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UNIVERSITY OF CALIFORNIA SAN DIEGO

SAN DIEGO STATE UNIVERSITY

Health implications and social network dynamics of emigration and depressive symptoms among “left-behind” Indigenous Maya in the western highlands of Guatemala

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy

in

Public Health (Global Health)

by

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2022

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University of California San Diego
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2022

Dedication

This dissertation is dedicated to the communities of the Tajumulquito health district in rural Guatemala. They have suffered, sacrificed, and persevered for generations to survive and secure a stronger future for their children, and their children's children. I have been welcomed into their homes and lives for 20 years, not only as a colleague in community healthcare and research, but also as part of their families. I am infinitely blessed to have met them when I was a young woman and I dedicate this dissertation and years of work ahead to them, and to their children's children.

Table of Contents

Dissertation Approval Page	iii
Dedication.....	iv
Table of Contents.....	v
List of Tables	vi
List of Figures.....	viii
Acknowledgements	ix
Vita	xii
Abstract of the Dissertation	xiv
Chapter 1: Introduction.....	1
1.1 International migration.....	1
1.2 Trends in international migration theory	2
1.3 Social and mental health impacts of international migration.....	2
1.4 Dissertation overview and conceptual frameworks	3
1.5 Figures.....	6
Chapter 2: Through our own eyes and voices: The experiences of those “left-behind” in rural, Indigenous migrant-sending communities in western Guatemala	7
2.1 Introduction	7
2.2 Methods	10
2.3 Results	17
2.4 Discussion and conclusions	31
2.5 Figures	37
Chapter 3: Socio-centric network dynamics of emigration in a rural migrant-sending community in the Western Highlands of Guatemala.....	40
3.1 Introduction	40
3.2 Methods	53
3.3 Results	56
3.4 Discussion and conclusions	60
3.5 Tables and figures.....	69
Chapter 4: Social network dynamics as moderators of the impact of being "left-behind" to international migration and depression in rural Guatemala.....	78
4.1 Introduction	78
4.2 Methods	83
4.3 Results	88
4.4 Discussion and conclusions	93
4.5 Tables and figures.....	100
Chapter 5: Conclusion	110
Supplementary appendix	116
References	128

List of Tables

Table 3.1 Summary statistics individual survey	69
Table 3.2 Results of logistic regression on predictors of migration	70
Table 3.3 Results of logistic regression on relationships remaining in home network as predictors of migration.....	71
Table 3.4 Results of logistic regression analyses testing the effect of an individual’s network characteristics on the probability of migration	71
Table 3.5 Results of logistic regression on predictors of migration (MALE).....	72
Table 3.6 Results of logistic regression on relationships remaining in home network as predictors of migration (MALE).....	73
Table 3.7 Results of logistic regression analyses testing the effect of an individual’s network characteristics on the probability of migration.....	73
Table 3.8 Results of logistic regression on predictors of migration (FEMALE)	74
Table 3.9 Results of logistic regression on relationships remaining in home network (FEMALE)	75
Table 3.10 Results of logistic regression analyses testing the effect of an individual’s network characteristics on the probability of migration	75
Table 4.1 Summary statistics individual survey	100
Table 4.2 Bivariate regression on predictors of depressive symptoms	101
Table 4.3 Results of GLM logistic regression on predictors of depressive symptoms (EMIGRANT TIE).....	102
Table 4.4 Results of GLM logistic regression on predictors of depressive symptoms (NUMBER OF EMIGRANT TIES)	102
Table 4.5 Results of GLM models on possible network moderators of depressive symptoms.....	103
Table 4.6 Bivariate regression on predictors of depressive symptoms (MALE)	104
Table 4.7 Results of GLM logistic regression on predictors of depressive symptoms (MALE)	105
Table 4.8 Bivariate regression on predictors of depressive symptoms (FEMALE).....	106
Table 4.9 Results of GLM logistic regression on predictors of depressive symptoms (FEMALE).....	107
Table 4.10 Results of GLM models on possible network moderators of depressive symptoms (FEMALE)	107
Supplementary Table 4.1 Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, Binary Exposure for emigrant tie...	119
Supplementary Table 4.2 Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, # ties exposure.....	120
Supplementary Table 4.3 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, Binary exposure for emigrant tie.....	120
Supplementary Table 4.4 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, including covariates from multivariate models, # emigrant ties exposure	121
Supplementary Table 4.5 Additional Models: Results of GLM models on moderators of depressive	

symptoms among those left behind to migration, including covariates from multivariate models, Binary exposure for emigrant tie.....	121
Supplementary Table 4.6 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models.....	121
Supplementary Table 4.7 Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, Binary Exposure for emigrant tie, By sex (MALE)	122
Supplementary Table 4.8 Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, # ties exposure, By sex (MALE)....	123
Supplementary Table 4.9 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, Binary exposure for emigrant tie, By sex (MALE).....	123
Supplementary Table 4.10 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, # emigrant ties exposure, By sex (MALE)	124
Supplementary Table 4.11 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models, By Sex (MALE).....	124
Supplementary Table 4.12 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models, By Sex (MALE).....	124
Supplementary Table 4.13 Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, Binary exposure for emigrant tie, By sex (FEMALE).....	125
Supplementary Table 4.14 Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, # ties exposure, By sex (FEMALE).....	126
Supplementary Table 4.15 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, including covariates from multivariate models, Binary exposure for emigrant tie, By sex (FEMALE)	126
Supplementary Table 4.16 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, including covariates from multivariate models, # emigrant ties exposure, By sex (FEMALE)	127
Supplementary Table 4.17 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models, By Sex (FEMALE).....	127
Supplementary Table 4.18 Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models, By Sex (FEMALE).....	127

List of Figures

Figure 1.1 Conceptual model detailing Community Based Participatory Research (CBPR) framework	6
Figure 1.2 Conceptual model detailing the Migratory Agency framework	6
Figure 2.1 Carlos’ representation of the poverty in his community	38
Figure 2.2 Brigida represents the desire to live with dignity with an image of stray dogs digging through garbage.....	38
Figure 2.3 Roberto describes a home that is possible with family in the United States.....	38
Figure 2.4 Catarina’s depiction of children with the opportunity to study because of parents that have emigrated	39
Figure 2.5 Carlos shares a bathroom in a home without someone in the United States	39
Figure 2.6 Carmen represents a family broken apart.....	39
Figure 2.7 Marta fears the children in her community may end up in the streets	40
Figure 2.8 Oscar shares graffiti representing MS 13 in his community.....	40
Figure 2.9 Marta is afraid of the growing presence of known gangs in her community.....	40
Figure 3.1 Migratory Agency Framework.....	76
Figure 3.2 Violin plot illustrating the probability density by age in years of an individual’s plans to emigrate to the United States within 12 months.....	76
Figure 3.3 Violin plot illustrating the probability density by age in years of having a child emigrated to the United States	77
Figure 4.1 Predicted probabilities of falling above the threshold for symptoms of major depression associated with number of emigrant ties at the mean level and +/- 1 standard deviation of out-degree...	108
Figure 4.2 Odds of falling above the threshold for major depressive symptoms associated with number of emigrant ties, stratified by three levels of out-degree	108
Figure 4.3 Predicted probabilities of falling above the threshold for symptoms of major depression for females with and without emigrant ties at the mean and +/- 1 standard deviation of transitivity score ...	109
Figure 4.4 Odds of falling above the threshold for major depressive symptoms for females with emigrant ties (compared to those without emigrant ties), stratified by five levels of transitivity score.....	109

Acknowledgements

I would like to acknowledge the many colleagues, family, and friends that I relied on for support during the completion of this PhD. First and most importantly, I would like to acknowledge the community residents that were both partners and participants in this research. Thank you for your keen interest in designing and executing this project and for candidly sharing your lives with us through your stories and data. I would like to thank my dissertation committee: Drs Holly Baker, Kimberly Brouwer, Eric Leas, Samantha Hurst, Ramona Perez, and Kate Swanson. And an additional thank you to Dr David Strong for being a steady guide star to myself and many of my peers in our more difficult moments. Dr Baker, thank you for your hundreds of hours of guidance, especially for holding me to your high standards and your patience through my growth while trying to reach those standards; you have most certainly made me a better scientist. Dr Brouwer, thank you for being a steadfast and kind guide during this challenging process. Dr Leas, thank you for always being available to discuss research questions, statistical methods, R code, critiques on my writing, and for treating me as both mentee and peer. You have been one of the most important people in my final stretch of completing this PhD and have helped me find the confidence to persevere. Dr Hurst, you have become not only a trusted colleague, but also a dear friend and life mentor. Thank you for our hours-long phone calls, for both academic guidance and personal support; I would not have made it through this process without you. Dr Perez, thank you for being a source of inspiration for myself and women scientists everywhere. Dr Swanson, thank you for being a warm and kind source of support and for understanding the great difficulties and rewards of working in our field. I owe a special acknowledgement to graduate students Luis Mandujano, who travelled to Guatemala and so empathetically assisted with data collection, and Ricardo Flores, who assisted with hours of transcription and translation of interview data.

Thank you to the Directors of the National Hospital and the Director of the Ministry of Health in San Marcos, Guatemala for allowing me to do this work. Thank you to the Auxiliaries of the communities whose data was used in this research, for taking hours of meetings to discuss the project and results, and for garnering support from your residents. A very special thank you to Conrado and Neftali

for helping facilitate all aspects of data collection for this research. Thank you to Eduardo “Guayo” Niz, who served as the nurse in the communities that participated in this research and has been a great friend and colleague for 20 years, may you rest in peace and know all of the good you did serving your community. Thank you to Don Simón, Doña Rosalinda, Claudia, and so many others – “mi familia” in Guatemala. We have shared meals together, prayed on our knees together at night, and I have watched your children grow; you cared for me when I was sick, discussed issues happening in your communities, and provided me the support only a family can. Thank you to Bridget Meyer Salazar and Valentin Salazar for being my partners in this work and my biggest cheerleaders for 20 years; I know you share in the joy of completing this degree. Thank you to Helen Lopez and her gracious family in Guatemala for always working so hard to help with this work and welcoming me into your homes. Thank you to Saul Bejarano and family for being so generous to the communities involved in this research and for being champions of my work there. Thank you to my colleagues Dr Erin Delker, Dr Erik Hendrickson, Dr Lorena Pacheco and Kazi Priyanka Silmi, that went through this process with me; your hours of supportive phone calls, texts and advice were invaluable and all that got me on to the next step at times.

Thank you to my friends and family who supported and kept me afloat over these sometimes-difficult years. Thank you to my grandparents, Gordon and Marvis McRoberts and Earl “June” McRoberts, for laying the scaffolding by which to build my life on and the compass by which to live it. To my parents, Barbara and Charles Laughery and Dennis Ciborowski for always believing that I could accomplish this feat and supporting me. Thank you to my sisters, Stephanie and Hillary Laughery and Rebecca Curry for being my biggest fans and rallying around me when I truly needed lifting up. Thank you to my brother, Scott Ciborowski for coming back into my life during this process and bringing me peace and joy in our relationship. Thank you to my aunts and uncles for being my second line of defense when I needed you; especially my aunt Bonnie Rae Dodson – I AM multifaceted just like a diamond – thank you for making sure I always knew that. Thank you to my cousins, my first heroes and friends, my teammates - growing up with you has been a hoot and an honor. Thank you to my wonderful friends,

especially Breanna Ray Clemens, Robby Tuttle, Felipe Eduardo Maytorena, and Mark Jennings, you have provided me with love, laughter, escape, space to work, and the support that only great friends can.

Chapter 2, “Through our own eyes and voices: The experiences of those “left-behind” in rural, Indigenous migrant-sending communities in western Guatemala” has been published in the Journal of Migration and Health. Co-authors include Drs Samantha Hurst, Ramona Perez, Kate Swanson, Eric Leas, Kimberly Brouwer, and Holly Baker Shakya. The dissertation author was the primary investigator and author of this material.

Chapter 3, “Sociocentric network dynamics of emigration in a rural migrant sending community in the Western Highlands of Guatemala” is currently being prepared for submission for the publication of the material. Co-authors include Drs Eric Leas, Kimberly Brouwer, Ramona Perez, Samantha Hurst, Kate Swanson, and Holly Baker Shakya. The dissertation author was the primary investigator and author of this material.

Chapter 4, “Social network dynamics as moderators of the impact of being “left-behind” to international migration and depression in rural Guatemala” is currently being prepared for submission for the publication of the material. Co-authors include Drs Eric Leas, Kimberly Brouwer, Kate Swanson, Ramona Perez, Samantha Hurst, and Holly Baker Shakya. The dissertation author was the primary investigator and author of this material.

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Abstract of the Dissertation

Health implications and social network dynamics of emigration and depressive symptoms among “left-behind” Indigenous Maya in the western highlands of Guatemala

by

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Doctor of Philosophy in Public Health (Global Health)

University of California San Diego, 2022

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Background: Migrants from countries in the Northern Triangle made up 92% of attempted crossings on the United States Southern international border in 2021; Guatemala is the top sending country in that region. Scholarship in Guatemala has focused on escape from violence and economic opportunity as reasons for migration; however, drivers of migration are more complex, including “aspirations” of transnational families and influences of social networks. Furthermore, few studies have addressed the mental health distress caused by being “left-behind” to migration in Guatemala. Social

network characteristics may moderate some mental health impacts of migration, but this has not been investigated using socio-centric network data from Central American migrant-sending communities.

Methods: This dissertation includes three studies undertaken in partnership with participants using CBPR. Study 1 leverages data from focus groups and Photovoice interviews to investigate perceived changes from migration impacting community health. Qualitative results informed the research questions in studies 2 and 3. Studies 2 and 3 use data from a census of a representative community in the region. Study 2 evaluates the demographics, social network characteristics, and network dynamics influencing migration decisions. In study 3, we evaluate the relationship between migration and depressive symptoms, and the social network characteristics that may moderate that relationship.

Results: Migration impacts rural communities in Guatemala in several ways, including mental health distress among those left-behind (Study 1). Twenty-two percent of the population had plans to migrate. Having a child emigrate reduced the odds of migration (OR 0.08). A spouse remaining was predictive of migration (OR 2.38) (Study 2). Having emigrant ties in the US increased the odds of depression (OR 1.11), as did a higher out-degree. Higher transitivity scores, especially for women, moderated the relationship between migrant ties and depression (Study 3).

Conclusions: Migration changes social structures in rural Guatemalan communities, resulting in feelings of sadness and loss. Social network characteristics influence migration decisions among transnational families. Migration from the region is not slowing, so understanding the mental health impacts in migrant-sending communities is imperative. Social network characteristics should be explored in further research as potential assets to ease mental health burdens among those left-behind.

Chapter 1: Introduction

1.1 International migration

According to the United Nations Department of Economic and Social Affairs, the number of international migrants worldwide has grown faster than the global population; that number reached 272 million in 2019, an increase of 51 million in less than a decade.¹ Fourteen percent of international migrants are below the age of 20, three-quarters are working-aged adults (20-64), and just slightly less than half are women.¹ The Southwest United States Border is one of the most transited in the world and is the destination for international migrants attempting to cross from origin countries in Central America. According to U.S. Customs and Border Protection, 1.6 million migrants were encountered between ports of entry in FY 2021, compared to 396,579 in 2018.² Migrants from Guatemala, Honduras, and El Salvador, the most dangerous countries in Central America known as the Northern Triangle, made up more than 90% of those attempts to cross the border.² Guatemala sends more migrants than any other country in the Northern Triangle, and the districts of San Marcos and Huehuetenango, near the border of Chiapas, Mexico, are Guatemala's highest volume sending areas.²

The setting for the research presented in this dissertation is the rural highlands of the San Marcos district, where all residents are of Indigenous Maya descent and have faced structural violence and oppression for generations. Migration research in Guatemala since the end of the civil war in 1996 has focused on migration as a strategy to escape violence, oppression, and the effects of poverty.³ However, there is a significant gap in literature identifying the complex dynamics behind migration decisions and the impacts of more than 25 years of migration post-civil war. Adding to the urgency of understanding migration from this region is the reality that it is unlikely to slow, as most residents are small-holder farmers relying on the production of coffee and subsistence crops. People living in these rural areas producing crops sensitive to drought and other extreme weather events are positioned among the most vulnerable to climate change, likely resulting in sustained or increased migration over the next several decades.⁴

1.2 Trends in international migration theory

Traditional migration theory suggests that migration decisions result from either “push” or “pull” factors. Factors pushing people away from home include violence and lack of employment, while factors pulling people to a destination country include draws like economic opportunity.^{5,6} Modern iterations of migration theory have evolved along with the shifting reasons for the movement of people.

Improvements in communication technology have been influential in the proliferation of “transnational families.”⁷ These family units may diversify their social capital by maintaining familial ties between members who have migrated and those remaining in the country of origin.^{8,9} The decisions about which members migrate and which remain at home are negotiated transactions between those able to migrate and those who will remain as caregivers to older family members and children.⁷ Contemporary migration theory since the turn of the century has pivoted toward the “drivers of migration,” or the forces at play when making migration decisions.¹⁰⁻¹² These forces include individual and family unit “aspirations” and encompass the influence of social networks on migration decisions.¹³ Migration decisions by individuals and families from rural Guatemala have changed since the end of their civil war, as escaping violence and oppression led to sustained flows for economic opportunity.¹⁴ Current migration decisions from the region are more complex, as trafficking lanes on the journey and support networks in the United States are well-established. Transnational families’ decisions to send representative members to diversify risk is increasingly the norm in rural farming communities. The rise of cartel activity and gang violence in the border region between Mexico and Guatemala is also influencing family migration decision-making.^{15,16} Families weigh escaping from gang violence and providing children with educational opportunities to avoid their involvement against the risk of leaving children to grow up without one or both parents.

1.3 Social and mental health impacts of international migration

There is a large body of migration scholarship focused on those that have migrated to a destination country. Migration scholars often refer to those that have not migrated but remain home in sending countries as “left-behind” persons. While far less research focuses on these populations, there is evidence that the loss of a parent, adult child, spouse, or other close social ties causes emotional,

behavioral, and developmental stress.¹⁷⁻²⁴ Migration research with those “left-behind” has documented significant increased depressive symptoms as well as reduced psychological well-being, loneliness, anxiety, and reduced emotional health.²⁵⁻³¹ Drastic changes in social networks of left-behind communities may be responsible for some of these poor mental health outcomes.^{32,33} There is evidence that social ties and network cohesion remaining at home can moderate the relationship between significant network relationships that have migrated and negative mental health consequences.^{30,34-36} For example, having a spouse remaining at home or particular friendship ties have effectively moderated the impacts of depression.^{37,38} Previous studies have found that social network size influences mental health outcomes; individuals with smaller networks may be more likely to experience depressive symptoms.³⁹ Other measures of social network position also impact mental health; for example, higher network centrality is associated with a significantly reduced likelihood of depression.⁴⁰ Social network “transitivity,” or the probability that two of an individual’s friends are also friends with one another is also important, as low transitivity is associated with social isolation, poor mental health outcomes, and suicidal ideation.⁴¹ There is evidence that the influence of social networks on migration and mental health outcomes may vary between men and women.^{42,43} Previous research has suggested that the differences in caregiving roles may be partly responsible for those differences, as women may be more exposed to traumatic or adverse events in the lives of those in their networks.⁴² While social network measures may be valuable in understanding some mental health outcomes associated with migration, they may also provide insight into the decision to migrate itself. Migration research has documented the influence of network ties in migration decisions. Some studies have found both social and symbolic ties linking individuals in migration networks and evidence of migrants using social capital and risk diversification within networks making collective migration decisions.⁴⁴⁻⁵¹

1.4 Dissertation overview and conceptual frameworks

The overall goal of this dissertation is to examine the drivers and impacts of migration from a unique social network perspective in a rural migrant-sending region of western Guatemala. We consider this in the following three chapters of this dissertation. Chapter 2 leverages data collected using two

qualitative methodologies designed in partnership with the communities themselves. Focus groups and Photovoice interview techniques allow research participants to share with “outsiders” their perceptions about the future of health in their communities in their own voices and images. Findings from Chapter 2 informed the research questions and methodologies addressed in Chapters 3 and 4. We use socio-centric network data from a single representative community in chapters 3 and 4 to examine drivers of migration and the mental health impacts of sustained migration from a novel social network perspective. Chapter 3 evaluates the demographics, social network characteristics, and social network dynamics influencing migration decisions. Chapter 4 evaluates social network characteristics and dynamics of depressive symptoms among residents of a community heavily impacted by sustained international migration to the United States.

This dissertation is a multi- and mixed-methods study, so the research questions were guided by two conceptual frameworks. Informing the project in its entirety, especially Chapter 2, are the principles of Community Based Participatory Research (CBPR).⁵² CBPR engages community members as partners in research design, collaborative discourse, and policy and intervention development. This conceptual model goes beyond research methodology to focus on partnerships between academics and communities that may otherwise be the “subject” of research (Figure 1.1).⁵³ The CBPR framework assumes co-learning, mutual benefit, and a long-term commitment between partners to prevent further marginalization.⁵⁴ CBPR is considered a strategy to decolonize and reduce racial health disparities in research by partnering with communities to incorporate their cultural practices and theoretical knowledge.⁵⁴ In CBPR, participants are involved in design and data production, democratizing knowledge, and authenticating community experiences in research about their lives.⁵⁴

Secondly, as we examine migration outside of traditional theoretical models, we have adapted the Aspirations-capabilities framework from Hein de Haas (2021) (Figure 1.2).¹³ This framework does not treat migrants as passive actors pushed and pulled by external forces but acknowledges their capabilities and aspirations to migrate within opportunity structures. This framework incorporates positive and negative liberties from Berlin (1969), which views migration as non-linear and complex;⁵⁵ it also adapts

the capabilities migration framework from Sen (1999), which views human mobility as a function of the choice to migrate and the choice not to migrate.⁵⁶ For people to access that choice, they must also have access to the required social and economic resources and the structural and environmental factors associated with sustained migration flows. The Aspirations-capabilities framework focuses on emotional connections and temporality and embraces “aspirations” and “drivers” of migration beyond causes and determinants.¹³ The concepts of aspiration and desire are tied to individuals’ relationships with the possibility of migration and to their relationships with others that have migrated, lending this framework to social network analysis.¹³ Migration aspiration is related to the diffusion of information within networks: individuals observe the ability of others to migrate and come to view it as a strategy for their own families.⁵⁷ Networks in sending and receiving countries influence migration decisions, and networks in destination countries help explain sustained migration flows.⁵⁸⁻⁶¹

Social network analysis has been missing in migration research, leaving a significant gap in literature understanding migration processes and outcomes from a network perspective.⁶² Social networks are integral to spatial mobility, destinations, and successful integration at those destinations.^{44,63-75} Social networks are also inextricably tied to the impacts of migration on those “left-behind”; in high-volume migrant-sending areas, social network compositions drastically change as members leave and transnational families become a normalized risk-diversification strategy. In sum, this dissertation adds to the literature understanding migration and its impacts from within a high-volume migrant-sending area from their own perceptions. It also addresses the drivers of migration and subsequent mental health consequences from a novel socio-centric network perspective.

1.5 Figures

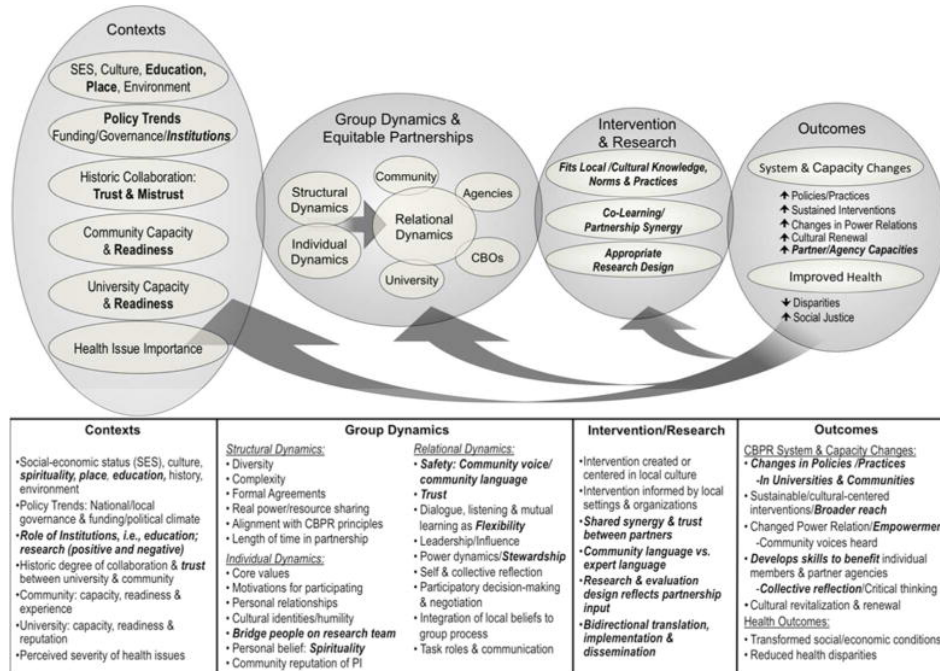


Figure 1.1. Conceptual model detailing Community Based Participatory Research (CBPR) framework, adapted from Wallerstein et al. (2008)⁵²

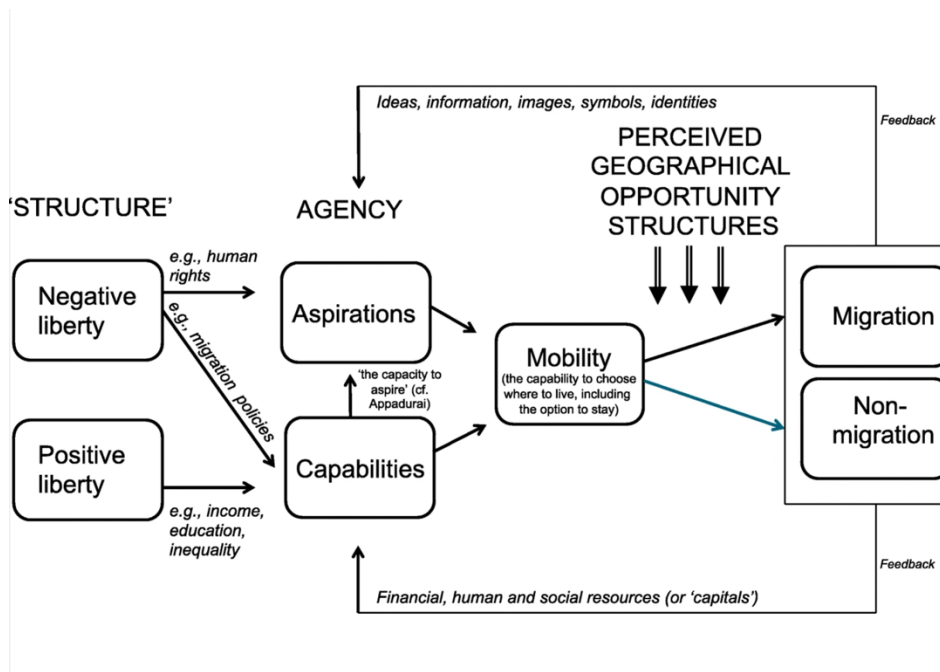


Figure 1.2. Conceptual model detailing the Aspirations-capabilities framework, adapted from De Haas (2021)¹³

Chapter 2: Through our own eyes and voices: The experiences of those “left-behind” in rural, Indigenous migrant-sending communities in western Guatemala

2.1 Introduction

Guatemalan Mayan people in the rural highlands emigrate to the United States at high rates as a result of economic poverty, exclusionary state policies, and gang violence. For many Indigenous Guatemalans, their current circumstances of extreme poverty are tied to years of government oppression and a violent civil war, and genocide.^{76,77} Guatemala’s recent history includes a 36-year civil war that ended in 1996. The Ladino government and military, with support from the United States, was responsible for the deaths of more than 200,000 people from some of the poorest areas of Guatemala.^{78,79} In highland Maya communities, the military was involved in more than 90% of 669 massacres of Indigenous people with many of these attacks being forcibly carried out in part by members within their own communities.⁸⁰⁻⁸²

Immigrants from Guatemala fled to the United States as refugees during the war, setting off the first waves of immigration north in the 1960s.⁸³⁻⁸⁵ The civil war and subsequent economic policies that favor large-scale agricultural exports like the Central American Free Trade Agreement (CAFTA) have resulted in financial pressure on rural Indigenous families.^{86,87} As with many areas that suffer from severe poverty, exclusionary policies, and weak government, gang violence and murder rates postwar have escalated, making Guatemala one of the most violent and dangerous countries in the world.^{88,89}

Drug trafficking and cartels in Guatemala became one of the dominant power structures in the postwar period in the 1990s, and was connected with the drug trade in Mexico and Colombia and exported into the United States.¹⁵ Cartels began working with corrupt military officials and law enforcement to create transport channels through Guatemala. This resulted in the rise of Guatemalan gangs and cartel groups with their own power structures in rural and border areas where drug trafficking routes emerged.¹⁶ These structures are still in force today in rural regions surrounding the border between Guatemala and Mexico and continue to lure and force participation of rural farming communities.

In addition to violence, financial issues are often stated as the top reason for households to incur substantial debt and send family members as undocumented workers to the United States.⁹⁰ The lack of economic opportunities and ongoing violence have prompted decisions to leave home to risk dangerous and expensive passage to the United States, creating “transnational families.” Remittances from the United States to Guatemala accounted for more than 12% of GDP in 2018.⁹¹ Despite the advances in economic stability that these remittances create for many families, research has documented that separation due to out-migration result in negative psychosocial consequences for those left behind.^{92,93} Transnational families face a unique set of challenges, including negative psychological and social impacts, feelings of isolation and sadness from separation, and financial and other stresses that result from the threat of deportation from the US.^{94,95}

According to the US Customs and Border Protection Agency, in FY 2021 there were 235,035 individuals with origins in Guatemala apprehended trying to cross the Southwest border of the United States.² The border region between Guatemala and Mexico is one of the largest outmigration regions⁹⁰ in all of Central America and Mexico.⁹⁶ The rural highlands within the departments of San Marcos and Huehuetenango, which are located in this border region, are the largest migrant sending areas in all of Guatemala.⁹⁶ The specific setting for this research is in rural highland communities of the Tajumulco municipality, within the department of San Marcos. People living in Tajumulco are of mostly Indigenous Maya descent, and have been through civil war and genocide, and continue to experience institutionalized structural violence and discrimination by the state.^{97,98} Many Indigenous Maya in this region reside in rural communities without paved roads and basic social services, usually several hours away from medical care, and without sufficient economic opportunity to sustain their families.⁹⁹

Mayan people in the rural areas of Guatemala use immigration to the United States as a strategy in response to lack of opportunity, to alleviate conditions of poverty¹⁴, and to escape violence; however, research suggests there are health and social consequences for Mayan communities left-behind to international emigration.^{95,100-102} The overwhelming breadth of immigration research focuses on those that have settled in an international destination. While there are consequences for both those that have

emigrated and those that are left behind, scholarship often focuses on the economic necessity and sacrifice of those who have left home.¹⁰³ Much less is known about the impacts of immigration on those living in communities of origin. This study begins to fill that gap in literature, focusing instead on the health and well-being of those left behind in rural Indigenous communities with drastically and rapidly changing social structures as a result of emigration.

While their social structures at home are changing, they are building new familial and network structures as “transnational families.” Many of the residents in the study region, including most of our participants have some kind of transnational relationships they are negotiating. Transnational families navigate relationships, make decisions, and share risk from across borders as a strategy of economic and social mobility.⁷⁻⁹ They use migration as an investment for the whole family unit, generating resources to provide education for children and further mobility for future generations.^{8,9} Transnational families are held together because of the need for collective welfare.⁷ However, literature has documented that maintaining those relationships at a distance comes at high emotional costs to both those that have emigrated and those left behind.^{7,22,104-107} Transnational families are also changing the landscape of parenting and emotional support, with advances in communication technology allowing families to maintain contact without being present for even decades at a time.⁷

This study builds upon previous participatory research with Indigenous Maya in different language and geographical subgroups. No known study has utilized methods of Photovoice and Focus Groups with Mam to draw upon native voices and images to address health challenges faced as high-volume “sending” communities. While there have been qualitative studies done with left behind populations of K’iche speaking Maya in the central highland region of Guatemala,^{95,100-102,108-110} the experiences of those linguistically, geographically and culturally distinct groups cannot be assumed to be the same as those of Mam speaking Maya in the western highlands living in proximity to a heavily trafficked international border. This study allows us to hear and see the perspectives of this distinct Indigenous population that has not previously been represented in literature concerning “left behind” populations. The Maya Mam of the Western Highlands share a common Mayan ancestry with Indigenous

communities in the Central Highlands but are recognized as a different ethnic group, with their own variant of the Mayan language, cultural practices, and traditional style of dress. The experience of one Indigenous linguistic ethnic group cannot be generalized to that of another, despite the shared common linguistic ancestry; furthermore, we do not know if the health concerns of those living in a migrant sending community on a heavily trafficked international border are shared with those living in the central region of Guatemala. This study builds upon the small body of literature that explores the experiences and health concerns of Indigenous Maya that have lived through oppression and genocide and that are now surviving in communities experiencing rapid changes from out-migration.

The overall objective of this study is to provide a platform by which Indigenous members of a high-volume migrant sending area in Guatemala can share their own narratives about the current and future challenges they perceive to the health and well-being of their own communities. This study was designed and implemented using principles of Community Based Participatory Research. CBPR requires that participants are involved in data production, as their health status can only be understood through the lens of their own life contexts.⁵⁴ Community leadership and community members were involved in every step of the design and implementation, including the topics covered in Focus Groups, the use of Photovoice techniques, and the narrowing of information learned in Focus Groups to inform the Photovoice research question. Interpretation of data in this study follows Social Constructivist Theory. In social constructivism, subjective meanings of the world in which an individual lives are varied and multiple, with the goal of relying on the participants' views of their own surroundings. Questions are broad and general, and the goal is to rely on the participants' views.¹¹¹⁻¹¹⁶

2.2 Methods

This research explores the challenges to health and prosperity of rural Indigenous Guatemalan communities through open ended interviews. Through this process, Indigenous Maya narrate their concerns for the future of their communities, the changes occurring as they adapt to out-migration, and the health consequences, as they understand them, of these shifts in culture and practice. Data informing this manuscript was collected in two rounds of field research. Focus groups were conducted in August of

2016 to identify health concerns held by the communities in this study. Secondly, focus group data informed the research question addressed by participants using Photovoice and interviews in January of 2018. Preliminary themes were also shared in discussion with both interview participants and community leaders to validate findings, and are included where appropriate in the results presented here. The use of these methods have been successfully incorporated in previous research documenting the experiences and consequences of migration for Indigenous Maya that has taken place since the end of the civil war in Guatemala.^{95,100-102,108-110}

Focus Groups

Two gender-separate focus groups were conducted with twenty participants each, using a series of semi-structured open-ended questions. Question content areas included: *1) perceptions of important health issues; 2) challenges facing young people, and; 3) the future of their community.* Holding more than one group with each gender, and with only 10 participants each would have allowed for more time and space for each participant's views, and allowed for evolution of the group moderation; however, given the physical constraints on travel in this region, the burden on participants to walk great distances from household and work duties, and to accommodate the many residents that showed up to take part in groups, it was decided upon to allow entry to 20 participants in each group. Genders were separated because of cultural concerns about perception of others' spouses and community members, and cultural gender differences in employment, mobility, and household roles. Genders were also conducted separately to account for and contrast differences between men and women with regard to the content areas addressed. Focus group participants ranged in age from 18-65 years in order to account for and compare the different viewpoints across age sets, and were recruited non-randomly. Leaders facilitated communication about focus group participation to residents across 11 communities. Focus group participation was offered across all 11 communities in the region to encompass the possible differences in opinions about the topic areas between different communities. Focus groups were held concurrently at a central health facility and a central church salon. These locations are the standard meeting commons for all matters involving the 11 communities in the area. Communities were informed that the first twenty

participants to arrive at the specified time would be included in the study. Participants were compensated for the time equivalency of hours of work missed (20 Quetzales). This amount was decided upon by the author and community leaders as an amount that was fair for time away from work and not a large enough amount to be considered coercive for participation. Focus group participants were each informed of their rights and of confidentiality procedures, and consent was obtained from each. Focus groups were conducted in Spanish, with a trained bi-lingual assistant, fluent in both Mam and Spanish present at each group to address any linguistic or cultural confusion. Focus groups were each moderated by a native Spanish speaker and assisted by a fluent Spanish speaker. To respect cultural gender norms and comfort of participants, the women's focus group was conducted by a female moderator and assistant, and the men's group by males. Moderators and assistants for both groups each have 15+ years of experience working with communities in the area.

Philosophical assumptions and frameworks

The use of focus groups with a marginalized, Indigenous population is only appropriate when culturally relevant, and depends on the level of cultural expertise of researchers when coding and theming responses.¹¹⁷ Previous research in Guatemala has successfully utilized culturally relevant focus groups as part of a sequential research design of community-based research to address health issues in rural migrant sending areas.¹¹⁸

Given the content area, focus group interviews were designed for the narrative voice to be incorporated, exploring the shared and individual experiences and opinions of being a member of a rapidly changing Indigenous culture. Experiences are expressed in the lived and told stories of individuals within the specific context of their shared history, geographic space, and cultural heritage.¹¹⁹ Philosophical assumptions are ontological, as focus groups explore the nature of reality in terms of current and future health, and the forces impacting them.^{111,112} Ontological assumptions consider that there are multiple realities for lived experiences, and employs various forms of evidence to develop themes using the words of individuals and their differing perspectives. Focus groups were interpreted through a social constructivist lens, through which participants construct their own narratives based on

their perceived experience of the world in which they live.¹²⁰ However, some aspects of transformative interpretation are also present, as focus groups serve as an empowering force for participants in vocalizing shared experiences and opinions, and findings are used to uncover what is most important to community members for the next stage of research. Transformative interpretation recognizes that knowledge is not neutral and reflects power and social relationships in society, with a purpose of aiding in improving it, especially for marginalized groups.^{121,122}

Photovoice

Findings from focus group meetings were discussed with community leaders, and the use of Photovoice was decided upon as an effective tool for allowing residents the opportunity to decide what was important for them to share about their own communities. The main research question for the Photovoice phase was decided upon in partnership between the author and the community. Using Photovoice was chosen to give ownership to participants, honoring the interpretations they deem important. This phase was undertaken to understand the lived experiences of cultural change due to out-migration, and how this impacts health in rural Indigenous communities. Twenty community members, ages 16-65 were chosen non-randomly from within all 11 communities in the study region. Community leaders informed their constituents of the study and those interested were invited to retrieve a camera from the investigator at a specified date and time. The first twenty people to arrive were included in the study (all participants were able to speak Spanish). While allowing more participants across all 11 communities would have been more inclusive, the number was decided upon between community leaders and the author as a manageable sample size that would still allow for a generous cross-section of socio-demographic characteristics. Photovoice participants were each informed of their rights and of confidentiality procedures, and consent was obtained from each. Participants were then given the following general research question to explore through photographs over a one-week period: *“Document images that represent any changes in your community that may impact the health and future of your community.”* Cameras were collected again after one week and photographs were developed and coded numerically for discussion. Participants returned to discuss between 5 and 10 photographs from their

collection through semi-structured individual interviews conducted in Spanish. Photovoice participants were compensated for the time equivalency of hours of work missed (50 Quetzales). This amount was also decided upon by the author and community leaders as an amount that was fair for time away from work and not a large enough amount to be considered coercive for participation.

Philosophical assumptions and frameworks

Photovoice technique involves the use of photographs taken by the participants themselves as a visual tool during their individual interviews.^{123,124} Photovoice is different from standard photo elicitation because it is typically used in participatory action research in which participants are the agent of documentation.^{125,126} Photovoice combines photography, dialogue and experiential knowledge to allow participants to communicate community concerns, social problems and to inspire social change.¹²⁵ The photovoice technique allows participants to use photographs as a place to externalize emotions felt during experiences, using the personal photographs as a focal point for dialogue.¹²⁴ This technique has been successful as a tool to support Indigenous individuals in contextualizing experiences, and positions Indigenous peoples' own knowledge and values at the center of research.¹²⁷⁻¹³⁰ The methodology is intended to create an environment whereby participants are able to describe and discuss distressing or traumatizing events by referencing those emotions through a photograph. Rather than confine their experiences to structured interview questions, this method allows individuals to share their perceptions and lived experiences using their own visual perception of the world around them. It would be impossible to assume the perspective of a rural Indigenous person living in the circumstances of poverty without having lived that experience. This methodology does not accomplish such insight; rather, the methodology provides a more equitable and less manipulated expression by participants.

The photovoice technique and subsequent interviews follow narrative approaches. Narratives collect stories from individuals as well as documents, photographs, and group conversations, and occur within specific places or situations. Contexts include descriptions of physical, emotional and social situations, and using visual narrative inquiry can create a more complex understanding.¹³¹

Philosophical assumptions using photovoice include the theory of community-based participatory research (CBPR), in which knowledge development is democratized and community members themselves are involved in data production, ensuring data authentic to community experiences.⁵⁴ CBPR assumes that the health status of a group can only be understood from the group's own knowledge of its values, priorities, responses to life disruptions, perceptions of health, help-seeking behaviors, and context in which they live.⁵⁴ As stated by Wallerstein and Duran (2006), "More than a set of research methods, CBPR is an orientation to research that focuses on relationships between academic and community partners, with principles of co-learning, mutual benefit, and long-term commitment and incorporates community theories, participation, and practices into the research efforts".⁵² CBPR focuses on collaboration with participants in an effort to prevent further marginalization.¹³²

Ethical considerations

The privacy and safety of participants were considered and protected in each phase of research. Particularly when using Photovoice, there are risks to anonymity of participants and other community members that might be captured in photographs. When designing this project, we took great care to ensure the safety of community members. Participants were given detailed instructions on omitting identifiable images, including geographic location and other individuals. Prior, during, and following the photovoice project, participants discussed confidentiality and consent with project facilitators. All participants indicated clear understanding of procedures for confidentiality and were ensured that their participation was voluntary, could be terminated by them at any time, or could be terminated by facilitators if confidentiality issues should arise. They were informed that in the case of termination of participation, photographs in possession of facilitators would be destroyed, as well as any other materials from their participation. Anonymity and safety of participants were discussed with International Review Board representatives at length, and it was agreed that the risk was minimal. The extremely rural nature of this region and the lack of technology to access collected data, make it virtually impossible for any individual participant to be identified and located. For those few photographs where human faces can be made out, appropriate consent was obtained from the individual. All participants were assigned a

protected identification number and alias only accessible to the first author prior to project inception. No other identifying information was collected from participants beyond their age and first name.

Analysis

Analyses were performed using NVivo 12 software, version 12.2.0. Recordings were transcribed in Spanish and translated to English by two fluent Spanish speakers, with discussions to mitigate translation discrepancies. Focus groups and Photovoice interviews were transcribed and analyzed using an interpretive framework.^{133,134} Major themes were coded following a traditional process of coding and classification for major themes.¹³⁴ Iterative interpretation was followed to locate patterns, stories, summaries, statements, and axial relationships among the community.¹³⁵ Discussions of preliminary findings with community leaders and Photovoice participants were also recorded, transcribed and translated under the same process as interviews. Segments were then organized under the major themes being addressed in that discussion segment.

Researcher community embeddedness

In qualitative research, the researcher serves as the primary instrument of data collection.¹²⁰ The first author has an 18-year history living and working with communities in the Tajumulco municipality. As a result, she has built trust with leaders and community members that positioned her to carry out the sensitive aspects of this study that might not otherwise have been feasible or as accurate. Many elements of this study required high levels of trust between community leaders, research participants, and researchers that are a result of decades of trauma and exploitation. While the main investigator is a white woman from the United States, she is fluent in Spanish and is a frequent and trusted presence within the homes of those living in the study site communities. In addition, a fluent speaker of both Maya Mam and Spanish was always present during data collection to clarify any language or cultural confusion with questions.

2.3 Results

Focus groups

Focus group participants described their current health challenges, revealing the difficulty of living in conditions of poverty. Both male and female focus group participants spoke about the difficulty of living without economic resources or opportunity in the rural highlands. Discussion crossed several subthemes, including specific illnesses faced by their communities and problems arising from lack of infrastructure, including access to clean water and healthcare. Though focus group discussions addressed an array of community health challenges, a concurrent thread running through the major themes and several subthemes within those, is their status as a migrant sending area, where more than half of households have at least one person that has emigrated to the United States undocumented. Participants addressed both the lack of resources that cause residents to seek economic opportunity elsewhere, and the vast changes occurring within communities as the population structure shifts. The major thematic axis that emerged in the focus groups was *“changes in values, culture, and community structure,”* and included *“migration”* and *“mental health.”* Major thematic axes within the Photovoice narratives included: *“poverty and migration”*; *negative consequences of migration”*; *“the experience of migration,”*; and *“community changes.”*

Changes in values, culture, and community structure

The majority of focus group discussions centered around a central theme of changes in values and family structures, and among young people in particular. The youth are becoming exposed to and involved with gang activity and substance use, including alcohol and drug abuse, and cigarette smoking. These were identified as marked changes in the cultural norms within these communities, within a timespan of just a few years. There was frequent mention of the presence of gang affiliation and associated drug use by youth in the area. Substance use was identified in children as young eight years old, with some participants suggesting that it is because, “they don’t have any parents,” referring to children left behind by emigrant parents.

Migration

Many participants spoke about the impact of emigration from their communities to the United States. Men discussed the ages of those that migrate and why, “they are fifteen, eighteen, twenty. There is no work.” Women talked of the difficult journey and financial burden of crossing through Mexico undocumented to the United States, and the fears they had for their own children and family members attempting to cross. They spoke of the disappointment that comes with being apprehended during an attempt to cross and being returned to Guatemala with the financial debt accrued during the attempt. The male group in particular highlighted community changes that are taking place, especially among young people left behind by parents that have emigrated to the United States. They spoke of problems at home between children and care givers due to lack of guidance because of one or more missing parental figures. They also discussed the impacts this has on substance use by young people, and girls resorting to partnering and becoming young mothers themselves to survive. Women mentioned that girls, “some of twelve, some of thirteen and fourteen,” become pregnant because of the lack of guidance for young women and their exposure to technology like cell phones and television where they learn about sex very young. One male participant, age 56 gave the following example:

“...what I am seeing in these times, some children here their fathers or mothers have been sent. Because sometimes there are parents who have gone north. And when they come home to the children, they are already grown up. They never had advice from their father, they no longer respect it. Sometimes, on the contrary, you do not see your child until they have a child. He's even a father. He comes home and is no longer a father but a grandfather. Why? Because there is a lack of work here...they raise themselves, nobody guides them...But here we see that the girls are not able to work, they do not study. What they do is marry older people because there is no work...So, when the father comes back, the girl already has a child or the boy has a child.”

Migration away from home is considered both a necessity and a dream, but there is often a desire to return once enough money is made for a better life.

Mental health

Emerging instances of suicide and mental health struggles were of great concern to many participants. There was significant discussion of young people beginning to take their own lives,

including one person remarking that, “five or six have already died.” One participant, age 45 whose nephew had died by hanging addressed the difficulties associated with a desperation that comes from living in a place without economic opportunity or choices. He spoke of leaving children behind to cross to the United States undocumented to provide for them, but leaving them without parental guidance, linking mental health problems and emigration:

“He was fourteen years old. He was still a child...Although we are sad — As we say, one struggles to provide for the children. You risk your life to cross in the desert. It’s like us here, we are not the same as you there. You come here anytime you want. You go in and out, but we don’t. And we get to where you live, and we stay a few years, five years or six, seven years. When we arrive, we think that our children are going to do well with their studies or that they are old so that they do not suffer from hunger. But when we come back, the children are grown up and one never knows where they are ...”

Women spoke particularly of economic pressures and the lack of work as contributing to mental health stresses, especially if young people feel like they have to help provide for the family, “So they feel like they have to be older, of being very old when they are young and they don't have the ability to handle everything. They say, “my mom has no resources. My mommy doesn't have this. I'm going to be asking for it and it hurts to ask. I better go to work.” It is a lot of responsibility for a young man.” The frequency with which participants spoke of community changes related to emigration inspired the visual and descriptive documentation of those changes during the Photovoice project.

Photovoice

Based on the issues affecting community health identified by participants in focus groups, the general research question for the photovoice project was agreed upon by community leaders, participants, and the author. Photovoice participants were asked to document and describe changes that may impact the health and future of their communities through visual images and discussion.

Echoing themes identified in focus groups, participants felt compelled to document living conditions that make it difficult to thrive within their own communities. Narratives describing photographs of struggle and the desire to live with dignity centered around the impacts of emigration to the United States. Perceived impacts from emigration were both positive and negative, including economic opportunity, sacrifice and loss of family, and the mental health challenges of being left behind

in a migrant sending community. Participants frequently documented major changes happening within their communities as social network structures shift from out migration. Narratives of these photographs describe changing values, increased substance use, and growing gang involvement among youth because of parental absence and lack of opportunity.

Poverty and migration

When contemplating photographs depicting conditions of poverty, several participants went on to relate those conditions to the necessity of migration to the United States. Men spoke of their own struggles, and of seeing their neighbors building homes that are safe, that they are proud of, and of wanting those things for their own families. Carlos, 34 described this feeling as making you, “want to leave your family, your mom or dad, your brothers, to have something like that. That is the reason why many people have immigrated from Guatemala to here [United States]. The poverty that is lived.” (Figure 2.1) Brigida, 16 compared their own existence living in poverty to stray dogs sifting through dangerous garbage, alluding to their desire to live with dignity under different circumstances. (Figure 2.2)

Men, who had experienced migration to the United States and returned, spoke about the great sacrifice they make when forced to leave their families to provide for them, and the loneliness they feel. One man quoted his uncle, who was living undocumented in the United States, as saying, “If it weren't for damn poverty, I wouldn't be here. I was with my children. But poverty is the need to make one come here and leave the family far away. It is the reality that we are living right now.”

Carlos, who was interviewed by the first author in the United States after crossing, gave an emotional testimony about being forced to leave all that he knew to support his family in a foreign land. With tears in his eyes and looking out in the distance, he said, “Because if I had money, I would have had my family. Well, I was with them. I was with them. I wasn't here. You think I don't miss my dad, my mom, my brothers. I want to walk on rainy afternoons over there. I want to play soccer, which is what I like to do. Then again, poverty makes you leave your family and look for an opportunity to survive. Not to get rich, not to make you a millionaire, but to survive.”

There was hope expressed in the discussions of themes in addition to acknowledging fears and challenging living conditions. Oscar, 25 felt it was important to tell us that the children are the future of his community and of his country. But with the lack of resources and lack of employment, he does not think their potential can be reached. He feared that the many beautiful traditions, the meals, the work they do in growing coffee, is in jeopardy. The population is increasing and there is no land for them to cultivate like there was in the past. Families of up to eight, ten children or more have limited access to education and there is no economic opportunity to support this growth with things as they are in his community.

Economic opportunity

All but two of the total 20 participants discussed emigration to the United States when reflecting on their photographs. Photographs offering comparisons between families that had people on the “other side” and those who did not have emigrant relatives were prevalent across all participants. Photographs depicting poverty, as well as those showing more expensive homes made of “block” and “cement” elicited comparisons between them in narratives. Participants emphasized the necessity for emigration to the United States for economic opportunity, as in their own communities there is little to no work, and education beyond primary school must be paid for.

When talking about emigration, participants realized the positive benefits of having someone who has crossed. Access to economic resources, the ability to construct safer, more beautiful homes, and being able to send children to school beyond the sixth grade were identified as positive changes they have experienced. Some relayed their own life experiences of making the dangerous journey across the desert in Mexico and crossing into the United States, or being the spouse of someone who has.

Many participants took photographs of homes that were built with the “fruits from the United States.” Comparisons of household resources for those who have people in the United States were also common. Forty-two-year-old Roberto, when discussing a photograph he took depicting a wooden house reflected in the rearview mirror of his truck, said, “Previously, many people had these little houses. Because there is not much money to buy blocks, to buy iron and cement. That is why they use wood.

Because economic resources are needed.” He explained why some people still have homes constructed in this way: “The difference is that we still use the wood if they do not have money to build. They are poor people and years have passed and they have never had a family member that has gone to the United States to earn more money, so they continue to use that house and they can’t do anything else but use that house.” (Figure 2.3)

Thirty-six-year-old Hector, while examining a photograph of a house he admired, also reflected on the perceived necessity of emigration to make a better life for your family, “Well, what I see is that, to have that in this community, I think for each person, if you want a house you have to save little by little or migrate there to the US. Here, we don't earn much. We only have enough for food, to support the family. One has to risk it all to immigrate there so that they can have a house like that. Because I imagine that the person who paid for this house has been in the United States for about ten or eight years. But yes, you can see that there is fruit from them.”

Men spent significant time discussing the desire to give to your family what others have been able to give through the sacrifice of leaving the family to emigrate north. Hector shared a photograph of his sister’s house. He described that ten years ago there was no house like this, but that his brother-in-law, “built his house to support the family with the fruits from going to the United States...I liked taking a photo because I thought that one day, maybe God will be able to make me a house just like him. That I can have a house like this too...Before they did not have that and now they do. And for them it has improved because he migrated to North America.”

Several people also reflected on their own children making their way to the United States. Hugo, 35 felt that children have all set their sights on going to the United States, “Because there is not much possibility here. It's convenient and a little dangerous. They say, I am going to the United States to work, to bring money, to do better.” Agustin, 37 said that his children already have the goal of going to the United States, and that most young people he knows have the goal to immigrate. He said it is because they suffer in Guatemala, and they want to prosper in their lives. He expressed, as other men had, that seeing others with resources from the United States is a driving force for young people to emigrate: “If

God wants, my son or my children can, they will migrate there [to the US]...because at the moment, as it is, it is a bit sad because I have seen in other places the kitchens are more equipped, a normal kitchen. But I am waiting on God and God with us and with our children, they can migrate there and that is the hope we have for the future.” Thirty-year-old Teresa, whose husband was in the United States for many years and had since returned, would be happy to see her children go to the United States, because they can have their own things, their own houses, though she would prefer they are there with her in Guatemala. She expressed fear about them going, saying, “Perhaps, for example, they die there in the desert, you don't know if they will arrive or not. These are the risks you take as a mother with your children, but maybe, at the same time I would be happy and support them.”

The motivation to provide education for children was a pervasive theme when participants discussed emigration. Thirty-five-year-old Catarina, who is a primary school teacher in her community, shared a photograph of the school where she teaches (Figure 2.4). She explained that it represented the place where, thanks for parents who are in the United States, children are able to improve their lives. “It is a very important issue because many children only reach primary school. They cannot enter high school because they do not have enough money to continue. But thanks to many parents who travel to the United States to give their children the best, they are the ones who get ahead. Now the parents who stay here in this country are the children who can no longer advance with their studies.”

Community leaders confirmed that emigration out of their communities was indeed a central theme representing future health of their constituents. One community leader felt that a lot of problems were happening as a result of emigration, as people are leaving in large numbers, “looking for a life.” He felt that necessity was driving people away from their families, and that there “are many parents or families where there is always pain, there is sadness-- Why? When one goes, it's very healthy, good. But sometimes they don't come back. They don't go back home, they no longer live there. It's the hardest thing for a family to be left without — no one is responsible for them anymore.” One leader spoke about families living in “severe poverty,” because they have been left behind by family members in the United States, and have not had resources sent to them. “Sometimes they do not have anything, nor do they have

a roof to live in, malnourished children, and a wife worried that she will eat every day. And being here, we don't have any studies...but there is no work. That is why they migrate.” He expressed concern in his role of community leadership to support the young people, some of seventeen and younger, that already have families and are trying to make lives for themselves without leaving for the United States.

Positive impacts of migration

Participants recognized the many positive changes they experience because of having people in the United States. Simple things like having the ability to send money to build a bathroom for your home. (Figure 2.5)

Teresa, 30 was hopeful for children going to school in her community because parents have migrated and can now give them, “uniforms, supplies, and all that.” She described that in the past, parents worked their own land for subsistence but did not have other employment, and so only had enough money to support the family and not send children to school. She went on to talk about her own experience of being a spouse left behind to emigration. When her husband was gone in the United States, she was happy at one point because she was able to improve her house from lamina to block, and now she has a safer home during hurricanes and they do not suffer as much. However, at the same time she is sad because her children ask about their father and, “...they want to live together and you can't because, how beautiful everything is when you live together, parents and children. But no, sometimes it is difficult to explain to them, because they ask questions. "Why isn't my dad here?" or "Why did he leave?" Or sometimes they don't understand. At the same time, yes, but thank God that if they are in the United States, they can help us here.”

Negative consequences of migration

In addition to discussing the reasons for and positive benefits reaped from emigration, participants spoke frequently about the negative consequences of being part of communities left behind by emigrant family members. Sacrifice and suffering from the loss of family was a commonly cited consequence of emigration to the United States. Mental health challenges attributed to emigration of close social ties, as well as a dearth in parenting for children and teenagers were of particular concern.

Men and women both expressed the negative consequences associated with family and other network members leaving for the United States. Women in particular shared photographs and narratives depicting the suffering endured by those left behind in their communities. Carmen, 31 chose a photograph of an abandoned home to talk about. She said that the family that had lived there was broken apart, and now the home is broken apart as well, with water streaming in. She said it brought her great sadness to see homes like this, and families like this because some of them have gone to the United States. (Figure 2.6)

Sacrifice and family loss

The theme of sacrifice and loss of family was common when discussing images related to emigration. The ability to send back resources was shadowed by the absence of important relationships in people's lives. Carlos, 34 recognized that most of the men in his community are leaving, and that most men he knew are now in the United States, leaving women alone back home. He shared a photograph of a very large home, and explained that only an older woman and her granddaughter live there, as everyone else is in the United States. Now they have a lovely home, but they suffer great sadness because none of the family is together. He said that the woman's hope is that the family will eventually return from the United States to live there with her, but this is not guaranteed. He explained that it is common for people to leave to make their money and then return home, but that often they never return: "Sometimes they don't come back. There are some who left fifteen, twenty years ago and have never returned. And the families, the abandoned children, are without parents and nothing. Women have gone with other men and so on, it is a lot of family destruction."

Participants also recognized that when children are left behind to be raised by grandparents and other relatives, it has a negative impact on their behavior. Children raised without a father, and sometimes without either parent, face emotional burden and are not given the guidance they need to navigate life in their own communities. Catarina, a 35-year-old primary school teacher who sees this scenario often in her work put it best: "...it's difficult for a child to grow up with parents separated. The

child always wants to see mom and dad together...It impacts the children, a lot, the separation and growing up without the love, the affection of a father. Well, those are the negative things that I look at.”

Mental health challenges

Participants identified the many mental health challenges they have noticed in their colleagues with family emigrated to the United States. Women are suffering with sadness at the loss of their husbands, and children are rebelling without proper guidance. Some are turning to destructive behaviors like drinking and using drugs, while others are struggling with depression and even suicide. Sixty-five-year-old Gilberto told us that, “so many young people are losing their health.” He went on to describe, just five days past, that a boy hanged himself, and that “There were several that have happened, like four have hanged themselves here. It was one here, a girl here on the fence. And another on the other side...Young, they are young. About fourteen. One of sixteen. One of seventeen. Yes, they are minors. Another twenty, it seems. So that is what happens now with the health of the entire community.”

In the discussion about themes, twenty-five-year-old Oscar talked about the pressures that are felt by men when they see their neighbors building their homes out of block with resources from the United States, compelling them to send their own relatives to cross. He also spoke of the pressure of cost to reach the United States, which causes another kind of mental distress: “We are talking about the cheapest that a trip can cost for a migrant to the United States is eighty thousand quetzals, the cheapest. There are even young people who will pay up to one hundred thousand, one hundred and twenty thousand for a trip. There are young people who do not make it on the first attempt. They have to try two, three, four times. Normally, like coyotes, as they are usually called - those who are in charge of taking people to the United States. They only give you two or three chances. There are people who lose those three attempts and do not arrive and continue spending.”

Gilberto, 65 agreed that the pressure for some families is overwhelming because they lack the means to send anyone across. He also spoke of the mental stress on children who are abandoned and grow up without an education because their fathers have left and do not send resources. One community leader explained this, saying, “Well, in many of the cases we have realized that there are men who leave

for the United States and as soon as they arrive, they forget their wives that are here. And so they create a new family there. Abandoning his relatives who are here, his wife, his children.” All of the participants agreed that there is a sadness that comes from having family gone in the United States, even when that affords them a better life.

Community leaders agreed that there are more men than women away in the United States, and that women left behind “go through a depression. Because they are not with their husbands...they are not living together as a family.” The group recognized that in some instances, depression became so difficult that suicidal thoughts were common: “There are some who believe the idea if they are not with their husbands, then life has no meaning and some have even killed themselves.” Another committee member agreed, saying, “...then, there comes a time when they believe that it no longer makes sense to continue living because of all the problems and they have even committed suicide.”

Participants also recognized that men face mental health challenges around migration in their communities. Men who do not have the resources to make it to the United States themselves face great pressure and often turn to alcohol to escape their feelings of inadequacy. Men who do make it to the United States and then are deported back to Guatemala also suffer mental health consequences. The high price paid for passage puts families in debt to other families in their community, and when someone is deported and returned before they have paid that debt, there is a feeling of hopelessness and despair. Participants said that they fall into depression and instead of using their money to support their families, they “drown their sorrows.” Maria, 26 gave the example of one of her neighbors who she saw struggle with this. He was detained and deported three times attempting to cross, and began to drink more each time. With each attempt, the severity of the crime is worsened, and by his third deportation and detention, his wife was forced to attempt to cross into the United States herself. Maria said this man now lives in deep depression and alcoholism, alone in his house, as his wife has gone to the United States.

In discussion of themes, community leaders were concerned with how many men had gone to the United States and left children and women alone. They described men leaving when children are just four or five years old, and not returning for fifteen years. “And what do they do? They put the noose around

the neck and hang themselves. And there they die. But it is the responsibility of the father or the mother for abandoning them.” According to one man on the committee, “...for lack of love and affection from parents, they feel alone.”

Experience of migration

Carlos, 34 shared his own “dangerous” journey traveling to the United States through Mexico. He described how he was beaten if he did not have the money to pay off officials he ran into along the way. He discussed how difficult it is to come up with the necessary fourteen thousand dollars required to cross undocumented, and what a momentous decision it is for them to leave: “In my mind, it's a very difficult decision for people. To use that money to cross. It is very difficult. It is the biggest decision you can make in your life. Especially if you have a wife, children, or a husband. Whatever is. That is difficult...I said, “I'm going to go. I'm going to help my family... And I have been able to help my family.” He emotionally conveyed the conflicted nature of being able to leave the family to help financially, but at the great cost of being without them: “At the same time, I am happy and sad because I can't be with my family. For example, important dates. Now that Christmas is coming and all that. One would like to be there. Who wouldn't want to be with the family? To give everyone a hug. Receive midnight. I cannot.”

Thirty-five-year-old Catarina, whose husband left for the United States many years ago, wanted to share her story so that others would understand the great sacrifice that comes with economic opportunity in the United States: “Well, my husband and I got married, we had a child, but we didn't have a home. We lived with the in-laws, with the brothers-in-law, and all there in the same house. We decided that he had to travel in order to build a house. Unfortunately, he found another woman there. Thank God he built the house for me. I stayed with my son, but he built my house. That was our wish, to have a nice house...but the negative, is that I lost my husband. So, there are positive and negative things that migration brings us...He stayed in the United States with another woman. But I am grateful to God and to him because he built my house...In other words, the price of that house was losing my husband.”

Community changes

Substance use

Of particular concern for community participants was the rising substance use in their communities. Several photographs were shared of cigarette butts and empty bottles of alcohol. To participants, this represented a significant change, and reflected the pain and sadness experienced by their neighbors. It was also a hallmark of the changing behavior of children lacking parental guidance because of emigration. Twenty-five-year-old Oscar, when talking about his photograph of discarded cigarettes, said that he knows children as young as ten years old that already smoke because their fathers are gone. He said he thinks these children feel smoking makes them look older and “command respect.” They are trying to fill a hole that is within them for lack of proper guidance and confidence from their parents.

Thirty-one-year-old Carmen, who had to pause during her narration because she began to cry, shared a photograph of an empty bottle of liquor and blamed adults for displaying this behavior in front of children. She also shared a photograph of a refrigerator in a small tienda. Now it was full of beer, but she said that in the past it had juices and no beer. She worries about what this is doing to her community, and said that the store owners put in juke boxes next to the refrigerators, so at night people gather there and drink next to the primary school. They are awake all night, and in the morning can be found sleeping in front of the children at school. Carmen explained that she became emotional while looking at this photograph, because it not only showed the problems in her community, but she was seeing the beauty of it as well for perhaps the last time. Carmen was leaving for the United States with her baby daughter in tow the following morning, and feared she was seeing her home for the last time in these photographs.

Marta, 22 took a photograph of a man that wanders the street drunk. It affected her emotionally because she felt like she could see this man as a child whose future would be like this. She wanted to understand what had happened to make him this way, and speculates that if he did not have opportunities and turned to drugs and alcohol. She sees this same problem arising in several children in her community, and it worries her for the future. (Figure 2.7) Theme discussions with participants confirmed the rise in substance use issues. They were sorry to say that previously only some adults were seen smoking, and now children of ten years old are using tobacco and marijuana. Maria, 26 offered that there used to be

more respect and discipline in her community, “But not anymore. I think it's also because right now there are several parents who traveled there (the US), they leave the mother here alone in Guatemala with three or four children.”

During the meeting of community leaders to discuss emerging themes, the issue of rising substance use was of great importance to elected officials. Stores selling beer and cane liquor, and providing loud music were of concern. They find that men are using all of their earnings in these activities, causing distress to wives and children. One member shared his own experience being deported three times from the United States and finding himself in heavy debt, using all of his earnings on “drink and smoke.” He was able to find his way out of his suffering, but he and the committee were unsure of how to deal with such a rapidly growing problem. One member likened it to the branch of a tree: “We remove a leaf, but after a week it already has another new leaf.”

Gang activity

Younger participants, as well as the community nurse, took photographs representing a rise in gang affiliation among young people in the area. They identified the lack of opportunity and parental guidance as causes for gang activity among young adults. Several photographs show graffiti on walls and carved into hillsides depicting the names of gangs that historically had stayed confined to larger towns near the border. Fifty-year-old Ernesto, the community nurse, said he just began noticing this activity about six years ago. He said he has witnessed them fighting with one another and heard of attempts at rape of young girls, as well as participating in public drug use. The most frightening thing for him was the involvement of younger children now, “from eleven to twelve years. Much younger than people of sixteen or eighteen.” He also shared that a couple months back in a nearby community, “they raped a nine-year-old girl and killed her.”

Oscar, 25 shared a photograph of graffiti reading, Mara 13, representing the gang MS 13, which has a presence on the border near this area. He spoke about emerging territories for different factions of the groups, with a photograph he took depicting an “18” replaced by a “13” indicating, he said, that “MS-13 came and took it away, like it took over this wall. As seen elsewhere, Mara 18 are no longer allowed to

enter because it is now the territory of Mara 13.” He fears for his own two-year-old son growing up in this environment, saying, “If we are like this now, what will happen in five or ten, fifteen years? How will our society be?” (Figure 2.8)

Otto, a 17-year-old young man, is afraid to walk in his own community at night, because “it would be very dangerous risking your life.” He believes this activity is the result of parents leaving children behind with no guidance. Many of the young women in the project felt it was important to document the graffiti symbols they see on walls. They recognize the meaning of the symbols and they are fearful that this dangerous activity has made it to the rural communities from the border. They are aware that these groups may pose a danger to them as young women, as Carmen, 31 recalled a story of a group of them that had “crossed out people,” and “sometimes even raped women” when they were out drinking. Twenty-two-year-old Marta, who reported she had learned about child psychology in school, believed this happened with children “who do not have a father, sometimes they just have a mom, because the father abandoned them.” She says drugs are an escape, and believes the children who become involved with these groups are doing so because of internal problems and from being without family (Figure 2.9).

2.4 Discussion and conclusions

Focus group participants and photovoice participants spoke frequently about living in conditions of poverty that prompt and perpetuate emigration to the United States. They described the health consequences of living without adequate resources and access to healthcare, and their inability to meet basic needs. These narratives echo the struggles and reasoning for emigration in current scholarship with people in migrant sending communities of other regions in Guatemala.^{95,102,103,110} Conditions of poverty as described in this research have been identified by social scholars as a continued form of structural violence experienced by vulnerable populations.¹³⁶ Structural violence is produced through historical and political systems that oppress sectors of the population through economic and social structures. These forms of oppression create and perpetuate disparities in areas including health and education.¹³⁷⁻¹⁴⁰ Engineered disparities incite racism, gender inequality, and suppress the power and socioeconomic mobility of society’s most vulnerable.¹⁴⁰

Studies with migrant sending communities in Guatemala have documented conditions of poverty suffered by Indigenous Maya as a catalyst for emigration to the United States^{95,102,118}. Narratives among our participants centered around economic hardship and the desire to live with dignity as driving factors for international migration. This is in line with existing scholarship that cites the lack of economic resources as one of the most powerful forces driving emigration across the Southern border of the United States.^{14,102} The use of migration as a strategy to provide education for their children with remittances was a pervasive theme among the participants in this study. Previous research describes a consequence of the lack of economic opportunity that necessitates sending children to work instead of school.¹¹⁸ Many narratives addressed this reality in our study, as children from families without migrant ties cannot attend school beyond free primary education; and often those children do not attend even to that level because of their need to contribute to the household economy. Consistent with research in other migrant sending communities of Guatemala, remittances sent home from immigrant household members provides the opportunity for children's education, more secure homes, and a life with dignity.^{95,102,103,109,110} Migration has become a normalized strategy for building transnational families that diversify the risks and opportunities for the whole family unit across borders. A study in the Central Highlands regions with Maya Ixil women found that being left behind to migration is part of a life course for making a better future for themselves and their children¹⁰⁰; however, being left behind was also a representation of why they leave, including living in rural poverty and lack of access to education.¹⁰⁰

Indigenous Mayans living in the rural highlands have lived through civil war and forced to flee to increasingly rural areas to escape genocide and other forms of violence. Identity as Indigenous in Guatemala carries with it an historical experience of oppression and inequality, and those forms of violence continue now, as reported by those involved in this study. This continued oppression and violence is described by people living in these communities as the major force driving emigration from the rural highlands of Guatemala to the United States. Research across several disciplines has also characterized the conditions of poverty experienced in this region as continued structural violence against Indigenous people following the civil war¹³⁶. A study in the southern K'iche region of Guatemala

described forms of violence that impact the lives of Indigenous people living in migrant sending areas, including violence in villages, with family members and neighbors forced to participate or to flee to the rural mountains.¹¹⁰ Accounts of domestic violence, Indigenous oppression and poverty have marked the struggles of those left behind, as well as the basis for emigration by their family members.¹¹⁰ A study with Maya Ixil women described intergenerational fear and discrimination from the civil war and genocide, and past and current human rights violations.¹⁰⁰ Indigenous women in Guatemala that endured gendered crime during the civil war are still subject to many forms of violence in their home communities.^{141,142} Gendered experiences of violence and migration in the Southern K'iche region contribute to pushing Maya women northward to the US along with a feeling of responsibility to support others left behind in communities.¹⁰⁹ For women in the Southern K'iche region, the lack of economic and educational opportunity is a form of structural oppression.¹⁰⁹

As frequently as people discussed the challenges of poverty, they also described the opportunities for advancement that come from emigration to the United States. However, along with the opportunity and economic mobility that come with remittances, the impacts of losing people to emigration carry social consequences that affect individuals, families, and entire community structures. While remittances received from family members emigrated to the United States provide economic advantages, there is evidence from a national-level survey that parental emigration has negative consequences on child social-emotional development not mitigated by remittance income.¹⁴³ Participants also spoke about the difficult choice to make the dangerous and expensive journey to the United States, which always carries with it the possibility of having to turn back or being deported. Previous literature describes fear about the immense debt that must be incurred to migrate, though remittances have made basic living expenses possible for families in Guatemala.¹¹⁰ Findings from a survey by Lykes (2020) included overwhelming debt of up to \$31,000 accrued from sending family members to the United States, but also the ability to build larger homes and have purchasing power once that debt was paid.¹¹⁰

Several people discussed the changes in values and family dynamics experienced as a result of parents having emigrated away, and the void in raising children being filled by aging grandparents and

other relatives. Some of these changes were described as manifesting in young peoples' affiliation with gang activity. The dangerous influence of "*maras*" in this border region has been evident since before the end of the civil war in 1996; however, community participants believe that the lack of opportunity and void left by absent parents is leaving space for desperate young people searching for a sense of belonging. Children left behind recognize the reasoning and importance of their parents' absence for many years, and of being raised by ageing grandparents; however, research with Mayan adolescents suggests harmful socioemotional consequences for these children regardless of advantages gained from remittances.^{103,144}

In addition to the loss of parental influence, narratives in this study described sacrifice and loss felt by those left behind by emigrated friends and family. Photographs and stories illustrated the sadness felt by those that have lost spouses and children to "*el otro lado*," though they are grateful for the remittances those losses facilitate. Some described the loss of their loved ones as "the price they paid" for economic survival. Focus group accounts and some narratives described the extent to which this sadness can manifest as serious mental health struggles and even instances of suicide by those left behind to emigration. Dramatic socio-emotional effects from the loss of family to emigration is documented in transnationalism research.^{103,145,146} Previous literature describes emotional losses due to the absence of loved ones as a significant consequence of being left behind for women. Stories of the lack of economic opportunity, abuse, poverty and alcoholism are compounded by the responsibility of having to care for households alone.¹⁰² Psychological costs of the transnational distance between family members include disabling sadness because of prolonged separations, and visits back home once a migrant has made it to the US are impossible.¹¹⁰

One of the major changes documented by participants was the increase in substance use among both adults and young people. Qualitative research in the Central Highland regions with Maya K'iche also identified a rise in alcoholism and mental health issues as a result of being left behind to emigration to the United States.¹¹⁸ Participants attributed a cultural shift from a changing social structure as responsible for the increased use of alcohol, drugs and tobacco by community youth. Narratives also described the use of alcohol by adults as a coping mechanism for those experiencing sadness from loss,

and being deported from the United States after incurring debt. Community members and leaders during discussion of results also felt that substances are used by those who cannot migrate; those individuals may be dealing with the hopelessness of their own economic immobility in a rural area with declining opportunity. Witnessing others' ability to send children to school and build larger homes is a pressure on both men and women as providers. Narratives suggest this pressure is a motivation for community members to acquire what others in their network have been able to through family emigration. Studies with left behind populations in other areas of the world have found significant mental health impacts on those who have lost someone to emigration, including in children, and in older and middle-aged adults.^{34,147-153} Narratives in this study suggest that similar struggles are being felt by those in migrant-sending communities of rural Guatemala.

The findings in this exploratory study provide a jumping off point for understanding the experiences of and motivations for migration among those left behind in rural Guatemala. Future research should focus on specific relationship factors that may motivate or facilitate emigration away from one's community. These findings have also suggested there are mental health concerns for those left behind to emigration. Future studies should examine the mental health impacts from the loss of relationships in one's social network, as well as the possible protective effect of having remaining social ties available. Although the number of women migrating to the United States is rising, current cultural norms in these communities still favor the immigration of men; therefore, exploration of gender differences in both the motivation to emigrate, and the mental health impacts of losing social ties to emigration may be important.

Limitations

This research is not without significant limitations. There were only two focus groups held as part of the initial phase of this research, and each group included 20 participants. In addition, focus group recruitment relied on verbal communication from community leaders to their constituents, and only allowed for participation of those that arrived first. Unfortunately, verbal communication from leaders may not have reached all residents in the 11 included communities, and inevitably there were residents

interested in participating that may not have received word of the meetings, that did not make the long trip in time, or that did arrive but could not be accommodated. However, given these limitations, moderators and observers, having lived and worked in these communities for almost two decades, took every effort to ensure the groups were representative of the larger population, and that all voices were represented in the data.

Photovoice interviews faced similar limitations. Recruitment was done through verbal communication by community leaders to constituents in 11 communities. Only the first 20 participants to arrive were included in this phase of the project. There was more interest in participation than could be accommodated due to resources and time constraints; therefore, it cannot be known for sure if participants adequately represent people across the 11 communities in this region. However, photovoice participants included both genders, varying ages, and members of differing socioeconomic statuses, therefore the authors are confident in the range of perspectives that are represented in the data.

Acknowledgments

This study was undertaken with the support of the Ministry of Health in Guatemala, the National Hospital of Guatemala, and local leadership. Special acknowledgement to the community members that facilitated and participated in this study. This study was approved by the University of California, San Diego Human Subjects Review Board. IRB#181152S.

Chapter 2, “Through our own eyes and voices: The experiences of those “left-behind” in rural, Indigenous migrant-sending communities in western Guatemala” has been published in the *Journal of Migration and Health*. Co-authors include Drs Samantha Hurst, Ramona Perez, Kate Swanson, Eric Leas, Kimberly Brouwer, and Holly Baker Shakya. The dissertation author was the primary investigator and author of this material.

2.5 Figures



Figure 2.1. Carlos' representation of the poverty in his community



Figure 2.2. Brigida represents the desire to live with dignity with an image of stray dogs digging through garbage



Figure 2.3. Roberto describes a home that is possible with family in the United States



Figure 2.4. Catarina's depiction of children with the opportunity to study because of parents that have emigrated



Figure 2.5. Carlos shares a bathroom in a home without someone in the United States



Figure 2.6. Carmen represents a family broken apart



Figure 2.7. Marta fears the children in her community may end up in the streets



Figure 2.8. Oscar shares graffiti representing MS 13 in his community



Figure 2.9. Marta is afraid of the growing presence of known gangs in her community

Chapter 3: Socio-centric network dynamics of emigration in a rural migrant-sending community in the Western Highlands of Guatemala

3.1 Introduction

The Southwest United States Border is the most transited border in the world and is the destination for international migrants attempting to cross from Mexico and Central America. According to US Customs and Border Protection, there were enforcement encounters with more than 1.6 million migrants in fiscal year 2021. Migrants from Guatemala, Honduras and El Salvador, countries in Central America known as the Northern Triangle, made up almost 92% of the total population attempting to cross the border during that year.² Guatemala sent the most migrants of any country in almost all migration categories, including family units and unaccompanied minors.² The districts of San Marcos and Huehuetenango, near the border of Chiapas, Mexico, are Guatemala's largest migrant-sending regions.¹⁵⁴

The reasons people from Guatemala decide to emigrate to the United States are multiple and complex. Scholarship on Guatemala has documented migration as an escape from violence and oppression following the end of the civil war in 1996, and many current popular and media accounts depict migration as a simple story of economic necessity. It is accurate that the receipt of remittances from the United States provides critical support to families and a pathway to otherwise unattainable housing, nutrition, and education opportunities. According to a March 2022 Migration Policy Institute (MPI) report on migration from the Western Highland region, 2021 remittances had surpassed all of Guatemala's exports and government revenue.¹⁵⁵ However, the simplification of migration to push and pull factors like escape from war and economic opportunity fail to capture interfamilial dynamics, gender roles, and aspirations, among other influential forces driving migration.^{13,156,157}

In more recent years, scholars have acknowledged that the reasons for migration are ever-evolving, and some complex structures and circumstances influence decisions to leave.¹³ Yet, despite these efforts, the role of social networks remains an oft-overlooked factor in migration research.¹⁵⁸ The use of social network analysis was identified as the "missing link" in migration and transnationalism research in a 2018 issue of the journal, *Social Networks*, calling upon migration researchers to fill that

gap in literature.⁶² This paper challenges simplistic push/pull explanations for migration decisions in a rural Indigenous Guatemalan community and offers an alternative paradigm invoking social network dynamics.

The Migration Policy Institute (MPI) argues that understanding the factors that drive people to leave their homes is the “critical first step” toward finding alternatives to current unauthorized migration.¹⁵⁵ In their 2022 report, the MPI identifies close-knit community networks as important social assets to leverage as alternatives to emigration.¹⁵⁵ In this study, we use social network analysis methods as a novel way to explore how social dynamics may influence the likelihood of having plans to emigrate within the year. We begin this paper with a brief examination of recent migration theories, then review current literature concerning Guatemalan migration, followed by social network analysis in migration research. Finally, we offer our contribution to understanding migration decisions from this region by exploring the demographics of those with plans to emigrate and the social network characteristics associated with migration decisions.

Theories of migration

International migration theories are often situated in three main categories: Macro, Meso, and Micro-levels. Traditional macro theories include the larger structural forces that can act as “push” factors to drive individuals away from a home country and “pull” factors that draw immigrants to a receiving country.^{5,6,159,160} Push factors most often include lack of economic opportunity relative to a possible receiving country and violence or war in a home country. Pull factors include improved labor markets or safer living conditions in another country.^{5,6,159,160} These theories usually apply to individuals and groups that are the first to begin emigrating from a home country, but they cannot explain sustained migration beyond the events that were catalysts to large-scale movement.¹⁵⁷

Meso-level theories are more suited to explaining sustained migration flows from a sending area. Meso-level theories use systems and networks to understand the dynamics of the groups and the social and symbolic ties that link individuals in migration networks.⁴⁴ These theories study processes that provide resources like information, social contacts, and economic and social support that make migration

feasible.^{34,44,66,161,162} Some meso-level theories address the “network effect” and include the Social Capital Model and the Risk Diversification Model. The network effect is the influence that migrants already living in a destination country exert on the flows of new migrants from the country of origin; without accounting for this effect, any analysis of migration flows may be flawed.¹⁶³ The Social Capital Model posits that migration maximizes human capital by drawing on social networks to reduce both financial and socio-emotional the costs and risks that come with emigration.^{72,164} Studies suggest that accumulation of migrant social capital in receiving countries supports the process of sustained migration flows from a single area.⁴⁴ Under the Risk Diversification Model, emigration occurs when members of households make economic decisions to migrate to maximize household income and minimize risks in times of financial strain.^{45,165,166}

Micro-level theories address how macro and meso-level theories translate to individual migration. These approaches focus on individual decisions to migrate, including Rational Choice Theory, and act as a check for other theories by accounting for people’s individual choices to migrate.⁵ Rational Choice Theory assumes individuals conduct cost-benefit analyses in deciding to migrate, treating people as resourceful actors that select from alternatives within environmental constraints and opportunities.¹⁶⁴

Another classification of traditional migration theories divides them as either functionalist or historical-structural.¹³ Functionalist theories include traditional push and pull factors and treat migration as an economic strategy undertaken by individuals and families following cost/benefit analyses. Functionalist theories are often applied in contexts of poverty, with households using migration as an income diversification strategy.^{167,168} De Haas (2001) argues that these theories fail to account for structural inequalities, violence, repression, and environmental factors that can force displacement or exploitation of migrants.¹³ Historical-structural theories include factors such as conflict and dependency, world systems, labor market, and globalization.¹³ These theories claim migration decisions are made in response to economic and power structures, such as labor markets, the exploitation of marginalized groups, and those using ideologies to justify oppression. Historical-structural theories fail to account for

migrant and family unit agency over decisions to leave, treating migrants as passive victims to forces outside their control.¹³

Scholars traditionally considered migration an economic choice made by young men,¹⁶⁹ but there have been new foci on transnationalism, feminist theory, and temporality of migration. Most notable has been the focus on transnationalism, as communication technology has broken down previous barriers of time and space. Transnationalism, first appearing in anthropology literature in the 90s, reframed migration from origin and destination as separate concepts and experiences to encompass the connected emotions, social processes, and economics between those who move and those left behind.^{47,170,171} As Carling (2018) described: in transnationalism, the migrant is no longer just an individual located in one place or another but is embedded in social structures that include sending and receiving locations. Transnationalist theories also include the processes and channels along the migration pathway and within one's social networks; this complex structure influences and shapes current and future migration processes and outcomes.¹⁷²

In current literature, families with migratory relationships across borders are called “transnational families.”⁷ Families play a significant role in decision-making, and migration theories that focus on the individual do not capture family migration channels.¹⁷³ Families must negotiate relationships across geographies and use migration as part of social mobility strategies.^{8,9} Goals differ across families: some seek to unify the family in a new country, some intend to migrate temporarily as an investment and return to their home country, and some send members to remain permanently in a new country to send back resources indefinitely.¹⁷⁴ Families seek to improve their conditions as a whole unit, making investments in educational opportunities for children and building economic capital, which drives both the ability to migrate and the necessity to remain in a receiving country.¹⁷⁵ Care for children and elderly is also a driving factor for those that chose to migrate, or for those that must remain at home.^{173,176}

Transnational families live separated from each other yet are held together through bonds of collective welfare and unity.⁷ However, maintaining these relationships across distance, especially involving nuclear relatives, can come at emotional costs.^{7,22,104-107} Transnational families are also

changing perceptions of traditional parenting and emotional care; technology has changed the ability of families to maintain contact, making it more accessible and cost-effective. Improved communication has also impacted migration channels and trajectories for migrants in their new locations.⁷

With these more nuanced perspectives on family dynamics, migration theory has shifted to include a new focus on emotional connections and temporality. Emerging theory has embraced “aspirations” and “desire” and “drivers” of migration beyond causes and determinants. Aspirations and desire represent the perception of migration as a pathway to improved education, material, and social advancements as a result of increased media exposure and contact with those who have emigrated.¹³ Drivers of migration include the multiple and complex factors that facilitate, enable, constrain, and spur migration flows.¹⁷⁷ Migration decisions are not just individual or group decisions but are related to more complex systems that dictate geographic aspirations, violence, social structures, and economic realities.¹⁷² Individuals may struggle with the desire to migrate to support the family and gain prestige. They often find support among those that have migrated before them and may become part of a network that supports others who migrate. At the same time, the loss of family structures and ties that have bound the community over time are challenged and present new ways of understanding and securing the family as a cohesive unit. Among communities with substantial symbolic practices representing important passages of persons and family units, transnationalism can fracture these practices, requiring new ways of understanding the self, the family, and the community. The concepts of aspiration and desire are also tied to individuals’ perceptions of the possibility of migration and their relationships with others with the ability to migrate.¹⁷² Migratory aspirations encompass the idea that not migrating is another choice, but some individuals view leaving as a superior option.^{75,157,172,178-181}

Hein de Haas (2021) has criticized migration theory as stagnant, treating migrants as “passive victims of capitalist forces.”¹³ To shift away from traditional theories, de Haas has built upon the concept of migratory aspiration as “a function of people’s capabilities and aspirations to migrate within given sets of perceived geographical opportunity structures.” He integrates Berlin’s (1969) positive and negative liberty as the structure within which migration decisions are made, as well as Amartya Sen’s (1999)

capabilities migration framework, representing the agency of would be migrants to stay home or migrate (Figure 3.1).^{55,56} The concept of positive and negative liberties positions migration as a non-linear, complex outcome of aspirations and capabilities. Sen's capabilities framework moves away from simple cause and effect migration theory and toward human mobility as a function of their freedom to choose to migrate or stay. In order to exercise that choice, people need access to social, cultural, and economic resources. This framework partially explains why economic development in an area is associated with a spike in migration.^{157,182-185} Small advances in income can improve education and infrastructure, and with access to resources, migration increases;^{183,186} this runs contrary to traditional theories in which a reduction in migration is expected following a reduction in poverty.¹³ While some of those factors may be considered drivers of migration, the term more accurately encompasses the structural and environmental factors associated with sustained migration, most notably climate change.¹⁰⁻¹²

The role of gender in migration

In some regions, migration flows have been feminized for many years; however, worldwide traditionally male migration flows are becoming increasingly feminized.^{187,188} Migration theory has usually focused on causes of migration without regard to who is migrating, thus neglecting the role of gender in migration.⁴² Traditional theory fails to clarify the complex decision-making that women undergo when they choose to become transnational migrants and potentially enter into dangerous migration channels, leaving intimate relationships at home. Migration decisions and consequences may be vastly different for women than for men, and migration theory will advance by acknowledging and documenting gender differences in migration.¹⁸⁹ Migration research in the 60s and 70s mainly referred to male migrants and their families, describing the male as the mobile actor and their wives and children as an extension; in the 70s and 80s, migration theory began to include women: not as the migrating party, but to question whether migration was beneficial to women as it freed them from traditional roles and norms.⁴² This research did not focus on why or where people migrated but acknowledged possible differences between men and women in their gendered roles. This era ushered in the classic push/pull theories of migration, which posited migration as an individual decision. Traditional gender roles

explained why men were more likely to migrate, including women's responsibilities to the family as wives and mothers and men as financial support.⁴² However, including the role of gender in household dynamics and power relations can also provide insight into who migrates and the consequences of migration; this is especially true in the historical and cultural specific contexts of Latin America.¹⁸⁹

Gender in migration theory has primarily focused on the systematic and macro-level factors contributing to the decision for a woman to migrate. These include gender norms, roles and hierarchies, and the structural characteristics of their home country.⁴² The recent increase in migration from Central America to the United States allows scholars to observe the gendered differences in emigration from this region. Women are particularly affected by patriarchal power structures and normalized violence against them. Obinna (2021) argues that in gender inequality, particularly in the form of violence, sustains the migration of women from Central America as they weigh the costs of staying or leaving.¹⁹⁰ Because the role of women in society is often linked to household power dynamics and family welfare, incorporating gender in migration studies advances migration theory by bridging the divide between economic necessity and social concerns specific to women.¹⁹¹

Migration studies in Guatemala

Migration from Guatemala to the United States has been occurring since the 1960s. There is a large body of work on reasons for migration since that period, including during the civil war and following the peace accords signed in 1996. Because of Guatemala's history of war, migration research often focuses on macro-level factors, including violence and economic opportunity.^{192,193} In rural Guatemala, emigration has been studied in terms of factors that push people from their home communities and pull people to their destination country. Push factors include consequences of the civil war, ongoing violence, and lack of economic opportunity.¹⁹² Pull factors in receiving countries include economic opportunity, the ability to send remittances, and safer conditions once they arrive.^{14,194-196} These studies most often cite lingering and new challenges around violence, including murder rates and gang activity.^{196,197} Some research addresses social network factors that facilitate migration to the United States from Guatemala. Those studies focus on individual choices or motivations to migrate and the

ability and willingness to migrate if there are established links to destination countries.¹⁹⁸⁻²⁰¹ One of the factors affecting migration decisions for rural Guatemalans is the decreasing availability of land and the resulting economic and food insecurity.²⁰²⁻²⁰⁴ International migration is a strategy to mitigate the shortage of arable land through remittances for purchase of land, food, and other resources.²⁰⁵

In contrast to most migration literature in Guatemala, a recent ethnographic study by Nichols (2021) explored the desires of Guatemalan youth to remain in home communities, even in the face of increasingly mobile environments.²⁰⁶ Nichols argues that striving for educational goals is an alternative to migration for some Guatemalan youth and that “striving” is an enactment of migration desires.²⁰⁶ Additionally, Scarnato (2019) used the Guatemalan return migrant experience to examine the role of immigrants that have gone to the United States and returned, by choice or by force, as an economic and development strategy for Guatemala.²⁰⁷ Alternatives to migration for rural Guatemalans should be a priority in research. Migration to the United States is dangerous and often results in heavy debt and forced return to Guatemala, so seeking alternatives to leaving home permanently is an encouraging area of research. The 2022 Migration Policy Institute report on migration from the Western Highlands of Guatemala describes the sense of identity and long-standing tradition of collective decision-making among Indigenous Guatemalans; they offer that the sense of belonging and existing community structures are opportunities to leverage as alternatives to permanent emigration.¹⁵⁵ The first step in developing those alternatives will be understanding the complex factors driving migration from the region, including the role of social networks.

Social network analysis in migration scholarship

As migration theory has evolved over several decades, theorists have acknowledged the shortcomings of simple, static push and pull factors in migration decisions. While some of those factors may exist, they only do so in concert with several other dynamic processes, including those of social networks. Social networks impact migration decisions on multiple levels: Relationships and responsibilities within networks at home play an important role, as well as relationships with those who have already emigrated to destination countries.²⁰⁸ Networks in destination countries can provide

pathways and resources, also termed “chain migration.”⁶⁶ The concept of chain migration relies heavily on social capital, with established routes of transit and resource-sharing communities formed in destination countries.^{209,210} Some social network migration scholarship suggests that migration decisions are undertaken from within network structures, including the family unit and at the community level. Migration is a decision undertaken as risk diversification for the collective survival and success of the whole, not just the individual.^{44,46,167}

Migration decisions and characteristics of social networks are intertwined. The extent to which individuals are tied to their communities in countries of origin and in destination countries impacts decision making. However, literature has focused most heavily on the strength of ties in receiving countries as assets for information sharing and resources.^{61,211,212} There is far less focus on the role of networks in countries of origin other than risk-sharing capabilities of strong or large networks in sending communities.²¹³

Social network data is either ego-centric, focusing on the relationships and characteristics from the perspective of an individual (“ego”), or socio-centric, focusing on all connections within a bounded network.²¹⁴⁻²¹⁶ Common measures used in network analysis include measures of network size and centrality like the “total degree” (total number of ties in an individuals’ network), “in-degree” (number of times an individual is named in others’ networks), and “out-degree” (the number of “alters,” or others named by an individual as part of their network). Measures of network size and centrality can elucidate questions around social capital and social support available in both sending and receiving countries. For example, in amassing the financial resources necessary to fund migration, and the ability to either assimilate into a new community or influence the desire to remain in ones’ home country. “Transitivity” is another network measure that can be used to answer questions around the ability of social capital and the flow of information necessary through network cohesion. Transitivity is a calculation of the probability that two of a person’s connections are also connected to one another.²¹⁷⁻²²⁰ Furthermore, a more sophisticated measure of centrality in social networks is “eigenvector centrality.” Eigenvector centrality ranks the importance of an individual ego or “node” in a network based on the number of ties

held by other nodes in their network.²²¹ In other words, a node with 200 network ties that have many friends themselves will have a higher eigenvector centrality than someone with the same number of ties but those ties have fewer friends themselves.²²² So, the connection to a more popular individual is more important than to a lone individual, according to the measure.²²³ It considers the centrality of the nodes that a single node is connected to, so it goes beyond how many people you know to account for who you know.²²³ Migration questions that can be investigated using eigenvector centrality include those regarding the influence of how connected or “popular” a person is in their network. Those factors may contribute to the availability of resources, including the social support that might lead an individual to choose not to migrate because of their popularity at home.

Migration scholarship acknowledges the importance of networks, but it is often descriptive and primarily investigated through simple dyadic relationships between an ego and their alters; whereas socio-centric data can offer insight into the influences of the complex network ties across an entire bounded network^{62,224-226} The lack of more robust social network analysis, including using socio-centric data in migration research, has left a gap in literature around migration processes and outcomes.⁶² Socio-centric network studies have been used in public health research investigating behavioral and disease network phenomena (see Perkins et al. (2015) for a review of studies),²²⁷ for example, in studies of health behaviors like adoption of latrine ownership in rural India²²⁸ and routes of diarrheal disease transmission in Ecuador.²²⁹⁻²³¹ However, no study has used socio-centric data to investigate migration dynamics from Guatemalan rural migrant-sending communities.

Several studies have addressed network structures of migrants in destination countries, including social support networks of Turkish immigrants in Germany;²²⁶ of Polish immigrant women in Ireland;²³² of different immigrant groups living in Spain;²³³ and social support reciprocity among immigrant women in Russia.²³⁴ Sommer and Gamper (2018) used networks of immigrants from the Soviet Union in Germany to investigate how social networks sustain transnational self-employment opportunities;²³⁵ and Ryan and D’Angelo (2018) explored temporality in both ego and socio-centric networks of migrants.²³⁶ However, the use of social network analysis techniques with those left-behind in sending countries is

somewhat absent from migration research, providing an opportunity for us to contribute to filling that gap in the literature.

Recent network studies in migration scholarship include Fu and Hao (2018), who used a population-scale social network constructed with observed familial ties and location of origin to analyze China's rural to urban migration.²³⁷ Their aims were to identify structural changes in the network and explain the acceleration of internal migration.²³⁷ They found that migration changes social networks by turning within-non-migrant connections to between-migrant-non-migrant, local connections to non-local, and creating among-migrant connections; the changes to social network structures influences the migratory propensities of well-connected non-migrants, making them more likely to migrate.²³⁷ Fazito and Soares (2015) used personal networks of returned migrants to analyze how social networks support the migration process between Brazil and the United States.²³⁸ They found that migration takes place along gendered networks and that returned migrants have more varied contacts and relationships through which they share migration information.²³⁸ This suggests that those with more or certain types of network connections resulting from ties that have previously emigrated may influence migration decisions. Wissink and Mazzucato (2018) described the changing social networks of sub-Saharan African migrants while in transit. They found that significant events in a migrant's life while in transit alter the makeup of their networks through the maintenance of certain relationships across distance and the abandonment of other relationships; network changes are different for each individual, depending on their capabilities, for example, communication infrastructures available to them.²³⁹ Popielarz and Cserpes (2018) compared the network characteristics of immigrants from various origin countries assimilating in Chicago in the United States with those of non-immigrants. They found that the size and density of immigrant networks are comparable to those of non-immigrants but there is less racial/ethnic diversity in immigrant networks, especially among Latinx and those without citizenship.²⁴⁰

Migration is embedded within social networks and networks are essential factors in spatial mobility, destinations, and successful integration at those destinations.^{44,63-75} Social networks also bear the impacts of migration in the lives of those left behind in sending countries, for example, creating

transnational family structures that must be navigated across vast distances and over time.^{47-50,63} Studies specifically focused on social networks, and transnationalism include Verdery et al. (2018) and Vacca et al. (2018), both of which used socio-centric networks to investigate the role of transnationalism in the process of assimilation. Verdery (2018) used The Network Survey of Immigration and Transnationalism (NSIT), a bi-national survey (N=607) of transnational immigrants in North Carolina, Houston, Texas, and Guanajuato, Mexico. They used a “link-tracing” sampling approach to examine network structure, tie counts, and communication frequency between network ties.²⁴¹ Vacca (2018) investigated country embeddedness, assimilation, and transnationalism using the personal networks of immigrants from a variety of origin countries (N=241). Network data was elicited through surveys to estimate the size and cohesion of an ego’s network and whether network ties were in the destination or origin country.²⁴² Both studies found that assimilation occurs even in the presence of sustained transnational relationships.^{241,242}

Social networks connect to the concepts of aspiration and desire in migration theory. Migration aspiration relates to the diffusion of information within networks: individuals observe the accessibility and success of migration experienced by members of their networks and see migration as an available strategy in their own lives.⁵⁷ Network studies have found that personal networks in both receiving and sending countries influence individuals’ migration decisions, and networks in destination countries help explain sustained migration flows.⁵⁸⁻⁶¹ Manchin and Orazbayev (2018) used ego-centric network data, finding that social networks are the most critical factors influencing rural to urban migration in Thailand.⁵⁸ They found that family and friendship ties impact migration decisions by accumulating social capital available in immigrant networks and mitigating the risks of leaving network ties at home.⁵⁸ They also found that having close friends or family that have emigrated significantly increases the probability of an individual migrating themselves.⁵⁸ Finally, Parsons (2016) used eigenvector centrality as part of a mixed-methods study investigating the role of remittances on rural to urban migration pressures in Cambodia.²⁴³ This study, undertaken with immigrants after they had migrated, used network centrality to estimate access to resources. They found that an immigrant’s access to resources and the pressure to send remittances influenced migration decisions.²⁴³

Contributions of this study

This paper draws on meso-level migration theories to look at the effects of social networks, social capital, and risk diversification strategies using socio-centric network data from a single, representative community in the Tajumulquito health district in the western highlands of Guatemala. We use the ideation, or “aspiration” to migrate to the United States within the following year to explore the social network effects on plans to migrate, and we assess which network characteristics are associated with an individual’s plans to migrate. Previous network research on migration has shown that the social capital associated with having emigrated contacts influences migration decisions.²⁴⁴ We hypothesize that, in line with the Migratory Agency Framework, which includes aspirations and desire as drivers of migration, individuals with a network tie emigrated to the US will be more likely to have plans to migrate themselves. Secondly, those with a larger networks, higher network cohesion, and more central in their networks may have more social capital at home and therefore be less likely to emigrate. We expect, in line with Social Capital Theory, those with higher degree measures, higher eigenvector centrality, and higher transitivity will have more social capital at home, and therefore be less likely to migrate; however, it could be that those with larger and more connected networks have more access to resources for migration and therefore increase their odds of migration plans. The nature of network ties may also play a role in migration decisions, for example, previous research shows that relationship types in both receiving and sending areas are influential.²⁴⁴ We expect that, in line with Risk Diversification Theory, specific relationship types remaining in an individual’s home network will influence their plans to migrate. Finally, we hypothesize that specific relationships to network ties that have emigrated to the US will influence an individual’s plan to migrate, for example, individuals with a familial tie to someone who has emigrated are more likely to emigrate themselves as compared with those lacking those relationships.^{162,245}

This paper examines the social network characteristics associated with plans to migrate from a rural sending community in the western highlands of Guatemala. In the process, we also explore which demographic characteristics are associated with the likelihood of plans to migrate within a year. Because

migration literature has documented the differences in the migratory experience between men and women, we also stratify our analyses by sex to examine possible differences in this population of Indigenous Mayans.

3.2 Methods

We performed a cross-sectional census survey with 653 residents of a single rural village in San Marcos, Guatemala in 2018. Inclusion criteria were that all participants were at least 15 years of age, able to speak Spanish, and able to provide informed consent. Surveys were conducted in Spanish. All participants were of Indigenous Maya ethnicity and included both men and women. Because of the sensitive nature of the topic and the involvement of individuals under age 18, this project underwent a rigorous human subjects ethics review at the University of California, San Diego. By surveying every individual in the village, we were able to map their interconnected social networks using social network analysis techniques; we excluded ties to individuals living outside of this community. The average village population in this region is roughly 1,000 residents, with some having more residents with emigrant ties and others with fewer residents with those ties. Community leaders chose this village to participate because it was representative of neighboring communities in terms of population size (654 residents), socioeconomic status, and emigration to the United States. For network analyses, we used “name generator” questions to record social relationships important to each individual.²⁴⁶ Name generator questions included who they trusted to confide in about something personal or private; who they passed their free time with; who they considered their closest friends; and the names of their spouse, parents, and siblings. The name generators resulted in an “edge-list” of $N=5,190$ unique social connections between participants. The range of named alters was 1-27, and $\mu=8$. The range of total network ties (total degree) for an individual participant was 1-45, and $\mu=13$.

Local leadership discussed the study with community members in advance to gain trust and buy-in. Along with trained local Public Health officials, the first author surveyed every eligible resident. The

response rate was 99.8%, with one resident refusing participation. Each participant was compensated 50 Guatemalan Quetzals (6.68 US dollars).

Measures

Outcome Variable

Ideation to migrate: Our primary outcome variable was a binary “yes” or “no” response to whether an individual had plans to emigrate to the United States within the next year.

Exposure Variables

Emigrant ties: Participants were asked whether they had any close friends or relatives that had previously been part of their social network and had emigrated to the United States as a binary “yes” or “no” response. We also asked about the nature of the relationship with each of those ties. Those relationships were: “spouse”; “parent”; “child”; “sibling”; and “close friend or neighbor”.

Social network variables: Network variables included measures of each individual’s network size, network position, network connectivity, and relationship types with those who have emigrated and those remaining in their network at home. Network size measures were total “degree” (the total number of network connections for an individual), “in-degree” (the number of times other participants name an individual), and “out-degree” (the number of other people an individual nominates in their network). We used eigenvector centrality for network position, which uses weighted scores for each individual based on their direct and indirect connections with other individuals.²⁴⁷ For individual network connectivity, we calculated transitivity, or the probability that two of a person’s connections are also connected to one another.²¹⁷⁻²²⁰ For relationships remaining in the home network, we used responses to questions asking participants to name their parents, children, siblings, and spouse currently living in the village.

Socio-demographic variables: Individual covariates included sex, age, marital status, education level, religion, whether they receive remittances from the United States, and income sufficiency (a collapsed binary measure of income sufficiency adapted from the question: “in general would you say your income is...” with the response options: “sufficient to live and save,” “sufficient to live but cannot save,” “not

sufficient and there are some difficulties,” “not sufficient and there are great difficulties”). See the Supplementary appendix for details of measures.

Analysis

To investigate our hypothesis that having an emigrant tie in the United States influences the likelihood of an individual having plans to migrate, we first explored the association between the primary exposure of having at least one person living in the US and our main outcome variable of plans to migrate within a year. We then tested the association between demographic characteristics and the outcome of plans to migrate. We built multivariate regression models to test the association between having an emigrant tie as the main effect and plans to migrate in the presence of demographic covariates. To investigate whether having any particular relationship emigrated to the US influences an individual’s decision to migrate, we added each of the relationships categories to the multivariate model. We then tested the relationships that were significant at $p \leq 0.05$ as the main effect in the multivariate model to assess the impact of that relationship on plans to migrate in the presence of covariates. Next, we built multivariate regression models testing each of the relationships remaining in participants’ home networks as the main effect on plans to migrate along with covariates. Finally, we constructed multivariate regression models testing each of the calculated social network variables (degree measures, eigenvector centrality score, and transitivity) as the main effect on plans to migrate along with covariates. To visualize some emigration patterns in this population, we plotted the associations between absent network relationships and age and plans to emigrate and age.

To perform these analyses, we built a dyadic dataset from the original data by identifying and linking each ego and their named alters to map the interconnected social network of the village; we excluded links to individuals outside of the village network. Using that mapped network, we used the igraph package in R studio version 1.4.116 to calculate measures of network size and centrality (total degree, in-degree, out-degree), centrality (eigenvector score), and cohesion (transitivity) for each participant. We then entered those calculated measures as variables in the original dataset. We ran bivariate logistic regressions to calculate odds ratios and 95% confidence intervals (95% CIs) and Chi-

square tests for associations with the main outcome of plans to emigrate. Those with $p < 0.10$ were included in multivariate models along with covariates. We used the Generalized Linear Regression (GLM) for multivariate models adjusting for demographic characteristics and income sufficiency. We ran all models adjusting for demographic characteristics, income sufficiency, and total degree. Because out-degree and in-degree are included in the measure of total degree, we tested for collinearity among variables in the adjusted models. Out-degree and total degree each shared a correlation coefficient of 0.79 in the collinearity matrix. We also calculated the variance inflation factor (VIF) of the adjusted model variables, with scores of 3.63 (out-degree) and 3.81 (total degree), and 3.08 (in-degree) and 2.82 (total degree); while the VIF scores for those variables did not indicate severe multicollinearity in the model, the correlation coefficient was sufficiently high enough to err conservatively for concern about collinearity with a $VIF > 2.5$.²⁴⁸ We made the choice to omit the adjustment for total degree in models testing out-degree and in-degree in part because of our population size of 653. Due to possible differences in the impacts of relationship types between males and females and culturally normative gender roles, we investigated each analysis stratified by sex. Results included in the text are presented as odds ratios (OR) and adjusted odds ratios (AOR), while regression models presented in tables provide beta coefficients as parameter estimates.

3.3 Results

Summary statistics are presented in Table 1. Twenty-two percent of participants had plans to emigrate to the United States within the year. Fifty-four percent of participants had at least one emigrant tie in the United States, though there were no major differences in the proportion with plans to emigrate between those with and without emigrant ties. Men were more likely than women to have the plans to emigrate, with 30% of men indicating emigration plans and just 16% of women. By age category, older participants were least likely to have plans to emigrate, with each age grouping showing a reduction in proportion with migration plans. Thirty-three percent of the youngest age group (15-20 years of age) saw themselves leaving for the US within the year, while just 11% of those in the eldest group (44-88 years of age) had plans to emigrate. Thirty-seven percent of single individuals saw themselves emigrating,

compared to 13% among married individuals. Those with more education were more likely to have plans to emigrate. Thirty-nine percent of participants reported having no education, and only 13% of those individuals saw themselves emigrating, while just 8% of participants attended school beyond primary grades, and 41% of them saw themselves migrating within the year.

For the 25% of participants who receive remittance payments from ties in the US, only 17% had plans to emigrate, while 24% of those without that financial support had emigration plans. Seventy-three percent of the total sample claimed that their income was insufficient to live, and 23% of those individuals had plans to emigrate, while 19% of the 27% of the sample that did feel their income was sufficient had emigration plans.

Table 2 displays bivariate and multivariate model results testing demographic characteristics and relationships with emigrants and plans to emigrate within the full sample. In bivariate analyses, having at least one emigrant tie in the US on its own was not significant with plans to emigrate, nor were receiving remittances and income sufficiency; however, age categories, sex, marital status, and religious affiliation were significant. Compared with those in the youngest age category (15-20 years of age), each age group had lower odds than the last to have plans to emigrate; this was especially true for those 30-43 years of age, whose odds were 56% less than the youngest group (OR = 0.44; 95% CI = 0.26 – 0.73) and for the eldest group of 44-88 years, whose odds were 74% less than the youngest (OR = 0.26; 95% CI = 0.14 – 0.45). Women had 53% lower odds than men to have plans to emigrate (OR = 0.47; 95% = CI 0.32 – 0.68), and married individuals had 57% lower odds to emigrate than singles (OR = 0.43; 95% = CI 0.30 – 0.63). As the level of education increased, so did plans to emigrate. Those who had attended primary school were 2.34 (95% CI = 1.52 – 3.67) times more likely to emigrate than those with no education, and those with more than primary school were 4.65 (95% CI = 2.41 – 8.95) times more likely than those with no education. In terms of relationships with emigrant ties, having a child emigrated resulted in 95% lower odds of emigration plans (OR = 0.05; CI = 0.003 – 0.21); having a close friend or neighbor emigrated increased the odds of emigration by 56% (OR = 1.56; 95% CI = 1.02 – 2.36); and having your spouse emigrated resulted in 76% lower odds of emigration (OR = 0.24; CI = 0.04 – 0.80). In the multivariate

model with just demographic characteristics and covariates (Table 2; multivariate model 1), simply having an emigrant tie in the US was not predictive of migration, but the eldest age group had 56% lower odds of emigration (AOR = 0.44; CI = 0.22 – 0.88). Additionally, women had 48% lower odds to emigrate (AOR = 0.52; 95% CI = 0.33 – 0.83). The most educated participants still had higher odds of emigration (AOR = 2.94; 95% CI = 1.42 – 6.09).

When testing the relationships to emigrants that were significant in bivariate analyses in the adjusted model (Table 2; multivariate model 2) only having a child who had emigrated remained significant, with 92% lower odds of emigration than those without a child emigrated (AOR = 0.08; 95% CI = 0.004 – 0.39).

Table 3 shows the results for relationships remaining in the home network. In bivariate analyses, all relationships remaining in the home network were statistically significant with plans to emigrate. But only having a spouse remaining was associated with 31% lower odds of migration (OR = 0.69; 95% CI = 0.47 – 0.99); mother remaining, father remaining, and sibling remaining were all positively associated with plans to emigrate. We tested each of those remaining relationships as the main exposure with plans to emigrate in adjusted models, with only the spouse remaining in the home network retaining statistical significance with covariates. With all other variables in the model, having a spouse remaining became predictive of emigration (AOR = 2.38; 95% CI = 1.06 – 5.95).

Table 4 explores our calculated social network variables with plans to emigrate. In bivariate analyses, total degree, in-degree, and eigenvector centrality were significantly associated with emigration, but out-degree and transitivity were not. For each additional person in a participant's network, the odds of their emigration decreased by 3% (OR = 0.97; 95% CI = 0.94 – 0.99); for each additional person that named an individual as part of their network (in-degree), the odds of emigration decreased by 7% (OR = 0.93; 95% CI = 0.88 – 0.98); and higher eigenvector centrality scores were also significantly associated with lower odds of migration (OR = 0.05; 95% CI = 0.002 – 0.49). We then tested each of those significant social network variables as the main exposure with plans to emigrate in adjusted models with

covariates. None of the calculated social network variables remained significant in those multivariate models.

Because there were statistical differences between males and females in the full sample, we stratified each analysis by sex (Table 5). For males, bivariate analyses yielded similar results as in the adjusted model, with having an emigrant tie in the US failing to test as statistically significant, but older age groups had lower odds of plans to migrate. Married males had 68% lower odds of emigration (OR = 0.32; 95% CI = 0.19 – 0.56), and those with higher levels of education had higher odds of migration plans than those with no education, as in the full sample. The sole relationship with an emigrant tie that was statistically significant for males was having a close friend who emigrated (OR = 1.89; 95% CI = 1.03 – 3.44). We tested having an emigrant tie as the main exposure, and relationships with emigrants as the main exposure with plans to emigrate in the adjusted model with covariates, and neither yielded significant results. We then tested each of the relationships remaining in the home network for the male sample. In bivariate analyses, having a spouse or either parent remaining was statistically significant, but none of those relationships retained significance as the main exposure in adjusted models with covariates (Table 6). We also tested our calculated social network variables for the male sample, with only in-degree showing significant lowered odds of emigration plans in bivariate analyses (OR = 0.93; 95% CI = 0.87 – 0.99). None of the calculated social network variables were significant as main exposures with plans to emigrate in adjusted models with covariates (Table 7).

For females in the sample, bivariate analyses yielded similar results as in the male sample (Table 8). Simply having emigrant ties in the US was not significantly associated with plans to emigrate, but older females had lower odds of emigration than those in age groups below them. Married females had 51% lower odds of emigration (OR = 0.49; 95% CI = 0.28 – 0.85), and more educated females had higher odds of emigration. Having a child emigrated was significant for 87% lower odds of emigration females in bivariate analyses (OR = 0.13; 95% CI = 0.007 – 0.61); however, this relationship to emigrant, along with all others, failed to retain significance in the adjusted models with covariates (Table 8). For females, none of the remaining relationships in the home network were significantly associated with migration

plans; however, when entered into the adjusted model with covariates, having a spouse remaining did become predictive of plans to emigrate (AOR = 3.13; 95% CI = 1.11 – 10.77) (Table 9). In the stratified analysis of calculated social network variables for females, in-degree and eigenvector centrality were significantly associated with no emigration plans, but neither remained significant in multivariate models with covariates (Table 10).

3.4 Discussion and conclusions

Within this rural migrant-sending community in Guatemala, we found that having ties emigrated to the United States on its own did not increase the likelihood of an individual planning to migrate within the year. The lack of association between having a network tie that has emigrated is not in line with our original hypothesis, but it is possible that any association that may have been detected in years past has been lost because of normalized exposure to migration to the United States over time, and well-established migration channels that do not require direct network ties to access. This finding may highlight the highly normalized nature of migration from the region as a strategy for advancement. However, older adults, women, married persons, and those with lower education levels had lower odds of plans to migrate. In terms of relationships with emigrants and those remaining in networks at home, having a close friend or neighbor emigrated was associated with higher odds of migration plans, while having a child or spouse emigrated was associated with lower odds of migration plans for individuals. All remaining relationships in the home network were associated with higher odds of migration plans in univariate analyses, and spouse remaining held significance with higher odds of migration plans in the adjusted model. For social network characteristics, total degree, in-degree, and higher eigenvector centrality were associated with lower odds of migration plans. For each additional person in a participant's network, their odds of migration plans decreased by 3%, and for each additional person that named a participant as part of their network, their odds of migration plans decreased by 7%. However, none of those measures retained significance in adjusted models. In analyses stratified by sex, having emigrant ties in the US was not significantly associated with plans to migrate for males or females, but older adults, married persons, and those with less education had lower odds of plans to migrate in both

groups. For males, having a close friend or neighbor emigrated resulted in higher odds of migration plans, and for females having a child emigrated resulted in lower odds of migration plans. Neither of those relationships retained significance in adjusted models. For males, a spouse or either parent remaining at home increased their odds of migration plans, and higher in-degree lowered their odds of migration plans; however, neither of those relationships retained significance in adjusted models. For females, a spouse remaining resulted in higher odds of plans to migrate in the adjusted model with covariates. Higher in-degree and higher eigenvector centrality were associated with lower odds of migration plans for females, but neither social network characteristic held significance in adjusted models.

Scholarship has wrestled with what prompts people decide to leave their homes and important relationships to migrate internationally for many decades. The circumstances in which people make these decisions are varied and complex, making the explanations for migration difficult to capture within single theories or frameworks. For many years, scholars described migration as a result of "historical-structural" and "functionalist" forces.¹³ Circumstances and events were labeled as "push" factors causing people to leave their countries of origin, while the possible opportunities existing in another location were labeled as "pull" factors drawing people toward destination countries.^{5,6,160} Migration theory has moved toward more comprehensive views of migration decisions, particularly in the feminization of migration and technological advancements that support a "transnational" existence.^{187,188} There is more focus on meso-level theories that address the decision to migrate from a network perspective.⁴⁴ These consider social and capital resources and decision-making processes of families and communities, diversifying risk and opportunity for the whole unit.^{45,72,164-166} Migration theorists now consider the concepts of aspiration and desire in migration decisions, and these concepts intertwine with social networks and individuals' relationships with other mobile individuals.^{13,172} Social Network Analysis techniques in migration research is an emerging field of scholarship. The size of migrant networks in host countries, as well as the social capital and resources this affords new immigrants, has been the focus of much of this research;^{61,198-201,211,212} however, the social network characteristics of those left behind that may be

contemplating migration are an inextricable part of the complex reasoning behind the decision to migrate internationally.

In Guatemala, migration decisions have been prompted and sustained by factors that have evolved considerably over the past 50 years. Traditional push and pull theories may have been adequate at explaining migration decisions following their violent civil war and subsequent economic struggles and oppressive government policies;¹⁹² however, established and sustained migration flows from this region, while still related to economic opportunity and fleeing from violence, have become a social norm and risk diversification strategy for Guatemalan families.¹⁹³ Our results did not support our hypothesis that simply having network ties in the United States would make an individual more likely to plan on migrating themselves. However, we found evidence of demographic and network characteristics that influence the likelihood of someone from a rural Guatemalan community deciding to emigrate to the United States.

Twenty-two percent of participants in this study stated they had plans to emigrate to the United States within the coming year. Because this was a socio-centric network study of an entire community, that indicates that almost a quarter of the population of an entire village believes they will leave for the United States in the following 12 months. While ideation to emigrate is not a guarantee that an exodus of a quarter of the population is imminent, it is evidence of an overarching trend of migration as a normalized strategy for residents in this area. More than half of the study population had at least one emigrant tie living in the United States. Previous literature has documented those relationships with migrants, including the resources they provide in terms of migratory routes and existing support structures built in receiving countries, that make migration and the ideation to emigrate accessible to those remaining in a sending country.^{34,44,66,104,161} Further research with this population may be of interest to track whether this large number of individuals chose to emigrate and realized their ideation.

In our study population, men were more likely to have plans to migrate than women. Though migration is becoming more feminized in this region, these findings are consistent with many previous studies presenting men as more likely to leave in areas with traditional gender roles.^{101,187,188} As the age of participants increased, their desire to migrate decreased. With each ascending age group, plans to

migrate were reduced. This is consistent with previous research outlining migration as an activity undertaken by working-aged individuals. In this region, as in other areas in the world, previous migration patterns may have been less defined to age group in reaction to fleeing from violence and oppression,^{192,193} however, as reasons for migration have evolved over the past several decades, so have the normalized characteristics of migrants. Consistent with studies in other areas of Guatemala, households and communities undertake migration as a strategy to diversify risk and opportunity for the whole unit,¹⁹⁸⁻²⁰¹ thus, it would stand to reason that young adults, especially males, would be chosen to migrate. In line with traditional gender roles, older adults and women are often expected to take the roles of caregivers to children and the elderly.¹⁰¹ Though migration is often a household economic diversification strategy, single individuals were more likely to have plans to migrate in our study population. Single persons may have fewer emotional ties to contend with, including having a spouse and children, but may still have the responsibility of the household. Large nuclear families in this region may still lay an economic burden on single individuals to contribute to the overall well-being of the family unit, with the idea that their lack of ties to a spouse and children makes their mobility less emotionally burdensome.

More educated individuals were more likely to have plans to migrate. Most of the community did not have any formal education. Only 13% of those individuals had migration plans, while 41% of the most educated group had plans to migrate. Education in this region is only provided free of charge through the 6th grade. It may be that more educated persons have the financial resources necessary to emigrate, as they had been able to afford secondary school. It is possible that those individuals have ties to existing emigrant channels in the United States, as they may have been receiving remittances from ties already living there. These individuals may also feel more equipped to make the journey to the United States simply because they have more education than their peers. Scholarship has addressed this trend, with migration researchers and community leaders raising concern about “brain drain” in rural migrant-sending areas.²⁴⁹ More educated individuals emigrate to provide income supplementation to the family but leave entire communities of residents with less than a 6th-grade education.

Receiving remittances slightly reduced plans to migrate, as did having a sufficient income. Migration theory has outlined the phenomenon by which a sudden increase in resources leads to an initial spike in migration because it is more accessible,^{157,182-185} however, in this population, it may be that the desire to stay outweighs the possibility of leaving if income is sufficient and they are receiving financial help. This is in line with some previous migration research in Guatemala, in which some of the population are exercising their desire to stay if they can access education and resources.²⁰⁶

In regression analyses with the full sample, having immigrant ties in the United States on its own was not predictive of migration, nor were receiving remittances or income sufficiency; however, age, sex, marital status, religion, and education were significantly associated with plans to emigrate. Younger, male, single, higher educated, and non-Catholic individuals were more likely to plan to migrate. In terms of relationships to emigrant ties, having a child emigrate reduced the odds of ideation to migrate. Having a child emigrate remained significant in the adjusted regression model with covariates and remained significantly associated with lowered odds of migration plans when tested as the main exposure in the adjusted model. As we suspected some relationship between having a child emigrated to the US and age, we ran an interaction between those variables without significant results; however, we plotted the absence of a child by age to visualize the relationship between the two variables (Figure 3.2). This figure demonstrates that older participants were more likely to have a child in the United States while simply having an outmigrant was not age-dependent. We also plotted the ideation to emigrate by age, showing that younger participants are more likely to see themselves leaving, which may help explain some of the relationship between age, migration plans, and having a child that has emigrated (Figure 3.3). Older individuals are more likely to have a child emigrate, which would prompt the assumption that they are receiving financial support and negating their own need to emigrate.

Having a friend or neighbor in the United States was also predictive of migration plans. This is in line with concepts proposed in new migration theories accounting for “aspiration” and “desire.” People in migrant-sending areas see their peers’ ability to become mobile and improve household prospects and develop the idea that migration is accessible and viable for their households as well.^{13,172} While these

households may have access to migration information from friends and neighbors that have gone before, they may not be receiving remittances from those individuals because they are not part of those nuclear families. Having a spouse emigrate decreased the odds of migration ideation in the full sample. In line with risk diversification theories, this may indicate that a household already has a representative that has emigrated, and the left-behind spouse must care for others, thus building a transnational family.^{7,45,165,166}

Relationships in the network remaining at home were all significant in bivariate analyses. However, in the presence of other covariates in the models, none of those remaining relationships remained significant. Social network variables yielded some interesting findings in bivariate regression analyses. Total degree, or the total number of people in an individual's network; in-degree, or the number of other people that name an individual as a part of their network; and eigenvector centrality, a measure of network centrality, were all significantly associated with lower odds of migration plans. Though some network and migration research has found evidence that more connected individuals may have increased ability to emigrate because of access to information and resources, within this population, it seems that having more social capital at home decreases the desire to move.^{66,209,210} Having a larger network, being more central in that network, and being more "popular" to your peers appears to provide the support necessary to put off migration. This may also indicate risk diversification in action, as having more ties and being more central at home may provide extra support to an individual and decrease the need for international migration. Our finding that higher eigenvector centrality scores were associated with lower odds of migration, or put another way, that eigenvector centrality scores are lower for those with plans to migrate, suggests that less connected individuals are more likely to emigrate. It could be, as stated above, that social capital at home puts off migration; however, it could instead be that those individuals have more of their connections living outside of their community already and thus plan on joining them, which represents an area for future investigation. None of the network variables retained significance in adjusted models with all covariates.

Perhaps due to the sample size when stratified, major differences between the male and female sample were not detected in this population. Simply having emigrant ties was not predictive of migration

plans for either group, but age, education, and marital status were. One difference between the groups was that for men, having a close friend or neighbor emigrate increased the likelihood of self-migration plans. Again, this is in line with the “aspiration” and “desire” concepts in which seeing others’ success in migration may drive an individual to undertake it themselves. For women, having a child emigrate lowered their odds of migration plans.^{13,172} Mothers with a child likely sending remittances encouraged them to stay home; they may also be caring for the migrant’s children or other elderly individuals in the household.⁴² In the adjusted model for women, having a spouse in her home network made her 3.13 times more likely to have plans to migrate, but there was a wide confidence interval for that statistic (95% CI=1.11-10.77), perhaps due to the small sample size. For both men and women, as in the full sample, a higher in-degree was associated with lower odds of migration plans, but eigenvector centrality only significantly lowered the odds of migration plans for women. Women more central in their networks may have more social capital at home and a better social support system, thus prompting them to wish to remain.

This research had several limitations. The survey was cross-sectional and was a network study of a single, purposively sampled village, so it does not allow for inference of causation, nor is it generalizable beyond this village; however, the village was chosen by local leadership as representative of villages in the health district of Tajumulquito. There is also the possibility of social desirability bias on plans to emigrate, as undocumented migration is of a sensitive nature, resulting in under-reporting of plans to emigrate to the US undocumented. As social network data, it is difficult to know whether links are tied to the characteristics we are studying or due to other similar characteristics of individuals. This is also a geographically bounded population with close familial ties, so connections in outcomes between egos and alters may be attributable to proximity, relation, or other factors affecting the population.

Conclusions

Our data, which included socio-centric network mapping of a complete community from the Western rural highlands of Guatemala, allowed us to investigate factors driving sustained migration under current sociopolitical contexts. Understanding migration decisions may allow researchers and

interventionists to build upon what motivates people to leave to investigate what may strengthen influential ties in sending communities. Furthermore, with the impacts of climate change predicted to add more than 200 million climate refugees to the world's mobile populations, it is becoming increasingly important to examine the migration processes of residents in rural, smallholder farming communities of Central America.²⁵⁰⁻²⁵²

Future research should focus on the nuances of certain network configurations and relationships that influence migration decisions. It is unknown exactly how a person's network position or the types of relationships they have at home and abroad impact migration decisions. While migration theory has evolved to encompass the many cultural, economic, and violence-driven reasons for migration, it is still unclear if those theories can fully explain migration patterns and decisions among Indigenous Maya in rural high-volume sending communities. Research should include further investigation of the drivers of sustained migration from this region apart from just economic mobility and escape from violence; it is possible that sustained migration flows from this area over the past few decades have evolved not only traditional drivers of migration but also toward a new attainable cultural norm.

Support

This study was undertaken with the support of the Ministry of Health in Guatemala, the National Hospital of Guatemala, and local leadership. This study was approved by the University of California, San Diego Human Subjects Review Board. IRB#181152S. This study was funded by travel and research grants from the UCSD Center for Latin American and Iberian Studies, Tinker Foundation, the Global Health Institute at UCSD, the International Institute at UCSD, UCSD Friends of the International Center, the Inamori Fellowship at SDSU, the Lt. Florence B. Choe Memorial Endowed Scholarship, and the John and Mary Anderson Memorial Endowed Scholarship in Public Health from SDSU.

Acknowledgment

Chapter 3, "Socio-centric network dynamics of emigration in a rural migrant-sending community in the Western Highlands of Guatemala," is currently being prepared for submission for the publication of the material. Co-authors include Drs. Eric Leas, Kimberly Brouwer, Ramona Perez, Samantha Hurst,

Kate Swanson, and Holly Baker Shakya. The dissertation author was the primary investigator and author of this material.

3.5 Tables and figures

Table 3.1. Summary statistics individual survey

Table 1			
Summary Statistics Individual Survey			
N=653			
Mean (SD) Age in years 33.96 (16.51)			
	Proportion of total sample	Proportion with plans to emigrate	Proportion with emigrant tie (<i>p-value</i>)
Emigrant in the United States			
No	46%	21% (0.870)	-
Yes	54%	23%	-
Sex			
Female	59%	16% (<0.001)	53% (0.166)
Male	41%	30%	57%
Age by quartile			
15-20	29%	33% (<0.001)	54%
21-29	23%	24%	57%
30-43	24%	18%	53%
44-88	23%	11%	53%
Marital status			
Single	36%	37% (<0.001)	55% (<0.001)
Married/Civil union	64%	13%	54%
Education			
None	39%	13% (<0.001)	50% (0.003)
Primary school	53%	26%	54%
More than primary	8%	41%	76%
Religious affiliation			
None	42%	25% (0.025)	52% (0.532)
Evangelical	35%	23%	56%
Catholic	23%	14%	55%
Receives remittances			
No	75%	24% (0.079)	39% (<0.001)
Yes	25%	17%	100%
Income sufficiency			
Sufficient	27%	27% (0.239)	61% (0.055)
Not sufficient	73%	73%	52%

Table 3.2. Results of logistic regression on predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree

Table 2												
Results of logistic regression on predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree												
N=653												
	Bivariate analyses			Multivariate Model 1 emigrant tie main effect			Multivariate Model 2 emigrant tie main effect with relationship to emigrant			Multivariate Model 3 child emigrated main effect		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Emigrant tie												
No	Ref			Ref			Ref					
Yes	0.049	0.19	0.796	0.128	0.231	0.58	0.225	0.499	0.652			
Total degree	-0.03	0.015	0.044	0.007	0.017	0.658	0.005	0.017	0.784	0.007	0.017	0.678
Child emigrated												
No	Ref						Ref			Ref		
Yes	-3.098	1.011	0.002				-2.667	1.113	0.017	-2.551	1.037	0.014
Friend emigrated												
No	Ref						Ref					
Yes	0.444	0.214	0.037				0.012	0.455	0.98			
Spouse emigrated												
No	Ref						Ref					
Yes	-1.442	0.737	0.05				-1.059	0.842	0.208			
Parent emigrated												
No	Ref						Ref					
Yes	0.676	0.449	0.132				0.246	0.519	0.635			
Sibling emigrated												
No	Ref						Ref					
Yes	0.293	0.22	0.184				-0.063	0.443	0.886			
Age by quartile												
15-20	Ref			Ref			Ref			Ref		
21-29	-0.453	0.246	0.065	-0.207	0.279	0.457	-0.143	0.283	0.612	-0.174	0.28	0.535
30-43	-0.818	0.26	0.002	-0.375	0.318	0.238	-0.336	0.33	0.308	-0.294	0.323	0.362
44-88	-1.362	0.3	<0.001	-0.813	0.354	0.022	-0.534	0.366	0.144	-0.556	0.361	0.123
Sex												
Men	Ref			Ref			Ref			Ref		
Women	-0.766	0.192	<0.001	-0.675	0.214	0.002	-0.724	0.238	0.001	-0.767	0.217	<0.001
Marital status												
Single	Ref			Ref			Ref			Ref		
Married/Civil union	-0.84	0.193	<0.001	-0.651	0.238	0.006	-0.617	0.244	0.011	-0.664	0.24	0.006
Education												
None	Ref			Ref			Ref			Ref		
Primary school	0.851	0.224	<0.001	0.467	0.246	0.058	0.357	0.254	0.16	0.356	0.25	0.155
More than primary	1.536	0.334	<0.001	1.079	0.371	0.004	0.885	0.382	0.02	0.924	0.375	0.014
Religious affiliation												
None	Ref			Ref			Ref			Ref		
Evangelical	-0.136	0.209	0.517	0.031	0.228	0.893	0.047	0.232	0.84	0.069	0.23	0.762
Catholic	-0.741	0.274	0.007	-0.572	0.291	0.049	-0.577	0.299	0.054	-0.523	0.293	0.074
Remittances												
No	Ref			Ref			Ref			Ref		
Yes	-0.439	0.236	0.063	-0.513	0.286	0.073	-0.219	0.327	0.504	-0.207	0.271	0.446
Income sufficiency												
Not sufficient	Ref			Ref			Ref			Ref		
Sufficient	0.284	0.221	0.2	0.28	0.237	0.237	0.234	0.244	0.339	0.253	0.241	0.293

Table 3.3. Results of logistic regression on relationships remaining in the home network as predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree

Table 3 Results of logistic regression on relationships remaining in home network as predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree N=653															
	Bivariate analyses			Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Spouse in home network															
No	Ref			Ref											
Yes	-0.379	0.19	0.046	0.867	0.437	0.047									
Mother in home network															
No	Ref						Ref								
Yes	0.711	0.201	<0.001				0.112	0.243	0.644						
Father in home network															
No	Ref									Ref					
Yes	0.497	0.191	0.009							-0.003	0.226	0.989			
Sibling in home network															
No	Ref												Ref		
Yes	0.707	0.241	0.003										0.473	0.269	0.079
Total degree	-0.03	0.015	0.044	0.007	0.017	0.689	0.006	0.017	0.727	0.008	0.018	0.647	-0.003	0.018	0.859
Age by quartile															
15-20	Ref			Ref			Ref			Ref			Ref		
21-29	-0.453	0.246	0.065	-0.209	0.28	0.455	-0.19	0.28	0.498	-0.2	0.28	0.475	-0.203	0.28	0.468
30-43	-0.818	0.26	0.002	-0.458	0.322	0.154	-0.341	0.324	0.292	-0.37	0.321	0.249	-0.334	0.319	0.296
44-88	-1.362	0.3	<0.001	-0.91	0.357	0.011	-0.757	0.379	0.045	-0.821	0.373	0.028	-0.773	0.354	0.029
Sex															
Men	Ref			Ref			Ref			Ref			Ref		
Women	-0.766	0.192	<0.001	-0.618	0.215	0.004	-0.68	0.213	0.001	-0.688	0.214	0.001	-0.653	0.214	0.002
Marital status															
Single	Ref			Ref			Ref			Ref			Ref		
Married/Civil union	-0.84	0.193	<0.001	-1.354	0.436	0.002	-0.632	0.242	0.009	-0.654	0.241	0.007	-0.591	0.24	0.014
Education															
None	Ref			Ref			Ref			Ref			Ref		
Primary school	0.851	0.224	<0.001	0.424	0.247	0.086	0.461	0.247	0.062	0.47	0.246	0.056	0.426	0.248	0.086
More than primary	1.536	0.334	<0.001	1.058	0.369	0.004	1.078	0.371	0.004	1.098	0.37	0.003	1.052	0.371	0.005
Religious affiliation															
None	Ref			Ref			Ref			Ref			Ref		
Evangelical	-0.136	0.209	0.655	0.034	0.229	0.883	0.033	0.228	0.884	0.033	0.228	0.884	0.048	0.229	0.834
Catholic	-0.741	0.274	0.008	-0.598	0.291	0.04	-0.571	0.291	0.05	-0.571	0.291	0.05	-0.548	0.291	0.06
Remittances															
No	Ref			Ref			Ref			Ref			Ref		
Yes	-0.439	0.236	0.063	-0.374	0.258	0.147	-0.445	0.255	0.081	-0.439	0.254	0.084	-0.446	0.255	0.081
Income sufficiency															
Not sufficient	Ref			Ref			Ref			Ref			Ref		
Sufficient	0.284	0.221	0.2	0.277	0.237	0.243	0.275	0.237	0.246	0.273	0.237	0.249	0.271	0.237	0.253

Table 3.4. Results of logistic regression analyses testing the effect of an individual's network characteristics on the probability of migration plans in the rural western highlands of Guatemala, adjusted for total degree

Table 4 Results of logistic regression analyses testing the effect of an individual's network characteristics on the probability of migration plans in the rural western highlands of Guatemala, adjusted for total degree N=653																		
	Bivariate analyses			Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
	Beta	SE	P	Total degree main effect			In-degree main effect			Out-degree main effect			Eigenvector centrality main effect			Transitivity main effect		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Total degree	-0.03	0.015	0.044	0.008	0.016	0.635							0.019	0.02	0.337	0.009	0.017	0.59
In-degree	-0.07	0.026	0.007				-0.013	0.029	0.662									
Out-degree	-0.01	0.022	0.644							0.028	0.025	0.264						
Eigenvector centrality	-3.102	1.378	0.024										-1.612	1.466	0.271			
Transitivity	-0.113	0.833	0.892													-1.154	0.887	0.193
Age by quartile																		
15-20	Ref			Ref			Ref			Ref			Ref			Ref		
21-29	-0.453	0.246	0.065	-0.2	0.279	0.474	-0.187	0.279	0.501	-0.211	0.279	0.45	-0.221	0.279	0.43	-0.231	0.289	0.414
30-43	-0.818	0.26	0.002	-0.369	0.318	0.246	-0.309	0.32	0.335	-0.371	0.313	0.237	-0.355	0.318	0.263	-0.417	0.319	0.192
44-88	-1.362	0.3	<0.001	-0.819	0.354	0.021	-0.727	0.365	0.046	-0.79	0.345	0.022	-0.776	0.356	0.029	-0.852	0.355	0.016
Sex																		
Men	Ref			Ref			Ref			Ref			Ref			Ref		
Women	-0.766	0.192	<0.001	-0.688	0.213	0.001	-0.681	0.217	0.001	-0.709	0.214	0.001	-0.715	0.214	0.001	-0.703	0.215	0.001
Marital status																		
Single	Ref			Ref			Ref			Ref			Ref			Ref		
Married/Civil union	-0.84	0.193	<0.001	-0.653	0.238	0.006	-0.634	0.238	0.008	-0.643	0.237	0.007	-0.646	0.237	0.007	-0.664	0.24	0.006
Education																		
None	Ref			Ref			Ref			Ref			Ref			Ref		
Primary school	0.851	0.224	<0.001	0.47	0.246	0.056	0.467	0.246	0.058	0.503	0.249	0.043	0.502	0.247	0.042	0.487	0.247	0.049
More than primary	1.536	0.334	<0.001	1.098	0.369	0.003	1.081	0.367	0.003	1.135	0.372	0.002	1.107	0.37	0.003	1.12	0.371	0.003
Religious affiliation																		
None	Ref			Ref			Ref			Ref			Ref			Ref		
Evangelical	-0.136	0.209	0.655	0.033	0.228	0.883	0.031	0.228	0.892	0.019	0.229	0.935	0.036	0.229	0.876	0.008	0.23	0.973
Catholic	-0.741	0.274	0.008	-0.571	0.291	0.049	-0.573	0.291	0.049	-0.574	0.291	0.048	-0.527	0.292	0.071	-0.603	0.295	0.041
Remittances																		
No	Ref			Ref			Ref			Ref			Ref			Ref		
Yes	-0.439	0.236	0.063	-0.439	0.254	0.084	-0.44	0.254	0.084	-0.436	0.254	0.087	-0.449	0.255	0.078	-0.421	0.255	0.099
Income sufficiency																		
Not sufficient	Ref			Ref			Ref			Ref			Ref			Ref		
Sufficient	0.284	0.221	0.2	0.273	0.237	0.249	0.269	0.237	0.255	0.296	0.238	0.214	0.289	0.237	0.224	0.309	0.24	0.198

Table 3.5. Results of logistic regression on predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree, by sex (male, n=269)

Table 5									
Results of logistic regression on predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree									
By sex (MALE) n=269									
	Bivariate analyses			Multivariate model 1 emigrant tie main effect			Multivariate model 2 emigrant tie main effect with relationship to emigrant		
	Beta	SE	P	Beta	SE	P	Beta	SE	P
Emigrant tie									
No	Ref			Ref			Ref		
Yes	0.007	0.27	0.98	-0.073	0.329	0.824	-0.749	0.91	0.41
Total degree	-0.022	0.022	0.308	0.037	0.026	0.15	0.035	0.026	0.179
Child emigrated									
No	Ref						Ref		
Yes	-16.898	688.683	0.98				-16.438	1074.076	0.988
Friend emigrated									
No	Ref						Ref		
Yes	0.634	0.308	0.039				0.879	0.87	0.312
Spouse emigrated									
No	Ref						Ref		
Yes	0.169	1.232	0.89				0.869	1.571	0.58
Parent emigrated									
No	Ref						Ref		
Yes	0.905	0.594	0.13				1.185	0.771	0.124
Sibling emigrated									
No	Ref						Ref		
Yes	0.314	0.311	0.31				0.512	0.789	0.517
Age by quartile									
15-20	Ref			Ref			Ref		
21-29	-0.384	0.356	0.281	-0.123	0.419	0.77	-0.083	0.424	0.844
30-43	-0.937	0.368	0.011	-0.51	0.457	0.265	-0.372	0.477	0.436
44-88	-1.849	0.44	<0.001	-1.375	0.552	0.013	-1.09	0.573	0.057
Marital status									
Single	Ref			Ref			Ref		
Married/Civil union	-1.134	0.281	<0.001	-0.772	0.372	0.038	-0.852	0.38	0.025
Education									
None	Ref			Ref			Ref		
Primary school	0.887	0.357	0.013	0.612	0.379	0.106	0.397	0.402	0.324
More than primary	1.501	0.475	0.002	1.236	0.523	0.018	0.891	0.537	0.097
Religious affiliation									
None	Ref			Ref			Ref		
Evangelical	0.125	0.305	0.68	0.2	0.337	0.553	0.141	0.347	0.681
Catholic	-0.215	0.37	0.56	0.123	0.41	0.764	0.225	0.425	0.597
Remittances									
No	Ref			Ref			Ref		
Yes	-0.445	0.339	0.19	-0.405	0.415	0.33	-0.044	0.487	0.929
Income sufficiency									
Not sufficient	Ref			Ref			Ref		
Sufficient	0.444	0.331	0.18	0.372	0.359	0.301	0.302	0.378	0.425

Table 3.6. Results of logistic regression on relationships remaining in the home network as predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree, by sex (male, n=269)

Table 6															
Results of logistic regression on relationships remaining in home network as predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree															
By sex (MALE) n=269															
	Bivariate analyses			Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Spouse in home network															
No	Ref			Ref											
Yes	-0.916	0.276	<0.001	0.261	0.716	0.715									
Mother in home network															
No	Ref						Ref								
Yes	0.98	0.293	<0.001				0.23	0.351	0.511						
Father in home network															
No	Ref									Ref					
Yes	0.911	0.28	0.001							0.389	0.331	0.24			
Sibling in home network															
No	Ref												Ref		
Yes	0.685	0.354	0.053										0.367	0.399	0.358
Total degree	-0.022	0.022	0.308	0.036	0.026	0.165	0.034	0.026	0.201	0.028	0.027	0.31	0.029	0.027	0.292
Age by quartile															
15-20	Ref			Ref			Ref			Ref			Ref		
21-29	-0.182	0.229	0.281	-0.141	0.416	0.735	-0.096	0.421	0.82	-0.061	0.423	0.886	-0.115	0.416	0.782
30-43	-0.937	0.368	0.011	-0.536	0.458	0.241	-0.443	0.47	0.346	-0.417	0.465	0.37	-0.501	0.456	0.272
44-88	-1.849	0.44	<0.001	-1.386	0.552	0.012	-1.221	0.598	0.041	-1.097	0.598	0.067	-1.32	0.551	0.017
Marital status															
Single	Ref			Ref			Ref			Ref			Ref		
Married/Civil union	-1.134	0.281	<0.001	-0.99	0.724	0.172	-0.749	0.37	0.043	-0.758	0.372	0.042	-0.72	0.37	0.052
Education															
None	Ref			Ref			Ref			Ref			Ref		
Primary school	0.887	0.357	0.013	0.598	0.379	0.115	0.59	0.38	0.12	0.612	0.381	0.108	0.588	0.38	0.121
More than primary	1.501	0.475	0.002	1.214	0.517	0.019	1.188	0.52	0.022	1.22	0.518	0.019	1.189	0.52	0.022
Religious affiliation															
None	Ref			Ref			Ref			Ref			Ref		
Evangelical	0.155	0.306	0.613	0.197	0.337	0.559	0.207	0.338	0.539	0.226	0.338	0.505	0.222	0.338	0.511
Catholic	-0.205	0.37	0.579	0.105	0.414	0.8	0.138	0.411	0.737	0.126	0.412	0.759	0.128	0.411	0.756
Remittances															
No	Ref			Ref			Ref			Ref			Ref		
Yes	-0.445	0.339	0.189	-0.437	0.378	0.247	-0.435	0.378	0.249	-0.443	0.378	0.241	-0.417	0.378	0.27
Income sufficiency															
Not sufficient	Ref			Ref			Ref			Ref			Ref		
Sufficient	0.444	0.331	0.179	0.376	0.359	0.296	0.366	0.36	0.31	0.347	0.361	0.336	0.378	0.36	0.294

Table 3.7. Results of logistic regression analyses testing the effect of an individual's network characteristics on the probability of migration plans from the western highlands of Guatemala, adjusted for total degree, by sex (male, n=269)

Table 7																		
Results of logistic regression analyses testing the effect of an individual's network characteristics on the probability of migration plans in the rural western highlands of Guatemala, adjusted for total degree																		
By sex (MALE) n=269																		
	Bivariate analyses			Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
	Beta	SE	P	Total degree main effect			In-degree main effect			Out-degree main effect			Eigenvector centrality main effect			Transitivity main effect		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Total degree	-0.022	0.022	0.308	0.037	0.026	0.154							0.05	0.03	0.101	0.039	0.026	0.136
In-degree	-0.071	0.035	0.041				0.024	0.041	0.557									
Out-degree	0.025	0.036	0.478							0.072	0.042	0.087						
Eigenvector centrality	-2.286	1.162	0.118										-1.49	1.717	0.386			
Transitivity	-0.074	1.066	0.944													-1.304	1.174	0.267
Age by quartile																		
15-20	Ref			Ref			Ref			Ref			Ref			Ref		
21-29	-0.182	0.229	0.281	-0.134	0.416	0.747	-0.143	0.415	0.73	-0.146	0.416	0.726	-0.161	0.417	0.7	-0.228	0.423	0.589
30-43	-0.937	0.368	0.011	-0.519	0.455	0.254	-0.482	0.456	0.29	-0.465	0.451	0.303	-0.521	0.456	0.253	-0.627	0.459	0.172
44-88	-1.849	0.44	<0.001	-1.375	0.552	0.013	-1.284	0.565	0.023	-1.227	0.528	0.02	-1.367	0.553	0.013	-1.47	0.557	0.008
Marital status																		
Single	Ref			Ref			Ref			Ref			Ref			Ref		
Married/Civil union	-1.134	0.281	<0.001	-0.763	0.369	0.039	-0.73	0.369	0.048	-0.717	0.364	0.049	-0.76	0.368	0.039	-0.775	0.376	0.039
Education																		
None	Ref			Ref			Ref			Ref			Ref			Ref		
Primary school	0.887	0.357	0.013	0.608	0.378	0.108	0.6	0.378	0.113	0.66	0.312	0.084	0.665	0.383	0.082	0.646	0.381	0.09
More than primary	1.501	0.475	0.002	1.219	0.518	0.019	1.165	0.513	0.023	1.212	0.523	0.014	1.252	0.521	0.016	1.246	0.521	0.017
Religious affiliation																		
None	Ref			Ref			Ref			Ref			Ref			Ref		
Evangelical	0.155	0.306	0.613	0.202	0.337	0.548	0.199	0.336	0.554	0.201	0.337	0.55	0.199	0.338	0.556	0.139	0.342	0.684
Catholic	-0.205	0.37	0.579	0.125	0.518	0.019	0.098	0.41	0.812	0.138	0.411	0.737	0.224	0.416	0.59	0.168	0.415	0.685
Remittances																		
No	Ref			Ref			Ref			Ref			Ref			Ref		
Yes	-0.445	0.339	0.189	-0.443	0.377	0.24	-0.452	0.376	0.229	-0.419	0.377	0.267	-0.446	0.378	0.238	-0.456	0.38	0.23
Income sufficiency																		
Not sufficient	Ref			Ref			Ref			Ref			Ref			Ref		
Sufficient	0.444	0.331	0.179	0.373	0.359	0.299	0.329	0.356	0.356	0.428	0.365	0.242	0.401	0.362	0.268	0.487	0.37	0.188

Table 3.8. Results of logistic regression on predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree, by sex (female, n=384)

Table 8									
Results of logistic regression on predictors of migration plans in the rural western highlands of Guatemala, adjusted for total degree									
By sex (FEMALE) n=384									
	Bivariate analyses			Multivariate model 1 emigrant tie main effect			Multivariate model 2 emigrant tie main effect with relationships to emigrant		
	Beta	SE	P	Beta	SE	P	Beta	SE	P
Emigrant tie									
No	Ref			Ref			Ref		
Yes	0.02	0.276	0.94	0.298	0.335	0.373	0.494	0.673	0.463
Total degree	-0.031	0.021	0.145	-0.009	0.024	0.715	-0.011	0.024	0.647
Child emigrated									
No	Ref						Ref		
Yes	-2.049	1.024	0.045				-1.901	1.18	0.107
Friend emigrated									
No	Ref						Ref		
Yes	0.325	0.31	0.29				-0.164	0.605	0.786
Spouse emigrated									
No	Ref						Ref		
Yes	-1.727	1.027	0.093				-1.686	1.171	0.15
Parent emigrated									
No	Ref						Ref		
Yes	0.141	0.794	0.86				-0.401	0.881	0.649
Sibling emigrated									
No	Ref						Ref		
Yes	0.273	0.321	0.4				-0.105	0.616	0.865
Age by quartile									
15-20	Ref			Ref			Ref		
21-29	-0.515	0.358	0.151	-0.241	0.393	0.541	-0.171	0.403	0.672
30-43	-0.763	0.38	0.045	-0.233	0.462	0.614	-0.238	0.483	0.622
44-88	-0.973	0.416	0.019	-0.456	0.474	0.337	-0.24	0.498	0.63
Marital status									
Single	Ref			Ref			Ref		
Married/Civil union	-0.714	0.278	0.01	-0.577	0.319	0.071	-0.462	0.333	0.165
Education									
None	Ref			Ref			Ref		
Primary school	0.636	0.299	0.033	0.419	0.342	0.221	0.409	0.347	0.239
More than primary	1.281	0.513	0.013	1.063	0.561	0.058	1.008	0.592	0.089
Religious affiliation									
None	Ref			Ref			Ref		
Evangelical	-0.145	0.301	0.629	-0.189	0.314	0.548	-0.086	0.322	0.789
Catholic	-1.084	0.429	0.012	-1.178	0.441	0.008	-1.237	0.47	0.008
Remittances									
No	Ref			Ref			Ref		
Yes	-0.378	0.336	0.26	-0.589	0.411	0.152	-0.188	0.475	0.692
Income sufficiency									
Not sufficient	Ref			Ref			Ref		
Sufficient	0.054	0.305	0.86	0.17	0.322	0.598	0.169	0.333	0.611

Table 3.9 Results of logistic regression on relationships remaining in the home network as predictors of migration plans in the rural western highlands of Guatemala, by sex (female, n=384)

Table 9 Results of logistic regression on relationships remaining in home network as predictors of migration plans in the rural western highlands of Guatemala															
By sex (FEMALE) n=384															
	Bivariate analyses			Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4		
				Spouse in home network main effect			Mother in home network main effect			Father in home network main effect			Sibling in home network main effect		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Spouse in home network															
No	Ref			Ref											
Yes	-0.161	0.277	0.562	1.141	0.571	0.045									
Mother in home network															
No	Ref						Ref								
Yes	0.411	0.283	0.146				0.056	0.351	0.872						
Father in home network															
No	Ref									Ref					
Yes	-0.01	0.277	0.972							-0.382	0.33	0.248			
Sibling in home network															
No	Ref												Ref		
Yes	0.616	0.333	0.065										0.558	0.37	0.132
Total degree	-0.031	0.021	0.145	-0.009	0.024	0.701	-0.009	0.025	0.702	0	0.024	0.992	-0.022	0.026	0.394
Age by quartile															
15-20	Ref			Ref			Ref			Ref			Ref		
21-29	-0.515	0.358	0.151	-0.234	0.396	0.555	-0.242	0.394	0.539	-0.241	0.394	0.541	-0.272	0.396	0.492
30-43	-0.763	0.38	0.045	-0.359	0.472	0.448	-0.229	0.468	0.625	-0.303	0.466	0.516	-0.186	0.466	0.689
44-88	-0.973	0.416	0.019	-0.635	0.48	0.186	-0.456	0.501	0.363	-0.624	0.491	0.204	-0.449	0.474	0.343
Marital status															
Single	Ref			Ref			Ref			Ref			Ref		
Married/Civil union	-0.714	0.278	0.01	-1.448	0.57	0.011	-0.546	0.334	0.102	-0.671	0.334	0.044	-0.481	0.324	0.138
Education															
None	Ref			Ref			Ref			Ref			Ref		
Primary school	0.636	0.299	0.033	0.353	0.344	0.304	0.412	0.343	0.23	0.428	0.345	0.214	0.354	0.346	0.306
More than primary	1.281	0.513	0.013	1.017	0.563	0.071	1.07	0.563	0.058	1.134	0.564	0.044	1.023	0.564	0.07
Religious affiliation															
None	Ref			Ref			Ref			Ref			Ref		
Evangelical	-0.145	0.301	0.629	-0.141	0.314	0.654	-0.169	0.313	0.589	-0.185	0.314	0.555	-0.161	0.314	0.608
Catholic	-1.084	0.429	0.012	-1.157	0.443	0.009	-1.166	0.442	0.008	-1.14	0.442	0.01	-1.115	0.443	0.012
Remittances															
No	Ref			Ref			Ref			Ref			Ref		
Yes	-0.378	0.336	0.26	-0.284	0.362	0.433	-0.409	0.359	0.255	-0.406	0.357	0.255	-0.45	0.361	0.213
Income sufficiency															
Not sufficient	Ref			Ref			Ref			Ref			Ref		
Sufficient	0.054	0.305	0.86	0.135	0.321	0.675	0.15	0.321	0.64	0.114	0.322	0.724	0.141	0.322	0.661

Table 3.10. Results of logistic regression analyses testing the effect of an individual's network characteristics on the probability of migration plans from the western highlands of Guatemala, adjusted for total degree, by sex (female, n=384)

Table 10 Results of logistic regression analyses testing the effect of an individual's network characteristics on the probability of migration plans in the rural western highlands of Guatemala, adjusted for total degree																		
By sex (FEMALE) n=384																		
	Bivariate analyses			Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
				Total degree main effect			In-degree main effect			Out-degree main effect			Eigenvector centrality main effect			Transitivity main effect		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Total degree	-0.031	0.021	0.145	-0.008	0.0245	0.725							0.011	0.028	0.709	-0.008	0.024	0.743
In-degree	-0.085	0.041	0.037				-0.047	0.045	0.292									
Out-degree	-0.009	0.03	0.754							0.012	0.034	0.71						
Eigenvector centrality	-6.346	2.977	0.033										-4.057	3.583	0.258			
Transitivity	0.619	1.385	0.655													-1.244	1.421	0.381
Age by quartile																		
15-20	Ref			Ref			Ref			Ref			Ref			Ref		
21-29	-0.515	0.358	0.151	-0.245	0.394	0.534	-0.22	0.392	0.575	-0.286	0.393	0.467	-0.265	0.395	0.503	-0.236	0.396	0.551
30-43	-0.763	0.38	0.045	-0.241	0.462	0.602	-0.129	0.469	0.783	-0.303	0.451	0.502	-0.187	0.462	0.686	-0.249	0.464	0.592
44-88	-0.973	0.416	0.019	-0.482	0.474	0.309	-0.344	0.491	0.484	-0.503	0.468	0.283	-0.378	0.48	0.432	-0.49	0.475	0.303
Marital status																		
Single	Ref			Ref			Ref			Ref			Ref			Ref		
Married/Civil union	-0.714	0.278	0.01	-0.562	0.319	0.078	-0.538	0.32	0.093	-0.555	0.319	0.082	-0.53	0.32	0.097	-0.568	0.322	0.078
Education																		
None	Ref			Ref			Ref			Ref			Ref			Ref		
Primary school	0.636	0.299	0.033	0.417	0.342	0.223	0.442	0.341	0.194	0.46	0.347	0.185	0.45	0.343	0.19	0.42	0.344	0.223
More than primary	1.281	0.513	0.013	1.081	0.56	0.053	1.096	0.559	0.05	1.115	0.562	0.047	1.083	0.56	0.053	1.139	0.565	0.044
Religious affiliation																		
None	Ref			Ref			Ref			Ref			Ref			Ref		
Evangelical	-0.145	0.301	0.629	-0.168	0.313	0.591	-0.198	0.314	0.528	-0.188	0.315	0.551	-0.169	0.314	0.591	-0.181	0.315	0.564
Catholic	-1.084	0.429	0.012	-1.164	0.441	0.008	-1.179	0.442	0.008	-1.18	0.442	0.008	-1.138	0.443	0.01	-1.292	0.462	0.005
Remittances																		
No	Ref			Ref			Ref			Ref			Ref			Ref		
Yes	-0.378	0.336	0.26	-0.402	0.357	0.259	-0.415	0.358	0.245	-0.395	0.356	0.267	-0.413	0.357	0.247	-0.348	0.359	0.332
Income sufficiency																		
Not sufficient	Ref			Ref			Ref			Ref			Ref			Ref		
Sufficient	0.054	0.305	0.86	0.147	0.321	0.647	0.168	0.322	0.601	0.159	0.321	0.621	0.156	0.322	0.628	0.118	0.323	0.715

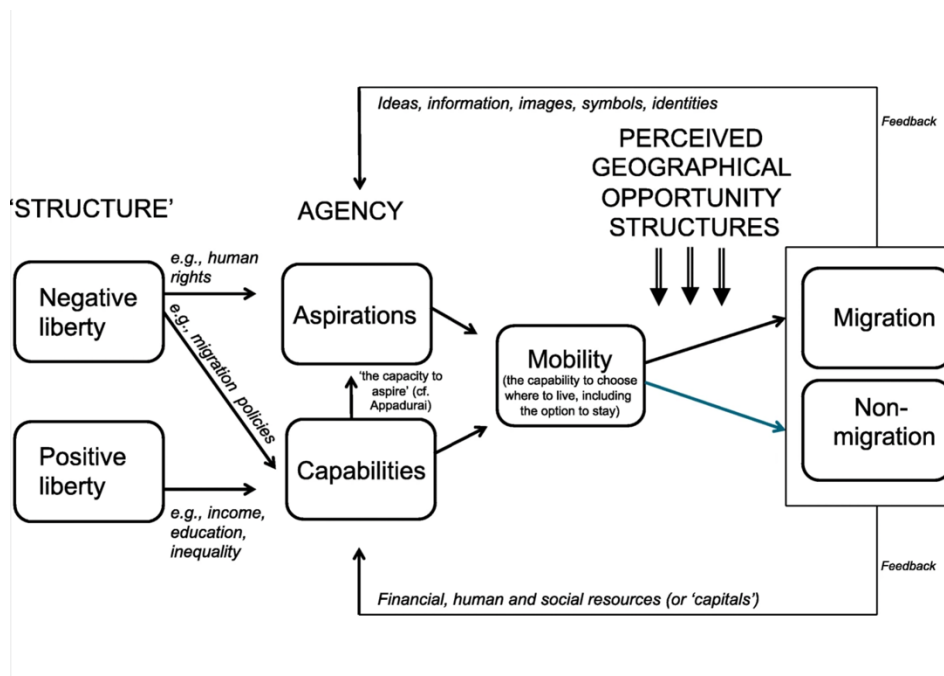


Figure 3.1. Migratory Agency Framework, adapted from Hein de haas (2021)¹³

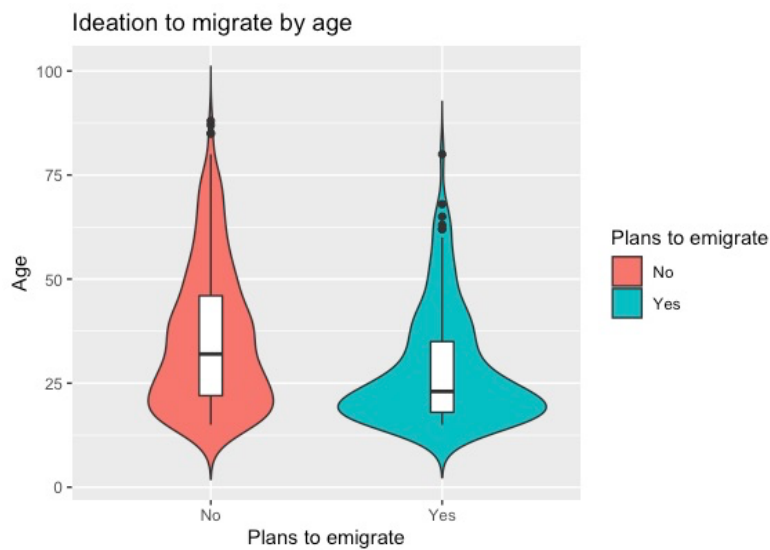


Figure 3.2. Violin plot illustrating the probability density by age in years of an individual's plans to emigrate to the United States within 12 months

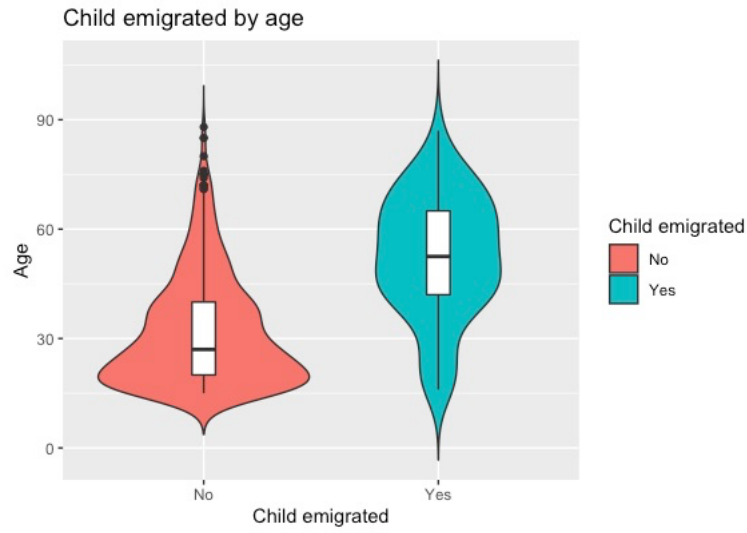


Figure 3.3. Violin plot illustrating the probability density by age in years of having a child emigrated to the United States

Chapter 4: Social network dynamics as moderators of the impact of being "left-behind" to international migration and depression in rural Guatemala

4.1 Introduction

Migration research with mobile populations across the globe has documented the impacts of migration on mental health outcomes.^{253,254} Many studies have focused on the mental health outcomes of those that have migrated, but far less is known about those that remain in their countries of origin, termed persons "left-behind." There is evidence that being part of a left-behind community is associated with depressive symptoms.^{17-21,28,106} Previous research suggests reduced psychological well-being and emotional health, and increased loneliness and anxiety in left-behind populations worldwide.^{16,23,26,27,29,30,255-265} Studies utilizing depressive symptoms in particular as a mental health outcome found evidence of significant increased depressive symptoms in those remaining in their home country.^{22,29,34,35,260,265-274} In Latin America, the concept of "nervios" is widely recognized as a depression-like disorder, often affecting women and children experiencing loss to migration. Nervios is marked by melancholy, extreme sadness, anger, and even violence stemming from loss and heartache.²⁷⁵

Women remain in their home countries in many locations while spouses and other network members emigrate domestically and internationally. Studies with these populations reveal varying experiences and consequences.^{16,152,261,269,270} Aghajanian (2014) found that Iranian women left-behind to emigration report no higher levels of mental health distress than their counterparts because of increased economic security but men in that study region tend to return after emigration as opposed to permanent resettlement.²⁷⁰ Studies with Mexican women left-behind by emigrated spouses, children, or other close ties experience elevated levels of mental health distress.^{16,152,261,276,277} However, it is important to acknowledge that the impacts of migration are not implicitly negative on women left-behind. There are often positive changes in traditional gender roles resulting in more independence for women. For example, a study with Maya in the Yucatan by Bever (2002) argues for the benefits of transforming gender roles through migration, bringing more autonomy and control of household resources for women.²⁷⁸ A study by Taylor, Moran-Taylor, and Ruiz (2006) with four rural communities in Guatemala

also reported female empowerment through migration. They provide accounts of female autonomy, escape from oppression and abuse, and increased participation of women in emigration.¹⁴ They note a gradual erosion of traditional gender roles, including brief parity of roles among men and women when men return. However, both studies reported the short-lived nature of changes in gender roles, attributable to deep cultural norms and social structures resistant to change.^{14,278}

Social network effects

There is evidence that emigration causes changes in the social network structures of communities left-behind.^{32,33} Studies looking at the association of poor mental health with being left-behind often identify the vital role of social ties against poor mental health outcomes.^{30,34-36} For instance, some research has found that social ties and network cohesion moderate the association between migration and poor mental health.^{34,35,106,256,257,277,279} There is a lack of migration research specifically using social network analysis techniques to explore how social network characteristics may moderate the mental health outcomes. However, the moderating effects of relationship types and network size described in social support literature suggest an opportunity to investigate the moderating effects of social network analysis variables in the relationship between migration and poor mental health. The use of socio-centric social network data presented in this study represents a critical step in filling that gap in the existing literature.

Network data can be either ego-centric or socio-centric. Ego-centric network data focuses on the personal network characteristics of an individual (also known as an "ego" in network terms).²¹⁴ Socio-centric network studies map all connections within a small, bounded network.^{215,216} Measures that may provide insight into mental health outcomes include those that describe structural position within a network and measures of network size.⁴⁰ Transitivity is a measure of structural position that reflects network cohesion by quantifying the probability that an individual's network connections are also connected to one another;^{217-219,280,281} or more simply, the extent to which an individual's friends are also friends with one another. Network size is most commonly measured by degree, or the total number of connections an individual has within a network.²¹⁴ In-degree describes the number of people that have

nominated an individual as a part of their network, while out-degree is the number of other people (also known as alters in network terms) that an individual names.²¹⁴ Research suggests that individuals with smaller networks are more likely to experience depression.³⁹ Research with adolescents suggests that social isolation, measured as total degree, and low transitivity are associated with poor mental health outcomes and suicidal ideation.⁴¹ Depression outcomes are also influenced by network centrality, or how connected an individual is to others in the network. For example, in a longitudinal study with more than 12,000 participants, Rosenquist, Fowler, and Christakis (2011) found that higher network centrality scores significantly decreased the likelihood of depression.⁴⁰

There is evidence of sex differences in the association between network measures and depressive symptoms.²⁸² Research lacks an understanding of how social support and depressive symptoms present differently in men and women.²⁸³⁻²⁸⁸ Some scholarship provides evidence that women are more likely to present depressive symptoms through emotional reactions while men engage more in risky behavior.^{285,289} One explanation for these differences is that women may take on caregiving roles and be more exposed to adverse events in the lives of those in their social networks.²⁸³ Feminist migration and geopolitical literature identify the gendered costs of migration-based changes to a woman's network. For example, a study by Torres and Carte (2016) with migrant-sending populations in rural Mexico found that migration places demands on women to become heads of household, a labor force, and managers of financial remittances in addition to their traditional roles and caring for children, elderly, and the infirm.²⁹⁰ They also note that women and older adults endure heavy workloads and care for children alone, causing children to suffer when over-extended caregivers cannot provide adequate supervision and support; these changes result in psychological and emotional stress, depression, substance use, and perpetuates migration.²⁹⁰

Mental health in Guatemala

Information on mental health in Guatemala is scarce. While there is a mental health plan in place in Guatemala, no funding is allocated to implement the plan, and no official mental health expenditure was reported on the 2020 World Health Organization mental health report.²⁹¹ According to that same

report, there were just eight studies published on mental health in Guatemala since 2019. Existing mental health studies in Guatemala predominately concern experiences of violence during and following the civil war. Sabin (2003) performed a study of 170 Guatemalan refugees aged 16 and older living in Chiapas, Mexico. Post-traumatic stress disorder, anxiety, and depression were common within that population, including 47.8% of 179 participants meeting symptom criteria for depression.²⁹² Keller (2017) surveyed 234 adults who had migrated from the Northern Triangle, 87% of whom reported direct exposure to violence or threats. Most other participants reported violence in their communities as the reason for immigration; twenty-four percent of that sample met the diagnostic criteria for depression.²⁹³ Puoc-Polanco (2015) surveyed 1,452 adults that had experienced violence during and following the civil war in Guatemala. Of that sample, 4.2% screened positive for depression. Women, Indigenous Maya, and urban dwellers had greater odds of experiencing poor mental health.²⁹⁴ Branäs (2013) found associations between violence and mental health, with 40.7% screening positive for depression among 86 people from Guatemala City and the Sololá department in the western highlands. Those rates were higher than expected but attributed to ongoing violence and fear since the end of the civil war because 90% of participants reported still fearing violence.²⁹⁵ Sabin (2006) surveyed 179 previous refugees that had returned to Guatemala after living in refugee camps in Mexico and found that 47.8% met the symptom criteria for depression.²⁹² No other studies were focused on depression incidence in Guatemalan populations outside of experiences of violence, highlighting the need for future research in this area of study.

While Guatemalan Indigenous women are immigrating north more often, they are still the dominant group being left-behind by the emigration of spouses, older children, and their parents.^{14,109,296} Historically, Indigenous women in Guatemala have faced mental health consequences from losing loved ones to violence, political persecution, and emigration, including during the 36-year civil war that ended in 1996 in which thousands of Indigenous Maya were victims of genocide.^{297,298} Research with Indigenous women in Guatemala has documented mental health distress from the direct loss of community, fear of violence, and economic insecurity.^{95,102,109,110} For example, Sanchez Ares and Lykes

(2016) documented feelings of suffering and abandonment among Southern Quiche women in Guatemala who had been left-behind by emigration.¹⁰⁹ Women in that study also expressed experiencing pressure to migrate for economic survival and feelings of responsibility to care for other women and girls left-behind by emigration.¹⁰⁹ On the contrary, there is also evidence of female empowerment and autonomy among left-behind women in Guatemala. Women may benefit from independence through escape from oppression or abuse and gain confidence in household decision-making.¹⁴

This study

Several studies have focused on the mental health and well-being of those that have migrated to a destination country.²⁹⁹ Few studies have assessed the mental health impacts of being left-behind by a migrating family member, and those are concentrated in Asia.^{16,28,34,35,151,152,276,277,300} This is the first known study investigating the mental health impacts of being left-behind to emigration among Indigenous Maya in Guatemala. This study was also the first to use social network data to explore the relationship between migration, social network structure, and mental health in this region.

Utilizing a socio-centric network of a single representative community, we explored the impact of emigration to the United States on depressive symptoms and social network characteristics that may moderate that relationship. Within our study, population network ties may be complex, as communities in this region are closely connected through familial relations but have a complicated and traumatic history. During the 1980s, throughout the civil war in Guatemala, thousands of Maya were victims of Indigenous genocide.²⁹⁸ According to the Comisión para el Esclarecimiento Histórico (CEH), the government regime targeted civilians to limit rebel support, and 83% of victims were Indigenous Maya.³⁰¹ The CEH estimates 200,000 people were executed, another 200,000 became refugees, and one million were internally displaced.³⁰¹ Most of the massacres were carried out by civilian patrols, often made up of members of one's own ethnic group.^{302,303} According to both recorded truth commission accounts and local oral history, this study population experienced this government-sanctioned Indigenous genocide, including individuals forced to kill others in their own communities. The experience has led to mistrust even between families still living as neighbors.

While the history of this population may be complicated, social network data may reveal important features of a rural community experiencing large-scale out-migration. Previous research suggests that simply the number of social ties may mitigate the adverse mental health effects of being left-behind by migration;^{34,277} however, it is unclear how other characteristics of social networks may lower the odds of poor mental health among Indigenous Mayans, even in the presence of missing family members.

This exploratory study drew from the *buffering hypothesis* in social support literature. The buffering hypothesis is the theory that social relationships can act as a buffer against depression, anxiety, and other mental illness following a traumatic experience.³⁰⁴ While we did not directly measure social "support" with our social network data, we followed inferred social support by the presence of essential relationships and numbers of network ties.³⁰⁴ In line with the buffering hypothesis, we investigated whether social network characteristics buffer against negative mental health impacts following the experience of network ties migrating to the United States. To this end, our research aims were: 1) to assess whether the migration status of close family and friends is associated with depressive symptoms in adults over the age of 15 in a rural Indigenous Maya community, and 2) to explore network characteristics that possibly moderate the relationship between having network out-migrants and symptoms of depression.

4.2 Methods

We conducted a cross-sectional complete census survey with 653 participants in a single rural village in San Marcos, Guatemala, collected in 2018. We defined our population as men and women aged 15 years and older; links to others living outside this community were excluded. By the nature of this study site, subjects were all of Indigenous Maya ethnicity. This project underwent a rigorous human subjects ethics review at the University of California, San Diego, especially because of the involvement of individuals under the age of 18. Within the communities in our study site, young people are often

considered adults by the age of 15 and were included as essential viewpoints in this research. The safety of participants was considered at every point in the research process.

Participant households were from a single village in order to use social network analysis techniques to map the interconnected networks of the entire village. The village was chosen non-randomly based on the population size, the possible number of respondents within the inclusion criteria, geographic centrality within the district, and under the advisement of local leaders. The typical village population in the Tajumulquito health district is roughly 500 – 1,500 residents. While some communities have fewer emigrant ties, economic resources, and more modest homes, others have residents with more economic mobility, primarily due to remittances from the United States. Community leaders chose the study village as it was considered representative of surrounding villages in terms of socio-economic status, migration, and substance use. Households within the community were made aware of the study in advance by local leadership. Our response rate was 99.8%, with one resident refusing participation.

For our network analysis, we collected socio-centric data from the village's entire population in the census survey. We used name generator questions to record significant network ties for each participant. Name generator questions are used within social network survey instruments to elicit network ties for each individual.²⁴⁶ Name generator questions included: whom they trust to confide in about something personal or private; whom they pass their free time with; whom they consider their closest friends; and how many friends or family members they see more than once a month that live outside of the community. We also asked questions to elicit the names of their spouse, parents, and siblings. The constructed edge list from name generator questions was $N=5,190$. The range of named alters was 1-27, and $\mu=8$. The range of total network ties for an individual (total degree) was 1-45, and $\mu=13$.

Measures

Outcome Variable

Symptoms of depression: Our primary outcome variable was a binary threshold score of depressive symptoms, measured using the Spanish translation of the Center for Epidemiologic Studies-Depression scale (CES-D).³⁰⁵ The CES-D is a 20-item scale that records responses about feelings and behaviors over

the past week. Scores are summed with a range of 0-60, with higher scores indicating more depressive symptoms. Numerous studies have validated this scale, including among Spanish-speaking populations in Latin America. Most studies testing the internal consistency of the Spanish version of the measure report a Cronbach's $\alpha > 0.90$. It is considered the most effective way to quickly measure depressive symptoms in a survey setting when more extended psychological interviews with mental health professionals are unavailable.³⁰⁵⁻³⁰⁷ The standard threshold for risk of major depression using this instrument is 16, which we used to create our binary outcome for the presence of depressive symptoms.³⁰⁸⁻³¹⁰

Within this study, we were not able to perform clinical interviews and diagnoses from psychiatric professionals against which to validate the use of the CES-D scale with this population; however, previous studies with Indigenous, refugee, migrant, and other left-behind populations can provide us some theoretical basis to justify the use of this tool in the absence of clinical diagnoses. The validity of the CES-D questionnaire has been tested among other Indigenous populations, including Latin American Indigenous.³¹¹⁻³¹⁴ Some of those studies support the measure's validity, while others note cultural problems with the tool while still acknowledging its value in the absence of more intensive diagnostic measures.³¹⁵⁻³²² This scale gives us a broad sense of depressive symptoms within this population. As these data are a census of the entire population of a single village, we can make some general observations about participant outcomes within the village, even if they cannot be generalized beyond this study population.³²³

Exposure Variables

Emigrant ties: We asked participants whether they have any close friends or relatives who migrated away to the United States as a dichotomous "yes" or "no" response. They were also asked to report the number of their friends and relatives who migrated to the United States. Finally, we asked the nature of the relationship with those ties. Those relationships included: "spouse"; "parent"; "child"; "sibling"; and other relationships that fell under the umbrella of "close friend/neighbor," which we collapsed into a single category.

Alcohol exposure variables: We asked participants questions from the *HCHS/SOL* alcohol consumption scale.³²⁴ *HCHS/SOL* is the largest study to examine alcohol use and contributing factors among diverse Hispanic/Latino heritage groups. To create the alcohol exposure variable used in these analyses, we asked participants if someone in their household regularly drinks to intoxication. We included the alcohol exposure variable because household family members with alcohol problems may increase the risk and prevalence of psychological conditions and social trauma.³²⁵ Living with an alcoholic spouse or partner can result in emotional problems and other psychological and social problems.³²⁶ Having an alcoholic parent increases the likelihood of alcoholism and depression in their adult children.³²⁷ The self-alcohol use variables were not included because of known social desirability bias in responses to self-alcohol use questions. Under-reporting was widespread, as family members of participants regularly stated that other participants living in their household regularly drink to intoxication, but those individuals denied their own alcohol use.

Social network variables: To test the possible moderating effects of certain social network characteristics, we used responses from the name generator questions to measure each ego's network size and connectivity. Measures of network size included total "degree," or the total number of network connections of an individual ego. Also measured were "in-degree," or the number of alters that nominated an individual, and "out-degree," or the number of alters named by an individual. As a measure of individual network cohesion, we used transitivity, or the probability that two of an individual's network connections are also connected to each other.²¹⁷⁻²²⁰

Socio-demographic variables: Individual-level covariates included sex, age, marital status, level of education, religious affiliation, and perceived income sufficiency. Income sufficiency was tested as a collapsed dichotomous measure of income sufficiency adapted from the question: "in general, would you say your income is..." with the response options: "sufficient to live and save," "sufficient to live but cannot save," "not sufficient and there are some difficulties," "sufficient, and there are great difficulties." (See Supplementary appendix for measure details).

Analysis

We first characterized the association between falling above the CES-D threshold score of 16 for possible major depression and two versions of the exposure variable. The first was a dichotomized representation of whether a participant had even a single social tie that had emigrated to the US. The second was the continuous number of social ties a participant had living in the US. We tested both iterations of the exposure variables for emigrant ties throughout our analysis. Only those that showed significance at $p \leq 0.05$ are presented here. Results from those analyses not presented in this paper are available in the appendix of supplementary tables.

After establishing the association between having any emigrant tie and higher numbers of emigrant ties, we investigated the demographic characteristics associated with depression. We built multivariate regression models to test the association between the emigrant tie exposure variables and depression in the presence of demographic covariates. We then tested the association of social network variables and falling above the CES-D threshold for possible major depression. We began with the types of relationships participants had with their emigrant ties in the US, followed by key relationships participants had still in their network at home, and finally, the calculated social network variables described below. We then tested the social network variables significantly associated with depression at $p \leq 0.05$ as the exposure variables in place of the two iterations of the emigrant tie variables in multivariate models. Finally, we tested the significant social network variables in multivariate models as interaction terms to investigate their possible moderating effect between emigrant ties and depression. We stratified significant interaction terms at multiple levels of the moderating variable for intuitive interpretation of the moderating effect.

To carry out these analyses, we first constructed a secondary dyadic dataset from the original dataset linking every ego with each of their named alters to map the network. Using that dataset, we then calculated network size (degree) and cohesion (transitivity) measures. We then entered the calculated social network variables as additional variables for each individual in the original dataset. We conducted bivariate analyses to test for associations with falling above the CES-D threshold for depression (main outcome) using logistic regression and χ^2 tests. Those with a significance of $p \leq 0.10$ were included in

multivariate models along with covariates. We ran Generalized Linear Regression (GLM) multivariate models for the binary exposure of having emigrant ties in the US, and the continuous exposure of the number of ties emigrated to the US. We ran all models adjusting for demographic characteristics, income sufficiency, and total degree. Because out-degree is included in the measure of total degree, we tested for collinearity among variables in the adjusted model. In the collinearity matrix, out-degree and total degree shared a correlation coefficient of 0.79. We also calculated the variance inflation factor (VIF) of the adjusted model variables, with scores of 3.24 (outdegree) and 3.35 (total degree); while the VIF scores for those variables did not indicate severe multicollinearity in the model, the correlation coefficient was sufficiently high enough to err conservatively for concern about collinearity with a VIF >2.5.²⁴⁸ Considering the sample size of 653, we made the choice to omit the adjustment for total degree in models testing out-degree.

For those significant network variables at the $p \leq 0.05$ level in multivariate models, we constructed interaction models to test for moderating effects on the relationship between emigrant ties and depressive symptoms. For interaction models where the interaction term was significant at $p \leq 0.05$, we then stratified the variables being tested as moderators to investigate the levels driving the moderating effect.

Because previous research provides evidence of differences by sex for migration behavior and mental health outcomes,^{328,329} we also stratified all analyses by sex. Regression models presented in tables provide beta coefficients as parameter estimates, while results in the text are presented as odds ratios.

4.3 Results

Summary statistics for the sample are presented in Table 4.1. The proportion of participants with a CES-D score of 16 and above, indicating the presence of depressive symptoms, was 33% among all participants but 59% among those with one or more emigrant ties living in the United States. More than half of the sample had at least one emigrant tie in the US. Among women, 45% reported CES-D scores above 16, compared to 16% of men. Thirty-nine percent of the sample never attended school, and of those participants, 46% had a CES-D score of 16 and higher. Fifty-three percent attended only primary school, and just 8% attended beyond primary. Both groups had lower proportions with CES-D scores below 16,

suggesting depression is more common among those with the least education. As the level of education increased, so did the proportion with emigrant ties, indicating that educated individuals also have more connections in the United States.

Seventy-three percent of the sample claimed insufficient income, and those individuals had a somewhat higher proportion of CES-D scores above the threshold for depression. Of those who felt that their income was sufficient, 61% had at least one emigrant tie in the US compared to 52% of those who felt their income was not sufficient. Thirty-seven % of participants reported a person who regularly uses alcohol to intoxication in their household. Of those, 39% had a CES-D score of 16 and above, as opposed to 29% for those without an alcohol dependent in the home.

In bivariate analyses (Table 4.2), simply having at least one emigrant tie approached significance for depressive symptoms, but having more emigrant ties was significantly associated with higher CES-D scores (OR = 1.10; 95% CI = 1.04-1.18). For each tie that had emigrated to the US, there was a 10% increase in the likelihood of falling above the cutoff for possible depression. Older individuals were more likely to experience depressive symptoms before adjusting for other variables. For each one-year increase in age, there was a 1% increase in odds of falling above the threshold for possible depression (OR = 1.01; 95% CI = 1.00-1.02). When broken down into age quartiles for this sample, individuals above 30 years of age were more than twice as likely to experience depressive symptoms than those in the youngest age group and more likely than those in the next oldest group (21-29 years) as well. Women in this study were significantly more likely to experience depressive symptoms (OR = 4.34; 95% CI = 2.97-6.44) than men.³³⁰⁻³³⁴ Marital status was not significantly predictive of depression; however, education appeared to reduce the odds of depression, as individuals in both education categories were less likely to fall above the cutoff than their peers without any education. Those affiliated with the church were more likely to have a score of 16 and above. Income sufficiency was not significantly associated with depression but was included as a covariate as a proxy for income. Those with an alcohol dependent in the household were 1.53 times more likely to be above the cutoff of 16 (95% CI = 1.09-2.14).

Looking at the relationships with those that have emigrated, only having a close friend or neighbor that has emigrated was predictive of depression (OR = 1.53; 95% CI = 1.25-2.66). In terms of relationships in the home network, those with a mother or sibling in their home network were less likely to experience depressive symptoms. For the calculated network variables, higher total degree and out-degree were associated with depression (OR = 1.03; 95% CI = 1.01-1.06). Higher individual network connectivity (transitivity) was associated with lower odds of depression in this population (OR = 0.11; 95% CI = 0.02-0.58).

We tested the binary exposure for having an emigrant tie and the number of emigrant ties in adjusted models for all participants. Having an emigrant tie was significantly associated with depression when adjusting for age, sex, marital status, education, religion, household alcohol dependency, income sufficiency, and total degree (Table 4.3). In model 2, we added transitivity, which was significant for the reduced likelihood of depressive symptoms (AOR = 0.14; 95% CI = 0.02-0.89). Because out-degree was also significant in the bivariate analysis, in model 3, we added out-degree. As with the other two models with the binary exposure for having at least one emigrant tie, sex, primary school, and household alcohol-dependent remained significant. Our additional network variable, out-degree, was also significant and positively associated with the likelihood of depressive symptoms (AOR = 1.05; 95% CI = 1.00-1.09). (See Supplementary appendix Table 1 for additional analyses).

Models with the number of emigrant ties as the main exposure yielded similar results as the bivariate models (Table 4.4). As with the binary exposure, the number of ties was significant in all three models, indicating that as the number of emigrant ties increased, so did the likelihood of depressive symptoms. The addition of transitivity and out-degree in models two and three each approached significance at $p < 0.06$. We eliminated other network variables that were significant in bivariate analyses because they failed to remain significant in models and are not presented in models here. (See Supplementary appendix Table 2 for additional analyses).

Interaction Effects

We tested transitivity as an interaction term as a possible moderator in the relationship between emigrant ties and depression; however, the interaction failed to reach significance. Out-degree was also tested as an interaction term and was significant in the model with the number of emigrant ties as the exposure, adjusting for all other variables from the models in Tables 4.3 and 4.4. For the out-degree interaction model, the coefficient was negative, suggesting the effect of the number of emigrant ties on depression will decrease as out-degree becomes larger (Table 4.5). Figure 4.1 shows the predicted probabilities of falling above the CES-D cutoff of 16 for possible depression by the number of emigrant ties in the US. Overall, the trend shows that more emigrant ties increased the probability of meeting the threshold for depression; however, lower out-degree increased the probability of depression even with a smaller number of emigrants in the US. With stratification at the median of out-degree, those with a lower out-degree have 1.32 (95% CI = 1.10-1.60) times odds of experiencing depressive symptoms based upon their number of emigrant ties, as compared to individuals with a higher out-degree, who had 1.08 (95% CI = 1.02-1.17) times odds of depression based on their number of emigrated ties in the US. Participants with more emigrant ties are still more likely to be depressed than those with fewer or none, but the odds of depression are lower for those in the high out-degree subgroup, even with more emigrant ties. To further investigate this finding, we stratified by tertiles, showing decreased odds of depression for each group as the number of named alters increased (Figure 4.2). (See Supplementary appendix Tables 3-6 for additional interaction analyses).

Differences by sex

Because we expected there to be differences in outcomes for women and men, we stratified the analyses by sex. Unlike in the total sample, in bivariate analyses for men, simply having an emigrant tie and not the number of ties is significant for being above the cutoff for depressive symptoms (Table 4.6). Age, marital status, religious affiliation, and income sufficiency were not significant for men, but those with a primary school education were significantly less likely to be depressed. Having an alcoholic in the household remained significant for depression in the male sample. For relationships to emigrants, having a friend or neighbor who emigrated remained significant for depression as in the total sample. For

relationships in the home network, having your spouse at home was associated with lower odds of depression, but having your father in the home network was associated with higher odds of depression. For network variables, those with a higher out-degree of named alters were more likely to be depressed, as in the total sample. In adjusted multivariate models, only emigrant tie as a binary exposure was significant for men, with none of the tested moderators reaching significance (Table 4.7). (See Supplementary appendix Tables 7-12 for additional analyses for males).

Unlike the male sample, for females, simply having an emigrant tie was not associated with depression in bivariate analyses (Table 4.8); however, higher numbers of emigrant ties were associated with depression among females. Older females were more likely to experience depression, and like the total sample, more education was associated with decreased odds of depressive symptoms. For females, religious affiliation was associated with depression, and like males, having an alcoholic in the house was associated with being above the cutoff score of 16. Having a friend or neighbor emigrate was associated with depressive symptoms, but having a mother or father at home in the network was associated with decreased odds of depression. For network variables, a higher total degree was also associated with depressive symptoms, and transitivity was significant for decreasing the odds of being above the cutoff score of 16. The association between having more emigrant ties and CES-D scores of 16 and higher remained significant in multivariate models for women with all covariates (Table 4.9). There was an 11% increase in the likelihood of depression with each additional person who emigrated. For network variables, transitivity remained significant in the second multivariate model, as did out-degree in the final model. (See Supplementary appendix Tables 13-14 for additional analyses for females).

To test for possible moderating effects of network variables among females, we ran models including interaction terms for those two variables. Out-degree was not significant in interaction models, but transitivity was significant. The interaction coefficient was negative, suggesting the effect of having emigrant ties on depression will decrease as transitivity gets larger (Table 4.10). For those with emigrant ties, having a more cohesive network resulted in a lower probability of reaching the CES-D threshold for depression; for those without emigrant ties, the probability of reaching that threshold remained consistent

regardless of transitivity score (Figure 4.3). When stratified at the transitivity median, those females WITH emigrants in the US and low transitivity, or a less connected and dense network, had 1.54 (95% CI = 0.83-2.89) higher odds of experiencing depressive symptoms than their peers without emigrant ties. However, those who have more connected networks, while still more likely to be depressed than their peers without emigrant ties, only had 1.25 (95% CI = 0.66-2.37) times higher odds of experiencing depression. When further stratified at transitivity tertiles, the differences in odds between groups can be seen with slightly more granularity (Figure 4.4). Estimates in the stratified analyses may not be precise, as confidence intervals are widened due to smaller sample sizes. (See Supplementary appendix Tables 15-18 for additional interaction analyses for females).

4.4 Discussion and conclusions

Within this rural migrant-sending community in Guatemala, we found that having close ties and more of them emigrated to the United States increased the likelihood of depressive symptoms. We also found that older adults, women, those with lower education levels, and individuals with an alcohol dependent in the household were more likely to experience depression. In terms of relationship types with emigrants and individuals in home networks, having a close friend or neighbor emigrate was associated with increased odds of depression, while having a mother or sibling in one's home network was associated with lower odds of depression. For social network characteristics, higher transitivity offered some moderation between having emigrant ties and depression in adjusted models; however, only out-degree was a significant moderator in the relationship between emigrant ties and depression. We found some differences between men and women in this population. For both groups, some relationships and social network characteristics were significant in bivariate analyses, but only the female sample's total degree and transitivity scores remained significant in the full models. Higher transitivity scores were a significant moderator in the relationship between emigrant ties and depression for women but not for men.

Though data on the overall prevalence of depression in Guatemala is scarce, one recent study estimated rates between 4-6% in those exposed to violence since the civil war.³³⁵ The Pan American Health Organization's (PAHO) most recent estimate of depression prevalence in Guatemala was 3.7% in

2015.³³⁶ To our knowledge, no study has investigated depression among Indigenous people in the western highland region. Thirty-two percent of our sample screened for depressive symptoms using the CES-D questionnaire, which is higher than other studies have reported for Guatemala; however, estimates for the prevalence of depression in Low-and-Middle-Income Countries (LMICs) are as high as 24% in some areas.³³⁷ Rates in this region may be higher than in other parts of the country due to circumstances specific to this area. Residents in these communities are of Indigenous Maya descent, and most came to live in the rural highlands to escape violence and discrimination because of their Indigenous status. Access to economic opportunity, education, and healthcare are particularly challenging in this area. Communities in this region also send individuals to the United States at high rates, as indicated with more than half our sample having at least one and up to 40 connections living in the United States.

Having emigrant ties was significantly associated with depressive symptoms in bivariate analyses and regression models adjusting for age, sex, marital status, education, religion, household alcohol dependency, income sufficiency, and total degree. Those with a primary school education are less likely to report depressive symptoms than participants with no education, and those with more than primary are less likely still. Only basic primary education is free in Guatemala, limiting access to many rural Indigenous residents. Boy children are favored in continuing education because of traditional gender roles for women in the household, and much of our study population may be impacted by lower levels of education for Indigenous people during and after the civil war.⁹⁹ In our findings, those with higher education were more likely to have contacts who emigrated to the United States, which may explain how those households had the economic resources to allow children to leave work in agriculture and the home to attend school and pay for tuition beyond primary grades. Possible explanations for lower odds of depression among those with more education include the increased economic prospects it affords and foreseen opportunities to join existing contacts in the United States.

We explored relationships and social network characteristics that may modify the association between having emigrant ties and higher CES-D scores. As emigration from the region does not appear to be slowing and mental health resources are scarce, it is important to investigate possible assets to leverage

within communities to ease the burden felt by those left-behind. Previous research has shown that the nature of even a single close relationship type may be enough to impact mental health.^{304,338} Additionally, previous research reports varying mental health impacts of certain relationship types over others in a network.^{36-38,40,59,339} In the total sample, having at least one close friend or neighbor that has emigrated away was associated with depression. In the case of these rural communities, an explanation may be the pressure to provide what one's neighbors are providing for their families in terms of quality of home construction or affording tuition for children. There may be some measure of self-worth through comparisons with an emigrant friend or neighbor. Another possible explanation is that in these tightly bounded communities, the supportive ties of friendship are more impactful at mitigating mental health distress than are those provided by the nuclear family.³⁴⁰

Having a mother or sibling in the home network also lowered the odds of depression, as did higher transitivity, but a higher total degree and higher out-degree were associated with depressive symptoms. However, when tested in adjusted regression models, only out-degree remained significant for depressive symptoms. This is a curious finding, as many previous studies have found that more socially isolated people have a higher risk of depression and have reported the positive effect of network size against poor mental health outcomes.^{40,341,342} Previous research provides evidence that more socially integrated people experience better mental health.^{304,343,344} Studies have reported mental health benefits associated with larger networks and have used network size as a measure of support that lowers the odds of depressive symptoms.³⁰⁴ However, there is also evidence in the literature that the quality of social support in relationships is more important for mental health than simply the existence of interpersonal relationships.³⁴⁵ In this sample, there seems to be a mechanism by which naming more people in your network increases the odds of depressive symptom reporting. Another explanation is a confounding variable unaccounted for in this study moderating that relationship, which is beyond the scope of the present study, but represents an area for future research. Further investigation of this relationship yielded significance for an interaction with out-degree. Stratification into subgroups by out-degree suggested that those with higher numbers of emigrant ties are still more likely to be depressed than their peers without

fewer or none, but the odds of depression are lower for those in the high out-degree subgroup even with increasing numbers of emigrant ties. This may indicate that those with more emigrant ties still have higher odds of experiencing depression, but individuals with bigger social networks at home may reduce their odds of depression. This finding requires further study to understand why the effects of emigrant ties on depression vary for different levels of stratified subgroups for out-degree.

Consistent with mental health research worldwide, women in our sample experienced more depressive symptoms.^{331,332,334} Although women are increasingly emigrating to the United States, they are still more likely to be left home in Guatemala to care for children and older adults. In analyses stratified by sex, having a friend or neighbor emigrate was associated with higher odds of depression for both males and females. Stratified analyses revealed some differences in the impacts of social network characteristics for males and females. For males, having a spouse at home was associated with reduced odds of depression. We found that having a father in the home network was associated with depression for males, which may be related to the pressure of "failed masculinity." Research from Perez (2012) argues that males experience a "sense of self" through migration. When providing financially through migration is unrealized, it challenges masculinity and can create a perceived devaluation of self.³⁴⁶ In adjusted models for males, no specific relationships or network characteristics retained significance, though the association between having emigrant ties and depression did remain significant in adjusted models.

For women, variables associated with depression were consistent with the total sample; however, missing a parent at home was also associated with increased odds of depression. Differing from the men in our study, higher transitivity, or the odds that two of a woman's friends are also friends with one another was associated with decreased odds of depressive symptoms. This finding remained significant in adjusted regression models. The interaction to test for the modifying effect of transitivity was also significant, suggesting that the effect of having emigrant ties on the probability of depression is buffered by this third variable of social network transitivity. There is evidence that transitivity in social networks is important for emotional support and that network cohesion is associated with reduced poor mental health outcomes.^{347,348} In this community, it may be the case that possible negative emotional impacts of having

close ties emigrated are mitigated for women with more cohesive support networks. However, the relationship between transitivity and network cohesion is nuanced. Social processes have been found to both increase and decrease depressive symptoms in highly transitive groups.³⁴⁹ Homophily, or the tendency for people's networks to be homogenous in socio-demographic, behavioral, and other characteristics, has been associated with transitivity in social networks.³⁵⁰

Transitivity in networks has been linked to depression under this principle of homophily, suggesting that depressed individuals may form connections with other people also experiencing depression.^{40,351} Highly transitive networks also do not allow for a major transgression from norms, and there is evidence of diffusion of depression in highly connected networks.³⁵²⁻³⁵⁶ The varied nature of findings around transitivity, mental health, and social support indicates that further research is necessary to understand how transitive networks in our study community provide relief from depressive symptoms for those with emigrant ties. Our findings suggest that a person in a more cohesive network is faring better against social loss; thus, future research should test measures of homophily and explore whether an individual's named alters also have someone who has emigrated.

Conclusions

The high number of out-migrants from rural communities in Central America is leaving behind community structures that are dramatically different than in previous generations. The Guatemalan Ministry of Health Directors are concerned about the mental health challenges facing people in their rural areas due to changed social structures. There are also few allocated resources for mental health for Indigenous Maya living in rural locations. Mental health resources are centered in major metropolitan areas, which are virtually inaccessible for Indigenous people living in rural regions. This study begins to fill the gap in the literature on the mental health challenges of rural Indigenous populations living in communities that are strongly impacted by out-migration. Using socio-centric network data to map possible assets within communities, including how to leverage social networks, may provide opportunities for easing burdens on these populations.

Future research should build upon these findings by further investigating network relationships and characteristics that exacerbate or improve poor mental health outcomes. Those ties and characteristics are possible assets to be leveraged in mitigating the social costs of losing network ties to out-migration. A better understanding of the relationship between measures of degree and depression is also important. In our study sample, it was unclear why contrary to existing literature, higher measures of degree were associated with depression in the total sample; and that the impact of emigrant ties on depressive symptoms was different by levels of out-degree. Also, the link between alcoholism in the household and depression and the relationship to higher rates of alcoholism in households with emigrant ties should be explored. The complexity of those relationships could not be addressed within the scope of this manuscript. The nature of depression within and apart from the transitive groups should be further investigated, as previous literature has found that transitivity can guard against depression and exacerbate it in highly transitive groups. Strengthening social ties and transitivity in personal networks may be a tool in mitigating depressive symptoms among women left-behind in this region. Finally, the link between emigrant ties and depression could be better understood by studying the temporal relationship between the numbers of ties, types of relationships lost, and the onset of depressive symptoms.

Limitations

These data are from a non-random survey census of a purposively sampled village; therefore, findings are not generalizable to all people living in rural areas of Guatemala. However, the village was chosen because local leaders believed it was representative of villages in the whole health district of Tajumulquito. The survey was a cross-sectional network study of a single village; therefore, it does not allow for an assessment of causality in the findings. There is also the possibility of social desirability bias on both migration and depression questions, as they were of a sensitive nature, which could have resulted in under-reporting of depressive symptoms and undocumented migration of friends and family. The CES-D depression screening tool, while widely studied and validated, is not as sensitive as interview methods with mental health professionals in the detection of depressive symptoms. The CES-D tool has also not been validated in this specific population against interview methods with mental

health professionals. Furthermore, there is no reliable mental health data reporting in Guatemala, and we did not have baseline depression scores for people living in the region of our study population, which limited our ability to interpret depression incidence found in this study; however, adding to the knowledge about mental health in this region with our findings on depression in this community is part of the value of this study.

Support

This study was undertaken with the support of the Ministry of Health in Guatemala, the National Hospital of Guatemala, and local leadership. This study was approved by the University of California, San Diego Human Subjects Review Board. IRB#181152S. This study was funded by travel and research grants from the UCSD Center for Latin American and Iberian Studies, Tinker Foundation, the Global Health Institute at UCSD, the International Institute at UCSD, UCSD Friends of the International Center, the Inamori Fellowship at SDSU, and the John and Mary Anderson Memorial Endowed Scholarship in Public Health from SDSU.

Acknowledgement

Chapter 4, “Social network dynamics as moderators of the impact of being “left-behind” to international migration and depression in rural Guatemala” is currently being prepared for submission for the publication of the material. Co-authors include Drs Eric Leas, Kimberly Brouwer, Kate Swanson, Ramona Perez, Samantha Hurst, and Holly Baker Shakya. The dissertation author was the primary investigator and author of this material.

4.5 Tables and figures

Table 4.1. Summary statistics individual survey

Table 1			
Summary Statistics Individual Survey			
N=653			
Mean (SD) Age in years 33.96 (16.51)			
Mean (SD) CES-D depression score 12.38 (9.90)			
Total network density 0.00855			
	Proportion of total sample	Proportion with CES-D score above 16 (p-value)	Proportion with emigrant tie (p-value)
CES-D score above 16			
No	67%	-	52% (0.093)
Yes	33%	-	59%
Emigrant in the United States			
No	46%	29% (0.093)	-
Yes	54%	36%	-
Sex			
Female	59%	45% (<0.001)	53% (0.166)
Male	41%	16%	57%
Marital status			
Single	36%	19% (0.838)	55% (1.00)
Married/Civiil union	64%	33%	54%
Education			
None	39%	46% (<0.001)	50% (0.003)
Primary school	53%	23%	54%
More than primary	8%	30%	76%
Religious affiliation			
No	42%	28% (0.044)	52% (0.307)
Yes	58%	36%	56%
Income sufficiency			
Sufficient	27%	29% (0.313)	61% (0.055)
Not sufficient	73%	34%	52%
Self alcohol dependency			
No	84%	31% (0.18)	53% (0.39)
Yes	16%	39%	58%
Household alcohol dependent			
No	63%	29% (0.016)	55% (0.727)
Yes	37%	39%	53%

Table 4.2. Bivariate regression on predictors of depressive symptoms in the rural western highlands of Guatemala

Table 2			
Bivariate regression on predictors of depressive symptoms in the rural western highlands of Guatemala			
N=653			
	Beta	SE	P
Emigrant tie			
No	Ref		
Yes	0.298	0.169	0.078
Number of emigrant ties	0.096	0.031	0.002
Age in years	0.013	0.005	<0.001
Age categories			
15-20	Ref		
21-29	0.486	0.247	0.049
30-43	0.927	0.238	<0.001
44-88	0.738	0.242	0.002
Sex			
Men	Ref		
Women	1.468	0.197	<0.001
Marital status			
Single	Ref		
Married/Civil union	0.051	0.175	0.77
Education			
None	Ref		
Primary school	-1.082	0.18	<0.001
More than primary	-0.724	0.323	0.025
Religious affiliation			
No	Ref		
Yes	0.361	0.172	0.036
Income sufficiency			
Sufficient	Ref		
Not sufficient	0.211	0.191	0.27
Household alcohol dependent			
No	Ref		
Yes	0.425	0.171	0.013
Friend/Neighbor emigrated			
No	Ref		
Yes	0.604	0.192	0.002
Spouse emigrated			
No	Ref		
Yes	0.426	0.374	0.25
Parent emigrated			
No	Ref		
Yes	-0.329	0.482	0.49
Child emigrated			
No	Ref		
Yes	-0.066	0.272	0.81
Sibling emigrated			
No	Ref		
Yes	0.211	0.198	0.29
Spouse in home network			
No	Ref		
Yes	-0.255	0.175	0.15
Mother in home network			
No	Ref		
Yes	-0.375	0.176	0.033
Father in home network			
No	Ref		
Yes	-0.273	0.175	0.12
Sibling in home network			
No	Ref		
Yes	-0.383	0.192	0.047
Total degree	0.033	0.012	0.006
In-degree	0.019	0.02	0.345
Out-degree	0.067	0.02	<0.001
Transitivity	-2.184	0.879	0.013

Table 4.3. Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala

Table 3										
Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala										
N=653										
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			
	Emigrant tie main effect			Emigrant tie main effect with transitivity			Emigrant tie main effect with out degree			
	adjusted for total degree			adjusted for total degree			adjusted for total degree			
	Beta	SE	P	Beta	SE	P	Beta	SE	P	
Emigrant tie										
No	Ref			Ref			Ref			
Yes	0.496	0.188	0.008	0.474	0.189	0.012	0.489	0.189	0.01	
Transitivity				-1.891	1.001	0.05				
Out-degree							0.044	0.021	0.039	
Age in years	0.01	0.006	0.117	0.01	0.006	0.107	0.012	0.006	0.05	
Sex										
Men	Ref			Ref			Ref			
Women	1.42	0.214	<0.001	1.401	0.215	<0.001	1.398	0.215	<0.001	
Marital status										
Single	Ref			Ref			Ref			
Married/Civil union	-0.126	0.206	0.541	-0.144	0.208	0.489	-0.112	0.205	0.585	
Education										
None	Ref			Ref			Ref			
Primary school	-0.78	0.21	<0.001	-0.763	0.211	<0.001	0.737	0.213	<0.001	
More than primary	-0.23	0.369	0.532	-0.171	0.371	0.644	-0.187	0.371	0.615	
Religious affiliation										
No	Ref			Ref			Ref			
Yes	0.179	0.195	0.36	0.147	0.197	0.454	0.166	0.196	0.398	
Household alcohol dependent										
No	Ref			Ref			Ref			
Yes	0.517	0.191	0.008	0.49	0.192	0.011	0.522	0.191	0.006	
Income sufficiency										
Sufficient	Ref			Ref			Ref			
Not sufficient	0.348	0.211	0.099	0.331	0.212	0.118	0.368	0.212	0.082	
Total degree	0.02	0.014	0.145	0.019	0.014	0.166				

Table 4.4. Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala

Table 4										
Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala										
N=653										
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			
	Number of emigrant ties main effect			# of emigrant ties main effect with transitivity			# of emigrant ties main effect with out-degree			
	adjusted for total degree			adjusted for total degree			adjusted for total degree			
	Beta	SE	P	Beta	SE	P	Beta	SE	P	
Number of emigrant ties	0.1	0.035	0.004	0.097	0.035	0.005	0.099	0.035	0.004	
Transitivity				-1.802	1.003	0.072				
Out-degree							0.039	0.021	0.066	
Age in years	0.01	0.006	0.11	0.011	0.006	0.097	0.012	0.006	0.055	
Sex										
Men	Ref			Ref			Ref			
Women	1.392	0.214	<0.001	1.374	0.216	<0.001	1.371	0.215	<0.001	
Marital status										
Single	Ref			Ref			Ref			
Married/Civil union	-0.102	0.207	0.622	-0.12	0.209	0.565	-0.094	0.206	0.649	
Education										
None	Ref			Ref			Ref			
Primary school	-0.758	0.21	<0.001	-0.745	0.211	<0.001	-0.714	0.213	<0.001	
More than primary	-0.222	0.373	0.551	-0.164	0.375	0.661	-0.173	0.375	0.644	
Religious affiliation										
No	Ref			Ref			Ref			
Yes	0.156	0.196	0.428	0.126	0.197	0.524	0.14	0.197	0.476	
Household alcohol dependent										
No	Ref			Ref			Ref			
Yes	0.481	0.192	0.012	0.456	0.193	0.018	0.487	0.192	0.011	
Income sufficiency										
Sufficient	Ref			Ref			Ref			
Not sufficient	0.428	0.217	0.048	0.41	0.218	0.059	0.45	0.218	0.039	
Total degree	0.015	0.014	0.272	0.015	0.014	0.296				

Table 4.5. Results of GLM model on out-degree as a moderator of depressive symptoms, adjusted for covariates in multivariate models

Table 5			
Results of GLM model on out-degree as a moderator of depressive symptoms adjusted for covariates in multivariate models			
N=653			
	# ties*Out-degree		
	Beta	SE	<i>P</i>
# Emigrant ties	0.366	0.111	<0.001
Out-degree	0.075	0.025	0.003
# Emigrant ties*Out-degree	-0.023	0.01	0.019

Table 4.6. Bivariate regression on predictors of depressive symptoms in the rural western highlands of Guatemala, by sex (male, n=269)

Table 6			
Bivariate regression on predictors of depressive symptoms in the rural western highlands of Guatemala			
By Sex (MALE) n=269			
	Beta	SE	P
Emigrant tie			
No	Ref		
Yes	0.851	0.375	0.023
Number of emigrant ties	0.098	0.058	0.089
Age in years	-0.005	0.01	0.62
Marital status			
Single	Ref		
Married/Civil union	0.407	0.214	0.057
Education			
None	Ref		
Primary school	-1.014	0.219	<0.001
More than primary	-0.253	0.452	0.576
Religious affiliation			
No	Ref		
Yes	.026	0.217	0.904
Income sufficiency			
Sufficient	Ref		
Not sufficient	0.54	0.441	0.221
Household alcohol dependent			
No	Ref		
Yes	0.446	0.212	0.035
Friend/Neighbor emigrated			
No	Ref		
Yes	0.486	0.241	0.044
Spouse emigrated			
No	Ref		
Yes	0.067	0.397	0.866
Parent emigrated			
No	Ref		
Yes	0.173	0.614	0.956
Child emigrated			
No	Ref		
Yes	0.173	0.346	0.617
Sibling emigrated			
No	Ref		
Yes	0.182	0.249	0.734
Spouse in home network			
No	Ref		
Yes	-0.862	0.34	0.011
Mother in home network			
No	Ref		
Yes	0.313	0.349	0.37
Father in home network			
No	Ref		
Yes	0.72	0.353	0.042
Sibling in home network			
No	Ref		
Yes	-0.076	0.396	0.849
Total degree	-0.009	0.027	0.736
In degree	-0.127	0.109	0.244
Out degree	0.052	0.023	0.027
Transitivity	-0.805	1.448	0.588

Table 4.7. Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala adjusted for total degree, by sex (male, n=269)

Table 7			
Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala adjusted for total degree			
By sex (MALE) n=269			
Multivariate Model 1			
Emigrant tie main effect adjusted for total degree			
	Beta	SE	<i>P</i>
Emigrant tie			
No	Ref		
Yes	0.976	0.399	0.014
Age in years	-0.006	0.012	0.654
Marital status			
Single	Ref		
Married/Civil union	-0.524	0.43	0.223
Education			
None	Ref		
Primary school	-0.866	0.402	0.031
More than primary	-0.946	0.623	0.129
Religious affiliation			
No	Ref		
Yes	0.622	0.37	0.093
Household alcohol dependent			
No	Ref		
Yes	0.47	0.371	0.205
Income sufficiency			
Sufficient	Ref		
Not sufficient	0.546	0.467	0.242
Total degree	-0.001	0.03	0.96

Table 4.8. Bivariate regression on predictors of depressive symptoms in the rural western highlands of Guatemala, by sex (female, n=384)

Table 8			
Bivariate regression on predictors of depressive symptoms			
in the rural western highlands of Guatemala			
By sex (FEMALE) n=384			
	Beta	SE	P
Emigrant tie			
No	Ref		
Yes	0.27	0.206	0.19
Number of emigrant ties	0.093	0.039	0.017
Age in years	0.03	0.007	<0.001
Marital status			
Single	Ref		
Married/Civil union	0.051	0.175	0.77
Education			
None	Ref		
Primary school	-1.082	0.18	<0.001
More than primary	-0.724	0.323	0.025
Religious affiliation			
No	Ref		
Yes	0.361	0.172	0.036
Income sufficiency			
Sufficient	Ref		
Not sufficient	0.264	0.228	0.254
Household alcohol dependent			
No	Ref		
Yes	0.425	0.171	0.013
Friend/Neighbor emigrated			
No	Ref		
Yes	0.604	0.192	0.002
Spouse emigrated			
No	Ref		
Yes	0.426	0.374	0.25
Parent emigrated			
No	Ref		
Yes	-0.329	0.482	0.49
Child emigrated			
No	Ref		
Yes	-0.066	0.272	0.81
Sibling emigrated			
No	Ref		
Yes	0.211	0.198	0.29
Spouse in home network			
No	Ref		
Yes	0.275	0.206	0.181
Mother in home network			
No	Ref		
Yes	-0.566	0.208	0.006
Father in home network			
No	Ref		
Yes	-0.523	0.209	0.012
Sibling in home network			
No	Ref		
Yes	-0.319	0.222	0.152
Total degree	0.042	0.015	0.006
In degree	0.065	0.028	0.022
Out degree	0.112	0.102	0.273
Transitivity	-2.698	1.123	0.016

Table 4.9. Results of GLM logistic regression on predictors of depressive symptoms in the rural highlands of Guatemala, by sex (female, n=384)

Table 9									
Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala									
By sex (FEMALE) n=384									
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3		
	Number of emigrant ties main effect			# Emigrant ties main effect with transitivity			# Emigrant ties main effect with out degree		
	adjusted for total degree								
	Beta	SE	P	Beta	SE	P	Beta	SE	P
Number of emigrant ties	0.107	0.043	0.013	0.105	0.043	0.015	0.106	0.043	0.013
Age in years	0.02	0.008	0.014	0.023	0.008	0.006	0.023	0.008	0.005
Marital status									
Single	Ref			Ref			Ref		
Married/Civil union	0.114	0.239	0.635	0.149	0.241	0.536	0.137	0.239	0.567
Education									
None	Ref			Ref			Ref		
Primary school	-0.662	0.256	0.01	-0.718	0.254	0.005	-0.619	0.259	0.017
More than primary	0.15	0.496	0.762	0.269	0.509	0.598	0.183	0.499	0.714
Religious affiliation									
No	Ref			Ref			Ref		
Yes	0.043	0.238	0.855	0.018	0.239	0.939	0.02	0.239	0.932
Household alcohol dependent									
No	Ref			Ref			Ref		
Yes	0.521	0.231	0.024	0.448	0.233	0.055	0.525	0.232	0.023
Income sufficiency									
Sufficient	Ref			Ref			Ref		
Not sufficient	0.37	0.253	0.146	0.309	0.255	0.225	0.386	0.254	0.129
Transitivity				-2.735	1.274	0.032			
Out degree							0.051	0.025	0.04
Total degree	0.028	0.016	0.09						

Table 4.10. Results of GLM models on possible network moderators of depressive symptoms among those left behind to migration, adjusted for all covariates in multivariate models, by sex (female, n=384)

Table 10			
Results of GLM models on possible network moderators of depressive symptoms among those left behind to migration, adjusted for all covariates in multivariate models			
By sex (FEMALE) n=384			
	Multivariate Model 4		
	Emigrant tie*transitivity		
	Beta	SE	P
Emigrant tie			
No	Ref		
Yes	0.841	0.352	0.017
Transitivity	-0.056	1.772	0.975
Emigrant tie*Transitivity	-5.086	2.651	0.05

Predicted Probabilities of reaching CES-D Depression Cutoff by Level of Out-degree

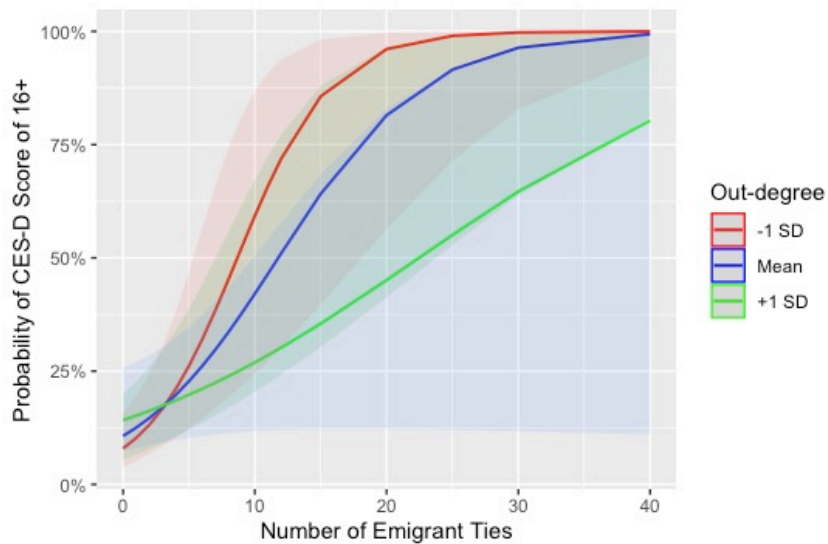


Figure 4.1 Predicted probabilities of falling above the threshold for symptoms of major depression associated with number of emigrant ties at the mean level and +/- 1 standard deviation of out-degree, with 95% confidence intervals

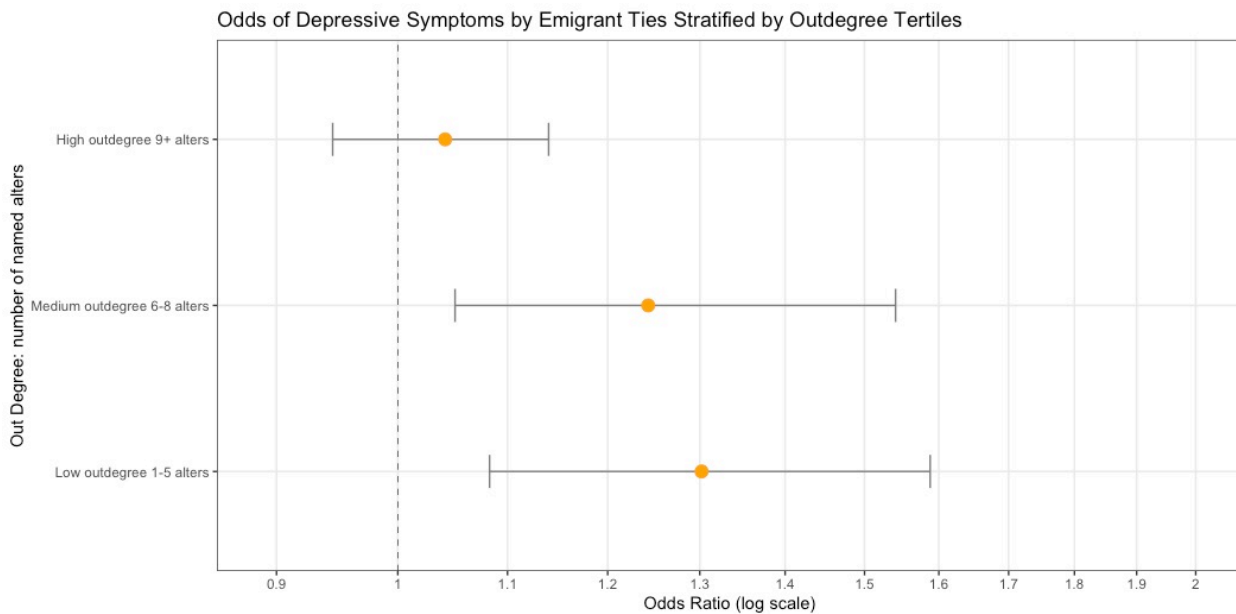


Figure 4.2. Odds of falling above the threshold for major depressive symptoms associated with number of emigrant ties, stratified by three levels of out-degree, with 95% confidence intervals

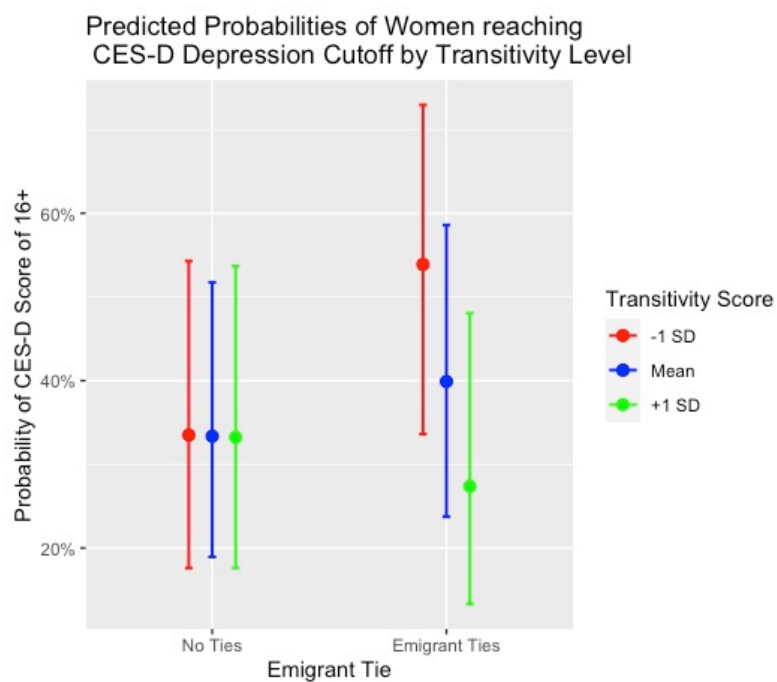


Figure 4.3. Predicted probabilities of falling above the threshold for symptoms of major depression for females with and without emigrant ties at the mean and +/- 1 standard deviation of transitivity score, with 95% confidence intervals

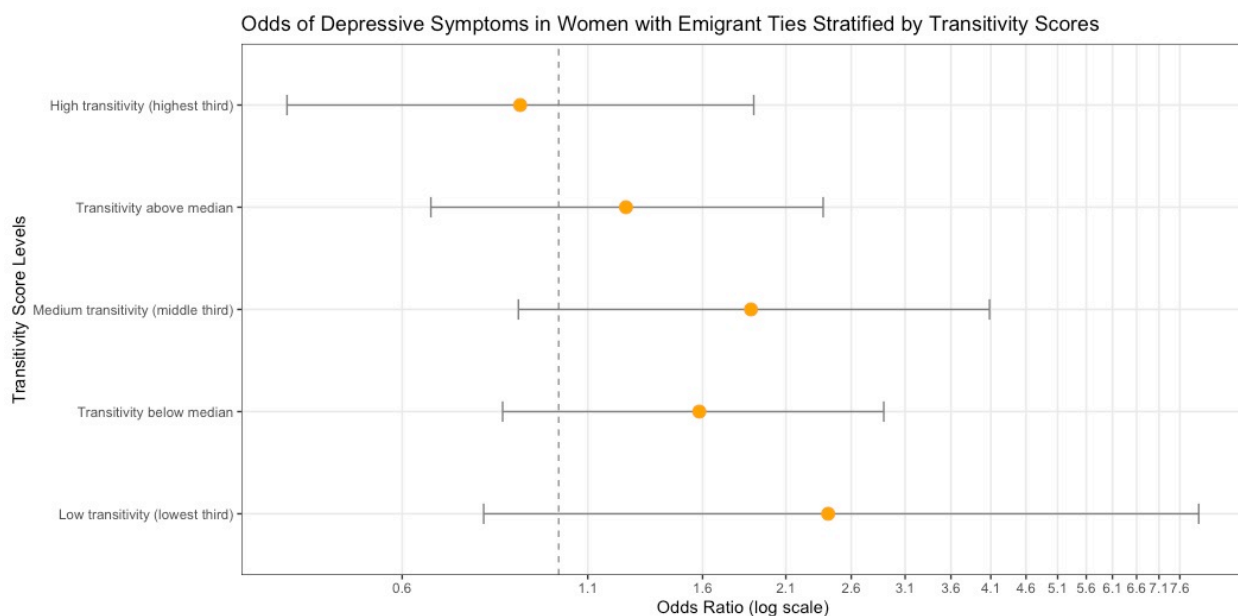


Figure 4.4. Odds of falling above the threshold for major depressive symptoms for females with emigrant ties (compared to those without emigrant ties), stratified by five levels of transitivity score, with 95% confidence intervals

Chapter 5: Conclusion

International migration continues to grow rapidly across the globe, reaching 272 million individuals in 2019.¹ The reasons people choose to emigrate from their homes and settle across international borders and the socioemotional consequences of that movement are multiple and complex. Identifying and understanding the motivations and consequences of international migration are increasingly important, as the number of international migrants worldwide has grown faster than the global population.¹

Migration to the United States has become a strategy for Indigenous people in Guatemala to escape violence and oppression and provide economic mobility for their families.^{192,193} Indigenous Maya living in the rural western highlands of Guatemala have been subject to generations of oppression and violence, including a state-sanctioned campaign of genocide during their 36-year civil war that ended in 1996.³ Since the conclusion of that war, Indigenous Maya have continued to experience oppression and structural violence, including marginalization that has led to economic immobility, lack of access to education and healthcare, and scarcity of arable land.^{97,98,205} International migration offers economic and social opportunities for Indigenous Guatemalans; however, widespread migration from rural areas causes social changes to populations still living within those communities, which may have consequences for those left-behind.^{17-21,261} Changes in individuals' social networks through the loss of key family and friendship ties impact emotional well-being, community cultural norms, and even individuals' own migration behaviors.^{32,33,36,66,208}

This dissertation research aims to advance the literature on the drivers and socio-emotional impacts of migration in rural, Indigenous, migrant-sending communities. The first step characterizes the landscape of Indigenous Mam-speaking Maya living in rural communities of Guatemala. In Chapter 2, titled "Through our own eyes and voices: The experiences of those "left-behind" in rural, Indigenous migrant-sending communities in western Guatemala," we used the principles of Community Based Participatory Research to frame the design and execution of a qualitative project done in partnership with the leadership and residents of 11 rural communities in the Tajumulquito health district in San Marcos,

Guatemala. Initial focus group interviews with local residents identified multiple urgent health problems facing those rural communities. We reported that the most pressing issues identified by residents were “*changes in values, culture, and community structure*” and included the impacts of “*migration*” and emerging challenges to “*mental health.*”

Findings from the focus group interviews informed an additional research question that was explored using the engagement tool strategy known as Photovoice. Participants documented changes that may impact the health and future of their communities through visual images, followed by semi-structured interviews in which they described the meaning of their photographs. Narratives shared in those interviews centered around living conditions that make it difficult to thrive in their communities. Photographs depicting hardships and the desire to live with dignity were accompanied by accounts of the impacts of emigration to the United States. Emigration was discussed as both positive and negative and included stories of economic opportunity, sacrifice and loss of family, and the mental health challenges of being left-behind. Narratives also documented major changes in their communities as social network structures shift due to emigration. Participants described changing values, increased substance use, and growing gang involvement among youth because of parental absence and lack of opportunity.

After characterizing the landscape of challenges to health and well-being from rural community residents’ own perspectives, we designed the next phase of the research project to investigate the unique social network characteristics that influence the ideation to migrate within the year (Chapter 3). Additionally, since residents identified mental health challenges related to being left-behind by emigration, we investigated the relationship between having emigrant ties in the US and symptoms of depression and the social network characteristics that may moderate that association (Chapter 4).

The literature on migration theory has evolved beyond simplistic “push” and “pull” factors influencing migration decisions to encompass the more complex “drivers of migration” and resulting formation of “transnational families” that navigate personal relationships across international borders.⁷ It is recognized in migration scholarship that social networks impact migration, including through the relationships and responsibilities within networks at home, and relationships with those who have

emigrated.²⁰⁸ Migration decisions are undertaken from within network structures, including within family and community units, as migration is often undertaken as risk diversification for the collective advancement of the whole group.^{44,46,167} The current literature, including that which addresses social network impacts, has limitations to understanding drivers of migration. Migration scholarship utilizing social network data has focused on the strength of ties in receiving countries as assets for information sharing and resources;^{61,211,212} there is less known about the role of networks in countries of origin, and social network data with left-behind individuals is not well-represented in migration research.²¹³ Additionally, there is evidence that migration causes changes in social network structures of communities “left-behind,”^{32,33} and adverse socioemotional consequences for individuals who have experienced the loss of personal relationships through emigration. Furthermore, studies investigating the association between emigration and poor mental health outcomes have identified the protective role of social ties.^{30,34}
³⁶ For example, some studies have argued that social ties and network cohesion moderate the association between migration and mental health.^{34,35,106,256,257,277,279} However, no study has utilized social network data to investigate the mental health impacts of being left behind to emigration in Guatemala, nor the possible moderating effects of certain relationships on that association. The use of social network data may indicate relationships useful for investigation in future research to leverage for novel interventions easing mental health burdens in those left-behind by emigration. This dissertation was designed to fill these gaps in the literature.

In Chapter 3, titled “Socio-centric network dynamics of emigration in a rural migrant-sending community in the Western Highlands of Guatemala,” we leverage socio-centric network data from a census of an entire representative community in the rural Tajumulquito health district. This chapter analyzes the relationship between having emigrant ties and the likelihood of having plans to emigrate within the year. We also analyzed the effects of certain personal relationship ties and social network characteristics on plans to emigrate. We found that having ties to someone who emigrated to the United States did not increase the likelihood of an individual’s plan to emigrate within the year, but having a close friend or neighbor emigrate was associated with higher odds of emigration plans. Having a child or

spouse emigrate was associated with lower odds of emigration plans, while a spouse remaining at home was associated with higher odds of emigration plans in the adjusted model. For each additional person in a participant's network (total degree), their odds of planning to emigrate decreased by 3%. For each additional person who named a participant as part of their network (in-degree), their odds of planning to emigrate decreased by 7%. For males, having a close friend or neighbor emigrate resulted in higher odds of emigration plans. A spouse or either parent remaining at home increased males' odds of emigration plans, and the more participants that named a male as part of their network lowered their odds of emigration plans. For females, a spouse still in their network at home resulted in higher odds of planning to emigrate in the adjusted model, and having a child emigrate resulted in lower odds of emigration plans. The more "popular" a female is in her community, and the more central she is in that community also lowered her odds of planning to emigrate. Chapter 3 expands upon existing migration literature by using socio-centric network data to investigate novel drivers of migration among Indigenous Maya from a community with well-established migration routes. We investigated network characteristics and relationships that may influence both driving people to migrate internationally and reducing their likelihood of emigration.

In Chapter 4, titled "Social network dynamics as moderators of the impact of being "left-behind" to international migration and depression in rural Guatemala," we employ socio-centric network data from the same census described above to evaluate the effects of having emigrant ties in the US on the likelihood of falling above the CES-D cutoff threshold for depression. We additionally analyzed the effect of the nature of the relationship with emigrants, of those remaining in one's network at home, and social network characteristics on falling above that threshold. We then analyzed which relationship types and social network characteristics moderate the association between having emigrant ties in the US and depression. We found that having more close ties emigrated to the US increased the likelihood of depressive symptoms. Having a close friend or neighbor emigrate was predictive of depression while having a mother or sibling remaining at home lowered the odds of depression. Higher transitivity, or the more connected one's network, the lower their odds of depression in the adjusted model. The number of

others an individual named as part of their network (out-degree) was a significant moderator in the relationship between emigrant ties and depression. For females, the higher number of people in their network (total degree) and higher transitivity scores were associated with lower odds of depression in the adjusted model. Higher transitivity scores were a significant moderator in the relationship between emigrant ties and depression for females. Chapter 4 expands upon existing literature by utilizing social network methodology never before used to explore and identify key relationships impacting depressive symptoms among Indigenous people left-behind by emigration. We also used Social Network Analysis techniques to identify relationships that may be investigated and leveraged as novel strategies to alleviate socioemotional distress among Indigenous Maya in a high-volume migrant-sending area.

In sum, this dissertation includes (1) a community-driven overview of the challenges to health and well-being for Indigenous Maya living in a high-volume migrant-sending area, (2) a methodologically novel evaluation of the effects of social networks on plans to emigrate, and (3) the use of socio-centric network data to evaluate the effects of emigration on symptoms of depression, and the moderating effects of social network characteristics on the association between having emigrant ties and depression. This area of research indicates a priority for public health in the global context because understanding the factors that drive people to leave their homes is a valuable step in finding alternatives to current unauthorized migration; close-knit community networks are important social assets to leverage as alternatives to emigration.¹⁵⁵

International migration does not appear to be slowing, nor its impact in creating fractured networks of personal relationships and transnational family ties that must be negotiated in the presence of detrimental socioemotional impacts on those left-behind. This dissertation represents a foundation on which to build our understanding of drivers of migration from a more nuanced perspective, incorporating the complex relationships and structures involved in the migration decision-making process. It deepens our understanding of how living in conditions of poverty and oppression not only drive migration, but also create new challenges for those still living in communities of origin. It also provides the opportunity for public health professionals to begin designing public health interventions mitigating the consequences

of migration using personal relationships as available resources to ease the socioemotional costs of being left-behind. The techniques used in this dissertation research present an exciting opportunity to leverage in other migrant-sending communities exploring socioemotional impacts of migration. The methods used in this dissertation, including Photovoice technique with Indigenous populations, and Social Network Analysis techniques, can also be leveraged in future research to investigate social network influences on consequences of migration apart from mental health outcomes.

Supplementary appendix

Chapter 3 Measures

Outcome Variable:

Ideation to migrate: Do you have plans to migrate to the United States within the next 12 months? Y/N

Exposure Variables:

Emigrant ties: Do you have any close friends or family members that have migrated to the United States (currently living there)? Y/N

What are each of their relationships to you?

Categorized as:

Spouse

Parent

Child

Sibling

Close friend/Neighbor

Social network variables:

Created from name generator questions:

Are you married or in a civil union? Follow-up: What is the name of your spouse?

Does your mother live in this village? Follow-up: What is your mother's name?

Does your father live in this village? Follow-up: What is your father's name?

How many brothers and sisters do you have?

How many are brothers?

How many are sisters?

How many are older than 12 years and live in this community?

What are the names of your siblings that are older than 12 years and live in this community?

Who can you trust to confide in about something personal or private?

Who do you pass your free time with?

Apart from your spouse, parents, or siblings, who do you consider your closest friends?

Socio-demographic variables:

Sex: Male/Female (self-identified)

Age: Years

Categorized into quartiles for this analysis

Marital Status: Are you married or in a civil union (civil union more common than legal marriage in rural communities) Y/N

Level of education: What grade did you complete in school?

No school

Primary

Secondary

More than secondary

Education variable collapsed to three levels due to small cell sizes for higher education levels:

No school

Primary

More than primary

Religious affiliation: Do you regularly attend church? Y/N

Follow up question: What church do you regularly attend?

Catholic

Evangelical

Other (there are no other churches represented in this area, so there were no “other” responses)

Receives remittances (money sent from emigrated network ties): Do you receive any financial assistance from your friends or family who have emigrated to the US? Y/N

Income sufficiency: Thinking about the total household income, would you say it is:

Sufficient to live and save

Sufficient to live, but no savings

Not sufficient and there are difficulties

Not sufficient and there are great difficulties

Income sufficiency variable collapsed to dichotomous: Sufficient/Not sufficient

Chapter 4 Measures

Outcome Variable:

CES-D 20 item for Spanish-speaking populations:

<https://cesd-r.com/wp-content/uploads/2019/03/CESD-R-Spanish.pdf>

Exposure Variables:

Emigrant ties: Do you have any close friends or family members that have migrated to the United States (currently living there)? Y/N

How many of your close friends or family members have migrated to the United States (currently living there)?

What are their relationships to you?

Categorized as:

Spouse

Parent

Child

Sibling

Close friend/Neighbor

Alcohol exposure questions:

Do you drink alcohol? Y/N

Over one week, how many beers do you have?

Over one week, how many drinks of liquor do you have (whiskey, etc.)

With what frequency do you drink 4 or more (5 or more for men) drinks in a span of 2 hours?

Never

Less than once a month

Once a week

Twice a week

3-4 days a week

5-6 days a week
Every day

Have you ever tried alcohol in your lifetime? Y/N

Approximately when was the last time you had a drink?
more than 2 years ago
1-2 years ago
This year

Is there anyone in this household that drinks until they are drunk? Y/N

Social network variables:

Created from name generator questions:

Are you married or in a civil union? Follow-up: What is the name of your spouse?

Does your mother live in this village? Follow-up: What is your mother's name?

Does your father live in this village? Follow-up: What is your father's name?

How many brothers and sisters do you have?

How many are brothers?

How many are sisters?

How many are older than 12 years and live in this community?

What are the names of your siblings that are older than 12 years and live in this community?

Who can you trust to confide in about something personal or private?

Who do you pass your free time with?

Apart from your spouse, parents, or siblings, who do you consider your closest friends?

Socio-demographic variables:

Sex: Male/Female (self-identified)

Age: Years

Marital Status: Are you married or in a civil union (civil union more common than legal marriage in rural communities) Y/N

Level of education: What grade did you complete in school?

No school

Primary

Secondary

More than secondary

Education variable collapsed to three levels due to small cell sizes for higher education levels:

No school

Primary

More than primary

Religious affiliation: Do you regularly attend church? Y/N

Income sufficiency: Thinking about the total household income, would you say it is:

Sufficient to live and save

Sufficient to live, but no savings

Not sufficient and there are difficulties

Not sufficient and there are great difficulties

Income sufficiency variable collapsed to dichotomous: Sufficient/Not sufficient

Chapter 4 Supplementary tables

Supplementary Table 4.1. Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, Binary Exposure for emigrant tie

Supplementary Table 1							
Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala							
Binary Exposure for emigrant tie							
N=653							
	Multivariate Model 1			Multivariate Model 2			
	Emigrant tie main effect			Emigrant tie main effect with mother remaining			
	adjusted for total degree			adjusted for total degree			
	Beta	SE	P	Beta	SE	P	
Emigrant tie							
No	Ref			Ref			
Yes	0.496	0.188	0.008	0.507	0.189	0.007	
Mother remaining							
No				Ref			
Yes				-0.159	0.224	0.478	
Age in years	0.01	0.006	0.117	0.008	0.007	0.254	
Sex							
Men	Ref			Ref			
Women	1.42	0.214	<0.001	1.412	0.215	<0.001	
Marital status							
Single	Ref			Ref			
Married/Civil union	-0.126	0.206	0.541	-0.163	0.213	0.445	
Education							
None	Ref			Ref			
Primary school	-0.78	0.21	<0.001	-0.768	0.211	<0.001	
More than primary	-0.23	0.369	0.532	-0.2	0.371	0.59	
Religious affiliation							
No	Ref			Ref			
Yes	0.179	0.195	0.36	0.176	0.195	0.367	
Household alcohol dependent							
No	Ref			Ref			
Yes	0.517	0.191	0.008	0.521	0.191	0.006	
Income sufficiency							
Sufficient	Ref			Ref			
Not sufficient	0.348	0.211	0.099	0.346	0.211	0.101	
Total degree	0.02	0.014	0.145	0.022	0.014	0.113	

Supplementary Table 4.2. Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, # ties exposure

Supplementary Table 2							
Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala							
# ties exposure							
	Multivariate Model 1			Multivariate Model 2			
	Number of emigrant ties main effect adjusted for total degree			Emigrant tie main effect with mother remaining adjusted for total degree			
	Beta	SE	P	Beta	SE	P	
Number of emigrant ties	0.1	0.035	0.004	0.1	0.035	0.004	
Age in years	0.01	0.006	0.11	0.009	0.007	0.205	
Sex							
Men	Ref			Ref			
Women	1.392	0.214	<0.001	1.385	0.215	<0.001	
Marital status							
Single	Ref			Ref			
Married/Civil union	-0.102	0.207	0.622	-0.125	0.213	0.558	
Education							
None	Ref			Ref			
Primary school	-0.758	0.21	<0.001	-0.751	0.211	<0.001	
More than primary	-0.222	0.373	0.551	-0.204	0.375	0.587	
Religious affiliation							
No	Ref			Ref			
Yes	0.156	0.196	0.428	0.155	0.196	0.431	
Household alcohol dependent							
No	Ref			Ref			
Yes	0.481	0.192	0.012	0.483	0.192	0.012	
Income sufficiency							
Sufficient	Ref			Ref			
Not sufficient	0.428	0.217	0.048	0.426	0.217	0.049	
Mother remaining							
No				Ref			
Yes				-0.102	0.223	0.649	
Total degree	0.015	0.014	0.272	0.017	0.014	0.241	

Supplementary Table 4.3. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, Binary exposure for emigrant tie

Supplementary Table 3																		
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala including covariates from multivariate models																		
Binary exposure for emigrant tie																		
N=653																		
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5			Multivariate Model 6		
	Emigrant tie*total degree			Emigrant tie*mother remaining			Emigrant tie*sibling remaining			Emigrant tie*transitivity			Total degree*Absence of friend/neighbor			Sex*Absence of friend/neighbor		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Emigrant tie																		
No	Ref			Ref			Ref			Ref			Ref			Ref		
Yes	0.404	0.404	0.317	0.323	0.269	0.229	0.192	0.338	0.571	0.707	0.285	0.013	0.203	0.22	0.355	0.213	0.222	0.337
Total degree	0.016	0.019	0.396	0.021	0.014	0.128	0.028	0.015	0.057	0.02	0.014	0.145	0.014	0.016	0.377	0.018	0.014	0.189
Mother remaining																		
No				Ref														
Yes				-0.352	0.301	0.243												
Sibling remaining																		
No							Ref											
Yes							-0.538	0.311	0.083									
Transitivity										0.637	1.468	0.664						
Absence of friend/neighbor																		
No													Ref			Ref		
Yes													0.471	0.469	0.315	0.955	0.393	0.015
Sex																		
Men																Ref		
Women																1.541	0.258	<0.001
Emigrant tie*Total degree	0.007	0.026	0.797															
Emigrant tie*Mother remaining				0.364	0.378	0.336												
Emigrant tie*Sibling remaining							0.458	0.407	0.26									
Emigrant tie*Transitivity										-2.225	2.027	0.272						
Total degree*Absence of friend/neighbor													0.016	0.029	0.575			
Sex*Absence of friend/neighbor																-0.392	0.449	0.381

Supplementary Table 4.4. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, including covariates from multivariate models, # emigrant ties exposure

Supplementary Table 4																							
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala including covariates from multivariate models																							
# emigrant ties exposure																							
N=653																							
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5			Multivariate Model 6							
	# ties*total degree	Beta	SE	P	# ties*mother remaining	Beta	SE	P	# ties*sibling remaining	Beta	SE	P	# ties*transitivity	Beta	SE	P	Total degree*Absence of friend/neighbor	Beta	SE	P	Sex*Absence of friend/neighbor	Beta	SE
# Emigrant ties	0.241	0.081	0.003	0.071	0.044	0.103	0.191	0.099	0.054	0.091	0.048	0.053	0.053	0.036	0.144	0.055	0.035	0.115					
Total degree	0.028	0.015	0.062	0.017	0.014	0.227	0.022	0.015	0.137	0.015	0.014	0.295	0.014	0.016	0.366	0.015	0.014	0.271					
Mother remaining																							
No				Ref																			
Yes				-0.187	0.243	0.441																	
Sibling remaining																							
No							Ref																
Yes							-0.163	0.257	0.527														
Transitivity																							
No																							
Yes																							
Absence of friend/neighbor																							
No																							
Yes																							
Sex																							
Men																							
Women																							
# ties*Total degree	-0.007	0.004	0.075																				
# ties*Mother remaining				0.06	0.067	0.371																	
# ties*Sibling remaining							-0.102	0.105	0.33														
# ties*Transitivity																							
Total degree*Absence of friend/neighbor																							
Sex*Absence of friend/neighbor																							

Supplementary Table 4.5. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models, Binary exposure for emigrant tie

Supplementary Table 5							
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models							
Binary exposure for emigrant tie							
N=653							
	Multivariate Model 1			Multivariate Model 2			P
	Emigrant tie*In-degree	Beta	SE	Emigrant tie*Out-degree	Beta	SE	
Emigrant tie							
No	Ref			Ref			
Yes	0.321	0.291	0.269	0.646	0.393	0.1	
In-degree	-0.012	0.031	0.702				
Out-degree				0.054	0.031	0.082	
Emigrant tie*In-degree	0.033	0.042	0.43				
Emigrant tie*Out-degree				-0.019	0.041	0.647	

Supplementary Table 4.6. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models

Supplementary Table 6						
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models						
N=653						
	Multivariate Model 1			Multivariate Model 2		
	# ties*In-degree	Beta	SE	# ties*Out-degree	Beta	SE
# Emigrant ties	0.162	0.056	0.004	0.366	0.111	<0.001
In-degree	0.008	0.024	0.731			
Out-degree				0.075	0.025	0.003
# Emigrant ties*In-degree	-0.006	0.004	0.173			
# Emigrant ties*Out-degree				-0.023	0.01	0.019

Supplementary Table 4.7. Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, Binary Exposure for emigrant tie, By sex (MALE)

Supplementary Table 7							
Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala							
Binary Exposure for emigrant tie							
By sex (MALE) n=269							
	Multivariate Model 1				Multivariate Model 2		
	Emigrant tie main effect				Emigrant tie main effect with mother remaining		
	adjusted for total degree				adjusted for total degree		
	Beta	SE	P		Beta	SE	P
Emigrant tie							
No	Ref				Ref		
Yes	0.976	0.399	0.014		1.006	0.403	0.013
Mother remaining							
No					Ref		
Yes					0.451	0.451	0.317
Age in years	-0.006	0.012	0.654		0.001	0.014	0.943
Marital status							
Single	Ref				Ref		
Married/Civil union	-0.524	0.43	0.223		-0.51	0.431	0.237
Education							
None	Ref				Ref		
Primary school	-0.866	0.402	0.031		-0.916	0.407	0.025
More than primary	-0.946	0.623	0.129		-1.036	0.631	0.1
Religious affiliation							
No	Ref				Ref		
Yes	0.622	0.37	0.093		0.634	0.371	0.088
Household alcohol dependent							
No	Ref				Ref		
Yes	0.47	0.371	0.205		0.455	0.372	0.221
Income sufficiency							
Sufficient	Ref				Ref		
Not sufficient	0.546	0.467	0.242		0.524	0.467	0.262
Total degree	-0.001	0.03	0.96		-0.007	0.031	0.828

Supplementary Table 4.8. Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, # ties exposure, By sex (MALE)

Supplementary Table 8							
Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala							
# ties exposure							
By sex (MALE) n=269							
	Multivariate Model 1			Multivariate Model 2			
	Number of emigrant ties main effect adjusted for total degree			Emigrant tie main effect with mother remaining adjusted for total degree			
	Beta	SE	P	Beta	SE	P	
Number of emigrant ties	0.117	0.068	0.085	0.138	0.071	0.052	
Mother remaining							
No				Ref			
Yes				0.573	0.461	0.214	
Age in years	-0.002	0.012	0.894	0.007	0.014	0.623	
Marital status							
Single	Ref			Ref			
Married/Civil union	-0.53	0.429	0.216	-0.5	0.43	0.246	
Education							
None	Ref			Ref			
Primary school	-0.703	0.398	0.078	-0.746	0.402	0.063	
More than primary	-0.697	0.608	0.252	-0.794	0.614	0.196	
Religious affiliation							
No	Ref			Ref			
Yes	0.538	0.368	0.143	0.546	0.369	0.139	
Household alcohol dependent							
No	Ref			Ref			
Yes	0.444	0.368	0.227	0.424	0.369	0.251	
Income sufficiency							
Sufficient	Ref			Ref			
Not sufficient	0.559	0.476	0.24	0.55	0.477	0.249	
Total degree	-0.021	0.033	0.537	-0.031	0.035	0.377	

Supplementary Table 4.9. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, Binary exposure for emigrant tie, By sex (MALE)

Supplementary Table 9															
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala including covariates from multivariate models															
Binary exposure for emigrant tie															
By sex (MALE) n=269															
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
	Emigrant tie*total degree			Emigrant tie*mother remaining			Emigrant tie*sibling remaining			Emigrant tie*transitivity			Total degree*Absence of friend/neighbor		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Emigrant tie															
No	Ref			Ref			Ref			Ref			Ref		
Yes	1.099	0.894	0.219	0.404	0.604	0.504	0.054	0.716	0.94	0.817	0.58	0.159	0.768	0.451	0.089
Total degree	0.007	0.061	0.911	-0.008	0.031	0.808	0.001	0.032	0.987	-0.005	0.03	0.865	-0.048	0.044	0.27
Mother remaining															
No				Ref											
Yes				-0.241	0.703	0.731									
Sibling remaining															
No							Ref								
Yes							-1.01	0.691	0.144						
Transitivity										-2.332	3.361	0.488			
Absence of friend/neighbor															
No													Ref		
Yes													-0.367	0.816	0.653
Emigrant tie*Total degree	-0.01	0.067	0.877												
Emigrant tie*Mother remaining				1	0.797	0.21									
Emigrant tie*Sibling remaining							1.334	0.873	0.126						
Emigrant tie*Transitivity										1.573	3.777	0.677			
Total degree*Absence of friend/neighbor													0.078	0.055	0.153

Supplementary Table 4.10. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, # emigrant ties exposure, By sex (MALE)

Supplementary Table 10															
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala including covariates from multivariate models															
# emigrant ties exposure															
By sex (MALE) n=269															
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
	# ties*total degree			# ties*mother remaining			# ties*sibling remaining			# ties*transitivity			Total degree*Absence of friend/neighbor		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
# Emigrant ties	0.489	0.16	0.002	0.055	0.079	0.482	0.231	0.279	0.408	0.092	0.082	0.264	-0.005	0.086	0.953
Total degree	0.014	0.036	0.708	-0.025	0.035	0.476	-0.017	0.036	0.636	-0.023	0.034	0.496	-0.04	0.043	0.356
Mother remaining															
No				Ref											
Yes				-0.069	0.519	0.894									
Sibling remaining															
No							Ref								
Yes							0.278	0.547	0.959						
Transitivity										-1.901	2.126	0.371			
Absence of friend/neighbor															
No													Ref		
Yes													0.095	0.785	0.904
# ties*Total degree	-0.012	0.006	0.05												
# ties*Mother remaining				0.447	0.161	0.005									
# ties*Sibling remaining							-0.121	0.285	0.672						
# ties*Transitivity										0.361	0.62	0.561			
Total degree*Absence of friend/neighbor													0.072	0.062	0.249

Supplementary Table 4.11. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models, By Sex (MALE)

Supplementary Table 11						
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models						
By Sex (MALE) N=269						
	Multivariate Model 1			Multivariate Model 2		
	Emigrant tie*In-degree			Emigrant tie*Out-degree		
	Beta	SE	P	Beta	SE	P
Emigrant tie						
No	Ref			Ref		
Yes	0.766	0.631	0.225	1.502	0.866	0.083
In-degree	-0.082	0.105	0.439			
Out-degree				0.09	0.088	0.306
Emigrant tie*In-degree	0.053	0.113	0.641			
Emigrant tie*Out-degree				-0.075	0.101	0.406

Supplementary Table 4.12. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models, By Sex (MALE)

Supplementary Table 12						
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models						
By Sex (MALE) N=269						
	Multivariate Model 1			Multivariate Model 2		
	# ties*In-degree			# ties*Out-degree		
	Beta	SE	P	Beta	SE	P
# Emigrant ties	0.37	0.131	0.005	0.68	0.214	0.001
In-degree	-0.026	0.057	0.643			
Out-degree				0.111	0.063	0.08
# Emigrant ties*In-degree	-0.015	0.008	0.052			
# Emigrant ties*Out-degree				-0.044	0.021	0.035

Supplementary Table 4.13. Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, Binary exposure for emigrant tie, By sex (FEMALE)

Supplementary Table 13							
Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala							
Binary exposure for emigrant tie							
By sex (FEMALE) n=384							
	Multivariate Model 1				Multivariate Model 2		
	Emigrant tie main effect				Emigrant tie main effect with mother remaining		
	adjusted for total degree				adjusted for total degree		
	Beta	SE	P		Beta	SE	P
Emigrant tie							
No	Ref				Ref		
Yes	0.358	0.222	0.106		0.4	0.225	0.076
Mother remaining							
No					Ref		
Yes					-0.34	0.269	0.206
Age in years	0.02	0.008	0.013		0.016	0.009	0.069
Marital status							
Single	Ref				Ref		
Married/Civil union	0.099	0.237	0.676		0.003	0.25	0.99
Education							
None	Ref				Ref		
Primary school	-0.663	0.254	0.009		-0.638	0.255	0.013
More than primary	0.219	0.485	0.652		0.285	0.488	0.559
Religious affiliation							
No	Ref				Ref		
Yes	0.066	0.236	0.779		0.058	0.236	0.807
Household alcohol dependent							
No	Ref				Ref		
Yes	0.566	0.229	0.014		0.575	0.229	0.012
Income sufficiency							
Sufficient	Ref				Ref		
Not sufficient	0.267	0.246	0.277		0.257	0.246	0.298
Total degree	0.028	0.016	0.084		0.035	0.017	0.045

Supplementary Table 4.14. Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala, # ties exposure, By sex (FEMALE)

Supplementary Table 14							
Additional Model: Results of GLM logistic regression on predictors of depressive symptoms in the rural western highlands of Guatemala							
# ties exposure							
By sex (FEMALE) n=384							
	Multivariate Model 1			Multivariate Model 2			
	Number of emigrant ties main effect adjusted for total degree			# Emigrant ties main effect with mother remaining adjusted for total degree			
	Beta	SE	P	Beta	SE	P	
Number of emigrant ties	0.107	0.043	0.013	0.113	0.044	0.011	
Age in years	0.02	0.008	0.014	0.016	0.009	0.075	
Marital status							
Single	Ref			Ref			
Married/Civil union	0.114	0.239	0.635	0.022	0.251	0.931	
Education							
None	Ref			Ref			
Primary school	-0.662	0.256	0.01	-0.638	0.257	0.013	
More than primary	0.15	0.496	0.762	0.213	0.499	0.67	
Religious affiliation							
No	Ref			Ref			
Yes	0.043	0.238	0.855	0.038	0.238	0.874	
Household alcohol dependent							
No	Ref			Ref			
Yes	0.521	0.231	0.024	0.528	0.232	0.023	
Income sufficiency							
Sufficient	Ref			Ref			
Not sufficient	0.37	0.253	0.146	0.364	0.254	0.153	
Mother remaining							
No				Ref			
Yes				-0.336	0.27	0.213	
Total degree	0.028	0.016	0.09	0.034	0.017	0.049	

Supplementary Table 4.15. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, including covariates from multivariate models, Binary exposure for emigrant tie, By sex (FEMALE)

Supplementary Table 15															
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala including covariates from multivariate models															
Binary exposure for emigrant tie															
By sex (FEMALE) n=384															
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
	Emigrant tie*total degree			Emigrant tie*mother remaining			Emigrant tie*sibling remaining			Emigrant tie*transitivity			Total degree*Absence of friend/neighbor		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
Emigrant tie															
No	Ref			Ref			Ref			Ref			Ref		
Yes	-0.012	0.489	0.98	0.416	0.323	0.197	0.157	0.395	0.691	0.841	0.352	0.017	0.046	0.263	0.861
Total degree	0.016	0.022	0.458	0.035	0.017	0.045	0.037	0.018	0.034	0.03	0.017	0.075	0.026	0.018	0.157
Mother remaining															
No				Ref											
Yes				0.325	0.347	0.349									
Sibling remaining															
No							Ref								
Yes							-0.494	0.361	0.172						
Transitivity															
Yes										-0.056	1.772	0.975			
Absence of friend/neighbor															
No													Ref		
Yes													0.634	0.615	0.302
Emigrant tie*Total degree	0.027	0.032	0.458												
Emigrant tie*Mother remaining				-0.031	0.451	0.946									
Emigrant tie*Sibling remaining							0.315	0.483	0.514						
Emigrant tie*Transitivity										-5.086	2.651	0.055			
Total degree*Absence of friend/neighbor													0.007	0.04	0.867

Supplementary Table 4.16. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala, including covariates from multivariate models, # emigrant ties exposure, By sex (FEMALE)

Supplementary Table 16															
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration in the rural western highlands of Guatemala including covariates from multivariate models															
# emigrant ties exposure															
By sex (FEMALE) n=384															
	Multivariate Model 1			Multivariate Model 2			Multivariate Model 3			Multivariate Model 4			Multivariate Model 5		
	# ties*total degree			# ties*mother remaining			# ties*sibling remaining			# ties*transitivity			Total degree*Absence of friend/neighbor		
	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P	Beta	SE	P
# Emigrant ties	0.15	0.107	0.162	0.209	0.104	0.044	0.17	0.106	0.11	0.113	0.064	0.076	0.069	0.045	0.127
Total degree	0.031	0.018	0.086	0.036	0.017	0.038	0.036	0.018	0.042	0.027	0.017	0.105	0.026	0.018	0.15
Mother remaining															
No				Ref											
Yes				-0.21	0.292	0.472									
Sibling remaining															
No							Ref								
Yes							-0.265	0.303	0.381						
Transitivity										-2.454	1.457	0.091			
Absence of friend/neighbor															
No													Ref		
Yes													0.418	0.615	0.497
# ties*Total degree	-0.003	0.007	0.651												
# ties*Mother remaining				-0.124	0.114	0.277									
# ties*Sibling remaining							-0.072	0.115	0.531						
# ties*Transitivity										-0.061	0.378	0.872			
Total degree*Absence of friend/neighbor													0.005	0.04	0.899

Supplementary Table 4.17. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models, By Sex (FEMALE)

Supplementary Table 17						
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models						
By Sex (FEMALE) N=384						
	Multivariate Model 1			Multivariate Model 2		
	Emigrant tie*In-degree			Emigrant tie*Out-degree		
	Beta	SE	P	Beta	SE	P
Emigrant tie						
No	Ref			Ref		
Yes	0.016	0.347	0.964	0.36	0.468	0.442
In-degree	-0.009	0.034	0.785			
Out-degree				0.051	0.035	0.139
Emigrant tie*In-degree	0.066	0.523	0.209			
Emigrant tie*Out-degree				-0.002	0.458	0.972

Supplementary Table 4.18. Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration, including covariates from multivariate models, By Sex (FEMALE)

Supplementary Table 18						
Additional Models: Results of GLM models on moderators of depressive symptoms among those left behind to migration including covariates from multivariate models						
By Sex (FEMALE) N=384						
	Multivariate Model 1			Multivariate Model 2		
	# ties*In-degree			# ties*Out-degree		
	Beta	SE	P	Beta	SE	P
# Emigrant ties	0.088	0.064	0.17	0.24	0.122	0.049
In-degree	0.011	0.03	0.708			
Out-degree				0.069	0.029	0.017
# Emigrant ties*In-degree	0.011	0.03	0.708			
# Emigrant ties*Out-degree				-0.014	0.012	0.216

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