making the results of this study more generalizable than most of the studies in which participants were recruited from facilities [126], the Young Lives dataset still should not be interpreted as being nationally representative in any of the study countries. Participants were oversampled from the poorest and most disadvantaged communities and do not reflect the national population [199]. With regard to the data available on shocks, we do not have data as to whether individual shocks were related to each other or on the perceived severity of the shock. Also, as women were only asked to report events that they believed disrupted their household's wellbeing, we do not have a comprehensive accounting of all shocks, and a woman's decision to include a particular shock in her response may be dependent upon cultural and social norms related to the interpretation of the severity of the event. Finally, we have no data on the mental health status for the women in the study prior to the post-partum assessment used in this analysis. As a result, we cannot control for the existence of mental disorder prior to pregnancy. Previous research has found an association between episodes of depression and anxiety before pregnancy and perinatal-depression [254].

Our study may also be subject to selection bias relating to survival. In order to be eligible to participate in the study, women must have given birth to a child within 18 months prior to enrollment, and the child must have been alive at the time of enrollment in the study. As a result, women who had a child who died prior to enrollment were not included, which could potentially affect the generalizability of this study women who experience the death of a child are more likely to experience CPMDs [255, 256].

Finally, the cross-sectional design of the study leads to some additional limitations. Collecting data on adversity retrospectively may lead to some women to over-report adverse life events or socioeconomic disadvantage, perhaps as a product of CPMD itself [131]. Also, as the temporal association between the onset of CPMD and social capital is unknown, it is possible that the presence of CPMD caused a decline in social capital, rather than the reverse [257].

## **Conclusions**

In conclusion, this study provides important evidence that social disadvantage and adversity put women at increased risk for the development of CPMDs in three diverse LMICs. Longitudinal studies that are not limited by the cross-sectional design of this study are needed to better understand the temporal relationship between the variables studied. The findings of this study may help programs in the identification of the most vulnerable, while they also point towards potential interventions strategies, by way of social capital, to improve maternal mental health outcomes. Interventions designed to reduce the risk of CPMDs may be most important in contexts where women face multiple adversities and layered disadvantage with limited social capital [132, 134].

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