PRESIDENT'S AWARD FOR GLOBAL LEARNING

HEALTH & HOUSING

A COMPREHENSIVE NEEDS ASSESSMENT OF LOW-INCOME COMMUNITIES IN PUEBLA, MEXICO

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Appendix 4: Intensive Case Study Lot Plans and Health Hazards:

https://lahn.utexas.org/Puebla/App4.html

Appendix 5: Focus Group Materials:

https://lahn.utexas.org/Puebla/App5.html

Appendix 6: Return visit in October- Presentations and Photographs:

https://lahn.utexas.org/Puebla/App6.html

PREFACE

Project Overview

The President's Award for Global Learning (PAGL)

The 2018-19 President's Award for Global Learning was the inaugural program of the International Board of Advisors at the University of Texas at Austin. Through the President's Office, the Office of the Executive Vice President and Provost, and Texas Global, the program was created to educate global leaders and participate in a cross- cultural experience to increase the global engagement of UT Austin (<u>https://presidentsglobalaward.utexas.edu/</u>). To create a highly interdisciplinary team, three faculty, four undergraduates, and two graduate assistants spanning nine colleges created a comprehensive needs assessment of low-income communities in Puebla, Mexico.

To compete for the prestigious award, the team (see below) worked on a 75-page proposal during Spring 2018 dedicated to explaining the project, including the research question, aims, proposed solution, outcomes, and budget. In the Fall we were informed that we were one of two finalists for the Latin America region, and were required to make an oral presentation to senior faculty and administrators. This involved a four-minute "pitch" and six-minutes of Q&A. Soon after, the team was notified that they had received the award, and in turn began preparing for fieldwork undertaken over ten weeks in the Summer 2019.

The award was extremely generous comprising all travel and living expenses for the student members of the team and for faculty and the GRA (as well as some stipend and per diem support). In addition, the award carried \$25,000 for project implementation, logistics, collaboration with our counterparts, etc. During 2019 the students received a total of 10 hours of course credit: 3 hours seminar in the Spring; 6 hours over the summer and a 1-hour credit for the Fall. The project was then implemented over ten weeks in country. The undergraduate students and Alfonso Rojas Alvarez spent ten weeks in Mexico, while the faculty each spent approximately two weeks at different times throughout the summer in order to work alongside the students and project stakeholders.

The Selection of Puebla, Mexico

As we describe in full detail in Chapter 1, Puebla is the fourth poorest state in Mexico, has the 6th highest infant mortality rate, and is ranked 27 out of 32 in access to healthcare. Furthermore, it was recently impacted by an earthquake in Fall 2017 and communities, especially those that are low-income, are still experiencing the psychological, social, and economic impact of that earthquake. The communities are also extremely close to an active volcano, Mount Popocatépetl, which regularly erupts volcanic ash, greatly impacting air quality and health. Also, Puebla has a large number of migrants to the United States, making it an important area to understand both for their community and similar communities in Texas. It is through these reasons that we chose Puebla, Mexico as the location for the assessment.

The Puebla PAGL Team and Collaborators

<u>At UT-Austin</u>

Undergraduate students in the team include Christina Ciaburri, Veronica Remmert, Andrea Sandoval Flores, and Claire Stephenson. Christina Ciaburri is a Psychology and Communication and Leadership double major who brought in expertise in the psychosocial aspects of health, bringing a trauma-informed approach to survey creation and data collection. Veronica Remmert is a Biology major with a public health certificate and has a strong background in public and global health as well as in health education and sampling and data collection. Andrea Sandoval Flores is a Civil Engineering major and provided a deep understanding of the impact that housing conditions, air quality, and water quality have on health. Claire Stephenson is a Management Information Systems and Business Honors Program double major who designed and built a data model to store, manage, and analyze the data collected in the assessment.

The three faculty mentors were Dr. Ricardo Ainslie, Dr. Tim Mercer, and Dr. Peter Ward. Dr. Ricardo Ainslie is the director of the LLILAS- Benson Mexico Center and holds the M.K. Hage Centennial Professorship in Education. Dr. Tim Mercer is the Chief of the Division of Global Health in the Department of Population Health at Dell Medical School and is a practicing physician. Dr. Peter Ward holds the C.B. Smith Sr. #1 Centennial Chair in the US- Mexico Relations and is a professor of Sociology and of Public Affairs. Hannah McDermott, a doctoral student in Educational Psychology, and Alfonso Rojas Alvarez, a doctoral student in Public Policy and Data Science, were both graduate assistants on the project, vital to receiving the award, creating the assessment, leading logistics, analyzing data collected, and providing support to students and faculty.



Photograph Preface 1: Photograph of the team at the awards dinner in October 2018. From left to right: President Gregory L. Fenves, Dr. Peter Ward, Dr. Tim Mercer, Andrea Sandoval Flores, Claire Stephenson, Veronica Remmert, Christina Ciaburri, and Laurie Young (Texas Global). Photograph taken by Texas Global Photographers.

Other UT faculty and students provided invaluable support to the team and to the project. Specifically, Ms. Melannie Ruiz, while not a formal member of the student team became a de facto "5th member". An undergraduate student in the School of Architecture she provided initial training on how to prepare dwelling structure measurements and plans, tied to the photographic record so that during fieldwork she was able to work closely with the team (remotely from Austin) in order access materials uploaded to BOX and prepare the intensive case study diagrams and architectonic images that appear in Chapter 4 and the Appendices (Appendix 4). We are grateful to the Deans of the School of Architecture for funding support to Ms. Ruiz in order to conduct that work. UT Architecture professor Dr. Benjamin Ibarra, a Mexican expert in earthquake reconstruction and colonial period monuments, provided invaluable guidance and advice throughout the project and has kindly offered to work closely with the team during Spring 2020 through his class project in which architecture students will be working on follow-up projects in two of the agricultural communities. Engineering graduate student, L. Stetson Rowles, and his supervisor Dr. Navid Saleh provided guidance and laboratory training on how to collect household water quality samples. Francisca Bogolasky, PhD candidate in the LBJ School of Public Affairs is warmly thanked for her assistance in making all of the materials publicly available on the Latin American Housing Network website (https://lahn.utexas.org/PueblaNeeds.html). See the Contents Page for the respective links to each appendix.

Dr. Adriana Pacheco, UT International Board Advisory member and alumnus, and herself a Poblana (from Puebla), was central to first putting us in touch with our partner collaborators in Puebla, and remained a constant friend, supporter (and sometimes active fieldworker!) throughout the project. Thank you, Adriana, – you worked us hard. Also at UT, we huge thanks and congratulations are due to Dr. Paul Stekler from the Dept. of Radio, TV and Film (Moody College of Communications) and his graduate student team of Cristoforo Magliozzi and Taniel Kilajian for their filming and production of the video that captures the President's Award for Global Learning and privileged our Puebla health needs assessment project (see video at <u>www.lahn.utexas.org</u> "Puebla Health Needs Assessment" link)

We are also grateful to the University of Texas at Austin for entrusting us with the honor of representing the University abroad and wish to express our appreciation to the Texas Global team, especially Laura Caloudas, Margaret Rieley, and Laurie Young, who were vital in providing guidance, support, and encouragement during the entire process.

Partners in Puebla

A key part of the research model was the utilization of the expertise and relationships of the partners. From the outset our success depended in part on the support and assistance provided by Fundación Comunitaria Puebla, and especially from its president and former presidents Roberto Solano Mendéz, José-Ramón Lozano-Torres, respectively its administrator Liliana Sánchez Ibarra, as well as from other foundation members. Thank you!

The Fondo Mónica Gendreau (FMG), a part of the Fundación Comunitaria Puebla (FCP), led by Patricia Vargas Espinosa and Alejandro Luna López, was integral to the integration into the communities. The trusted relationships that this husband and wife team had forged with the communities allowed us to be accepted by community members and enabled us to learn and collect as much data as we did. They also provided a nuanced understanding of the communities and provided detailed feedback to our draft survey instruments adding questions that were vital to more fully understanding perspectives and issues within the communities.

On the ground, we worked with the FMG and the Benemérita Universidad Autónoma de Puebla (BUAP). The FMG helped us through recruitment of participants and BUAP was vital in implementing the survey. Students of BUAP led surveys and provided assistance with focus groups. A key outcome of this project was the growth of relationships in Mexico and through the collaborations with FCP, FMG, and BUAP, we were able to create sustainable, long-term relationships. The University of Texas at Austin and BUAP are forming an academic global health partnership that will be well poised to work with communities, governments, and public-sector health care delivery systems to respond to the population health needs, working towards improving health outcomes.

In Santa Ana Coatepec, Dr. Edith Álvarez was a great asset to the team. She provided critical support in Santa Ana Coatepec, as well as healthcare services for our team while in Mexico. Her kindness and friendship are greatly appreciated. While we had excellent entrees into the three pueblos through Paty and Alejandro, none at FCP or the FMG were familiar with urban colonia popular communities. As we explain in Chapter 1, we were eager to have a comparator low income community in the town of Atlixco. Dr. Ward, one of our faculty mentors has extensive experience of working in informal settlements in Mexico and after a field visit in March 2019 he identified two or three possible colonias sites. The one selected was Colonia Flores Magón, but lack of familiarity by FCP partners and concerns about insecurity required us to take soundings about the relative safety of surveying in that community. We would like to thank María de Jesús Rosales, the local síndico who paved our way with the government and provided security and local government resources for us in Flores Magón. We would also like to thank Ing. Sergio Hidalgo for his advice and orientation, and for connecting us with members of the Ayuntamiento of Altixco (City Council) who kindly gave their support to the project and even offered some police support if needed. We would also like to thank Katie and Jessica for their help and hospitality during our time in Colonia Flores Magón.

The Project Timeline

As mentioned above, the Spring semester consisted of an intensive three hour weekly seminar in which the team and faculty undertook the various preparations in advance of fieldwork: elaboration of a health needs assessment survey; requests for IRB approvals; methods training (survey, focus groups, key informant interviewing etc.); training in intensive case study methodology and in the collection of air and water quality measurements; cultural orientation; as well all of the logistical planning required to travel and live in the field for ten weeks. The summer fieldwork began in late May and went through August 8th and the detailed timeline and findings form the body of the Report and are not repeated here. However, a note about the post fieldwork phase is important to mention briefly. Fall 2019 was spent analyzing and disseminating the data, preparing a Final Report, and submitting paper proposals for presentation at academic conferences in 2020, (three of which were subsequently accepted for the Latin American Studies Association (LASA) Congress in Guadalajara in mid-May), and at the Consortium of Universities for Global Health (CUGH) conference, being one of the top 60 abstracts out of 1,200 submitted that are selected picked for an oral presentation, abstracts of which are published in *The Lancet Global Health* -- the top journal in the Medical field.



Photograph Preface 2: Photograph of the large announcements posted prominently in each community upon the team's departure in August, announcing that we would "Return" in October. This one is in Santa Ana Coatepec, posted in the Auxiliary Municipal President's Office and Community Meeting Room.

Equally important were our return visits to the communities and to our partners. In mid-October 2019 the whole group (minus Dr. Mercer) returned to the four communities. This we had promised to do at the end of fieldwork (see Photo 2), and we spent three days visiting with each community in turn to discuss the principal findings relating to each community. The meetings were well attended by community members and were important both in terms of our substantive discussions, but also in fulfilling our commitments to return, thereby consolidating the close links that had been forged with each of the pueblos. We also spent one day making presentations to our partners at the Fundación Comunitaria Puebla. Two weeks later, Drs. Mercer and Ainslie returned to Puebla to provide detailed briefings and findings to our faculty collaborators at the Medical School of the Benemérita Universidad Autónoma de Puebla (BUAP), and to the Puebla Secretaría de Salud

Final Acknowledgments from the Students

The undergraduates want to give our deepest thanks to the professors and graduate assistants. The professional and personal mentorship has been greatly appreciated and impactful. We are truly thankful for the opportunity to learn and work alongside each of you. Thank you to Hannah McDermott for your commitment to helping us propose, pitch, and implement the project. Thank you to Alfonso Rojas Alvarez for your willingness to help us with logistics, data collection, and constant and steady support.

We are particularly thankful to our families who have supported us through the countless hours spent working on the project. Thank you for your unending love and support.

We also wish to show extreme gratitude to San Francisco Xochiteopan, Colonia Agrarista Emiliano Zapata, Santa Ana Coatepec, and Colonia Flores Magón. Thank you for opening your doors to answer our survey and for sharing with us your joys, hopes, and fears. Many thanks for the hospitality, kindness, and friendship shared.



Preface photo 3: Undergraduate team and graduate assistant at Teotihuacán in Mexico City.

CHAPTER 1.

THE STUDY AIMS AND LOCATIONAL CONTEXT

Puebla Broad Overview

The state of Puebla is located in East- Central Mexico and is the fourth largest metropolitan area in Mexico ("OECD Reviews of Health Systems: Mexico," 2016). Puebla is the fourth poorest state in Mexico and two thirds of the population live under the poverty level, compared to around half of the population in Mexico ("OECD Reviews of Health Systems: Mexico," 2016). The state of Puebla is greatly affected by systemic health inequalities, including inequity within the built environment and health system, because the state's development is centered on the capital city of Puebla, causing large economic gaps between rural and urban populations. These issues significantly impact low income communities. This inequity manifests itself in lack of access to healthcare and increased infant mortality rates. Puebla is ranked 27th out of 32 states in access to healthcare and has the highest infant mortality rate in the country ("OECD Reviews of Health Systems: Mexico," 2016). To create community-based solutions, we must first understand what lies at the root of these problems through the perspectives of the community members.

Mexico is a country with one of the highest number of people living with non-communicable diseases (NCD), which accounts for 47% of premature deaths from all causes in men and more than 67% of premature deaths in women(Córdova-Villalobos et al., 2008). In response to the high number of people with an NCD, the Mexican government has been prioritizing interventions to improve health. As such, people without formal employment, such as agriculturists, have access to free health services through Seguro Popular Clinics and Hospitals. In Puebla, 72% of employees have an informal job, a 14-percentage point increase from the national average ("Measuring Well-being in Mexican States," 2015) and as a result, 72% of people in Puebla have access to enroll in free health service programs. Despite this healthcare policy, we found that on average, approximately 35% of people utilize private practitioners and not Seguro Popular clinics or hospitals.

Research Project and Primary Research Questions.

With our established community partner, Fundación Comunitaria Puebla (see Preface), we created a mixed method approach to understand the root of the systemic health inequity in Puebla, by examining three rural communities and one urban low-income community. We had three goals with our study:

1. Understand what the perceptions of health needs and priorities among residents.

2. Determine how and where do residents access health care, and what are their healthrelated behaviors.

3. Explore how the built environment, specifically housing, air and water quality, impact the health and perceptions of health.



Figure 1.1: Map showing locations of all four communities relative to each other and Puebla city. In the top left you can also see the location of the active volcano, Popocatépetl (Image created by Alfonso Rojas Alvarez).

Methodology: A Mixed Methods Approach

An original methodology was created prior to starting the research to Mexico where we had collected and analyzed secondary data such as census data, government reports, reports from NGOs, and health system data. While the secondary data provided a good foundation to prepare for conducting the research in Mexico, we utilized community-based participatory research (CBPR) so we could adapt properly to individual challenges and patterns each community presented. Each step to the methodology featured its own unique ways of being modified to best fit the communities and were conducted in Spanish to best connect with the groups we worked with.

Human Subjects Review Board (IRB) Approval

The research methods were all approved by the Internal Review Board at the University of Texas at Austin. The IRB Approval number is #2019-01-0131.

The Household Survey

The primary survey was created with the help of our community partner, Fundación Comunitaria de Puebla, and made available via Qualtrics, a data collection tool. Drafted originally in English during the Spring 2019 semester, the actual household surveys were conducted on tablets in Spanish (see

https://lahn.utexas.org/Puebla/Appendix1/Appdx1.1Final_English.pdf Appendix 1 for copies of the

English survey which were transferred into Qualtrics). The topics covered in the survey ranged from house demographics, health needs and access to healthcare, mental health and wellbeing in the communities, and health-impacting behaviors and housing. Household demographics focused on understanding their household structure including education levels and transportation. Health needs and access to healthcare primarily covered where the community member received healthcare, how they accessed it, and why they received medical attention (chronic versus acute illnesses). The housing section of the survey featured air and water quality tests to better understand the impact of upstream health determinants through direct measurement. In total, 242 surveys were conducted across the four communities.

Photograph 1.1: A UT student and a BUAP student conducting a survey at one of the homes in the communities. Students went into homes and outdoor spaces to receive responses (Image taken by Alfonso Rojas Alvarez).



Intensive Case Studies

Intensive case studies were employed to better understand the intersection of health and housing through detailed data gathering which included videos, photographs, interviewing, and measurements of the lot and precise measurements of the lot, buildings, and room dimensions. This later allowed us to draw up detailed plans and 3D models of houses, highlighting the respective health hazards of households. The five intensive case studies were chosen after having spent a week in each community, so we were able to experience a wide variety of houses and their inhabitants. The houses were selected based on the criteria that they best exemplified certain elements of the intersection of how housing interacts with health (see Chapter 4 for further details on selection). Each case study involved the whole team plus students from BUAP (for whom this was an entirely new research technique). Thus between 5 and 8 team members would be working in site for 2-4 hours. The fieldwork plans were then drawn up in a clean format and upload for the later elaboration of clean architectural plans by architecture student Ms. Melannie Ruiz who was supported with a grant from the SOA to work with the team remotely and developed the plans using software.



Photograph 1.2: A UT student and two BUAP students creating a sketch of the house. The measurements were then used to create 3D sketch- ups (Image taken by Alfonso Rojas Alvarez).

Focus Groups

Focus groups were conducted to collect qualitative data beyond the survey and to expand on themes we found to be important to each community. Two focus groups were conducted per rural community. The topics included air quality, diet and nutrition, immigration, chronic illnesses, street dogs, and alcoholism. Each focus group had 10- 15 participants. The focus groups helped us to understand on a deeper level what the priorities were of the community members and to help identify solutions they might have thought of for topics that were problem-based. Overall, six focus groups were conducted. Two were conducted in Xochiteopan over Diet and Nutrition and Air Quality. Another two were conducted in Colonia Agrarista over Migration and Chronic Illness. Lastly, two were conducted in Santa Ana Coatepec over Alcoholism and Dogs. See appendix 5 for more information about the focus groups (https://lahn.utexas.org/Puebla/App5.html).



Photograph 1.3: A focus group conducted by two BUAP students. Focus groups included Diet and Nutrition, Air Quality, Migration, Chronic Illness, Dogs, and Alcoholism.

Key Informant Interviews

Similar to the focus groups' focus, key informant interviews were used as a means to gather data around a topic beyond what was captured within the survey. Key informant interviews were semi-structured interviews in order to provide informants the space to be as open as possible about their perspectives. The informants were selected once we had spent time within the community and identified them as relevant to information that the surveys had briefly seen but needed further expansion. Key informants ranged from local clinic workers to the person that treated the local water source, and other leaders within the communities.

Data and Information Analysis

Questionnaire design: From Paper to Qualtrics to Tablets

The questionnaire for this project was designed using Qualtrics Survey Software and the Qualtrics mobile app was installed on the tablets that were used to capture data in the field. The questionnaire contained 204 discrete data points and was administered over the course of 45-90 minutes. It was important that the final dataset be de-identified, interpretable by the public and available in many formats, while also being flexible enough to adapt to changes or additions made in the field. A lot of time was spent making sure the questionnaire was able to fill all of these prior to the administration.

Data cleaning and preliminary analysis

The survey data was collected using the survey software Qualtrics, in four Samsung Galaxy tablets. The data was downloaded in CSV format and cleaned using R statistical software, following the principles of tidy data cleaning. First, each row constituted an ith household surveyed, with a set of columns for the descriptives of each of the jth members of the

household. Then, each of the matrix questions were separated into binary variables corresponding to 1 if the person selected a given option, or 0 if they didn't.

Furthermore, an intensive data cleaning process was required to standardize the responses for both numeric and text variables. In many cases, researchers inputted data differently, for example, using commas or periods for decimal numbers. To get around manually cleaning each of these observations, a set of loops were developed to automatically clean and standardize the inputting of the variables in the clean data set. Finally, it also became necessary to set the variables as either factors, categorical, or text, in order for the analysis to correspond to the type of construct each question was aiming to study. Once this initial cleaning was ready, a data dictionary was built in order to guide the interpretation of each variable.

In order to do an exploratory analysis, means and proportions were calculated for all the variables, with the required adjustment in the denominators to account for whether the denominator represented households, household members, or number of people to whom the particular question applied. Then, these summary statistics were divided by community, and then by rural and urban denomination, in order to make comparisons based on those categories, especially the case of Flores Magón as an urban comparison group.

Finally, several graphs and smoothed density estimations were built for each community, in order to visually explore the general distributions that each question followed. For more information about the analysis as well as the redacted dataset, please visit appendix 2 (https://lahn.utexas.org/Puebla/App2.html)

Table 1.1: Survey Metadata about number of households, sex of participants, and number of case studies and focus groups per community and in total.

Survey Metadata					
Community	Surveys	Female Respondents	Male Respondents	Focus Groups	Case Studies
San Francisco Xochiteopan	81	0.728	0.272	2	3
Colonia Agrarista	55	0.818	0.182	2	1
Santa Ana Coatepec	60	0.7	0.3	2	1
Colonia Flores Magón	46	0.804	0.196	0	0
Total:	241	0.756	0.244	6	5

Source: Household Survey, Focus Groups, Case Studies

Communities Overview

The Study Focus: Three Pueblos

Three of the four communities selected for the study were rural pueblos that rely strongly on agricultural production, both for self-consumption and for economic profit, and predominantly utilize carbon and leña as cooking fuels instead of natural gas or electricity due to financial constraints. One community (Santa Ana Coatepec) is located much closer to Atlixco and is better described as a peri-urban community, albeit primarily dedicated to agriculture. As we shall observe, health behaviors and access are rather different in that pueblo primarily because it is closer to the urban facilities of the town.

The volcano of Popocatéptl looms large across the whole region and its eruptions of ash and its intermittent seismic activity are a near daily feature of life. The two most isolated rural communities are quite literally "Under the Volcano" to quote from Lowrey's novel. These are communities that were also impacted to varying degrees by the September 2017 earthquake, with San Fco. Xochiteopan exhibiting the heaviest impact.

Later in the report, we will examine the differences and similarities between each community with a focus on the intersection between health, housing, and the built environment. But first, we begin by introducing the four communities in Puebla, Mexico.



Photograph 1.4: Photograph of active volcano Popocatéptl by Dr. Peter Ward in July 2019.

Pueblos and Sites	San Fco.	Colonia	Santa Ana	Colonia Flores
	Xochiteopan	Agransta	Coatepec	Iviagon
Total Population*	984	306	1147	4500**
Classification	Rural	Rural	Peri-Urban	Urban
Average Household Size	3.9	3.7	4	4.4
% of Extended Family / Multiple Lots	42%	33%	28%	32%
% of Households with One House on Lot	56%	65%	72%	67%
% of Households with Two Houses on Lot	28%	22%	22%	17%
% of Households with Three or more Houses on Lot	14%	11%	7%	15%
Average Tenure of Family in Home (years)	27	33	25	34
% of Female Respondents	73%	82%	70%	80%
Average Age of Respondent (years)	49	53	49	52
% of Respondents who Completed Secondary School	25%	29%	35%	54%
% in Possession of Vehicle	35%	20%	52%	46%
Primary Economic Activity of Community	Agriculture	Agriculture	Agriculture	Services
Secondary Economic Activity of the Community (After work in the Home)	In the Home	In the Home	In the Home	In the Home
Primary Agricultural Product	Amaranto (47%) Chia (36%)	Chia (69%) Amaranto (49%)	Corn (80%) Beans (47%)	NA
% with Food Insecurity	17%	18%	15%	9%
Distance from Atlixco (km)	38.5	41.5	11.5	1.5

Table 1.2: Overview of demographics in each community.

*= Taken from 2015 Census data

** Approximation by PMW and VMR in February 2020

Source: Household Survey; Table adapted from Alfonso Rojas Alvarez PhD proposal, February 202

San Francisco Xochiteopan

San Francisco Xochiteopan is located in the Municipality of Atzitzihuacán in the state of Puebla. It has a population of about 984 and approximately 354 dwellings. In this community, 81 surveys, 2 focus groups, and 1 key-informant interview were conducted for the study. This community is characterized by their first-level clinic operated by BUAP medical students and the large impact of the 2017 earthquake on the infrastructure - particularly their church - as well as on the mental health of the community.



Figure 1.2: Aerial image of San Fco. Xochiteopan

Xochiteopan is a small town deeply connected to their church and their town's saint, San Francisco. After the earthquake hit, many families were left without a home and without the church they worshipped so much. After spending weeks carrying out the surveys, interviews, and focus groups, it became clear that the collapse of this religious complex had a tremendous impact on the mental health of the entire community. The trauma embodied by the fallen church continues to play an immense role in the way Xochiteopan continues moving forward, and it is evident that their number one priority is and has always been to restore this establishment and restore a new sense of hope in the process. Whether this can be achieved or not, Xochiteopan will always be a community of aspiring, dedicated, and generous people that firmly believe in a better tomorrow largely due to the hope instilled by their town church.



Photograph 1.5: Town church deeply affected by the 2017 earthquake (Image taken by Dr. Peter Ward).

As our first community, San Francisco Xochiteopan surprised us with many open doors, offerings of food and drinks, and a street dog who would quickly become the research team's mascot named *Pulga*. Before arriving in Puebla, MX to carry out this project, we had tremendous worries and concerns about the willingness of families to participate. Much to our surprise, this was not the case in Xochiteopan or in any of the communities under study. Almost every single door was answered and almost every single family was willing to spend hours sharing with us their stories, their preoccupations, but also their hopes and dreams. Every interaction was met by children playing with us, mothers giving us bags of fruits and seeds, and a cup or two of Coca Cola. As our first community, San Francisco Xochiteopan made our fears and worries disappear and ignited the excitement we'd had since the day this project was born.



Photograph 1.6: typical setup of dwellings in rural communities – many homes were made of adobe and metal sheets (sometimes combined with concrete), and the lots were generally shared and split by multiple families (Photograph taken by Dr. Peter Ward)

Colonia Agrarista Emiliano Zapata

Widely known by the shorthand Colonia Agrarista or simply Agrarista, the full name carrying Emiliano Zapata is a source of great pride: indeed, the community center has an image of him on the wall. Colonia Agrarista is located in the Municipality of Atzitzihuacán. It has a population of about 306 and approximately 115 dwellings. The smallest of the three rural pueblos studied, Colonia Agrarista emerged around 40-50 years ago as they separated from San Fco. Xochiteopan following land disputes and moved into neighboring land uphill. The newcomers divided the land in the designated urban area (the zona urbana ejidal) equally amongst themselves with 50m x 50m (2500m2) plots. And, as part of the land reform program each ejidatario was allocated a series of agricultural parcels.



Figure 1.3: Aerial image of Colonia Agrarista from Google Maps.

Colonia Agrarista counts with a small *Casa de Salud* operated by an appointed member of the community who has no professional medical experience and therefore has limited resources and power in relation to what she can and cannot treat for patients. Significantly between our first visits and return in October a brand-new Casa de Salud had been constructed (see Chapter 2). This establishment works closely with the 1st-level clinic in San Fco. Xochiteopan to which patients from Col. Agrarista are referred for more serious illnesses. The overarching characteristics of this community were the migration of relatives, water quality and perceptions, and the level of difficulty in accessing health-related services due to their location.



Photograph 1.7: Recently constructed Casa de Salud that opened in August 2019 (Image taken by Dr. Peter Ward).

Although Colonia Agrarista exhibited an urgent need of better and more accessible infrastructure and healthcare services, it also exhibited the greatest optimism of all the communities we were able to work with. During our community entrance event, we introduced ourselves and the project, and when we opened the panel for questions, the first things they asked where: "Where are you going to sleep while you work here?", "what will you eat?", "do you have any allergies for when we make you food?". And as the close-knit community that they are, they offered to take turns letting us sleep in their homes and cooking for us. And although this was not necessary since we had housing and food arrangements prepared beforehand, we knew Colonia Agrarista would truly have taken us in as their own. This community cohesion and hospitality was truly inspiring and gratifying to see.



Photograph 1.8: UT Austin students and faculty with collaborators and community members after receiving two large buckets of home-grown fruits as a gift (October Return Visit).

Santa Ana Coatepec

Santa Ana Coatepec is a peri-urban community in the municipality of Huaquechula, located approximately 6.2 miles from downtown Atlixco with a population of around 1200 inhabitants. Santa Ana represented an interesting case in the study since it exhibited a mix between some of the benefits and challenges of being located close to the Atlixco urban center, while it also had high proportions of its population dedicated to small-scale ejidal agriculture. Its agricultural sector is not largely dissimilar from that of San Francisco Xochitoepan and Colonia Agrarista, but much more diversified in terms of products, and access to water sources, as reported in the findings of this document.



Figure 1.4 Aerial image of Santa Ana Coatepec from Google Maps.

However, in comparison to those communities, it was possible to observe large housing structures, in numbers much larger than found in the rural communities. This might be a consequence of more lucrative economic activities which are possible given the community's proximity to Atlixco, and, to a lesser extent, to the city of Puebla. Furthermore, in terms of its infrastructure, the roads and public services were mostly equivalent to those of Atlixco, which illustrates public investments and growth as a consequence of its location in the ladders of the Puebla - Mexico City highway. It was also notable, in terms of access to water, that many houses had access to their own water well, providing families with an alternative to the use of public water, or private bottle consumption.



Figure 1.5: Santa Ana counts with more paved roads which facilitates private and public transportation. Picture was taken from Google Maps.

In terms of safety, Santa Ana Coatepec exhibits resemblances to urban areas, with moderate levels of gang violence, high levels of abuse of alcohol and drugs, and a generally unsafe environment after 4 or 5pm in the afternoon. Operationally, this implied that the survey collection needed to be adjusted for earlier hours of the day, but beyond that no major inconveniences occurred as a consequence of this difference.

Santa Ana has a BUAP location, led by the School of Nursing, which provides some basic healthcare services, especially for newborn babies and infants. It is also the only community of the four studied which has a rehabilitation center for people with drug or alcohol addictions. However, after an informal visit and conversation with the administration and its patients, it was possible to determine that its engagement with the community is modest, with most of its patients originating from other communities, and even other states in Mexico.

Santa Ana Coatepec was also the community with lower levels of participation in the community events, and with the highest number of families unwilling to complete the survey. As a larger constituency than both of the rural communities, it also became clear that the ability of the team to reach the entire location was limited. These limitations led to a prominence of respondents who had previous work with FCP, or with a higher inclination for community participation. Additionally, the owners of small grocery stores had a much higher acceptance rate and given the elevated numbers of those locales in the community, they also represented a large amount of the responses in that community. In total, 60 surveys were conducted in this community, 2 focus groups, one intensive case study, and two key informant interviews, over a span of 10 days

Colonia Flores Magón

Colonia Ricardo Flores Magón is a typical *colonia popular* located within the town of Atlixco in the Municipality of Atlixco. Like so many cities and towns in Mexico that were rapidly experiencing urban growth and widening economic activities land capture and self-built at the periphery of the city became the primary form of housing production in Mexico – in some cases

comprising 30-50% of the population and build to area. Flores Magón is one such, forming around a small *ejidal* outlier in the 1940s, as land was sold off informally to would be homeowners and builders – usually on lots measuring 15x20m (modal lot size = 300m2). It now forms part of an inner urban ring beyond the traditional city center, and, as the city has expanded outwards, newer *colonias* have formed such as Lomas de Tejaluca, as well as middle-income *fraccionamientos* (subdivisions). Indeed, the team based itself in one such neighborhood (Cristo Rey), built around the golf course and country club that was once part of a hacienda in the Southern part of the city. Since the early 2000s, as in many cities across the nation, supported by the central government, private mass social-interest housing developments have been promoted targeting working and low middle-class populations. Atlixco has three such developments to the North East and North located outside of the city in the peri-urban area. However, these are only available to certain income and formal workers, so informal settlements continue to grow at the periphery.



Figure 1.6: Aerial image of colonia popular Flores Magón from Google Maps.



Figure 1.7: Neighborhood map showing colonia popular Flores Magón in Atlixco, Puebla (from Google Maps).

Flores Magón is now completely urbanized with paved streets, piped water supply and mains drainage. Dwellings are largely self-built (often using hired labor), and while most of the *colonia* homes are single-story, there are also many two-story homes – such as that of the family that helped support our efforts in the community. As one can see in Figures 1.6 and 1.7, the *colonia* comprises around 20 blocks (or half blocks), with each full block containing around 80 individual lots (blocks being 10 by 8 lots).

Its two major boundaries are the main road Emiliano Zapata, and the small river and *barranca* that runs through the township, sometimes bordered by a small road (e.g. Barranca del Carmen). Flores Magón residents – especially those living close to the *barranca* -- complained about the smell and contamination from small industries and the abattoirs upstream, which generated health concerns from the local population. Most dwellings and activities turn their backs on the *barranca* and many lots along its margins are either undeveloped or less well consolidated. Residents look towards the town center and the main road of Emiliano Zapata (see Figure 1.7).

We chose to also work in a low-income *colonia* popular because we were interested in contrasting the medical and health profiles of rural pueblos with that of the urban population whom, we assumed, would have rather different activity patterns, health behaviors and better access to health care. Also, the more consolidated physical environment should reveal major differences in the microenvironment of health and housing conditions.

However, we did not have the same access to the community through the Fundacion Comunitaria Puebla as we did in the rural communities. Indeed, several members of the FCP board had major concerns about the safety of our working in a low-income *colonia* and were hesitant to work in an area that we knew little about. Therefore, we consulted with Mr. Sergio Hidalgo (the father-in-law-to-be of Eder, one of our BUAP medical faculty interns), who was well known in Atlixco and who had good contacts with the *Ayuntamiento*. With his help we were put in touch with María de Jesúus Rosales a local *sindico* (Trustee member of the council) who kindly secured the support of local elected political leaders from different parties. Moreover, the Public Security Secretary of the city council offered to provide police monitoring and escorts (which we tactfully declined), and he and other council members came to our launch meeting in the community. Once in the field and conducting surveys, a police vehicle periodically passed through the *colonia* to check that all was well.

Which it was, until halfway through the survey when two large black Suburbans without license plates began asking local residents who we were, and what we were doing. Likely members of a local drug gang, we immediately pulled the team out, leaving us with only half the surveys completed. But everyone felt that it was the right decision.



Figure 1.8: Typical paved roads in the urban colonia. Image retrieved from Google Maps.

Being an urban community, we made changes to survey accordingly, and dropped sections relating to agricultural activities, storage of chemicals, etc. In retrospect this was a mistake, since a number of respondent families were engaged in agriculture.

Given that the *colonia* had been settled thirty to forty years ago and is today located quite close to the city center (within 15 minutes walking distance), some of the lots and dwellings closest to the center house renters and small commercial establishments. These are clearly visible having two or more electricity meters for each lot or dwelling. Because we were interested in owner households, we excluded the blocks closest to the city center from our survey.

In this urban community, 46 surveys were conducted for the study (half of what was originally planned). This community exhibited the best physical infrastructure (roads, dwellings) and access to health-related services. Apart from the level of infrastructure, the most significant distinctions between Col. Flores Magón and the three rural pueblos were the use of natural gas as a cooking fuel, the purchase and consumption of bottled water, and concerns over safety and substance consumption.

References for Section 1

- Córdova-Villalobos, J. Á., Barriguete-Meléndez, J. A., Lara-Esqueda, A., Barquera, S., Rosas-Peralta, M., & Hernández-Ávila, M. (2008). Las enfermedades crónicas no transmisibles en México : sinopsis epidemiológica y prevención integral. *Salud Pública de México*, *50*(5), 419–427. https://doi.org/10.1590/S0036-36342008000500015
- Measuring Well-being in Mexican States. (2015). In OECD Publishing. https://doi.org/10.1787/9789264246072-en
- OECD Reviews of Health Systems: Mexico. (2016). OECD Publishing. https://doi.org/http://dx.doi.org/10.1787/9789264230491-en

CHAPTER 2. HEALTH NEEDS, HEALTH PROVIDERS, PRIORITIES, AND CHALLENGES TO EFFECTIVE MEDICAL TREATMENT

(Primary Authors: Veronica Remmert and Tim Mercer)

Introduction

Mexico Health Policy and Health Infrastructure

Federal Level

Puebla is one of Mexico's poorest states and faces systemic health inequity. This health inequity is compounded by the impact of a severe earthquake that affected the region in September 2017. The inequities manifest in areas related to the built environment, including air, water, and housing structure, health system, and health-related social practices. While the Mexican government has invested significantly in new Secretaría de Salud hospitals and clinics, acute shortage of trained medical staff creates a large discrepancy in the health care equity for the poor (Vázquez, Galván-Martínez, Ramírez-Cuadra, & Frenk-Mora, 1992). Puebla falls second to last for all Mexican states on the availability of both doctors and nurses in hospitals, and like many states, has low ratios of paramedical staff (nurses, etc.) to doctors (Secretaría de Salud, 2019).

From 1985-2000, without clear direction of financial allocation, the federal Secretaría de Salud reformed the healthcare system, delegating responsibility of healthcare of the uninsured to the states. Previous to the reforms, the Mexican health system was segmented and even those with social security paid large out-of-pocket expenditures to receive care (Knaul et al., 2012). In the 1990s, the first national health accounts showed that 50% of the health expenditure was outof-pocket. This result showed that the Mexican people, especially the poor and uninsured, relied heavily on providers not within the public sector (Frenk et al., 1995). Due to the financial burden of health care, Mexico had a low rating of fairness of financial contribution on the World Health Report in 2000 (Etienne et al., 2010). The out-of-pocket costs that many Mexicans paid was the actualization of service rationing through poor and inequitable service, medicine shortages, and incomplete access to covered services (Zurita, González Rosetti, Knaul, & Soberón, 2001). As a result of the inequities, in 2003, the Mexican government created a health reform that legislated the System of Social Protection in Health (SSPH). The 2003 reform was motivated by imbalances in funding and low general spending, characterized by private and out-of-pocket spending, unequal state contributions and unfair allocation of public health resources between the poor and the rich. Since this reform, Mexico has advanced in universally enrolling all people in healthcare coverage, which in turn allows for access to equitable health package services including promotion, prevention, treatment, and rehabilitation services. Through SSPH, Mexico's national health insurance program, Seguro Popular, was introduced and has provided comprehensive health services for 52.6 million previously uninsured Mexicans (Knaul et al., 2012). The reform of the healthcare sector through SSPH was primarily done to improve equitable and sustainable access and achieve successful universal coverage. Seguro Popular guaranteed access to packages with services and more costly and specialized services

for Mexicans working in the informal sector, including in agriculture. For Seguro Popular funding, the federal government and state government contribute. The federal contribution is allotted to states based on a legally mandated formula of enrolled individuals, health needs, and performance, a large change from the previously subjective budgeting before SSPH.

Enrollment of poorer groups were increased by *Oportunidades*, more recently named *Prospera*, which were conditional cash transfer programs that benefitted nearly six million families, usually poor and chronically underserved. The idea of these programs was to give families money for sending their children to school and health centers, allowing families to make important time investments into these events, breaking the cycle of poverty (Dávila Lárraga, 2016).

Currently, 92% of the population is affiliated with some form of public healthcare insurance. People working in the formal labor market are insured under mandatory social security insurance through either the Mexican Institute of Social Security (IMSS) or the Institute of Social Security of State Workers (ISSSTE). 62 million people are insured under IMSS and 12.9 million people are insured under ISSSTE. *Seguro Popular*, which insures those without formal work, covers 54 million people (Doubova et al., 2018). Approximately eight percent of the population are privately insured and an additional eight percent lack health insurance (Doubova et al., 2018).



Figure 2.1: A graphical display of Mexican healthcare sector levels (Doubova et al., 2018).

State Level

Each Mexican state has a Secretaría de Salud that is responsible for healthcare delivery of the uninsured and partially contributing to healthcare spending. Because federal health funding is related to Seguro Popular enrollment, states have implemented federal level programs like *Oportunidades* and *Prospera* to increase enrollment to Seguro Popular, further increasing the allotment they receive from the federal government. To this end, in some cases, states illegally

split families living in the same household to increase enrollments and federal resources, putting at risk the financial structure that funded state programs. A limitation of federal financing calculations is that the calculation per household is based on the average nuclear family size of 4.3 members, which does not capture the variance in average nuclear family size across states. As a result, the allocation per person was larger for wealthier states where the average family size is smaller, and a lower allocation for states with a larger average nuclear family, producing systemic inequities (Knaul et al., 2012). Puebla is recognized as a low income state, further emphasizing the need to understand healthcare utilization. It is important to note that the state of Puebla has one of the highest rates of percentage of people eligible for Seguro Popular, a marker of number of people in the informal economic sector, usually agrarian work in rural communities, and therefore a marker of poverty.

In the state of Puebla, there are three levels of attention. The first level is the first contact and primarily where preventative health measures are provided, which are usually Casas de Salud, which are run by community members who do not have formal training, and Centros de Salud, which are usually run by a physician and a nurse. In the state of Puebla, there are a total of 572 Centros de Salud, 339 of them are in rural areas, 38 are mobile dentist clinics, 15 traditional medicine facilities, and 1,587 Casas de Salud. The second level is specialized care, or integral care hospitals, and the third level is the highest level of specialization, or general hospitals. In Mexico, these hospitals often have primary care services and can be utilized as first healthcare contact. Within the hospital systems, or the second and third level, there is a code system for services provided where code green is the lowest level, increasing to code yellow, code orange, and then code red. Code green are in the second level and mean the facility does not have specialized doctors, and there are 18 green level hospitals in the state. Code yellow are in the second level and mean that there are four specialist areas, including gynecology, pediatrics, internal medicine, and surgery, along with anesthesiology. There are 14 of these facilities in the state. Code orange are in the second level mean that there are the previous specialists in larger numbers and potentially orthopedics and ophthalmology. There are 10 code orange facilities in the state. Code red, which is the highest designation and within the third level, have more specialists and subspecialists, and there are 20 of these within the state (Secretaría de Salud, 2019).



Figure 2.2: Levels of Attention at Mexican Ministry of Health Facilities doctors (Secretaría de Salud, 2019).

Community Level

In the urban town of Atlixco, there is a large Secretaría de Salud named Hospital General Río Arronte that began operations in April 2015. Services at this hospital include anesthesiology, public health, surgery, obstetrics and gynecology, internal medicine, pediatrics, trauma and orthopedics, emergency care, radiology, and a clinical laboratory. It is a secondary level provider. This hospital serves people with Seguro Popular insurance who need more extensive care or require general surgeries. This hospital is 1.9 kilometers from Colonia Flores Magón, 10.2 kilometers from Santa Ana Coatepec, and 39 km from Xochiteopan.

	A second second second
COMPLEJO MÉDI	CO GONZALO RÍO ARRONTE

Photograph 2.1: The entrance to Hospital General Río Arronte in Atlixco, Puebla, Mexico. It is a secondary level provider and is most closely located to Colonia Flores Magón¹.

In Santa Ana Coatepec, there are two clinics in the community, a BUAP clinic and an IMSS clinic. Many community members also use Secretaría de Salud Hospital General Río Arronte located in Atlixco. Combis, large public transportation vans, run multiple times a day to Atlixco.

A Secretaría de Salud clinic is located in Xochiteopan, and is staffed with one general physician, who is completing their Social Service requirement, and one to two nurses. This facility was intended for use for both Xochiteopan and Colonia Agrarista community members. The physician present in the clinic is there for six months as a part of their Social Service requirement and after the six month requirement is over, a new doctor resumes the healthcare service distribution (Medcalf, Bhattacharya, Momen, Saavedra, & Jones, 2015). The nurses are present in the clinic throughout the year and help the physician transition by educating the physician about the problems that the community faces. One nurse is currently being paid by the community members due to funding cuts.

¹ Retrieved from: <u>http://municipiospuebla.mx/nota/2015-03-25/atlixco/con-inversi%C3%B3n-de-299-mdp-inauguran-complejo-m%C3%A9dico-en-atlixco</u>

Colonia Agrarista is the smallest community and is located the farthest from a formal healthcare facility, and as such faces unique barriers to receiving healthcare treatment. The center of Colonia Agrarista is approximately 2.6 kilometers from the clinic in Xochiteopan, requiring most residents to either walk, use their horse, or use a car to get to the clinic, as public transportation is not regularly available between the two communities. In Colonia Agrarista, there is a Casa de Salud, which employs one staff member who is a community member. The Casa de Salud has very basic supplies like bandages, medicines, and equipment. After the earthquake, the community built a small building out of cinderblocks to maintain services that was being utilized until August 2019. Since then, the governmental contractors have built a formal Casa de Salud, as seen in photo 2.4, a structure that has a waiting room, one patient bed, and basic supplies. The woman who works there has little formal training and no professional medical education. She is able to provide basic support through handing out medicines, measuring blood pressure, measuring blood glucose, and taking maintaining basic demographic surveys. In photograph 2.2 she is seen speaking with our collaborators and students outside of the previous Casa de Salud.



Photograph 2.2: An employee of the Casa de Salud speaks with team members after discussing her work in Colonia Agrarista. She is a member of the community who works in the Casa de Salud in the afternoons during weekdays (Image taken by Taniel Kilajian, July 2019).



Photograph 2.3: A few examples of the posters in the new Casa de Salud. On the left is a map with all of the houses in Colonia Agrarista. She is tasked with taking demographic surveys including ages of all community members. To the right is a public health poster about mosquitos and how to decrease mosquito breeding (Images taken by Veronica Remmert, October 2019).



Photograph 2.4: The picture above is the new Casa de Salud constructed during August 2019 and finished in early October of 2019. The structure was built by government contractors and replaced a cinderblock room that was created after the Earthquake in 2017 (Image taken by Dr. Peter Ward, October 2019).

Epidemiology

In Mexico, communicable diseases and noncommunicable diseases coexist and are evidence of stratification and systemic inequity. Despite Mexico's status as a middle-income country,

Mexico is entering the advanced stage of the epidemiological transition, much like high-income countries, such that a majority of the disease and injury burden are from noncommunicable diseases. Puebla and other southern states are the least developed and have higher poverty and mortality than the national average as a result of lack of infrastructure and development (Stevens et al., 2008). The rates of noncommunicable disease and injuries were highest in southern states, including Puebla. Within Mexico, noncommunicable diseases caused 75% of total deaths and 68% of total disability- adjusted life years (DALYs). Obesity, high blood glucose levels, and alcohol are the main noncommunicable disease risks in the country. Undernutrition and communicable, maternal, and perinatal diseases caused another 14% of deaths and 18% of disability-adjusted life years (DALY) in the country as whole and are as high as 23% in Southern states like Puebla. In Mexico, leading causes of death are ischemic heart disease, diabetes mellitus type 2, cerebrovascular disease, liver cirrhosis, and road traffic injuries (Stevens et al., 2008).

Since 2000, diabetes has been the leading cause of death in women and is the second leading cause of death in men in Mexico ("Situación de salud en México- Indicadores Básicos," 2001). Diabetes prevalence in Mexico in 2016 reached 9.7% in males and 11.0% in females, where 63.4% of the total population are overweight, 27.6% are obese, and 25.4% are physically inactive (WHO, 2016). It is expected that 11.7 million Mexicans will have diabetes by 2025, emphasizing the need for appropriate public health measures and behavioral health modifications to lower diabetes disease burden (King, Aubert, & Herman, 1998). Diabetes has a large impact on the Mexican health system and infrastructure, as it was the 11th most frequent cause of hospitalization in 2000, where the mean length of a hospital stay is 6.1 days versus 3.5 days for people without diabetes. According to the 1993 National Survey of Chronic Diseases, individuals with the lowest income were the socioeconomic group with the highest prevalence of diabetes.



Figure 2.3: Mortality of Diabetes Mellitus in Mexico by state. Puebla is one of the states with the mortality being between 58.2-76.4 per 100,000 habitants("Situación de salud en México-Indicadores Básicos," 2001).

Hypertension is one of the leading causes of mortality in Mexico and from 1996 to 2000 the prevalence increased from 25% to 33.3% (S Barquera, Durazo-arvizu, Luke, Cao, & Cooper, 2008). In 2006, the prevalence of hypertension rose to 43.2% in the country. The significant increase could be related to the aging population and the unprecedented raise in percentage of people who are overweight or obese (Simón Barquera, Campos-nonato, Hernández-barrera, & Flores, 2009), and have type 2 diabetes in the country (Monroy, Peralta, & Esqueda, 2002). In Puebla in 2006, it was found that 40.2% of people had hypertension. The diagnosis rate is also very low because 61.1% of the population with hypertension were not aware of their condition, and only 29% of participants in a study had adequate control (S Barquera et al., 2008). Inadequate education and general lack of knowledge can exacerbate the condition because patients are unaware or lack access to equitable and sustainable treatment and therefore control.

Known Access Issues and Barriers to Care and Quality

In 2000, almost 60% of the population in Mexico did not have access to health insurance despite the goal for universal health coverage. The total health expenditure was low and favored states with higher incomes, leading to inequity in services and access available to low-income Mexicans, especially those that lived in low-income states (Knaul et al., 2012). Individuals often had to make out-pocket costs to pay for medical care, leading to health inequity and larger cost burdens. To ensure the appropriate expansion of healthcare coverage to the poor, the System of Social Protection in Health (SSPH) became incorporated with the national health system, introducing Seguro Popular and universal insurance for informal workers (Gutiérrez, García-saisó, Dolci, & Ávila, 2014).

Results and Discussion

Community-Level Health Challenges

We started the survey by asking respondents to reflect on what they considered to be the biggest health problems affecting their communities. Families reported both specific diseases, namely diabetes, and broader health system issues related to access and quality of care, as the major health problems affecting their communities (Table 2.1). Diabetes ranked in the top three highest perceived problems across all four communities. The other two health problems were broader issues that included "access to care" and the "availability and quality of medicines." These responses were distinct from health care associated costs, which were reported as a problem but to a lesser degree. Colonia Flores Magnon did not identify the issue related to medicines in the top three, but rather "quality of health care services" generally.

The burden of chronic disease and disability was high among households surveyed. Half (49%) of households surveyed reported a family member with a chronic illness, ranging from 39% in the rural community of Colonia Agrarista, to 57% in the urban Colonia of Flores Magón. Diabetes, hypertension, and musculoskeletal conditions were the top three chronic illnesses reported among families across all four communities. Nearly a quarter (22.5%) of families reported a family member with a disability.

Pueblos and Sites	San Fco.	Colonia	Santa Ana	Colonia Flores
	Xochiteopan	Agrarista	Coatepec	Magón
% of Households	50% (40)	38.88% (21)	50% (30)	56.52% (26)
Reporting a Chronically				
Ill Household Member				
% of Households	50% (40)	38.88% (21)	50% (30)	56.52% (26)
Reporting a Household				
Member with a				
Disability				
Top 3 Chronic Illnesses in	1. Diabetes	1.	1.	1. Diabetes
the Households	2. Hypertension	Musculoskeletal	Musculoskeletal	2. Hypertension
	3.	Conditions	Conditions	3.
	Musculoskeletal	2. Diabetes	2. Diabetes	Musculoskeletal
	Conditions	3. Hypertension	3. Hypertension	Conditions
Top 3 Health Problems	1. Access to Care	1. Access to Care	1. Access to Care	1. Diabetes
in the Community	2. Diabetes	2. Diabetes	2. Diabetes	2. Access to Care
	3. Medicine	3. Medicine	3. Medicine	3. Medicine
	Availability/	Availability/	Availability/	Availability/
	Quality	Quality	Quality	Quality

Table 2.1: Perceptions of Health Problems

Source: Household Surveys

Diabetes

The national prevalence of diabetes in Mexico in adults was estimated to be 8.9% in 2012 (Meza et al., 2016). Across all four communities, respondents reported a high percentage of diabetes in their families, ranging from an average of 20% in Colonia Agrarista to a high of 39% in Colonia Flores Magón. To further explore the burden of chronic illness, and, specifically, diabetes, we conducted a focus group around this issue in the rural community of Colonia Agrarista. Many people stated that 'el susto' or a strong emotion, can cause diabetes. They shared an example of this perception where a woman was shocked with a surprise birthday party, and then only a few weeks later was diagnosed with diabetes. They stated that 'el susto' was the cause of her diabetes diagnosis. There was also a general consensus that the effects of insulin were similar to an illicit drug. They state that if one uses insulin, a person will get worse, as it makes "people go blind" and is "something that should be avoided." In a key informant interview we conducted with the physician at the first level Secretaría de Salud health center in in San Francisco Xochiteopan, she stated that it is hard for her to treat patients as they often resist changes in medicines because they are scared from the experiences of others. Reasons for these misperceptions may be related to delays in diagnosis, low health literacy, lack of health education and promotion, misinformation spread among community networks, negative experiences with medicines and the health care system, among others. These misperceptions need to be explored further, and future interventions to address diabetes must be culturally appropriate and locally adapted.

Given the significant epidemiologic burden of diabetes, obesity, and metabolic syndrome among the Mexican population, we explored dietary risk factors related to these conditions (Table 2.2). A quarter of families reported drinking sugary beverages, such as soda or juice, daily or most days of the week. Nearly half of families reported eating processed foods, such as cookies, candy, or chips, at least two days per week. The peri-urban community, Santa Ana Coatepec, and the urban colonia, Flores Magón, had higher percentages of reported unhealthy dietary practices compared to the two rural communities. We also asked about the healthy dietary practices of fruit and vegetable consumption. While we did not collect this data in our first surveyed community of San Francisco Xochiteopan, three-quarters of families in the rural community of Colonia Agrarista reported eating fruits and vegetables two days per week or less. We did explore diet and nutrition in a focus group discussion conducted in the rural, agrarian community of San Francisco Xochiteopan. It was clear that most dietary practices are driven by economics. Frijoles (beans) and maize (corn) tortillas are the stable foods, eaten daily, and regularly eating a variety of other foods, including meat, fruits, and vegetables, was unaffordable. It also emerged that while the health risks of sugary beverages were generally known, people simply like the taste and have little inclination to give it up. Also, cultural labor practices nearly require Coca-Cola as a reward for the work done.

Pueblos and Sites	San Fco. Xochiteopan	Colonia Agrarista	Santa Ana Coatepec	Colonia Flores Magón
% of Households Who Drink	14% (11)	24% (13)	30% (18)	30% (14)
Sugary Beverages "Daily" or				
"Most Days per Week"				
Processed Food Consumption	41% (33)	29% (23)	45% (27)	63% (29)
(cookies, chips, candy) at				
Least 2 days per Week				
Meat Consumption 2 Days	ND*	98% (54)	73% (44)	52% (24)
per Week or Less				
Fruit Consumption 2 Days	ND*	78% (42)	27% (16)	26% (12)
per Week or Less				
Vegetable Consumption 2	ND*	69% (38)	33% (19)	26% (12)
Days per Week or Less				

Table 2.2: Nutritional Practices

Source: Household Survey

*Question not asked during survey as it was added after this community due to discussion from focus group.

Burden of Other Health-Related Conditions

In addition to chronic disease, we also explored the burden of other health-related conditions, including acute illnesses, injuries and accidents, pregnancy, and mental health (which will be reported in Chapter 3). The two most common acute illnesses were "gripe" (equivalent to a "cold" or "flu") and gastrointestinal illnesses. The latter is concerning, given the high prevalence of unclean water and other hygiene-related issues discovered in the housing
environment, that is discussed in detail in Chapter 5. Pregnancy was relatively uncommon among households surveyed, with only about 10% of respondents reporting that someone in their household had given birth in the last two years, and everyone reported delivering in a health care facility. Severe accidents and injuries were reported by 15% of survey respondents, including those related to cooking, working, falling, or using a motor vehicle. Falls were the most commonly reported accident, which we know disproportionately affects the elderly and can be related to uneven surfaces and other mobility impediments in the home environment (Prince, Corriveau, Hébert, & Winter, 1997). We explore this relationship further among households surveyed in Chapter 5. Overall, while 15% is a relatively low rate, severe accidents and injuries carry a very high rate of morbidity and mortality. They can also be economically burdensome to poor families, due to the potential of extended hospital stays, time spent away from work, and future disability.

Pueblos and	San Fco.	Colonia Agrarista	Santa Ana Coatepec	Colonia Flores	
Sites	Xochiteopan			Magón	
Top 3 Acute	1. Cold/ Flu-	1. Cold/ Flu-	1. Cold/ Flu- 60%	1. Cold/ Flu- 76.09%	
Illnesses	104.94% (85) *	70.91% (39)	(36)	(35) 2.	
	2. Cough- 34.57%	2. Gastrointestinal-	2. Gastrointestinal-	Gastrointestinal-	
	(28)	43.64% (24)	25% (15)	43.48% (20)	
	3. Gastrointestinal-	3. Cough- 18.18%	3. Chicken Pox -	3. Cough- 30.43%	
	30.86% (25)	(10)	18.33% (11)	(14)	
Severe Acciden	ts per Household in Po	ast Year			
Yes	12.35% (10)	20% (11)	16.67% (10)	15.22% (7)	
No	85.19% (69)	78.18% (43)	83.33% (50)	84.78% (39)	
Do Not Know/	2.46% (2)	1.82% (1)	0	0	
DNR **			0		
Pregnant Hous	ehold Member in Past	2 Years			
Yes	13.58% (11)	10.91% (6)	6.67% (4)	13.04% (6)	
No	85.19 <mark>% (69)</mark>	87.27% (48)	93.33% (56)	86.96% (40)	

Table 2.3: Other Health Related Conditions

Source: Household Survey

*Note that some of the acute illness percentages are greater than 100% because the data was taken per household member, such that multiple members of the household can have the cold/ flu in the past three months.

** DNR= Did not respond

Health Care Utilization and Access

"Access to care" was one of the top three problems related to health across all four communities. Over half of families surveyed reported difficulty accessing health care ("medium" or "very" difficult). The two most communities furthest from Atlixco were San Francisco Xochiteopan and Colonia Agrarista, and both had the highest percentage of people who stated that it was "very" difficult in receiving treatment. Specifically, three-quarters (75%) of respondents in Colonia Agrarista, the most rural community surveyed without any hospital or clinic in their community, reported this high level of difficulty accessing care. Conversely, the urban Colonia of Flores Magón had the highest number of respondents who stated that it was not difficult to receive treatment (26%). Travel time, transportation costs, opportunity costs associated with travel (i.e., lost wages, need for childcare), distance to trusted provider, and access to medicines are all burdens that rural communities face, impacting their difficulty level in accessing care. Location in relation to healthcare services seems to be an important factor that affects the perceived difficulty in accessing healthcare services. To get to their medical appointments, different modes of transportation were used, including walking, combis (large public transportation vans), and cars, either rented or borrowed. In the peri-urban and urban communities, most people either walked or used a combi to access health care, reflecting the proximity of health clinics and hospitals to these communities, and the presence of public transportation. In San Francisco Xochiteopan, the majority of people walked, as the Secretaría de Salud clinic was right in their community. Others used cars, likely to access private or other specialty services in the urban areas. While there was a combi present in San Francisco Xochiteopan, it only ran to and from the city of Atlixco once a day, making it relatively inconvenient for community members. In Colonia Agrarista, by contrast, most people took a car, because the nearest clinic was several kilometers away in San Francisco Xochiteopan, and there was no public transportation in Colonia Agrarista either. Only 20% of those surveyed in Colonia Agrarista reported owning a personal vehicle, therefore most people would have to borrow a car in order to get to the clinic, likely driving their perceptions of difficulty accessing health care services. The mean time to get to a medical appointment was 50 minutes in Colonia Agrarista, but only 19 minutes in Flores Magón.

Pueblos and Sites	San Fco.	Colonia Agrarista	Santa Ana	Colonia Flores
	xocniteopan		Coatepec	iviagon
Mean Time to Get to	41.6	50.4	26.3	19.4
Appointments				
(minutes)				
Principal Mean of Tran	sportation to Medi	ical Appointments		
Bus	1% (1)	0	3% (2)	2% (1)
Walking	51% (41)	36% (20)	27% (16)	43% (20)
Borrowed car	15% (12)	35% (19)	0	4% (2)
Personal Car	12% (10)	11% (6)	23% (14)	17% (8)
Combi	16% (13)	13% (7)	45% (27)	33% (15)
Rented Car	5% (4)	0	2% (1)	0
Difficulty Level in Acces	ssing Healthcare Se	ervices		
Not Difficult	20% (16)	11% (6)	23% (14)	26% (12)
Little Difficulty	22% (18)	13% (7)	23% (14)	15% (7)
Medium Difficulty	22% (18)	33% (18)	33% (20)	35% (16)
Very Difficult	35% (28)	42% (23)	20% (12)	24% (11)
Do Not Know / DNR	1% (1)	2% (1)	0	0

Source: Household Survey

Perceptions of Health Care Quality

A significant minority of families interviewed report lack of confidence and dissatisfaction with health care services in their communities (Table 2.5). Respondents from Santa Ana Coatepec had the most confidence and satisfaction in their health care providers and with health care services in their community, respectively. Perhaps this reflects the plurality, and proximity, of health care services, both public and private, in and around this community. Among the two rural communities San Francisco Xochiteopan and Colonia Agrarista, more respondents from San Francisco Xochiteopan reported "little" or "no" confidence in their health care provider (37% vs 22%) as well as lack of satisfaction with the quality of their health care services (57% vs 42%). 63% of respondents from Colonia Flores Magón reported they are not satisfied with the quality of health care services in their community; however, in discussion with community members, it was noted that technically there are no health care providers within the boundaries of Colonia Flores Magón, although the majority of residents use either the private sector or the second-level Secretaría de Salud hospital very nearby in Atlixco.

Pueblos and Sites	San Fco.	Colonia	Santa Ana	Colonia Flores				
	Xochiteopan	Agrarista	Coatepec	Magón				
Satisfaction with Quali	Satisfaction with Quality of Healthcare Services in the Community							
Yes	35%. (28)	55% (30)	53% (32)	30% (14)				
No	57% (46)	42% (23)	37% (22)	63% (29)				
Do not know/ DNR	8% (7)	4% (2)	10% (6)	7% (3)				
Confidence Level in Provider								
No Confidence	2% (2)	3.64% (2)	5% (3)	13% (6)				
Little Confidence	35% (28)	18% (10)	13% (8)	20% (9)				
High Confidence	62% (50)	76% (42)	80% (48)	67% (31)				

Table 2.5: Perceptions of Quality of Health Care Services

Source: Household Survey

Poor quality health care services, both perceived and empirical, is a known problem in Mexico as well as globally (Jha et al., 2013; "Quality governance in a pluralistic health system : Mexican experience and challenges," 2018). The reasons for this are multifactorial and complex. Medicine availability and quality (coded as "medicines, not including cost") was one of the top three community health problems identified by our survey respondents, reflecting difficulty obtaining needed medicines at their clinic visits. This issue was brought up within the focus group discussion on chronic illness (https://lahn.utexas.org/Puebla/App5.html), where members stated that the Secretaría de Salud clinic does not always have the medicines that are needed, forcing patients to go to a pharmacy to buy them. This was particularly taxing for residents of Colonia Agrarista and San Francisco Xochiteopan as neither community has a pharmacy separate from the Secretaría de Salud clinic. During a key informant interview with the Secretaría de Salud clinic. During a key informant interview with the secretaría de Salud clinic, in San Francisco Xochiteopan, the physician stated that while the clinic has basic medicines, including insulin and Metformin for diabetes, among others, any medication that is not carried in the clinic, or is out of stock, must be purchased at an outside pharmacy and these medicines are not covered by Seguro Popular. Since the clinic is a public institution, they cannot sell medications that are not covered by Seguro Popular, requiring people to take transportation to another institution or pharmacy to obtain these medicines. Later in the focus group discussion on chronic illness, there was consensus that it sometimes took multiple trips to a provider to get appropriate care, tests, and medicines, which at times was too burdensome to complete. This likely affected community perceptions of quality of their health care services.

Health Care Utilization

To further explore issues related to access and quality of health care, we asked respondents about their families' health care utilization preferences and practices. Nearly everyone we surveyed across all four communities worked in agriculture and generally, in the informal sector. Therefore, nearly all households would be eligible for free primary care services at the Secretaría de Salud through Seguro Popular. However, over one-third of all respondents utilize the private sector as their primary health care provider. In the two rural communities San Francisco Xochiteopan and Colonia Agrarista, 43% and 50%, respectively, use the first level Secretaría de Salud clinic as their primary provider, while 31% and 36%, respectively, use a private practitioner as their primary provider. As noted above, there is a first level Secretaría de Salud clinic in San Francisco Xochiteopan, but the closest private practitioner would be in the city of Atlixco. The peri-urban community of Santa Ana Coatepec has a mixed health care infrastructure, including an IMSS clinic, BUAP nursing clinic, nearby Secretaría de Salud hospital, and several private practitioners in the nearby city of Atlixco. Nearly half (48%) of respondents in Santa Ana Coatepec report using a private practitioner as their primary provider, the highest of any community surveyed. In general, health care utilization was high across all four communities, possibly reflecting the high chronic disease burden among families surveyed. Health care utilization was lowest in Colonia Agrarista, and while they also reported the lowest chronic disease burden, they reported the highest difficulty in accessing care. Therefore, this relatively lower rate of utilization may reflect under-diagnosis related to relatively less access to care. In the other communities, about one-quarter of families report going to a clinic or hospital 3-4 times in the past 3 months, and approximately 10% of families report going to a clinic or hospital more than 5 times in the past 3 months.

Pueblos and Sites	San Fco. Xochiteopan	Colonia Agrarista	Santa Ana Coatepec	Colonia Flores Magón
Percentage of People who named Primary Level Secretaría de Salud Services as Primary Provider	43% (35)	50% (27)	20% (12)	2.17% (1)
Percentage of People who named Secondary Level Secretaría de Salud Services as Primary Provider	6.17% (5)	5% (3)	3.33% (2)	34.78% (16)
Private Practitioner as a Primary Provider	31% (25)	35% (19)	48% (29)	37% (17)
Household Utilization Frequency in	n Past 3 Months			
0 times	23% (19)	36% (20)	37% (20)	35% (16)
1-2 times	38% (31)	42% (23)	32% (19)	22% (10)
3-4 times	30% (24)	16% (9)	22% (13)	30% (14)
5+ times	9% (7)	4% (2)	10% (6)	13% (6)

Table 2.6: Health Care Utilization

Source: Household Survey

Public vs Private-Sector Health Care Utilization

We conducted a secondary analysis of the data in order to examine perceptions of access and quality according to public-sector vs private-sector utilization preferences. Three-quarters of respondents reported paying "some" of "all" of their health care costs out-of-pocket. Despite universal, public-sector health care coverage for the poor through Seguro Popular and the Secretaría de Salud, Mexico has one of the highest rates of out-of-pocket health care spending among all Organization Economic Cooperation and Development (OECD) countries ("OECD Reviews of Health Systems: Mexico," 2016). This may reflect a multitude of factors, although use of the private sector is a major driver of this. In our survey, among families who reported that their primary provider is a private practitioner, nearly 100% reported paying "some" or "all" of their health care costs out-of-pocket, as seen in Figure 2.4. What's more, nearly 100% of families reported that these out-of-pocket expenditures were difficult financially for their families. In the rural communities of San Francisco Xochiteopan and Colonia Agrarista, families who reported that their primary provider is a private practitioner had a much higher rating of "difficulty accessing health care" compared to families who identified the public sector as their primary provider. Furthermore, respondents who identify a private practitioner as their primary provider report higher use of cars or combis to get to their medical appointments, compared to those who identify the public-sector as their primary provider, who report higher rates of walking. Use of cars or combis for transportation reflects the need to travel longer distances to access care and incurs additional costs for families. Perhaps reflective of these higher costs and access issues, respondents who reported a private practitioner as their primary provider utilized health care services less frequently in the past 3 months than those

who reported the public-sector was their primary provider. In conversation with respondents during and after the survey, we heard repeatedly that most people use over-the-counter medicines to care for acute illnesses instead of receiving care from a provider, in order to minimize out-of-pocket costs. During the focus group on chronic illnesses in Colonia Agrarista(<u>https://lahn.utexas.org/Puebla/App5.html</u>), some people stated that it was very difficult to get an official diagnosis for chronic illnesses. One woman stated that her husband had to go to many different appointments and pay over 5,000 pesos (\$250 USD approximately) to see a private specialist and receive a diagnosis. In the public sector some participants of the focus group stated that they needed many different referrals and appointments to have the issue resolved. It became evident during the focus group that many people have to go Hospital General Rio Arronte to have laboratory tests done, sometimes requiring them to return multiple times to get an official diagnosis and treatment plan.

Across all four communities, however, families who identified the private sector as their primary provider rated higher confidence in their health care providers. This is important, as higher degrees of confidence and trust in health care providers can promote improved health outcomes (Birkhäuer et al., 2017). Given that one-third of families, entitled to free public sector primary care, prefer the private sector as their primary provider, and despite high and financially burdensome rates of out-of-pocket health care expenditures, and more difficulty accessing care private sector care, lack of confidence in providers seems to be a greater driver of health care utilization patterns than geographic proximity and cost.



Source: Household Survey

Figure 2.4: Perceptions of Access and Quality of Care According to Public-sector vs Privatesector Utilization.

Women's Health

Lastly, we asked respondents about their perceptions of access to women's health care services (Figure 2.5). Specifically, we asked whether respondents thought there was adequate access to sexual and reproductive health care services, family planning, and breast and cervical cancer screening in their communities. In general, responses were favorable, with over 70% of respondents saying there was adequate access to these women's health care services in their communities. Over 80% of respondents in Santa Ana Coatepec responded favorably to these questions. While perceptions of access to women's health care services was generally good, this stands in contrast to perceptions of general primary care services in the community, as described above. This may be due to the presence of mobile campaigns promoting breast and cervical cancer screening (Photograph 2.5) or a multitude of other factors which will require more empiric studies. Consistent with community perceptions, cervical cancer screening rates in Puebla, Mexico are quite high (Bruni et al., 2019). However, the age-standardized incidence rate of cervical cancer in Puebla was 11.0 per 100,000 women in 2018, much higher than would be expected with this strong screening uptake ("U.S. Cancer Statistics Working Group", 2018). The leading causes of cancer mortality in Mexican women are breast and cervical cancer (Mohar-Betancourt, Reynoso-Noverón, Armas-Texta, Gutiérrez-Delgado, & Torres-Domínguez, 2017). And breast and cervical cancer both continue to be one of the top five leading causes of death among women in Mexico (Knaul et al., 2008). Cervix cancer is still more common among lower socioeconomic women but breast cancer is steadily increasing and closing the gap (Knaul et al., 2008). Therefore, the discrepancies between reported screening rates, disease incidence, and mortality warrants further investigation.



Source: Household Survey Figure 2.5: Perception of Access to Women's Health Care Services



Photograph 2.5: Mobile Mammography Campaign for Breast Cancer Screening in San Francisco Xochiteopan (Image taken by Dr. Tim Mercer, 2019).

Conclusion

We conducted a broad, community health needs assessment of 242 household in four lowincome communities, accompanied by pragmatic and responsive focus group discussions and key informant interviews to more deeply explore the health issues that emerged from the household survey. Through this methodology, we discovered both known, and novel, information about the health of these communities, including nuanced and detailed differences between each community.

This section of our community health needs assessment explored the following health-related categories (mental health and environmental health are reported in other chapters):

- Health Problems and Challenges
- Diabetes
- Nutrition
- Perceptions of Access and Quality of Health Care
- Health Care Utilization
- Women's Health

In general, we found a high burden of chronic disease, specifically diabetes, difficulty accessing care, perception of poor quality of care, and higher than expected rates of private sector health care utilization. More specifically, our main findings include the following:

- The burden of chronic illness and disability is high: approximately 50% of households report a family member with a chronic illness and 25% of households report a family member with a disability.
- Diabetes, Hypertension, and Musculoskeletal conditions were the top three chronic illnesses in the family identified in all four communities.
- Diabetes, Access to Care, and Medicine Availability/Quality were the top three health problems identified across all four communities.

- There were significant misperceptions on the causes and treatment of diabetes among community members including about causes and treatment.
- Unhealthy nutritional practices that increase risk for diabetes were relatively common, and health nutritional practices were not as common as is recommended, and this was more pronounced in rural communities, possibly a marker of poverty.
- Almost all respondents surveyed were eligible for Seguro Popular and entitled to free primary care at the Secretaría de Salud, but nearly 1/3 identify a private practitioner as their primary provider.
- The majority of families surveyed reported difficulty accessing health care in all four communities.
- Approximately 3/4 of families reported paying out-of-pocket health care costs, and over half of these families reported paying these out-of-pocket costs as financially difficult for their families.
- Over 1/4 of respondents reported little or no confidence in their health care provider.
- Respondents who identified a private practitioner as their primary provider had higher rates of paying out-of-pocket costs and rated access care more difficult, compared to respondents who identified a public sector practitioner as their primary provider. Those who identified the public-sector as their primary provider had higher rates of rating a lack of confidence in their provider, compared to those who use a private practitioner.
- Perception about access to women's health care services was generally good, although this stood in contrast to poorer perceptions about access to general primary care services in the community.

We hope this information will be useful to local stakeholders, including community-based organizations, academic institutions, and government in planning future research, health interventions, or health-related policies. This information may also be useful for people living or working in other poor, rural communities throughout Mexico and Latin America. These findings illustrate the importance of engaging with communities to develop a deep understanding of their needs and priorities. Addressing these needs will require a combination of further research, education, clinical care, public health interventions, and new policy proposals. This community health needs assessment galvanized the start of an academic global health partnership between UT and BUAP that will adapt the Academic Model Providing Access to Healthcare (AMPATH) paradigm to work with communities and public-sector health care delivery systems to improve population health outcomes.

References for Chapter 2

Barquera, S, Durazo-arvizu, R. A., Luke, A., Cao, G., & Cooper, R. S. (2008). Hypertension in Mexico and among Mexican Americans : prevalence and treatment patterns. *Journal of Human Hypertension*, *22*, 617–626. https://doi.org/10.1038/jhh.2008.9

- Barquera, Simón, Campos-nonato, I., Hernández-barrera, L., & Flores, M. (2009). Obesity and central adiposity in Mexican adults : results from the Mexican National Health and Nutrition Survey 2006. Salud Publica de Mexico, 51(January). https://doi.org/10.1590/S0036-36342009001000014
- Birkhäuer, J., Gaab, J., Kossowsky, J., Hasler, S., Krummenacher, P., Werner, C., & Gerger, H. (2017). *Trust in the health care professional and health outcome : A meta-analysis*. 1–13. https://doi.org/10.1371/journal.pone.0170988
- Bruni, L., Albero, G., Serrano, B., Mena, M., Gómez, D., Muñoz, J., ... de Sanjosé, S. (2019). *Human Papillomavirus and Related Diseases Report: Mexico*. (June). Retrieved from https://hpvcentre.net/statistics/reports/MEX.pdf
- Dávila Lárraga, L. G. (2016). How Does Prospera Work? *Inter- American Development Bank,* (April). Retrieved from http://www.iadb.org
- Doubova, S. V., García-Saisó, S., Pérez-Cuevas, R., Sarabia-González, O., Pacheco-Estrello, P., Leslie, H. H., ... Infante-Castañeda, C. (2018). Barriers and opportunities to improve the foundations for high-quality healthcare in the Mexican Health System. *Health Policy and Planning*, 33(10), 1073–1082. https://doi.org/10.1093/heapol/czy098
- Etienne, C., Evans, D. B., Elovainio, R., Humphreys, G., Chisholm, D., Kutzin, J., ... Xu, K. (2010). The World Health Report: Health Systems Financing: The Path to Universal Coverage. *World Health Organization*.
- Frenk, J., Ruelas, E., Bobadilla, J. L., Zurita, B., Lozano, R., González Block, M. A., ... Rosset, A. (1995). Economía y salud: propuesta para el avance del sistema de salud en México, informe final. *Estudios Sociológicos*, 13(39), 645–653.
- Gutiérrez, J. P., García-saisó, S., Dolci, G. F., & Ávila, M. H. (2014). Effective access to health care in Mexico. *BMC Health Services Research*, *14*(186), 1–9.
- Jha, A. K., Larizgoitia, I., Audera-lopez, C., Prasopa-plaizier, N., Waters, H., & Bates, D. W. (2013). The global burden of unsafe medical care : analytic modelling of observational studies. 809–815. https://doi.org/10.1136/bmjqs-2012-001748
- King, H., Aubert, R., & Herman, W. H. (1998). Global Burden of Diabetes, 1995-2025: Prevalence, numerical estimates, and projections. *Diabetes Care*, 21(9), 1414–1431. https://doi.org/10.2337/diacare.21.9.1414
- Knaul, F. M., González-Pier, E., Gómez-Dantés, O., García-Junco, D., Arreola-Ornelas, H., Barraza-Lloréns, M., ... Frenk, J. (2012). The quest for universal health coverage: Achieving social protection for all in Mexico. *The Lancet*, *380*(9849), 1259–1279. https://doi.org/10.1016/S0140-6736(12)61068-X

- Knaul, F. M., Nigenda, G., Lozano, R., Arreola-Ornelas, H., Langer, A., & Frenk, J. (2008). Breast cancer in Mexico: a pressing priority. *Reproductive Health Matters*, 16(32), 113–123. https://doi.org/10.1016/S0968-8080(08)32414-8
- Medcalf, A., Bhattacharya, S., Momen, H., Saavedra, M., & Jones, M. (2015). Health for All: THe Journey to Unversal Health Coverage. *Centre for Global Health Histories*.
- Meza, R., Barrientos-Gutierrez, T., Rojas-Martinez, R., Reynoso-Noverón, N., Palacio-Mejia, L. S., Lazcano-Ponce, E., & Hernández-Ávila, M. (2016). Burden of Type 2 Diabetes in Mexico: Past, Current and Future Prevalence and Incidence Rates. *Department of Health and Human Services*, 445–450. https://doi.org/10.1016/j.ypmed.2015.10.015.Burden
- Mohar-Betancourt, A., Reynoso-Noverón, N., Armas-Texta, D., Gutiérrez-Delgado, C., & Torres-Domínguez, J. A. (2017). Cancer Trends in Mexico: Essential Data for the Creation and Follow-Up of Public Policies. *Journal of Global Oncology*, 3(6), 740–748. https://doi.org/10.1200/jgo.2016.007476
- Monroy, Ó. V., Peralta, M. R., & Esqueda, A. L. (2002). Hipertensión arterial en México : Resultados de la Encuesta Nacional de Salud (ENSA) 2000. *Archivos de Cardiologia de Mexico*, 72, 71–84.
- OECD Reviews of Health Systems: Mexico. (2016). OECD Publishing. https://doi.org/http://dx.doi.org/10.1787/9789264230491-en
- Prince, F., Corriveau, H., Hébert, R., & Winter, D. A. (1997). Gait in the Elderly. *Elsevier Science*, 5, 128–135.
- Quality governance in a pluralistic health system : Mexican experience and challenges. (2018). *The Lancet Global Health Commission, 6,* 1149–1152. https://doi.org/10.1016/S2214-109X(18)30321-8

Sistema de Referencia y Contra Referencia. (2019). *Secretaría de Salud [Powerpoint Slides].* Situación de salud en México- Indicadores Básicos. (2001). *Organización Panamericana de La Salud*.

- Stevens, G., Dias, R. H., Thomas, K. J. A., Rivera, J. A., Carvalho, N., Hill, K., & Ezzati, M. (2008). Characterizing the Epidemiological Transition in Mexico : National and Subnational Burden of Diseases, Injuries, and Risk Factors. *PLoS Medicine*, 5(6). https://doi.org/10.1371/journal.pmed.0050125
- Vázquez, D., Galván-Martínez, O., Ramírez-Cuadra, C., & Frenk-Mora, J. (1992). The supply of physicians in Mexico: excess and shortage. *Salud Publica de Mexico*, *34*(5), 540–545.

WHO. (2016). Diabetes Country Profiles - Mexico. World Health Organisation.

Zurita, B., González Rosetti, A., Knaul, F., & Soberón, G. (2001). Hacia un México más Saludable: Una visión del sector privado. Fundación Mexicana Para La Salud. Retrieved from http://funsalud.org.mx/portal/wpcontent/uploads/2013/08/Hacia_un_Mexico_mas_Saludable.pdf

CHAPTER 3. MENTAL HEALTH AND COMMUNITY WELLBEING

(Primary Authors: Ricardo Ainslie, Alfonso Rojas Alvarez, with Veronica Remmert)

Introduction: Mental Health Matters

Our study included the dimension of mental health in our assessments of overall community health. There are numerous reasons for this decision. Much research has documented the relationship between mental health and overall health (Thornicroft, 2011). Individuals with poor mental health are more likely to have a variety of health problems and mental health variables can play a role in whether or not people participate adequately in their own health care decisions and follow medical recommendations (Candia & Barba, 2011). In addition, mental health affects productivity, social engagement, and other indices of healthy living. Finally, there is very little research on mental health in economically poor communities. Individuals from such socially marginalized environments are often treated as if they are not "psychological beings," a form of dehumanization that is itself a source of stress and emotionally taxing (Waxman, 1977). Thus, there is a gap in the literature when it comes to understanding the mental health needs of individuals residing in such communities.

To address these gaps in the literature and to better understand the mental health context in poor, rural and urban communities in Puebla, we approached our research in three ways. First, we selected three widely used clinical measures that have good psychometric properties to assess the most common mental health symptoms that individuals tend to encounter. The Patient Health Questionnaire 2 (PHQ2) was used to assess depression in our participants; the Generalized Anxiety Disorder 2 (GAD2) was used to assess levels of anxiety; and the Perceived Stress Scale (PSS6) was used to assess levels of stress in our respondents. Given the overall length of our survey, we used the shortened versions of these three measures, although, as noted, all have excellent psychometric properties. In addition to these specific measures, we asked participants to rate the extent to which they felt mental health concerns were a problem in their community (single item). We also asked respondents to rate the extent to which they felt the following health/mental health-related issues were problems in their community: tobacco use, drug abuse, alcoholism, and domestic violence.

We were aware that the communities in which we were working had experienced a severe earthquake in the fall of 2017. In all of the communities the physical effects of the earthquake (such as collapsed buildings and buildings that were architecturally unstable and therefore dangerous) were still quite present. Some communities had individuals who had been trapped within collapsed buildings from which they had to be rescued. There were injuries and even deaths. Beginning with Kai Erikson's landmark book, "Everything in its path: Destruction of community in the Buffalo Creek flood" (Erikson, 1976) there is a significant literature on the psychological impact of natural disasters. These impacts affect both individual mental health as well as the social fabric of communities (Erikson, 1991). For this reason, we incorporated into our survey a question that asked respondents to identify what psychological symptoms, if any, they had experienced in the aftermath of the recent earthquake. Finally, community cohesion is another variable that affects mental health because in healthy communities' individuals tend to feel more supported, less alone, and part of a larger social system (Berkman, 2000). Such characteristics are associated with better mental health outcomes. To assess community cohesion, we asked respondents to rate the extent to which they believed their community participated in collective activities, supported one another, shared values, etc. These questions were aimed at providing a rough index of community cohesion in each of our four communities. In addition, aware that many communities in Mexico have experienced high rates of migration and aware that such migration can have a profound effect on communities, we explored the experience of migration within the families we interviewed.

Together, this multi-faceted approach to assessing mental health and community wellbeing allowed for an unusual window into the mental health needs in the four communities (two rural, one peri-urban, one urban) that formed the basis for our study.



Photograph 3.1: UT faculty and students speak to Colonia Agrarista community members to present the results (Image taken by Alejandro Luna López in October 2019).

Mental Health Results

Perceptions of Mental Health and Depression, Anxiety, and Stress Measures

A significant number of participants perceived mental health to be a "serious problem" in three of our four communities. In two of these, San Francisco Xochiteopan and Flores Magón, nearly

half of the respondents were of the opinion that mental health was a serious problem (Figure 3.1). Interestingly, for the most part our participants' scores on the depression, anxiety, and stress measures were within normal ranges (see below). However, between a quarter and a third of our respondents had clinically significant scores on these measures. Overall, while respondents tended to view mental health issues as a serious problem in the community, their self-ratings on these symptom measures tended to fall within a normal distribution. The only exception to this was the PSS, which measures stress. On this scale, aggregate scores in each of the four communities were at or above the cut off scores for clinical levels of stress (moderate or severe).



Source: Household Survey

Figure 3.1: Extent to which mental health is construed as a serious problem in the four communities.

Tuble 511. Assessments of Depression, Anxiety & Stress						
Pueblos and	San Fco.	Colonia	Santa Ana	Colonia Flores		
Sites	Xochiteopan	Agrarista	Coatepec	Magón		
Depression (PHQ-2)	1.6	1.33	1.01	1.63		
Anxiety (GAD- 2)	1.81	1.47	1.06	2.2		
Perceived Stress Scale (PSS)	7.6	7.75	7.4	8.19		

Source: Household Survey.

It is noteworthy that our one urban community, Flores Magón, had somewhat higher average scores on each of the three symptom measures and the highest report that mental health problems represented a serious issue in the community (Table 3.1). These findings suggest that life in economically poor urban communities is more taxing on mental health than life in more rural areas, notwithstanding the latter's greater poverty as reflected in lower levels of educational attainment and greater levels of food insecurity, for example. It also bears noting that while responses to the three measures were evenly distributed within each community, the absence of mental health services means that individuals whose scores were at the higher end of these diagnostic scales (that is, on the upper "tail" of the normal distribution) were likely not receiving services of any kind for these concerns. It is also likely that our mental health assessments represent an under estimation of these symptoms given cultural taboos around mental health topics (Mascayano et al., 2016). It may have been easier for our respondents to acknowledge mental health problems "out there" in the community, but when asked about their own experiences they were perhaps less inclined to share their felt symptoms. After all, they were typically interviewed by two team members who were strangers to them and, occasionally, other family members were present.



Source: Household Surveys Figure 3.2: Perceived stress scales for each of the four communities

Perceptions of Behavioral Problems in the Communities

Participants were also asked to assess the extent to which they believed tobacco use, drug abuse, alcoholism, and domestic violence were problems in their respective communities. As with the measures of depression, anxiety, and stress, respondents in Flores Magón, the urban community, were more likely to rate tobacco consumption, drug abuse, and alcoholism as "serious problems" in their community as compared with the other three communities' ratings. In Santa Ana Coatepec, a focus group was held on the topic of alcoholism (<u>https://lahn.utexas.org/Puebla/App5.html</u>). The participants all widely recognized that alcoholism was a problem, but it is was considered hard to control due to the easy access of alcohol at the many corner stores. They identified the youth within the community as the primary users of alcohol. The one exception was for domestic violence, where San Francisco Xochiteopan had a notably higher domestic violence rating (40-percent) as compared to the other three communities. Otherwise, rural communities reported lower levels of these concerns than our urban community. It is important to underscore that ratings of these four issues do not necessarily represent an index of their actual prevalence; rather, they are residents' perceptions of the importance of these issues in the community.

Pueblos and	San Fco.	Colonia	Santa Ana	Colonia Flores
Sites	Xochiteopan	Agrarista	Coatepec	Magón
Tobacco Abuse	53%	15%	73%	76%
Drug Abuse	33%	2%	35%	25%
Alcohol Abuse	53%	15%	73%	49%
Domestic	40%	6%	12%	21%
Violence				

Table 3.2: Unhealthy Behaviors Perceived as Serious Problems

Source: Household Surveys

Psychological Impact of the 2017 Earthquake

When asked if they experienced symptoms of fear, anxiety, or depression in the aftermath of the earthquake, all four communities had high numbers of respondents who reported at least one of these symptoms. The trauma literature recognizes that individuals who have suffered traumatic experiences may vary in their symptomatology.



Photograph 3.2: Visible damage of the church in San Francisco Xochiteopan from the 2017 Earthquake (Image taken by Dr. Ricardo Ainslie in October 2019). San Francisco Xochiteopan had the highest percentage of respondents who identified one or more of these symptoms (nearly 95%). It is noteworthy that this community also had the starkest reminder of the earthquake itself: Its 18th Century church had collapsed, trapping some 30 people inside until community members could rescue them. Portions of the churches' walls that did not fall during the earthquake remained precariously propped up with wood boards while large sections of the structure lay in ruins that were clearly visible from the street. A chain-link fence surrounds the space. At a community meeting, while we were presenting preliminary results of our study's findings, the community's leadership council openly pleaded with us to help them get their church back. "We are San Francisco Xochiteopan. This church is our San Francisco; it is our identity. Without it we are nothing," is the way the municipal president put it.

Pueblos and Sites	San Fco.	Colonia	Santa Ana	Colonia			
	Xochiteopan	Agrarista	Coatepec	Flores Magón			
At least One Earthquake-	93.82%	78.18%	83.33%	84.78%			
related Trauma							
Symptom (Sadness,							
Anxiety, or Fear)							

Table 3.3: Post-Earthquake Mental Health Trauma

Source: Household Surveys

Community Cohesion and Optimism

Communities vary in the extent to which they are cohesive and a source of support to their members as opposed to being fragmented social structures whose constituents feel isolated and alienated (Bramston & Chipeur, 2002). A community's felt cohesion is an index of the health of the community and a reflection of the extent to which a community is psychologically "serviceable" for its members. In order to assess community cohesiveness we asked participants the following five questions (rated on a five-point scale): "The people in my community share the same values as my family;" "There is a sense of pride in my community;" "When problems arise the residents of my community are able to deal with them;" "Residents participate in community events;" and, "People in my community support one another." Responses to these ratings were summed, giving each person a Community Cohesion score that could range from 5 (no cohesion) to 25 (high cohesion).

Residents of our two most rural communities, San Francisco de Xochiteopan and Colonia Agrarista, rated their communities the highest in terms of felt cohesion, while Santa Ana Coatepec and, especially, Flores Magón (the urban community) had lower scores on this variable (Figure 3.3).



Source: Household Survey Figure 3.3: Average Levels of Community Cohesion

In an effort to further ascertain each community's overall wellbeing we asked participants to answer the question: "In 15 years-time this community will be . . ." Response options were "Worse" "More or less the same" or "Substantially better." In other words, this question tapped a respondent's felt optimism for the future of their community. Again, our rural communities, led by Colonia Agrarista were clearly more optimistic about their community's future (Figure 3.4), whereas in our urban community residents were most likely to feel that their community would be "worse" (39-percent) in fifteen-years' time.



Source: Household Survey Figure 3.4 Optimism About the Future.

Migration

Migration to the United States has had a significant impact on many Mexican communities, both urban and rural. Nearly one in nine native born Mexicans now resides in the United States (Gonzalez-Barrera and Lopez, 2013) In an effort to understand the broader social context of the communities in which we were working, we explored questions related to migration, not least since our-migration from Puebla to the United States (the New York area especially) is widely documented (Castañeda, 20). The impact of migration was readily apparent in our data. Over 70% of the individuals surveyed indicated that they had family members currently residing in the US. In one of the rural communities (Colonia Agrarista), the percentage was as high as 84%. Given the importance of this topic, we conducted a focus group (https://lahn.utexas.org/Puebla/App5.html). Focus group members described how migration had changed their community, as well as the impact of remittances on everything from quality of housing to making their living conditions better. However, they also discussed who immigration had in some instances resulted in the disintegration of families.

More than half of our respondents indicated that these relatives had now resided in the US for more than ten years, and over sixty percent had resided abroad five years or more. The impact of such migration on family culture and relationships is perhaps best reflected in the amount of contact and communication that respondents reported in relation to the relatives living abroad. In our study, very few of those with family members in the USA had little or no contact with them, and for many (30%) the contact was frequent and ongoing (at least once a month). One household head of our intensive case studies (Manuel in Colonia Agrarista) talks at least once a week with his daughter on Skype and she provides an important stream of both emotional and financial support to him – important given his physical disabilities (Ch. 5 Case 5). Just in the period between July and October, he had built a new bathroom, living room, and installed a solar panel water heater on the roof– largely from remittances from his daughter.

Because of these contacts, we found that respondents were very aware of anti-immigration rhetoric and actions in the United States. One respondent spontaneously referred the current American president as "that man who does not like us" and many spoke of the fact that it was much more difficult (and costly) to cross the border today because of US government policies. There was also great awareness of deportations. In fact, on a few occasions, when we got to immigration questions, it became necessary to clarify that we were not part of the US government and that this information would confidential (de-identified) and not used against them or their family members.

Indeed, the importance of migration to the economic support of families was widely seen in their reports of remittances. Roughly twenty percent of our respondents indicated that they received remittances at least every six months and these were ranked as either very important or moderately important by roughly 30% of the respondents. Health-related needs and food were the two most cited uses of remittances, with clothing the third most commonly reported use of the remittances.

Do your relatives send remittances?	San Fco. Xochiteopan	Colonia Agrarista	Santa Ana Coatepec	All Rural Pueblos Combined	Colonia Flores Magón
Yes	21 (48.84%)	20 (43.48%)	29 (59.18%)	70 (50.72%)	11 (34.38%)
No	22 (51.16%)	26 (56.52%)	20 (40.82%)	68 (49.27%)	21 (65.62%)

Table 3.4: Remittances from the U.S.

Source: Household Survey

In addition to asking about relatives who had migrated, we also asked if the respondents themselves had ever migrated. Almost a quarter of our respondents indicated that they had lived in the United States prior to returning to their communities (the average length of time they had resided in the US was nearly 5 years). This was probably an underestimate of the actual proportions, since the large majority of our lead respondent heads of household were female, and while women also migrate, men represent the dominant migrant flow. Together, data of family member and respondent migration underscore the powerful impact of migration on these four communities. It is noteworthy, too, that migration is one of the few variables that appeared to cut across both rural and urban communities, having a salient impact on both. In addition, although reports of how remittances were used tended to focus on health, food, and clothing, we had numerous examples of families that had returned home from the US with savings that were used to remodel their homes and start businesses. There were also numerous examples of homes in the community where remittances from the US had been used to construct houses that were of better quality in terms of materials and design.

Conclusions & Summary

While residents in all four communities tended to view mental health concerns as a "significant problem," objective measures of depression and anxiety were within normal distributions. However, between a quarter and a third of our respondents had clinically significant scores on these measures. This is especially noteworthy given the total absence of treatment options or resources available for mental health needs. In addition, stress levels were moderate to high in all four communities and likely a reflection of the emotional toll of living in marginalized and economically poor communities.

It is noteworthy that the psychological impact of the September 2017 earthquake remained strong across all four communities almost two years after the event, with an exceedingly high percentage of the respondents reporting at least one major symptom (depression, anxiety, or fear). It is well documented that catastrophic environmental events can affect the social fabric of a community and have a powerful emotional impact (Erikson, 1991). The fact that the nearby volcano, Popocatepetl, continues to be quite active, with plumes of smoke, rumblings, and lesser earthquakes are a staple of daily life, serves both as a constant reminder to residents

of these communities of what took place and evokes a sense of threat that another significant seismic event could happen again.

Finally, in mental health terms, rural communities appeared healthier when compared to our urban community, with lower levels of perceived mental health problems overall and higher indices of cohesion and future wellbeing. This is paradoxical given that the urban community had more access to healthcare and was better off economically, as reflected in levels of education, food security as well as quality of food (meat, vegetables, and fruit consumption frequency), use of gas rather than wood for cooking, vehicle ownership, and non-agricultural work. Our urban community fared worse on almost all of our assessments of mental health.

Similarly, our most rural community, Colonia Agrarista, was consistently the strongest on all of our mental health assessments as well as assessments of community cohesion and felt optimism. Colonia Agrarista was our smallest community, with a population of 306. It is possible that size, coupled with comparatively greater isolation (they were the farthest from Atlixco, the nearest city) contribute to a healthier community. Colonia Agrarista had also separated from San Francisco Xochiteopan some fifty years ago and that act of self-definition may have had enduring effects when it comes to community cohesion.

What stood out to our team is the fact that there were essentially no mental health services available, especially in the three rural or peri-urban communities. While we documented a variety of mental health concerns, community residents had nowhere to go to receive help for these concerns. In short, mental health is a key element in health and community wellbeing, yet it is often ignored (or downplayed) by health care agencies when compared with the more visible epidemiological aspects of health identification and care.

References for Chapter 3

- Berkman, L. F. (2000). Social support, social networks, social cohesion and health. Social work in health care, 31(2), 3-14.
- Bramston, P., Pretty, G., & Chipuer, H. (2002). Unravelling subjective quality of life: An investigation of individual and community determinants. Social Indicators Research, 59(3), 261-274.
- Candia, P. C., & Barba, A. C. (2011). Mental capacity and consent to treatment in psychiatric patients: the state of the research. Current Opinion in Psychiatry, 24(5), 442-446.
- Castañeda, J.G. (2007). Ex Mex: From Migrants to Immigrants. New York The New Press.
- Erikson, K. (1976). Everything in its path: Destruction of community in the Buffalo Creek flood. New York: Simon and Schuster.

Erikson, K. (1991). Notes on Trauma and Community. American Imago, Vol 48, No.4. 455-472.

- Gonzalez-Barrera, A.; and Lopez, M. (2013). "A demographic portrait of Mexican-Origin Hispanics in the United States. Pew Research Center. https://www.pewresearch.org/hispanic/2013/05/01/a-demographic-portrait-ofmexican-origin-hispanics-in-the-united-states/
- Mascayano, F.; Tapia, T.; Schilling, S.; Alvarado, R.; Tapia, E.; Lips, W.; Yang, L. (2016). Brazilian Journal of Psychiatry, 38(1). http://dx.doi.org/10.1590/1516-4446-2015-1652
- Thornicroft, G. (2011). Physical health disparities and mental illness: the scandal of premature mortality. The British Journal of Psychiatry, 199(6), 441-442.

Waxman, C. I. (1977). The Stigma of Poverty; A Critique of Poverty Theories and Policies.

CHAPTER 4. HEALTH-IMPACTING BEHAVIORS AT THE HOUSEHOLD LEVEL, AND THE INTERSECTION OF HOUSING AND HEALTH AND WELLBEING.

(Primary Chapter Authors: Andrea Sandoval & Peter Ward with Melannie Ruiz)

Introduction

Previous chapters of this Report have analyzed household morbidity patterns and relative access to medical treatment across the four communities, with a particular focus rural pueblos and comparisons to a *colonia popular* in Atlixco. In addition, and all too rare in health studies in Mexico, we have sought to better understand issues of mental health and perceptions of community wellbeing among residents. In this section we turn to a more detailed analysis of how the physical structure of the dwelling environment intersects with health outcomes, wellbeing and, sometimes, presents particular risks. We examine the use of the lot as part of the agricultural production process; household cooking and food preparation practices; adequacy of water and electricity provision; and household organization and the use of rooms and patio spaces. In the first chapter Table 1, we showed that it is common for lots to have two or more families sharing the lot and living space either as "compound" arrangements (in which two or more close kin related households live in separate dwelling/spaces).² More common are extended household arrangements (parents, adult children, and grandparents), parents, adult children, etc.).³ Nuclear families are also common especially in the more established communities such as Santa Ana and Flores Magón, but even here compound and extended arrangements are commonplace. Singleton households are very rare, although as we discuss later in this chapter we selected one such case for intensive case study, in large part because the owner was severely disabled.⁴

Our discussion below examines responses to the survey,⁵ complemented by data from focus groups that broke out from concerns expressed by members of the community themselves, or were health related issues that the team identified as worthy of further study.⁶ In a similar vein we used an intensive case study methodology that had been developed earlier as part of the Latin American Housing Network (<u>www.lahn.utexas.org</u>) and which had been applied in Mexico as well as in Texas low income *colonias* (Ward et al. 2015). These intensive case studies involved the team working on site for several hours measuring rooms, taking photographs and recording videos, conversations with household individual members, with the goal of examining the links between the physical structure and specific health and mobility challenges faced by households in these agricultural pueblos. Five intensive cases were purposively selected to

² An example is provided in Appendix 4: Case Studies #1 & 2 San Fco. Xochiteopan where households share the lot in separate dwellings: 1) Nuclear family of parents and children and 2) the nuclear family of the eldest son. But both households share the "kitchen" and often eat together.

³ Appendix 4: Case # 2

⁴ Appendix 4: Case # 4

⁵ See Appendix # Sections, **

⁶ These explored nutrition and food security; cooking practices and the use of starter fuels (plastic bottles); and concerns about dogs running loose in one particular community (Santa Ana Coatepec).

explore health challenges presented by: 1) hazardous air quality in homes and kitchens; 2) mobility impediments and risks of accidents associated with self-help building structures and lot organization; 3) health risks associated with living in very close proximity to farm animals (goats; chickens, cows, etc.; 4) disease and poor health linked to dirt floors, flimsy housing structures, pests, etc.; and 5), the utilization of new dwelling units that had been provided to households who lost their homes in the 2017 earthquakes.⁷

Behavioral Household Practices

We begin by first exploring household behaviors within the dwelling environment which may shape health and wellbeing: nutrition and food security; cooking practices; access to potable and other sources of water for drinking and other household uses.

Nutritional Intake and Relative Food Security

A significant minority (17% - Table 4.1) had experienced food insecurity in the past year and reported to having had to skip meals or tighten their belts. Our focus group discussion (https://lahn.utexas.org/Puebla/App5.html) underscored the basic diet: "beans and tortillas". What else Dr. Ward asked? "More beans and tortillas" (laughter...). In the poorer pueblos (Agrarista and Xochiteopan) meat or fish figured in meals once or twice a week at best, and invariably would be chicken. Consumption of fruit and vegetables were also somewhat irregular, but in the two pueblos for which we have data, around 28% did report eating both vegetables and fruit either daily or 4-5 times a week. That said, the focus group suggested that it was usually not quite that frequent – at least once a week – and that access to fruit and vegetables was better in the rainy seasons (July – October) when squash, *alaches/queletes*⁸ etc. are most plentiful. Those with greenhouses are able to grow year-round and irrigate (see Intensive Case # 2 Figure 4.4 below – Francisca's greenhouse

<u>https://lahn.utexas.org/Puebla/Appendix4/Case2a.pdf</u>). There have been attempts through school to teach healthy eating, participants in the focus group mentioned that kids get slapped down if they remonstrate with their parents (focus group- <u>https://lahn.utexas.org/Puebla/App5.html</u>). Agricultural workers are paid on Saturdays so the following day they go to the market and buy cheese, milk, fruit etc. Sundays is also the day when they will buy tortillas rather than make them at home, and also prepare foodstuffs – *pico de gallo* etc. However, in the planting season even Sundays are considered a workday.

⁷ All (and each) of the detailed plans and lot hazards documentation referred to in this chapter are included in https://lahn.utexas.org/Puebla/App4.html

⁸ These are high protein plants which grow wild and are gathered and added to the diet when available. We observed *alaches* when we returned in October

Pueblos and Sites	San Fco.	Colonia Agrarista	Santa Ana	Colonia Flores Magón
	Xochiteopan		Coatepec	, and the second s
Family Nutrition Behaviors				
Have rationed food in last 12 months	17.3% (14)	19% (10)	15% (9)	8.7% (4)
Drink sodas (sugary drinks): daily or 4- 5 * a wk.	13.6% (11)	22.6% (13)	30% (30)	30.4% (14)
Rarely eat cookies and chips	58% (47)	67% (37)	54% (34)	37% (17)
Eat meat once or twice a week at the	ND	38% (21)	66% (40)	43.5% (20)
most				
Sources of Cooking Fuel (may use				
Leña % who use	97.5% (79) *	87.3% (48) *	78.35 (47)	19.6% (9)
Carbon % who use	76.5% (62)	78.2% (43)	73.3% (44)	26.1% (12)
Gas tanks propane % who use	34.6% (28)	43.6% (24)	76.7% (46) *	98% (45) *
* = principal				
Drinking water - household usage always or very frequently				
Tap (llave) maybe via tank	82.7% (67)	60% (33)	60% (36)	98% (45)
Pozo (well)			49% (29)	9% (4)
Tap & Bottled (purified)		3.6% (2)	43% (26)	76% (35)
Don't know or don't believe that tap water is chlorinated	17.5% (14)	47% (37)	1.6% (1)	4% (2)
Regularly boil water before drinking	14.81 (12)	30.91 (17)	40 (24)	50 (23)
Strongly agree that water needs to be improved (O142-1)	43.21 (35)	54.55 (30)	58.33 (35)	69.57 (32)
Mean chlorine concentration (ppm)	0.0307	0.0393	0.1151	0.1461
Air Quality in the Home and Community				
Very satisfied air quality in home (145-	79.01 (64)	74.55 (41)	73.33 (44)	76.09 (35)
Yet also believe that are significant problems of air quality in the home 145-3	49.38 (40)	36.36 (20)	30 (18)	45.65 (21)
Very satisfied air quality in the community	64.2 (52)	72.73 (40)	56.67 (34)	30.43 (14)
Air Quality in Kitchen				
Mean CO2 concentration (ppm)	792.48	760.71	812.44	987.91
	(Moderate)	(Moderate)	(Moderate)	(Moderate)
Mean PM2.5 concentration (ppm)	44.58 (Unhealthy for Sensitive Groups)	70.91 (Unhealthy)	38.14 (Unhealthy for Sensitive Groups)	12.68 (Moderate)
Mean PM10 concentration (ppm)	58.75 (Moderate)	87.97 (Moderate)	48.36 (Good)	16.5 (Good)
Measures of Air Quality PM 2.5; Pm10; and CO2				
Poor levels of PM2.5 (N)	66.7% (9)	57.14% (42)	71.3% (42)	54.55% (33)
Unhealthy levels of PM 2.5 (N)	33.30%	2.38%	2.38%	3.03%
Hazardous Levels of PM2.5 (n)	0%	7.14%	2.38%	0%
Poor levels of PM10 (N)	33.30%	5% (40)	2.38%	3.03%
Unhealthy levels of PM 10 (N)	0%	0%	0%	0%
Hazardous Levels of PM10 (n)	0%	7.50%	2.38%	3.03%
Poor levels of CO2 (N)	33.3% (33)	50% (42)	40.48% (42)	54.55% (33)
Unhealthy levels of CO2 (N)	7.69%	0%	14.29%	15.50%
Hazardous levels of CO2 (N)	0%	0%	2.38%	0%

Table 4.1. Household Cooking and Nutritional Behaviors, Perceptions and Measures of Water and Air Quality

Source: Household Survey

In the focus groups it was argued that the use of fats and cooking oils for soups, potatoes, refried beans etc., were limited because of cost, but Paty mentioned afterwards that in her view they are not as costly as *refrescos*, and that people overused fats and oil in food preparation. However, we were not able to measure this in the survey. Given the high rates of chronic illnesses such as diabetes and obesity we were especially interested in exploring the consumption of sugary drinks and high calorie snacks such as cookies, potato chips etc. Table 4.1 shows that a significant minority of the population drink sodas (mostly coca cola) daily or several days a week, and while many participants in the focus groups professed to like sodas, they were largely constrained by cost (especially in Agrarista and San Fco. Xochiteopan).

Significantly, people are well aware of the links between sodas and diabetes but they said they liked it so much. It is something of a status symbol, and one focus group member said that if her husband did not provide coca cola his *peon*, then the latter would refuse to work for him. Another woman whom we interviewed in Flores Magón had diabetes (as did several of her adult siblings), but they all blithely drink coke regularly – much, she said, to the dismay of her doctor! The cost and lower availability appears to constrain households in the pueblos especially from eating unhealthy store snacks with between half and 67% rarely buying such "treats". In both pueblos cost remains the major constraint, but as pressures or the capacity to purchase sugary sodas (especially) rises (as it might), campaigns to reduce intake or go with sugar free sodas will be important. But our data show that lack of awareness is not the issue. Upon our return to the communities in October we described the health problems related to sugary drinks and described anti-soda campaigns in Chile and Mexico.⁹ The reaction was one of interest and some shock/surprise, but our sense was that little behavioral changes should be anticipated.

In sum, baseline poverty is closely related to relative nutritional poverty (especially in the two more rural communities) and this clearly relates to poor health (diabetes and hypertension, etc., although the lower intake of sugary drinks and the physical exercise of agricultural activities (especially for men) almost certainly mitigates obesity levels in those two communities. Poor nutritional practices (sugar drinks and snacks) in better-off communities such as Santa Ana and Flores Magón almost certainly exacerbates the primary diseases that we found.

⁹ Specifically, the poster: "Would you give 12 cuchardas of sugar to your kids?" <u>www.actuaporsalud.org</u>

Pueblos and Sites	San Fco.	Colonia Agrarista	Santa Ana Coatepec	Colonia Flores
	Xochiteopan			Magón
Lot size Trimmed mean (5%)	1015m2 (37)	2377m2 (26)	917m2	566m2 (22)
Dwelling Number of Ro	oms Excluding Kitchen	and Bathroom		
One or two	53% (43)	46% (25)	35% (21)	33% (15)
Four or more	16% (13)	27% (15)	30% (18)	28% (13)
Most Cited Problems in	Specific Rooms and Sp	paces (Top 3)		
Kitchen Response Rate	1. humidity/	1. humidity/	1. humidity/ goteras	1.plague/pests
	goteras 16.05% (13)	goteras	11.66% (7) 2 nlague/nests	21.74 (10) 2 humidity/
	2. smoke	20% (11)	6.67% (4)	goteras
	14% (11)	2. smoke		15.22 (7)
	3. plague/pests	9.09% (5)		3. smoke
	7.41% (6)	3. plague/pests 3.64% (2)		4.35 (2)
Bathroom	1. humidity/ goteras	1.	1. humidity/goteras	1. humidity/ goteras
	8.64% (7)	humidity/gote	8.33% (5)	4.35% (2)
	2. smoke 1.23 (1)	ras 3.64% (2)	2. plague/pests	2. plague/pests
Redrooms Princing		2. NA	1.67% (1)	4.35 (2)
Problems	1. humidity/	1.	1. humidity/ goteras	1. humidity/
	goteras 38.25%	humidity/goteras	33.34% (20)	goteras
	(31)	47.28% (29)	2. plague/pests	34.79 (16)
	2. plague/ pests	2. plague/pests	8.33% (5)	2. plague/pests
	6.17% (5)	25.45% (14)	3. NA	19.57 (9)
	3. smoke	3. smoke		3. NA
	1.23% (1)	9.09% (5)		
Living Area	1. humidity/	1. humidity/	1. humidity/ goteras	1. humidity/ goteras
	goteras 7 41% (6)	goteras 20 (11)	2. plague/pests 1.67	2 plague/pests
	2. plague/pests 2.47% (2)	2. plague/pests 3.64 (2)	(1)	10.87 (5)
Households that store	40.3% (25)	43% (23)	37% (22)	NA
fertilizers or fungicides				
in the home.				
Stored in almacen /	48% (12)	61% (14)	64% (14)	NA
Stored in patie grea	160/ (4)	1 20/ (1)	270/ (6)	ΝΔ
Stored in pullo died	10% (4) 20% (E)	4.5% (1)	27% (0)	NA
dwelling	2078 (3)	5078 (7)	970 (Z)	
rooms/corridor				
Stored in kitchen	8% (2)	4.3% (1)		NA
Do use fosfuro de	65% (53)	80% (44)	50% (30)	NA
aluminio on maize				
storage				
Of those storing	58% (24)	44% (23)	71% (21)	NA
recognize dangers	. ,			
of storage agrochemicals in the home				

Table 4.2. Dwelling Structures and Problems

Source: Household Surveys

Water Sources and Patterns of Consumption

All three of the communities have access to a piped water supply (*de la llave*) and which is widely understood to be clorinated (although many in Agrarista said they were unsure). In the two most rural pueblos (Xochiteopan and Agrarista) all households pay a month fee assessed upon the number of members in the family (at 20 pesos per person in Xochiteopan, where the high cost is largely to cover the costs of pumping from the aquifer). Largely for the reasons of cost, in both communities supply was provided only twice a week (Sundays and Wednesdays), and sometimes only once (as occurred in the week that we were doing fieldwork. Supply in Flores Magón comes via the city.



Photograph 4.1: Typical Well in Santa Ana Coatepec (Image taken by Dr. Peter Ward)



Photograph 4.2 (left): Roof-fed Rainwater to Storage Tank SFX. Photograph 4.3 (right): Water storage tank in San Fco. Xochiteopan. Note the feeder in-pipe, as well as buckets to scoop water for washing etc. (Images taken by Dr. Peter Ward).

However, in our survey we found that while tap water supply is widely used both for drinking and for daily household uses, several other sources are also locally important: wells in Santa Ana (Photograph 4.1); storage tanks and cisterns across all three pueblos (see Photographs 4.2 & 4.3 above for a storage tank in Xochiteopan which was used to provide water for the household as well as for the animals. It was fed from the piped supply (*llave*), and while these tanks may also be sourced from rainwater most are also supplied by network (*llave*). Often, therefore, we were unable to distinguish between the true original water source. Our attempts to measure the water quality (presence & level of chlorine) were made problematic therefore, since water from the tap via a storage tank would inviably register much lower levels of chlorine than that directly off the network (see below for data).¹⁰ Despite being potable, a proprtion of households (25% in the three pueblos) boiled their water before drinking it. With the exception of Flores Magón and Santa Ana, few families regularly purchased bottled (purified) drinking water (Table 4.1), largely because of cost: in Flores Magón respondents reported paying an average of 60 pesos a week for bottled water.

Internationally adding chlorine is used as disinfectant in water treatment processes to eliminate pathogens and reduce contaminants and other harmful organisms present in water. However, the amount of chlorine introduced to the distribution system must remain within certain levels to ensure its efficiency. According to the EPA, the maximum amount of chlorine in a public water system is 4 mg/L. The smell or taste of chlorine can be detected when the levels are around 1 mg/L, so poor smell reports are not an uncommon occurrence. However, the optimal chlorine levels range from 0.3 to 0.5 mg/L (EPA). If water is stored for any length of time, chlorine tends to dissipate and eventually stops disinfecting the water – certainly it becomes difficult to measure with any exactitude, as we found in practice.

In the two most rural pueblos (Xochiteopan and Agrarista), the concentration of chlorine in households was significantly low, with an average of about one tenth of the prescribed minimum level (i.e. 0.03 ppm). In large part this could be due to our often having to test on stored water since daily tap water flow is not continuous, as mentioned earlier. However, even in the instances when tap water was available for measurement , the samples collected displayed low levels of chlorine. This suggests that not enough chlorine is being introduced into the distribution system, and as we observe in Table 4.1, some families regularly boil water that they drink.

In the case of Santa Ana Coatepec and Flores Magón, chlorine levels in the water appeared to be the highest with averages of 0.12 and 0.15 mg/L, respectively. This was substantiated by the perceptions of the communities with 98% and 96% of households responding to being aware of their tap water receiving treatment (Table 4.1). However, these more urbanized communities opted to purchasing bottled water due to concerns with the water supply. In Santa Ana Coatepec many expressed dissatisfaction with the taste and smell, perceived their water as being overchlorinated, and believed that the quality needed improvement. In Flores Magón, the dissatisfaction with the water supply came from distrust in the treatment process. The

¹⁰ For the water quality data collection, we used the eXact I-Dip[©] smart photometer system with Bluetooth, see <u>sensafe.com/idip-compatible-devices</u>. After letting the water run for two minutes and flushing the instrument with sterile water, the IDIP receptacle cell is filled, the test selected, the cell closed and meter primed and then a dip strip is introduced to the cell water receptacle and the results read after which the results are sent and saved via Bluetooth. In addition, we measured for solids and water temperature using a simple TDS meter.

belief of the water needing improvement was slightly greater in these communities than in the rural ones.

Safe Water Practices

As mentioned earlier, water availability is limited to once or twice a week in the rural communities which obliges them to regularly store their water in large containers and to use these as their source of drinking water. The issue with this practice is that if the water is stored for longer than 24 hours, or the containers themselves are not adequately equipped to prevent contamination, then there is the potential for hazard to health. Some recommended practices for safe water storage include regularly sanitizing the storage containers, ensuring that "old" water is fully replaced by fresh water, and using containers that have a small cover or lid that discourages the insertion of hands or objects into the tank to draw water (Photograph 4.3). Because chlorine will dissipate over time, and the storage of water is the only viable option for some of these communities, it is crucial to introduce and encourage safe water storage practices to reduce potential risks to waterborne diseases.

In addition to safely storing water, other steps can be taken to reduce health-related risks associated with poorly treated water such as boiling and filtering water before consumption. Boiling the water will eliminate pathogens and other contaminants while filtering will separate and remove particles and sediments from the water. These two forms of treatment can also be beneficial for rainwater collected for drinking or cooking purposes as was observed in the communities, particularly in Colonia Agrarista. Rainwater is generally safe for consumption and is evidently an important source of drinking water for rural communities, so ensuring the education over safe water practices can have positive health outcomes.

Dwelling Environments & Post Earthquake Reconstruction.

Traditional building and lot arrangements in these pueblos requires a sizable lot for dwellings, animals, and storage of wood, fertilizers and grain, etc. As our intensive case study diagrams illustrate (below and in Appendix 4), lot-sizes of around 1000m2 or more is normal, and is almost double that in Agrarista (Table 4.2). Most are *ejidatarios* who, as part of the original creation of the *ejido*, received both a lot for residence in the "urban" *ejidal* zone, and larger parcels of land for cultivation outside of the pueblo. Many will walk for an hour or more to reach their parcels.

Dwellings traditionally were made of adobe which rarely allow for a second story, and rooms often lack natural lighting or, have small window openings. More recent building is of concrete block (*tabique*) which does allow for a second story provided that steel reinforcement is used and that the first-floor roof is made of concrete. Otherwise roofs are of laminated iron or bituminized cardboard (*lámina de cartón*).

The 2017 September earthquake hit both communities very hard especially Xochiteopan where the Church was destroyed, as were many homes. There were few casualties since most people were out in the fields when it struck at 1:00pm, but such was the damage especially to the adobe structures that a major rebuilding effort was put in place. The first phase was an

emergency campaign to provide basic materials (tarps, wood, plastic etc.) for temporary shelter, followed by funding support for rebuilding and a number of new homes were built by FONDEM (3 bedrooms) and by the FCP (2 bedrooms -- See Appendix 4 Case 1a & Case 1c for prototype examples of FONDEM dwellings, and Case # 2 [Appendix 4 Case 2b) for FCP L-Shaped buildings with an open patio <u>https://lahn.utexas.org/Puebla/App4.html</u>.) ¹¹



Photograph 4.4 (left): Earthquake damage to consolidated adobe walled house (Image taken by Alejandro Luna López). Photograph 4.5 (right), Members of the FCP on site to discuss plans for new homes with Doña Francisca's family (see also Appendix. 4 Case 2a https://lahn.utexas.org/Puebla/App4.html) (Image taken by Alejandro Luna López)



Photograph 4.6 (left): Lidia's house in March 2018. Photograph 4.7: in July 2019 showing enclosure of the patio (now a dining/living area). (Both images taken by Dr. Peter Ward.)

The self-help modifications to the FCP dwelling suggests that the FCP's premise of an open patio in which to cook was misconstrued since families continue to cook outside using wood, and until they choose or can afford propane gas (tanks) they are unlikely to move to an inside kitchen. Thus, the FONDEM designs seem better designed. In a later section we will examine the health challenges presented by both the new and the older traditional housing structures.

¹¹ Note: All names have been changed in order to offer of confidentiality relating to the cases and their households. However, we understand that local identification from the photographs may be possible and we have redacted any sensitive information (location of kin in the USA, particular health problems of indoviduals, etc.) that may cause embarrassment to the families.

In reconstruction some families preferred financial support to design and construct new homes for themselves, although this can lead to a stall in the building process when money runs out (or is diverted for other uses) -- as we found in one of the case studies (Appendix 4 Case 2a). Thus, core housing with the opportunity for extension, or completed new house design can have a dynamic effect, albeit in often unpredictable ways. The structure as planned and installed is not always congruent with the family's needs, and will be adapted accordingly. Also, it appears that post-earthquake reconstruction support can generate and raise expectations such that building activity stalls when no additional (or external) resources are available.

We were also struck that in these poorest agricultural communities much of the interior space of dwellings (new or old) is largely for sleeping and/or storage, and that little effort appears to be made to furnish rooms: most of the daily activities are in the patio/yard and/or the external kitchen area. An action item here might be to create a micro loans program that would allow families to finish-out the interior of buildings.

Pueblos and Sites	San Fco.	Colonia	Santa Ana	Colonia Flores			
	Xochiteopan	Agrarista	Coatepec	Magón			
Lot size Trimmed mean (5%)	1015m2 (37)	2377m2 (26)	917m2	566m2			
				(22)			
Dwelling Number of Rooms Excluding Kitchen and Bathroom							
One or two	53% (43)	46% (25)	35% (21)	33% (15)			
Four or more	16% (13)	27% (15)	30% (18)	28% (13)			
Construction Materials Used in the Various Rooms*							
Tierra/earth	41.5% (16)	21.82% (12)	1.67% (1)	6.5% (3)			
Concrete	86.3% (70)	90.91% (50)	83.3% (50)	71% (33)			
Tile/mosaic/Loseta	5% (4)	10.8% (6)	20.1% (13)	34.77% (16)			
Other							
Walls*							
Adobe	24.7% (20)	41.82% (23)	5% (3)				
Block/tabique/concrete	96.2 (79)	87.27% (48)	112.7% (87)	113.1% (52)			
Wood/lamina/plastic etc.	8.62% (7)	9.1% (5)		2.2% (1)			
throwaways							
Roof*							
Concrete	78.96% (64)	67.3% (37)	88.3% (53)	91.3% (42)			
Zinc corrugated etc.	33.4% (27)	50.1% (28)	25% (15)	26.9% (12)			
Lamina de carton/asbestos	13.61% (11)	21.8% (12)	10% (6)	10.9% (5)			
Other							
Type of wc/toilet/connection			1				
Latrina/fosa septica	40.73% (33)	43.64% (24)	5% (3)	2.1% (1)			
WC connected to drainage	56.78% (46)	50.9% (28)	94.7% (12)	97.80%			
system							
Type of Bathing			1				
Ducha/Shower	25.9% (21)	21.8% (12)	61.6% (37)	60.9% (28)			
<i>Tina</i> /bathtub	13.6% (111)						
Tazón (bowl)	40.74% (33)	70.9% (39)	36.7% (22)	40% (28)			
Jicarazos (bowl)	17.2% (14)	3.6% (2)	1.7% (1)				

Table 4.3. Characteristics of Dwelling Structures, Building Materials etc.

% households reporting rooms without natural lighting	28% (12)	14.4% (7)	9.3% (2)	8% (2)
Primary room where no natural lighting	Bedrooms	Bedrooms	Kitchen & bedroom	Bedrooms

Source: Household Surveys

*Floors might be mixed materials and thus percentages may add up to more than 100%

Contemporary Dwelling Characteristics:

As one can observe in Table 4.3, dwellings in Xochiteopan and Colonia Agrarista are somewhat smaller (excluding the kitchen and bathroom spaces), with around 50 percent of the dwellings comprising one or two rooms (Table 4.3). This leads to higher rates of overcrowding -- a fact that can have important negative health implications especially when several members are sleeping in the same room (e.g. TB, respiratory illnesses, skin infections, etc., see Pemberton *et al.* 2007). Many homes comprise rooms made of more than one material, and while walls and floors are made of permanent materials such as concrete and bricks, Xochiteopan and Agrarista have a significant proportion of dirt floors in one or more rooms (42% and 22% respectively);¹² walls made of traditional adobe (25% and 42%), and occasionally more temporary materials such as lamina, wood and plastic (see examples in Figure 4.1).

¹² Important since several important diseases and parasitic infections are often related to dirt floors.

SOLEDAD-ENTIRE LOT PLAN WITH PHOTOGRAPHS



Figure 4.1: Example of Lot and Photos Plans in Appendix 4 Case 3a & 3c. María Carmen's house. Note dirt floors, and flimsy building materials.

As mentioned above the earthquake impacted Xochiteopan especially hard and destroyed many of the housing units made of adobe; it was less severe in Agrarista which still has many homes built of adobe (42%). In the construction of the one observes greater variation of materials with a large minority of homes having one or more rooms roofed in zinc or other laminated materials. Concrete roofs are important not only because they provide better conditions for heating and cooling, but are also easier to keep clean and reduce infestations from pests, etc. As we expected, the somewhat better-off communies of Santa Ana Coatepec and urban Flores Magón have more consolidated and larger dwellings (Table 4.3).

Toilet and bathing facilities vary, the former especially being predicated upon the household connection to a formal drainage network – as exists in Santa Ana and Flores Magón. Both Xochiteopan and Colonia Agrarista rely upon pit latrines of one sort or another (above 40% of cases); and only 22-26% of dwellings have a formal shower/bathroom facility; the majority making do with a *taz*ón (bowl) to bath themselves. One focus group mentioned that lice infestations (*piojos*) were a serious problem among children and, to the extent that hair washing is less frequent among those families without showers, then these less effective forms

of personal hygiene may exacerbate the problem (although it invariably also requires medication treatments as well, and these are relatively expensive).

Natural lighting is important -- both for its own sake as well as to enhance ventilation -- and while relatively few homes have no rooms without natural light/windows, a modest number do – in Xochiteopan especially (28%, double that of Agrarista, and three times as high as Santa Ana and Flores Magón).

As we were preparing the survey, we were alerted by our collaborators at the Fondo Mónica that it would be good to include some questions about the use and storage of agrochemicals and fertilizers in the three agricultural pueblos. The majority of farmers use aluminum phosphide to fumigate their maize crop, and we were interested to know how household members viewed the relative risk of storing such chemicals in and around their home, and where these were stored on site. As shown in Table 4.2, the majority of households were aware of some of the dangers of storing chemicals (although it was significantly lower in Agrarista (44%). Moreover most households had a dedicated space (*almacén*) in which to keep them (lower in Xochiteopan [48%]), but a minority also kept them in living spaces around the home, sometimes even in bedrooms or cooking areas (See Table 4.2 & Figure 4:4 Case 2 below [Appendx. 4 Case 2a & 2c).

Air quality and Perceptions

Because the majority of households in rural pueblos cook with wood (*leña*) especially and *carbon* for tortilla stoves (see Figures 4.8 & 4.9 below), kitchens and cooking spaces are often outside or adjacent to main dwelling and living spaces, and are especially likely to be made of lámina, sometimes open on one side and giving out onto the patio (see photos in Appendix 4. Case 5a). Even if partially open on one side, if good ventilation is not assured, then very poor or even hazardous air quality may ensure (see below and Appendix. 4 Case 1a & 1cd).


Photograph 4.8 (top): Typical wood fire in outdoor kitchen. Photograph 4.9 (below): Large bowl set above a wood fire (for *mole*) and small stoves for carbon and heating *tortilla* (Images by Dr. Peter Ward).



Photograph 4.10: Wood fire *comal* and chimney. Photograph 4.11: Wood fire oven with small stove and coal (Images by Dr. Peter Ward).

Health Parameter Guide							
PM2.5	PM10	AQI	CO2(ppm)	Status	HCHO(mg/m ³)	TVOC (mg/m ³)	Displayed Contents
0.0-12.0	0-54	0-50	0-700	Good	0-0.1	0-0.5	Safe
12.1-35.4	55-154	51-100	701-1000	Moderate	> 0.1	> 0.5	Unsafe
35.5-55.4	155-254	101-150	1001-1500	Unhealthy for Sensitive Groups			
55.5-150.4	255-354	151-200	1501-2500	Unhealthy			
150.5-250.4	355-424	201-300	2501-5000	Very Unhealthy			
≥250.5	≥425	≥301	≥5001	Hazardous			

Figure 4.2: Air Quality Thresholds for PM2.5, PM10, and CO2.

During the survey we gathered household perceptions of air quality within the home and in the wider community locality, and then followed up with measurements of actual air quality in several rooms (particularly the kitchen), in order to assess the possible impact of poor indoor air quality on health (for details on each of the measures and instruments used see https://lahn.utexas.org/Puebla/App3.html). Measurements were taken using a handheld instrument which provided detailed readings of particulate matter in the air PM2.5 and PM10), (largely smoke and ash particles, etc.), as well as of carbon dioxide, humidity, and temperature.¹³ Most households gave us permission to take air quality samples in at least two areas of the dwelling, and we focused mostly on the kitchen and the patio space which is where most people spend much of their time. But we often also obtained readings for bedrooms and occasionally for bathrooms.

We focus primarily on CO2 and on particulate matter, specifically PM2.5 as it consists of finer particles that are widely known to be detrimental to health. Short-term exposures to particulate matter can aggravate asthma, heart, and lung disease, leading to respiratory problems. Long- term exposure can lead to the development of heart and lung disease and premature mortality. This can be especially harmful to young children who we observed spend a lot of their time close to their mothers, and some women reported having to carry their toddlers while they cooked – a practice that occupy them for three hours at a time. Children are more prone to developing acute or chronic respiratory diseases when exposed to CO2 and particulate matter in poorly ventilated dwellings. Health effects of poor indoor air quality include low birth weight, tuberculosis, asthma, and the development or worsening of other respiratory illnesses. In San Fco. Xochiteopan, for example, asthma was the third highest chronic illness and can be linked to the poor levels of PM2.5 and CO2 in this rural community. Poor respiratory health outcomes among children in low-income residential settings can be

¹³ Temtop Model M2000C https://www.temtopus.com/

stimulated by a combination of inadequate ventilation, crowded, unsanitary conditions, and the lack of resources to use safer fuel alternatives (WHO, 2005).

Fuel combustion, agricultural activity, and emissions from unpaved roads are all sources of particulate matter. In the case of the three rural pueblos, agriculture is the primary source of economic activity and the majority of the households utilize wood as cooking fuels over natural gas or electricity (Table 4.1 and Photos 4.8-4.11). In Flores Magón, 98% use natural gas, although they, too, often use *carbon* and *leña* for occasional cooking.

The limited or poor ventilation observed in many kitchens and homes can increase the exposure to toxic pollutants emitted by solid fuels (Maldonado et al. 2011). We also observed plastic (usually bottles or cups) being used as an accelerant to start the wood fire, and even when fires were outside the house smoke often drifted back into ones' eyes and face. Where cooking was done in a single room (see Fig. 4.3 Intensive Case # 1 below, [also Appendix. 4 Case 1a & 1c), with limited ventilation, the readings were often hazardous and toxic. This inspired us to run a focus group strictly over air quality and cooking practices in San Fco. Xochiteopan. Through that exercise we learned that community members seem to be more concerned about the volcanic ash periodically emitted by the volcano than by the smoke from their own kitchens. This suggests that cooking with wood, and the discomforts that arise (eye and skin irritation, cough, etc.), have become the "normal" in rural communities that lack education and, most importantly, do not have the resources to use safer fuel alternatives. It was through this focus group(https://lahn.utexas.org/Puebla/App5.html) that we learned of people burning plastic to intensify and speed the lighting of fires. Awareness of the hazards of such practices was widely voiced; however people reiterated that wood was simply more affordable and accessible, and gave their meals a better taste.

Particulate matter (smoke and ash):

In the three rural pueblos, concentrations of PM2.5 had means ranging from 38 to 71 ug/m3 (ppm see Table 4.1). By comparison, EPA's annual air pollution standard for PM2.5 is 12 ug/m3. The levels in the rural communities were considered unhealthy as Table 4.1 shows. These are average levels, but we have also disaggregated the "tail" of the distribution in order to highlight the proportion of households exposed to unhealthy and very unhealthy particulate and CO2 readings across each of the three communities (Table 4.1).

Carbon Dioxide (CO2):

In all four communities the mean CO2 concentrations ranged from 760 to almost 1,000 ppm and fell under the "moderate" health category. Although CO2 did not vary and show such high levels as particulate matter, there were still some alarming observations within the homes, particularly in the kitchen spaces. It is important to note that most households had their cooking space set up outside, but the existence of adequate ventilation varied greatly from home to home. See Appendix 4. Case 1b & 1c for further discussion on indoor air quality and its impact on family health. Additional possible sources of poor indoor air quality can be attributed to the a number of practices: storage of agrochemicals inside the home, sometimes in the spaces used for sleeping (See Case Study #2), proximity between humans and farm animals in or around the living space, and, lastly, from the building materials themselves. Fertilizers, pesticides, and other agrochemicals are widely used in the three rural communities, however, if not properly stored, they can have adverse effects on human health. Acute illnesses such as skin rashes, headaches, dizziness, nausea, among others have been linked to contact with pesticides. In more serious cases, chronic illnesses such as prostate, lung, and breast cancer have been correlated to the use of agrochemicals. Although the majority of households in the communities under study reported storing such chemicals in a designated space away from the living space, a large proportion do store them inside the home, including in the kitchen (Table 4.2).

Overcrowding of sleeping space, unclean bedding and poor ventilation can also comprise health and wellbeing (infestations) and poor air quality (high CO2). In these agricultural communities most yards had a range of farm animals which can also impact the quality of air in a home and in all four communities a large percentage of household's own livestock (cows, chickens, horses, etc.). In some cases chickens were loose and climbed onto beds and other furniture. Building materials and household furnishing can also be a source of indoor air pollution. Domestic or non-domestic animals can shed or spread allergens, biological particles, and some gases. This close interaction between humans and animals was commonplace. Formaldehyde and volatile organic compounds (VOCs) can be emitted from wood products and paints, and earthen floors can emit radon as well as generate higher levels of suspended particulate matter.

Perceptions of Air Quality:

More than 50% of households in the three rural pueblos reported being very satisfied with the air quality within their homes, while often also believing that there are significant health problems related to indoor air quality (over 30% of reports). As for the quality of air outdoors, a lower percentage of people reported being satisfied, and blamed most of this discomfort on the Popocatepétl's frequent discharge of ash. It was surprising to hear that most people believe the random volcanic eruptions that send ash in their direction when the wind comes from the volcano posed a much greater risk on their health and on pollution than the smoke and pollutants generated by the daily wood-and-plastic-burning inside their homes. Additionally, most individuals who reported smoke being a problem in their kitchen, also denied experiencing any form of discomfort including eye and skin irritation, cough, etc. However, we did witness several families coughing or rubbing their eyes while cooking (including ourselves). Cooking with charcoal, without a ventilation fan, was associated with an even higher increased risk for asthma.¹⁴

¹⁴ From <<u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2760246/</u>>)

Housing & Poor Health & Exposure to Hazards.

We conducted five intensive case studies purposively selected in order to explore some of the micro aspects of the dwelling environment that could impact upon health and (im)mobility of household members around the lot. These case studies were identified after we had concluded the survey phase in each community, and it followed an intensive case study methodology used elswehere (Ward, 2015). Comprising several team members simultaneously on site to undertake a number of data gathering activities: 1) detailed measurements of the dwelling structures to prepare lot and building plans; 2) photographs and video records of all buildings and features; 3) air quality readings in all of most of the rooms, as well as water quality readings; and 4) one-on-one interviews with family members and with the original interviewee(s).

In order to conduct these intensive case studies, we first visited with the family in order to explain the objectives and to request their permission for five or six team members to come on site, not least since there would be considerable intrusion both in their dwelling space and demands upon their time. While families had not received any remuneration for the original interview which took around 30 minutes, given the intrusion and the time we expected to spend on site (3-4 hours) we offered a modest payment (500 *pesos*). We also informed the case study families that we would return in the Fall and provide each with copies of the detailed lot and dwelling plans.¹⁵ Of the six households whom we approached, only one family declined. A mutually convenient time and date was arranged for the second visit. In each case our architecture student, Melannie Ruiz, base in Austin drew up the specific house plans with lot and photos (see Appendix 4, Case Studies 1a-5a

<u>https://www.lahn.utexas.org/PueblaNeeds.html</u>), as well as detailed dwelling construction plans and 3-D sketch-ups, which, as we had agreed at the outset, we delivered to each of the five households when we returned in October 2019. (These internal house building plans are not included in Appendix 4.) We also created a second set of lot and dwelling diagrams in which we sought to pinpoint locations that presented possible health risks to household members. These risks included poor or dangerous air quality; poor building materials; proximity to animals (turkeys, goats, cows, etc.); uneven or dangerous surfaces, hose pipes, high entry lintels on doors all of which would impede mobility especially for the elderly; rooms with high humidity; and garbage or dump areas on the lot which attracted flies, and offered breeding sites for mosquitos etc.

In the following section we offer a discussion of each intensive case study and use the second set of lot and photo diagrams (below and Appendix 4 Cases 1b-5b), in order to explore how the micro lot environment and three dimensional structures, air quality readings for different

¹⁵ We are indebted to UT School of Architecture undergraduate student Ms. Melannie Ruiz who turned our sketches and measurements into the final plans as well as creating 3D sketch ups of each building. We returned in October 2019 and delivered the plans to each of the five families, usually at the open community meeting called at which we presented our broad-brush findings.

structures/rooms, behaviors and room arrangements may present health risks and hazards to household members.

Intensive Case Study # 1. San Fco. Xochiteopan. Rationale for Case Study

As we document in the Appendix this case was selected for three reasons (https://lahn.utexas.org/Puebla/Appendix4/Case1c.pdf). First, the survey had identified extremely poor air quality and the burning of plastic in the kitchen area (as an accelerant), such that smoke problem in the "cocina" was off the charts on p.10 = 928.05 (Hazardous) and p2.5 = 230.1. Second, it was a clear case of two dwellings, so we wished to explore lot sharing arrangements and organization of space: namely two families and proximity to a range of farm animals. Third, this family had been badly affected by the earthquake on September 19th 2017, and they were the recipient of targeted support from FCP and FUNDEN – and had received two prototype dwellings (houses). See Appendix 4: Case 1a for the initial detailed lot map with photos (https://lahn.utexas.org/Puebla/Appendix4/Case1a.pdf). (The diagram below is the health hazards plan derived from the initial photos and plans.)





Figure 4.3: Lot plan with Health Hazards. Intensive Case Study # 1 Xochiteopan: Home of Doña Victoria and family (see also Appendix 4 Case 1a-1c).

Synthesis of the Case from the Original Survey

Victoria ** and husband Vicente are owners. She is 46 (he 48), and there are two dwellings on lot; theirs and that of her son Felipe and his family. This is a "nuclear compound" arrangement (even though the two families often cook and eat together). Three people sleep in her house (she, husband Vicente and their daughter ** 10 years old). This is the green house marked on the plans with three rooms (apart from the *cocina* and *baño*).

Their home was one of many that were badly hit or destroyed by the earthquake and was the subsequent target of housing replacement intervention. Fortunately, no-one was hurt: it hit at 1:00 pm when most were in fields. But they returned to find houses destroyed. Doña Victoria & Don Vicente and daughter slept in their *camioneta* for three weeks until donors delivered some materials and they were able to construct a wooden room which they used for sleeping. Not until August 2018 (almost a year later) were the two houses were built and ready for occupancy. Meanwhile their son (Felipe) and his family slept in a shelter in the school. Don Vicente was part of the Committee Emergency kitchen – cooking -- and would arrive home at midnight.

In the upper sections of lot. The original house was built of adobe with space for the *camioneta*. The other "blue" house (on the plans) is partly made of adobe and block [see Figure 4.3 above, and Appendix 4 Case 1a), and this became the temporary housing for the two families. Today each room in the blue house is used for storage: Victoria has one side and son Felipe the other. The wooden structure (now above the blue house) was where Victoria's family lived once they received the temporary building materials, and while they were strongly advised not to use temporary wooden structure or the original rooms (the adobe structure blue house) after receiving their new homes, they nevertheless kept them and today use all three rooms for storage. The upper wooden structure is very awkward (and somewhat dangerous) to get to.

In the lower section is a brown shed (also built from materials donated after the quake), and is used as a breeding area for chickens and turkeys). It comprises a penned area for smaller ones, while the larger ones roam free in the daytime. The lower section also has a small *huerta* area. In their field plots they also grow some *hortalizas* (vegetables) in rainy season and do so off site because here the chickens etc. would otherwise eat them. They also showed us two pomegranate trees - Red and Grenada Amarillo -- and banana trees.

Middle Section of lot has a tractor "port" (they have 2 tractors which makes them better off than most), and this is also the area where the larger animals are penned (see photos): specifically several cows, horses and a donkey which they take to the fields each day so that they can forage, but it takes an hour to get there. They also have: 30 *borregos*; many *guajolotes*; 3 *caballos*; 1 *burro*; 5 *vacas* and one calf. They are *ejidatarios*, and have two tractors which they also rent out to other farmers.

Health Commentary:

Upon our return to undertake the intensive case study the hazardous air quality was confirmed in the kitchen (where the families also eat). We asked Victoria if this was common practice and,

a tad embarrassed, she nodded and said "most". This suggest that there is some awareness, but they do it anyway – i.e. it is not a lack of awareness. Somewhat unexpectedly given that these were newly constructed, rooms in both the pink and green houses also recorded poor air quality – either moderate of unhealthy for sensitive groups -- due in part we believe to poor ventilation (the windows were kept closed). Clearly there is little apparent cultural interest in cooking indoors since most people prefer wood and can't afford gas and gas cookers etc., https://lahn.utexas.org/Puebla/Appendix4/Case1b.pdf).

This is a serious working agriculture unit, and fertilizers were stored in the blue house, so they did not present a health risk. Although the cows and horses were close to the house the other animals (goats) were corralled away from the dwelling space; as were the chickens and turkeys.

The water cistern (see Photograph 4.2 earlier), is fed from the tap supply and is used both for drinking and for watering the animals. While not fetid, the water clearly was not fit for human consumption (insects etc.): if used as a drinking source it would be a health hazard.

The pipes and hoses leading to and from the cistern impede mobility and present a danger to mobility and may cause falls. Although no-one in the family is yet elderly, the high lintel to the blue house; multiple hose pipes, and an uneven climb to the kitchen and dwellings impeded mobility. And climbing up to the temporary storage room above the blue house was dangerous (climbing up of a chair).

The multiple stacks of wood, while set aside, are always a possible fire risk and likely harborage of pests such as snakes and scorpions etc.

Intensive Case Study # 2. San Fco. Xochiteopan. Rationale for Case Study

This case was selected primarily because it appeared on the survey as comprising three households living on the lot (<u>https://lahn.utexas.org/Puebla/Appendix4/Case2c.pdf</u>). Also of interest was that it included one of the post-earthquake FCP core houses which we first saw in a preliminary visit to the site in March 2018, and which by the time we conducted fieldwork a year later it was apparent that there had been considerable building activity. This included the enclosure of the open patio area on the FCP dwelling, and two new but as yet unfinished dwelling structures (see Appendix 4. Case 2a

https://lahn.utexas.org/Puebla/Appendix4/Case2a.pdf).

AIR QUALITY & OTHER HEALTH HAZARDS- CASE#2:S.F.XOCHITEOPAN



Figure 4.4: Lot plan with Health Hazards. Case # 2. Xochiteopan: Home of Lidia and Francisca, Extended Family (see also Appendix 4 Case 2b & 2c)

Synthesis

The original survey was conducted with Lidia, a 30-year-old mother who has lived on the lot all of her life and today lives in the FCP built dwelling with her son (aged 9) and daughter (aged 4). As we gathered the data it became apparent that this was actually

a mixed compound/extended household structure, headed by the matriarch Lidia's mother (Francisca), whose son Marcelino and daughter (Noemí) also live on the lot. Marco has **redacted health problems, is ** and sleeps in the blue wooden house (with the Guadalupe Image [now hidden on the site photos]), while Noemí is studying *preparatoria* and sleeps with her mother (Francisca) in the small two-roomed building (house # 2 Appendix 4 Case 2a). Francisca has two other adult children who live elsewhere, one of whom Erendino is building on site.

The incomplete new constructions are destined to be for Francisca and Noemí,¹⁶ while the redbrick dwelling will be for Erendino.¹⁷ The lot is large with two pig pens at the rear, and a plastic greenhouse (provided by the Fondo Mónica Gendreau) that Francisca attends to year-round – watering from the two large tanks (see plans at Appendix 4 Case 2a). These tanks were originally designed to store rainwater, but now are filled from the tap.¹⁸ She grows a variety of vegetables largely for home consumption. There is also a dilapidated storage shed and kitchen area adjacent to Marcelino's room, as well as a small corral for goats not marked on the plot map. Most of the cooking is done with wood in this kitchen, and there is also a baking oven on the corner of Lidia's house (see photos). In the entrance to the newly enclosed area of Lidia's house they have a small stove on which they cook tortillas (using *carbón*), and on the sink area they have an electric blender.

Health Commentary:

As one can observe on the plans (Figure 4.4 above, "Health Hazards" [see also Appendix 4 2b]), many of the rooms have poor air quality. Lidia's house is classified as "Unhealthy" in all rooms with particulate and CO2 readings at "unhealthy" or "moderately unhealthy" levels. We also noticed some damp in the former patio area at the entrance to one of the bedrooms. The poor air quality in the two bedrooms and bathroom are almost certainly the result of some dampness and inadequate ventilation. The "sala" which is the now enclosed patio space, even with an open doorway and gap above the new *tabique* block walls also has unhealthy levels, resulting from the heavy use as a dining area, and the small cooking stove located at the entrance.

¹⁶ It seems that Francisca's house is also being built – at least in part -- using earthquake reconstruction funding from FONDEN, but which are insufficient to complete the job (she said that in part because Marcelino demands money for drink).

¹⁷ Some confusion here since the notes also refer to an Erendino (son) who is building the brown house and that Marco will move into Francisca's two room dwelling when she and Noelmí move into the spacious new house. In fact, when we checked the red house in construction is for Erendino, and Marco will eventually take over Francisca and Noella's rooms. There are also plans to build two more homes at the back of the site for her other children. Upon our return in October we also met with Francisca's father and mother who have a house nearby in Xochiteopan.

¹⁸ In October when we returned, she showed me that she was prepping the greenhouse for new planting. October was harvesting seasons in the campo and there was also a lot of other food that could be gathered so fresh vegetables etc., were hardly necessary at this time of the year.

Marco sleeps in the wooden box room which has fertilizer bags stacked up at one end (removed by October when we returned), and this, too, has very poor air quality – actually "hazardous" on both particulate counts, almost certainly due to the poor ventilation and to the smoke from the kitchen area next door. The latter was also very unhealthy on the 2.5 particulate matter measures. Francisca's house is actually just bedrooms (for she and Noemí), and again the poor air quality is due to a lack of adequate ventilation (there is no cooking area – it is all done in the kitchen and in Lidia's house). Photos reveal that they also share a bed in one of the rooms. Improving air quality is a relatively easy fix through better ventilation, namely by opening the windows for air circulation.

Somewhat to our surprise, the two buildings in construction also showed poor air quality measures in one or more of the room spaces, which we interpret as a result of construction dust and also maybe proximity to the road and vehicle fumes, etc. The rubble and building materials lying around could cause problems for the youngest daughter (** or "chatterbox" as Dr. Ward called her).



Photographs 4.12a-d: Images from Case 2 showing garbage and hazards to mobility (Images taken by Dr. Peter Ward). See also Appendix 4. Case 2b.

In addition to the air quality problems that this case presents we can point to several other health issues in this micro-environment. Uneven surfaces and the hose pipes and building materials lying around the front half of the lot impedes mobility, and are especially hazardous for young children as well as the elderly (see photos in Photographs 4:12a-b). Uneven ground and entrance (to Francisca's house) would also likely to cause trips and impede mobility. Lidia is heavily overweight and appears to be in very poor health (diabetes?). The kitchen area is bare earth and combined with the dirty lot areas could be a source of infectious diseases.

Their drinking water comes from the piped supply. Hoses are used to move water around the lot and to fill the two cisterns (for the greenhouse). Although chlorinated, these on-site usage practices may lead to poor or contaminated water.

The rear part of the lot is strewn with garbage (plastic etc. – see photos 4.12 a-d above), and also smells foul -- in part due to the pig pens at the back. There is OK separation from the residential areas, but the area is a locus of flies, mosquitos (breeding grounds) etc., and other pests and disease carriers. Better yard care and cleanup would undoubtedly help reduce health risks here,¹⁹ as would removal of the junked vehicle.

Intensive Case Study # 3. San Fco. Xochiteopan. Rationale for Case Study

The rationale for selection was threefold: 1) the house comprised a single large room made of rudimentary and mixed materials for the walls, including plastic tarps, galvanized metal, and brick. The floor was also one of the few case study main rooms that had a dirt floor (which has major health implications); 2) Animals, including chickens and pigs and the chickens were free to roam inside the house, walking on the table and the beds. Thus, we were interested to explore how animals in close proximity to living space can impact health and quality of life. 3) The interviewee's six-year old (Christian) has mental and physical disabilities and for some years went to physical therapy to help him walk, so we were interested in observing his movement around the house and if he is frequently exposed to possible health risks presented by the animals on the property (https://lahn.utexas.org/Puebla/Appendix4/Case3c.pdf).

Synthesis of Case from Survey.

María Carmen Pérez is a 33-year-old single mother of a child with disabilities who no longer has any relationship with her partner. She lives with her elderly father (** 77), mother (** 75), and her young son (**). A brother also lived with them, but he died ** redacted. Until that time both her brother and father worked the fields, and the father continues to do so and hires a *peon*. Thus, this is a mix between an extended and nuclear family (extended since we focus on

¹⁹ We discussed this mess with Francisca upon returning in October, and she said that she was planning on clearing it up in the dry season -- now everything was too wet. She is also planning on building two more homes at the rear of the lot for her other two children, at which time she will get rid of the pig pen and the tree.

María Carmen). (See Figure 4.5 below, and Appendix 4. Case 3a Lot Plan and Photos for a detailed lot description.



Figure 4.5: Health Hazards' Case # 3. Xochiteopan: Home of María Carmen & Family

Our discussion here focuses on the lot plan above (Figure 4.5), but of importance in this case is that there is another house 15 mins walk away that belongs to a brother who lives in Puebla. Before the 2017 earthquake María Carmen and her family used to live in her brother's house down the street, but it collapsed. They received aid from the government and her brother, who is an architect, oversaw the reconstruction of the house. While they waited for the construction on the brother's house to be finished, María Carmen, her parents, and her son moved into the house they currently live in. It was originally built by her father around 10 years earlier to store the truck and tractor, but after the earthquake it became a place of daily residence. At the beginning it was only the brick wall and a rudimentary roof. The ceiling's galvanized laminated roof and tarps were added immediately after the earthquake to serve as walls and make it livable. The house consists of one single room that serves as a dining room, bedroom, and storage space. The floors are made of dirt and there is only one bed. Only María Carmen, her mom, and ** (son) sleep there since her father decided to sleep and guard the brother's house for fears of someone breaking in.

They walk back and forth between the two dwellings, and while the brother's house is much nicer and safer, her parents prefer to stay on the lot with María Carmen because they have more space, and there is room for the animals. They view the other house as too small, but prefer not to keep coming back and forth (difficult when it is raining and when she [María Carmen] is cooking). So she would rather stay here and do everything (feed everyone and the animals). María Carmen does use the brother's house as the hairdressing salon where she works Saturdays.

María Carmen's son ** has epilepsy since birth and received physical therapy to learn how to walk (achieved when he was 2.5 years old). He has still not learned to speak fully, saying a few words in broken-Spanish (e.g. "ia" instead of "mira"). María Carmen says he has the mind of a 2-3-year old. He used to go to speech therapy twice a week in Atlixco, now he goes only once a week. María Carmen said that he (son) doesn't have mobility problems in the house.

Animals in Proximity to Living Space.

They have chickens, turkeys, goats, sheep, and pigs. She says they used to take the sheep and goats to the *cerro*, but now there isn't anyone that can take them, so they are always locked up. Some chickens are kept in an enclosed area, but others are always loose. These walk into the house and climb onto things, including the only bed shared by 3 people. The animals always sleep outside, so at night they do not have access to the house. The pigs are located between her house and the goat pen (see Figure 4.5). She cleans their area every 8 days. The son ** plays in the goat corral and plays with the sheep and goats. Indeed, he plays with everything: the tree, with the pigs and with the chickens.

Like most families she cooks with wood and charcoal (carbón). The dwelling is one large room where they cook, eat, and sleep. There is humidity present in the room. They use a *jícara* to wash, not having a formal shower (although there is a shower in their brother's home).

Health issues Presented by the Case:

This case study presents several major health concerns. The quality of the primary dwelling is problematic, comprising a single room made of provisional building materials and tarps, with a dirt floor. All of the family eat and sleep in this single room, and different sections of the space are dedicated to different functions (sleeping, cooking, eating), and show moderately unhealthy air quality readings. A second hazard is the close proximity of the animals and particularly the fact that chickens freely roam all parts of the dwelling. Third, are the mobility risks that the uneven surfaces pose to María Carmen's son and to her elderly parents (see Appendix 4 Case 3b, 3c).

Intensive Case Study # 4. Colonia Agrarista. Rationale for Case Study

It is relatively rare to find single person households and even more unusual to find a disabled person who lives alone. He is paralyzed from the waist down, is unable to walk, and doesn't use a wheelchair to move within house. He moves around by himself (crawling) and does all

the house duties, including taking care of his yard and his *burro*. Therefore, the case of Manuel was of particular interest and we hoped it would provide insights about how the physical dwelling structure and the lot environment would be adapted to allow for mobility, as well as allow us to explore and identify the particular health challenges or hazards he faced. Specifically: how does he move around his house; how are his daily needs met? And how is his house modified to fit his disability (<u>https://lahn.utexas.org/Puebla/Appendix4/Case4c.pdf)</u>. We had also identified some poor air quality in one area of the patio.

AIR QUALITY & OTHER HEALTH HAZARDS- CASE#1:Col. AGRARISTA



Figure 4.6: Case # 4. Colonia Agrarista Emiliano Zapata

Synthesis of Case from Survey

Manuel Flores (51) owns his house and has lived there for 40 years. His house has been added onto during these 40 years. He is originally from San Francisco Xochiteopan and is one of the original founders of the Colonia Agrarista.

He was three years in the military and served as a lieutenant in Mexico City which is where he had his shooting accident that left him paralyzed from the waist down (the bullet hit him in the spinal column). He was 22 and married with a one-year old daughter at the time. Four years later his wife left him, leaving him to raise their five-year old daughter as best he could. Much later his daughter migrated to the USA and now lives in Brooklyn. Each month she sends him money – a lifeline for him -- and they talk often via the internet (there is a dish on the top of the house). He has had an internet connection for several months (since April), and it works very well so that he spends time on social media, and on other internet outlets to distract himself. But mostly, he uses it to talk to his daughter through videocalls. His father (83), and *sobrina* (niece) live in the community (actually next door), and everyday family members come and visit him, which he says, makes his life a lot easier because they increase his accessibility. He relies on his family to bring him groceries and take him into town.

Health issues Presented by the Case:

Mobility challenges are the first and foremost issue. His paralysis greatly affects his mobility and how he interacts with his house, and he utilizes great ingenuity to modify the dwelling to fit his needs and mobility issues. While these methods do substantially improve his mobility and independence, they are also a potential cause of injury. For example his house has a lot of steps because of the slope of the lot (See Appendix 4: Case 4a), and despite the fact that most of the house was built after Manuel's accident, it is not wheelchair accessible. To deal with the steps he has a lot of sticks and brooms around the house, which allows him to pull himself up into the rooms. (Ramps within the house, even used when he is on his hands, would improve safety and mobility.) As Manuel ages, he is at a higher risk for injuring himself again. As is well known, injuries from falls are commonplace in the USA and pose a hazard in all of the cases that we explored using case studies, especially as household members age (Under and Riley, 2016: 41; see also <u>https://stacks.cdc.gov/view/cdc/79969).</u>

Because he owns the house, he has been able to make modifications and accommodate to his unique needs, including setting light switches, shower fixtures, latrine, and kitchen appliances at an accessible height. While he mostly uses cups for showering, his shampoos and soaps are at a low level to allow him to independently take a shower. In fact, in the months since we conducted the survey, he has added a well-equipped bathroom, a "sala", and installed a solar panel water heater (see below).



Photographs 4.13a-c: Additions to Manuel's home July-October 2019: Solar panel water heater; new bathroom and "sala/bedroom"

The latrine is located far from the house, making it less easy to access, but is a good option to improve sanitation. This latrine is a concrete hole in the ground without an above ground seat, which is very comfortable and accessible for Manuel (see Appendix 4: Case 4a).

The kitchen appliances are also low to the ground and accessible to Manuel, allowing him to enjoy one of his favorite tasks – cooking -- while also helping him maintain his independence and cook for himself. Unlike most of the community he cooks using propane – which is probably for the best since the kitchen has no windows (see Appendix 4 Case 4a & 4c) so the air quality is not affected. He believes that the water is very poor quality and does not think that it is chlorinated. There was no evidence of humidity or pests, and fertilizers are stored in the patio which he thinks is safe. In fact, this is the one area where there is poor air quality ("Very unhealthy" and "unhealthy" readings – see Figure 4:6 above for levels).

The house has concrete floors. While this is practical and health wise is the best option, he moves using his hands and protects his arms using an old feed-bag. Again, this method seemingly works for him but could cause injury and pain in his arms and legs. A wheelchair can ease mobility burdens and improve quality of life.²⁰ The storage shed has dirt floors which could present a disease problem given that he uses his bare hands to move around.

As a step to increase his independence, Manuel is able to mount his donkey by himself using a house modification that he created. In his storage shed he has a space to mount his donkey using rope and a pole that runs across the entire building. To get on his donkey he wraps a rope around himself and pulls himself up. While he pulls himself up, he calls the donkey over and when the donkey comes he drops himself down onto the animal. This gives him independence and allows him to visit the fields and talk to people. But it is also risky – should he fall (although he says he has no falls in two years). As Manuel gets older, there is a higher propensity for a dangerous fall while using these informal methods.

²⁰ https://www.youtube.com/watch?v=qCHVuMgz18c

The road that leads to the house is very rocky and is one of a number of streets in the pueblo that has yet to paved. This limits his mobility within the community as he is unable to use the wheelchair. In order to leave the property he must rely on the help of others, specifically his niece and father who live nearby. They bring him into town in a car for doctor's appointments and usually bring his groceries to the house.

This is a remarkable and unique case from which it is difficult to generalize. Even more remarkable is his optimism. With great individual ingenuity and perseverance, he has modified his dwelling environment to enable him to largely overcome his disability and enjoy a degree of mobility. His donkey is his lifeline to the outside; as are his *sobrina*, friends, and the financial and moral support that he receives from his daughter in the USA. While by no means well off economically, his fields and the remittances from the USA allow him to survive. One wonders how he would manage without. The principal health challenges are hazards associated with his disability. At first glance one would assume that modification of steps to ramps would improve his use of a wheelchair, but at the same time, *he needs and uses the steps to exercise that mobility*, and a wheelchair and ramps might present even great hazards in the event of loss of control. Laying a concrete floor in the storage shed would both improve access and reduce the disease risk associated with the dirt floor. Unless and until the road infrastructure is improved, a (the) wheelchair is not an obvious solution: he will continue to rely on his donkey.

Intensive Case Study # 5. Santa Ana Coatepec. Rationale for Case Study

The case was selected for several reasons that broke-out of the survey. The house structure is the most consolidated of the five cases; there is good lot space organization within the house at the front; and with the location of the *huerta* and animals at the rear (good separation of the animals [*borregos*]). Ana lives with her elderly mother who has mobility problems, and they have a small store at the front of the house, and we wondered how tempting it might be to regularly graze on snacks and sodas. Finally, remittances have greatly impacted family finances, substantially improving living conditions (<u>https://lahn.utexas.org/Puebla/Appendix4/Case5c.pdf)</u>.

IRMA-ENTIRE LOT PLAN W/ PHOTOGRAPHS

LEGEND: Air Quality Indicators: pm 2.5;pm10.0

CO2:

Levels: Good (not shown on diagrams) Unhealthy categories: Moderate (M); Unhealthy Sensitive Groups (USGs); Unhealthy (U); Very Unhealthy (VUH); Hazardous (H!)



Figure 4.7 Case # 5. Santa Ana Coatepec

Santa Ana Coatepec while being a pueblo is located close to Atlixco which we classified as "periurban". The proximity to Atlixco means that the employment structure is more diverse, and that consequently it is somewhat better off than San Francisco Xochiteopan and Colonia Agrarista. Being much closer to Atlixco it also has better access to medical attention (see Chapter 2).

Synthesis of Case from Survey

Doña Ana is aged 52 and lives with her mother Xochitl (aged 84)and her son Simón (23) who is currently away at university. They have a single (but sizeable) home that was previously owned by her grandmother who was one of the original *ejidatarios*, going back 100 years or so. Her grandmother split the lot in two, and her cousin is her neighbor.

They frequently go to Ana's niece, (** a nurse) to get medical check-ups. Ana has lived in the U.S for a year, but returned a long time ago, and has another son who was born and lives in McAllen, Texas. She also has a brother that lives in the U.S and has arthritis. She uses both gas and carbón to cook, but primarily uses gas. Her family eats fruit regularly, and in the backyard she has dragon fruit, pomegranates, and calabazas. The family uses well water and bottled water, the latter since she is worried about the chlorine levels in tap water. Her mom pays for the aqua potable (tap), but they use mainly water from the well and drink bottled water.

Her Mom (Xochitl) is the formal owners (although there are no deeds), but she pays the *predial* (property tax) and the utilities and has all the records. Xochitl has a Will, and the beneficiary is Ana's brother. She, Ana, has extensive contacts and family in the United States, including her son in New York, and her brother in McAllen with whom she is quite close. She has four brothers and a sister, and her mother receives remittances from all of her siblings. The money her mother receives is mostly for health issues, as well as for the maintenance of the various properties and fields. Her mother has had knee surgery most recently through Seguro Popular, as well as cataract surgery on one eye.

The house is structurally sound with an open sided cooking area with a wood fired oven and chimney. The floors (in her Mom's rooms) are made of a material that makes it easier for her mom to walk around. But in her room it can also be slippery, so they put a special floor for her to walk about (see Appendix 4 Case 5a-c).

Relative to the other cases there was a large amount of space in the house, and each member has their own part and seemingly has to share very little with other family members. They even had multiple storage spaces for different things. It was also interesting to see how the lot was separated and had been split in two, but the cousins (next door) still keep in close touch and mutual visiting is via a chain link door connecting the backyard, and a small chain link "window"/door at eye level through which to share food and stuff without having to go out the front.

Health issues Presented by the Case:

In general Ana's house presents relatively few negative health issues. The husbandry of the animals is well organized and removed to the back of the lot. The cooking area is well ventilated, and her wood fire has a chimney to extract the smoke, but she generally uses gas (propane). The well is covered and well maintained, although we did not measure its quality, and the water is mostly for household use (Ana uses bottled water). Care has been taken to minimize the dangers of her mother falling by laying down a non-slippery surface, and the front patio area is made of concrete and is reasonable flat. There are stairs down into the small shop, and while steep her mother seems to be capable of getting up and down.

The only real health issues are the "Moderate" levels of CO2 in several rooms and in the car port area at the front of the house. When we pointed this out to her, and expressed our surprise, she suggested that it was probably due to cars on the road. The moderate levels in her bathroom, bedroom and storage area (see Figure 4.7 left hand side of the diagram [Appendix 4 Case 5a) are probably the result of poor ventilation, and the windows being closed. We observed some dampness in her mother's bedroom which she also later explained (in October when we delivered the plans), was due to water coming in off her neighbor's roof.

In short, this case presents a good example of a well-maintained home and lot: good site organization; well-constructed physically (for the most part); clean and offering reasonable mobility around the lot especially in the front half. Group reflections as we exited and

discussed the case, were that unlike other cases this home was clean and "modern", with much more interior furniture. The dwelling appears to transition through the lot to more provisional structures (around the patio and "kitchen"), through to the rear section which comprise sheds and storage and provisional outbuildings, the *huerta*, and pens for the goats, etc. It was as if there were two adjacent cultures all integrated into a single case. In many respects this is exactly what it is: a peri-urban pueblo in which agricultural activities sit alongside more service and other activities. Both traditional and modern, but in ways that are a positive hybrid (not a dichotomy).

Ana clearly takes considerable pride in what she has achieved (with her brother's help), and from her own hard-won earnings as a seamstress (*costurera*) and later through the shop.

Overall Summary of our Principal Conclusions on Chapter 4: Housing and Health.

The wider survey, our interviews, focus group discussions, taken together with the insights formed by these intensive case studies provide further evidence of how important and helpful it can be to examine the micro (dwelling and lot) environment and multiplex interaction between the physical fabric and how these shape people's health and wellbeing. Household and individual behavior mitigates or accentuates risks. Moreover, this dynamic changes over the life course: what affects young children and adolescents is likely to be significantly different to the middle aged and elderly, and vice versa.

Previous sections of this report have highlighted that the principal health (often chronic) challenges are diabetes, hypertension and muscular skeletal pain (arthritis etc.), all of which are known to present at increasing levels over the life course. We have also noted the widespread nature of "lighter" (non-chronic) illnesses such as diarrhea and gastroenteric diseases, as well as respiratory illness such as asthma, etc. In ways that are often well known, the dwelling environment can exacerbate such adverse outcomes (Unger and Riley, 2016; Tartof et al., 2016). We have documented many similar outcomes, but our research has also complemented the literature by providing a much more nuanced understanding of the physical and behavioral interactions in poor rural pueblos in Mexico.

Infrastructure Water and Drainage

Access to potable water is essential and our study highlights the following:

- Ensuring that potable water supplies are appropriately chlorinated is essential, and that adequate levels appear not to be met in the study communities.
- Increase the number of days water supply each week (to reduce the need for storage and possible chlorine dissipation).
- Where other (non-chlorinated) water is captured (rainwater collection; wells, etc.), and where tap water is not effectively chlorinated, then water should be systematically boiled and/or filtered, and wherever possible refrigerated, before drinking.
- Enhance cleanliness practices when scooping or drawing water from storage tanks.

• Bottled drinking water is rarely consumed in the poor pueblos, although it is more widely used in the better off peri-urban pueblo of Santa Ana and in urban *colonias* and neighborhoods. Cost is the primary mitigating factor, but we also found is also widespread suspicion about the purity of bottle water. Such suspicion and lack of confidence should be addressed.

Sanitation is generally through pit latrines and septic tanks.

 We have little information about whether or not this contaminates water sources (wells especially). However, it seems likely that close proximity to farm animals and animal feces are a likely contaminant (directly or indirectly) of water tanks and present hazards to household water usage such as washing, bathing cleaning etc.
(Tapeworm and other infections can be absorbed from well and other water sources without actually being drunk.)

Many streets lack formal paving and this inhibits access and mobility especially for the elderly and infirm. That said, the recent street expansion in the newer section of San Fco. Xochiteopan will greatly assist access and mobility to that half of the community.

Household Behaviors with the Home:

Our primary findings are those that will improve nutrition to mitigate poor health outcomes:

- Reduce the consumption of sugary drinks in all communities, but especially those where rising incomes are likely to make consumption more available. Sugary drinks are related to obesity and diabetes especially. Greater awareness and production of natural & consumption of fruit drinks (with potable water) is encouraged, especially building upon existing producers (as in nearby *pueblo* San Fco. Huilango for example where Alejandro has promoted this).
- Reduce intake of unhealthy "snack-type" foodstuffs (this is largely in the better off communities where people can better afford it).
- While poverty is the principal constraint to regular consumption of meat, encouraging greater access and consumption of vegetables, fruit and wild plants should be a priority (*hortalizas* – as it already is through Fondo Mónica).

Improved air quality.

Behaviors to improve air quality and reduce negative health outcomes:

- Ensure greater (or more adequate ventilation) around wood burning stoves and ovens. This might include openings that would encourage breezeway flows; and removal via extractors or other fans, etc.
- Promote the adoption of safer fire lighting procedures (not using plastic as an accelerant).
- Develop workshops to promote the adoption (&/or retro installation) of chimneys and other more efficient wood burning systems.

- Maintain separation between cooking and family eating areas.
- Keep children away from the smoke and cooking area since their lungs are less capable of resistance to damage and it can exacerbate asthma, and other respiratory diseases in younger children.
- Increase awareness about CO2 (how it is produced through exhaling, car exhaust etc.), and the widespread existence of poor air quality due to (unseen) CO2 levels. Ventilation is key here, especially in bedrooms and enclosed spaces.
- Windows should be opened, and bedding aired daily.
- Avoid storage of chemicals and fertilizers close to, or in spaces that are used for sleeping or dining. They make for poor or even hazardous air quality.

On the dwelling structures and lot management

Poverty, by its very nature means that many on site dwelling constructions are of poor quality and offer inadequate protection from the elements, and in some instances harbor threats to poor health and wellbeing. Unlike in the USA and in most urban areas where people spend a large part of their daily lives indoors, rural populations such as those we observed in Puebla, spend most of their time outside – either in the fields, in the outside patio – working, cooking, playing, relaxing, and eating. They use the indoors far less, and rarely do so for cooking unless they have electric and gas stoves. Even the modern prototype homes built after the earthquake were "urban design", and our observation (and video coverage) revealed that they were primarily used for sleeping, as a place to mount their religious altar and candles, and for storage, rather than as safe areas for play or entertaining. Indeed, the relative lack of furnishings demonstrated the clear differences with what would be consider "normal" households' use of room spaces in urban society.

Our surveys were largely conducted in people's homes and patios, so we experienced a wide range of housing conditions (as Table 4.3 shows), ranging from well-built homes, new earthquake replacement dwellings, to one and two-room hovels. Our five intensive case studies broadly cover that span and offer many insights:

- While earth floors are no longer as common as in the past, they are difficult to keep clean, and present a risk to disease and infection especially to children (Chargas disease, malaria, etc.). Small scale loans (or grants) to provide a concrete floor in living spaces would help. (Also important in non-living spaces, to which children have access.)
- Attention to minimize damp and high humidity especially in sleeping spaces.
- Improve ventilation and air circulation by ensuring that windows and openings provide for a throughflow of fresh air.
- Increase availability of natural lighting in all rooms, and especially where none currently exists Ensure safe storage of foodstuffs and maintain a level of surface hygiene that will minimize pests and the disease dangers and bites that they can pose.

- Minimize uneven floors and walking areas that impede mobility and pose a threat to falls.
- Similarly, keep yard space clear of items that impede mobility and cause tripping and falls (hoses, pipes, etc.)
- Keep yards clear of garbage and other items (tires for example) that provide harborage for pests and disease
- Maintain a healthy level of separation between farm animals and household sleeping and eating and food preparation spaces.
- To the extent possible, maintain tree and shrub foliage close to the dwellings to provide shade and to improve air quality (plant absorption of CO2).

In short, our detailed discussion in this chapter, and the summary overview provided above, emphasizes the need not only to better understand the epidemiology of these communities and the ways in which health care is sought and received, but also the ways in which the micro level environment of housing and home are inextricably bound-up with behaviors and practices that impact upon health and wellbeing. In fact, we venture to suggest that such interactions between housing, home, and good health outcomes, are more dynamic and more volatile than they are in urban and more "safe" housing environments.

References for Chapter 4

- Belanger, K., & Triche, E. W. (2008). Indoor combustion and asthma. *Immunology and allergy* clinics of North America, 28(3), 507–vii. doi:10.1016/j.iac.2008.03.011
- Biswas, Sudhangshu Kumar, Rahman, S., Kobir, S. M. A., Ferdous, T., Banu, N. A. (2014). A Review on Impact of Agrochemicals on Human Health and Environment: Bangladesh Perspective. *Plant Environment Development, 3* (2), 31-35.
 <u>https://www.researchgate.net/publication/275659333 A Review on Impact of Agroc hemicals on Human Health and Environment Bangladesh Perspective</u>
- Bogolasky, F., & Ward, P. M. (2018). Housing, Health, and Ageing in Texas Colonias and Informal Subdivisions. *Current Urban Studies*, *06*(01), 70–101. https://doi.org/10.4236/cus.2018.61004
- CDC. The Safe Water System: Safe Storage of Drinking Water (1996). *Centers for Disease Control* and Prevention. <u>https://www.cdc.gov/safewater/pdf/safestorage_2011-c.pdf</u>
- Children's environmental health. *World Health Organization*. <u>https://www.who.int/ceh/risks/cehair/en/</u>
- Dietert RR, Etzel RA, Chen D, et al. (2000). Workshop to Identify Critical Windows of Exposure for Children's Health: immune and respiratory systems workgroup

summary. *Environmental Health Perspectives*, 108; 483-490. <u>https://www.ncbi.nlm.nih.gov/pubmed/10852848</u>

- Frank, A. L., (1992). ATSDR Case Studies in Environmental Medicine. Taking an Exposure History. U. S. Department of Health and Human Services, 26, 1-55. <u>https://www.atsdr.cdc.gov/csem/exphistory/docs/exposure_history.pdf</u>
- Pemberton, S., Gordon, D., Nandy, S., Pantazis, C., & Townsend, P. (2007). Child rights and child poverty: Can the international framework of children's rights be used to improve child survival rates? *PLoS Medicine*, 4(10), 1567–1570. <u>https://doi.org/10.1371/journal.pmed.0040307</u>
- Perez Maldonado, I. N., Pruneda Alvarez, L.G., Diaz-Barriga, F., Batres Esquivel, L. E., Perez Vazquez, F. J., Martinez Salinas, R. I., (2011). The Impact of Air Pollution on Health, Economy, Environment and Agricultural Sources, 361-365. <u>https://www.researchgate.net/figure/Percentage-of-Fuel-Wood-Users-at-the-</u> <u>Municipal-Level-in-Mexico-2000-Source-Masera_fig3_221917200</u>
- Rowles, L. S., Alcalde, R., Bogolasky, F., Kum, S., Diaz-Arriaga, F. A., Ayres, C., ... Saleh, N. B. (2018). Perceived versus actual water quality: Community studies in rural Oaxaca, Mexico. *Science of the Total Environment*, 622–623, 626–634. <u>https://doi.org/10.1016/j.scitotenv.2017.11.309</u>
- Ward, P. M., Jiménez Huerta, E. R., & Virgilio, M. M. Di. (2014). Intensive Case Study Methodology for the Analysis of Self-Help Housing Consolidation, Household Organization and Family Mobility. *Current Urban Studies*, 02(02), 88–104. <u>https://doi.org/10.4236/cus.2014.22010</u>
- WHO (2005). How to measure chlorine residual in water. *Technical Notes for Emergencies*, 11, 5-8. <u>https://www.who.int/water_sanitation_health/hygiene/envsan/chlorineresid.pdf</u>

CHAPTER 5: THE KEY TAKEAWAYS FROM THE PAGL STUDY (Primary Chapter Author: Peter M. Ward)

In this final chapter we seek to provide a summary overview of the main findings of the various dimensions of our study and, wherever possible, to point to some potential action items that might be considered by the communities themselves in collaboration with our partners (the Fundación Comunitaria Puebla [FCP], Fundación Mónica Gendreau [FMG], and by the Benemérita Universidad Autónoma de Puebla [BUAP]).

The Context

The main goal of the study was to undertake a health needs assessment of very poor agricultural pueblos in the State of Puebla, and our selection was driven by communities in which our partners were working on various projects identified by each community (mostly but not exclusively agricultural extension efforts). UT-Faculty mentors made the final selection after visiting a number of pueblos and elected to work in two of the agricultural pueblos (Xochiteopan and Colonia Agrarista), which while being physical adjacent and sharing many characteristics, were also sufficiently different as to offer variation in responses to health and poverty challenges. They were unequivocally rural agricultural communities, both at a similar considerable distance from the nearest major town and market (Atlixco). San Francisco Xochiteopan was the larger of the two, ostensibly more developed (paved streets, more consolidated housing construction, had slightly better access to transportation systems, enjoyed more baseline health facilities and outreach services, but had also suffered more extensively from the September 2017 earthquake. Colonia Agrarista Emiliano Zapata was fiercely independent and proud, with a much smaller population and a strong sense of community cohesion. While it had also suffered earthquake damage, the impact appeared to have been far less than in Xochiteopan. As it turned out, these a priori bases for selection did carry over into distinct differences in health care and community organization, which we have documented and analyzed in the chapters and which we summarize below.

The third rural pueblo was selected because it, too, offered significant *prima facie* differences with the two rural pueblos. Santa Ana Coatepec, while largely agricultural also offered more service economy activities. It was also the more consolidated pueblo with paved streets, one-and two-story houses, and relatively good transportation services. At first sight the population looked to be better off economically. Santa Ana can best be characterized as being a "peri-urban" rural community given its close proximity to Atlixco.²¹ We expected Santa Ana to show

²¹ Peri-urban designation relates to those communities that are beyond the city boundary but are firmly in the penumbra of the nearby town of city. They can include rural pueblos (as in Santa Ana); better off exurban commuter villages and neighborhoods often with weekend amenity homes; and increasingly throughout Mexico,

health profiles closer to that of the urban neighborhoods such as our fourth community of study which was a lower-income urban *colonia popular* in Atlixco itself.

Santa Ana is located under a small hill (an extinct volcano), with small side streets built off a long main street leading down to the church and its main square, which also holds the offices of the municipal president (*auxiliar*). The pueblo's water source and treatment plant are located halfway up that hillside. Scross the community the water table is quite near the surface such that many (most) households had their own well (*pozo*) in their yard. This feature of private wells also interested us.

As mentioned above, the fourth neighborhood was an urban colonia popular – Colonia Flores Magón – which had developed, or more accurately, stated as a pueblo on the outskirts of Atlixco and had expanded into a colonia popular some 40 years earlier ago and was therefore now quite close to the city center. Our selection was predicated upon the anticipated differences in health behaviors given the relative advantages of access to health providers. We also wanted to extend the study to allow us to engage with low-income informal settlements which are widespread in urban Mexico, as well as in Texas where they are known as "colonias" and as "informal homestead subdivisions" (Ward and Peters 2007; Ward 2015). We hoped that a future element of the AMPATH model would extend to these informal settlements as part of a health-based community outreach program in central Texas.

The Communities and the Survey Sampling

The Purpose and Goals of study were 1) to conduct a rigorous health needs assessment *a la* AMPATH; 2) to examine mental health, reproductive health and general community wellbeing, and to gauge the community organizational capacities that exist in these communities; and 3) to examine the ways in which the physical structures of dwellings and the micro lot environment may affect health and health outcomes.

In developing our sampling framework, we were aware that lot sharing among households that are close kin related (adult daughters and sons, in-laws, etc.) are a common feature of both rural and long established urban *colonia* communities. This arises for various reasons, but lead to multigenerational family and household arrangements. These can be extended household structures, or so called "compound" structures, where kin related families live separately as individual family units. A single lot may have two or three close kin related nuclear households, one or more of which may also be an extended household structure (including an elderly parent, for example). Shared lots were quite common in our survey, and we often found ourselves having to make a decision about which household (of several on the lot) to interview, and to decide how far we should explore the "reach" of health care arrangements across households living on the lot. For the most part we focused upon a single household but took

low income mass social-interest housing estates promoted by developers since the late 1990s taking advantage of the lower land prices on tracts way beyond the city's built up fringe.

cognizance that there was a broader network of experiences and perceptions among the wider family.

We adopted a mixed methods research strategy, but the mainstay was a household survey which ultimately generated 242 responses overall. While we originally intended to conduct random selection this quickly fell by the wayside, since we found ourselves heavily dependent upon introductions to households from our community partners at the "Fondo Mónica" -- Paty and Alejandro. Without their help in introducing us to households (usually those with whom they had worked in their extension activities), we would likely: 1) not have got such a positive response (or an any response at all!); and 2) certainly not received such an open and receptive response from interviewees. Does it matter that the survey was non-random? Yes, of course, to the extent to which we cannot as readily generalize to the wider community population. However, these are not highly heterogenous communities: lot size, household activities; poverty and economic levels are broadly similar, as are consumer behaviors. In addition, the number of surveys conducted in each community (with the exception of Flores Magón), represented a substantive percentage of the overall households. Therefore, we are confident that our findings are fairly representative of the baseline community as a whole.

In addition to the survey we conducted key informant interviews, focus groups on key issues that arose in the course of our survey and community engagement, and several intensive case studies to explore the ways in which dwelling environments impact upon health and wellbeing.

In Colonia Flores Magón data were gathered solely through the survey, and here we did adopt a randomized selection strategy (every Nth house, for example), and here any bias was largely that of whether and whom we found in and available to respond to our questions on that day and at a particular time. (We did not interview after 5:00pm.) While we had hoped for 70-80 interviews (as elsewhere), regrettably we were obliged to abort surveying for security reasons midway through the interviewing cycle (see Chapter 1).

Health Care & Quality of Attention

Gathering information about the health profiles and patterns and quality of attention received was a primary goal for our study. Given that household selection was non-random and that the data were reported by household heads for members of their family, our findings cannot be presented as generalizable prevalence or incidence rates. Rather these data report on response rates provided by the head of household (usually female) about members of her household. Our findings look at levels of reported illness and treatment: chronic illnesses; other acute periodic illnesses; and serious accidents requiring treatment. The principal findings were:

Primary <u>chronic illnesses</u> reported across all three communities were: 1) Hypertension,
2) Diabetes, and 3) Musculoskeletal problems. Diabetes and hypertension are closely linked, and the high reported percentages of musculoskeletal conditions are most likely an outcome of age and/or the labor-intensive lifestyle of agricultural workers.

 "<u>Acute illnesses</u>" such as intestinal health disorders, respiratory and severe 'flu like illnesses are almost certainly related to a multitude of issues including, but not limited to, poor air quality (volcanic ash and smoke inhalation from wood burning), changes in temperature and inability to control in-house warming or cooling, lack of clean drinking water, poor hygiene, and poor physical conditions of the dwelling structure itself.

We asked detailed questions about access to health care and treatment in order to identify some of the principal challenges faced by the respective communities. Especially in the case of the two remote agricultural pueblos we found the following major challenges:

- 1) The difficulties of leveraging access to health care and medical attention (due to <u>limited transportation services</u>, and costs of the same (especially time).
- 2) On the <u>lack of availability of medicines</u> in public sector facilities such that people invariably had to go to a pharmacy (usually in Atlixco), and buy the medicine out of pocket, furthering adding to the financial burden.
- 3) On the relative <u>quality of the actual treatment</u> received. Significantly, our findings show that even with Seguro Popular coverage, a large proportion of the population seek treatment from private providers doctors whom they know and trust and can see more expeditiously (by appointment). This implies higher costs as the private providers must be paid for: Specifically:

Public vs private sector. Nearly one third are using private sector despite the increase cost of receiving private treatment. The reasons appear to be:

- That private providers are utilized more because of increased confidence, trust, and continuity from care givers versus public clinics and hospitals (the public provider in Xochiteopan rotates every 6 months)
- The fact that in most cases medicines must be purchased at a pharmacy anyway, even when treatment is in the public sector. This makes private treatment a better option for many even though they pay for the actual consultation.
- Private consultation charges are considered to be reasonable, especially taking account of the time saved (avoiding long wait times etc.)

Although only a relatively small proportion of households reported a severe accident in the previous 12 months, given the severity and high costs, most treatments would be in public sector facilities – as would major surgeries and hospitalizations.

• 4) Women's <u>health and reproductive health services</u>; breast and cervical cancer screenings, etc.

- Awareness and knowledge about such services was good and household perceptions were generally quite positive, largely we believe as a result of the PROSPERA program (since terminated by the López Obrador administration).
- Significantly this level of positive perceptions and usage of public sector services for reproductive services is in sharp contrast to the health care patterns outlined above.
- 5) <u>Nutritional Practices</u>. Given the high levels of reported diabetes and the obesity epidemic in Mexico, we asked questions about nutritional intake both generally, as well as in less nutritious foodstuffs. Our findings are:
 - Regular soda and juice (sugar added) drinking is quite high at around one quarter (25%) of households consuming several times a week. Our data (and focus groups) suggested that this was because people liked sodas, and we found some resistance to change. Another reason for drinking soda and juices are that it is a source of clean hydration, whereas the tap water may not be perceived as drinkable/safe.
 - Processed foods: candy, cookies, chips etc., were also widely consumed (45%) especially to kids after school and were usually bought from local corner stores.
 - Undertaking healthy nutritional practices is a challenge for many households due to the costs and the seasonal nature of access to fruits, vegetables, etc. Many households cannot afford meat and eat it only once a week or less. Vegetables are purchased at the market in Atlixco, which is a far drive from the rural communities and is, for many, a once weekly shopping trip.

Mental Health and Community Wellbeing

Following on from our questions about health we felt that it was important to get a clear sense of respondent perceptions of mental health and to ensure that the issue of mental health was placed firmly on the agenda in terms of low-income communities and public health. We also explored perceptions about common health challenges faced in each community (alcoholism, drug use, smoking, domestic violence, etc.). We were also interested to gauge the level of community interaction and solidarity – collective social capital -- that would help to confront such challenges. Given the high levels of out migration from Puebla to the USA, and what we anticipated would be a relatively high level of connectedness to those who had kin in the USA, we were interested in knowing more about the frequency of contacts and the extent to which there is a heavy reliance upon remittances and engagement with family that affects health.

In order to examine the issue of mental health we used three standardized measures adopted by the World Health Organization: namely Patient Health Questionnaire (PHQ2) – Depression; Generalized Anxiety Disorder (GAD2); Perceived Stress Scale (PSS). Including these mental health measures in our study was innovative since it rarely figures as a major arena in public health issues – at least not in low income and rural communities. On the basis of our findings we argue that it should firmly be on the agenda of BUAP and public health agencies.

Standardized Tests on Mental Health

Stress levels were moderate to high in all four communities and are likely a reflection of the emotional toll of living in marginalized and economically poor communities. In other words, unlike anxiety and depression, stress was elevated in all four communities. Also, the Flores Magón scores were consistently higher across all three measures.

We also found that many respondents were uneasy about recognizing mental health in terms that are not "pathological" and abnormal. There is an obvious need for improved communication, especially in addressing the stigma often associated with mental health.

One area where we found high levels of anxiety and stress appeared to be related to the 2017 earthquake and the ongoing seismic activity in the area. To assess the mental health toll of the earthquake we asked people if they had experienced "depression" "anxiety" or "fear" in its aftermath. Significantly, all communities registered very high reports of at least one of the symptoms as being very high due to the earthquake (between 78% and 94% of respondents). Of these, "anxiety" is the most recognized and tangible. The earthquake had a profound psychological impact which persists today, and could provide a "hook" to get people to think and talk about other areas of mental health as non-stigmatized.

Community Perceptions of Addiction, Mental Health etc.

As well as trying to assess how people viewed mental health, we asked respondents about the extent to which they perceived mental health issues to be a problem in general. We also asked about perceptions of the presence and levels of severity of practices such as alcoholism, smoking (tobacco), drug abuse, and domestic violence.

In two of our communities, one rural one urban, a third of the respondents described mental health as a "serious problem." Our data also show fairly high perceptions that alcoholism, tobacco, and drug abuse are problems within the community. This was especially the case in the urban community of Colonia Flores Magón. Two communities reported significant levels of domestic violence while the other two reported comparatively lower levels of the same. It should be noted that particularly in the rural communities, there's no place to actually address these problems: specifically, no community-based rehabilitation centers or professionals who

are able to talk to people about these challenges. Similarly, as mentioned above, there is no space to talk about mental illness or substance abuse, both of which remain highly stigmatized.

Community Cohesion:

Overall, rural communities see themselves as having fewer mental health problems compared to the urban community. Moreover, rural communities appear to have significantly greater cohesion and optimism about their future. Optimism about the future was high in the two most rural communities, which we interpreted in part as a reflection of the ongoing community infrastructural and other improvements: in Colonia Agrarista the construction of a new clinic; and in San Fco. Xochiteopan the road link to the upper and newer part of the community, although other variables may account for these indicators of community wellbeing,

In Colonia Flores Magón, community solidarity and mobilization would have been high when the *colonia* was first established and populated but has long since attenuated. It was the outlier when measured in terms of community cohesion and optimism about the future, and many expressed their concerns about smell and unhealthy conditions arising from the barranca alongside one edge of the *colonia*, and also about insecurity. Flores Magón also scored consistently higher on all of our mental health measures, indicating greater mental health concerns in that neighborhood.

Immigration and Links to the USA

As is well documented in the literature, the state of Puebla and its rural communities are widely engaged in transnational networks. Such networks can be important especially in so far as there is regular communication between households and family members living in the USA, as well as generating remittances to rural households which can be important to bolster subsistence, to pay for the costs of medication and treatment, and for home improvements, especially after the earthquake.

Our study found all of these things. Almost 50% of the households interviewed had a close family member living in the USA, and some had themselves spent time living in the USA. Communication with family remembers was generally frequent. In two of our intensive case studies we were able to document the importance of this regularity of contact and its impact upon health care and home improvement.

Housing and Health – Summary of Findings.

There is widespread research about how the micro housing environment can impact health, not least since, in the USA and Europe, people spend over 70% of them time indoors. Also, there is considerable research and policy advocacy relating to "ageing in place", especially around the idea of retrofitting dwellings and ensuring that neighborhoods retain a mixture of housing opportunities that can continue to accommodate the elderly (Bogolasky and Ward, 2018).

However, there is less research about housing and health in less developed country environments, especially low-income neighborhoods and in informal housing settlements (Corburn and Riley 2015). Moreover, in Mexico as in many cultures of Latin America, the elderly either age-in-place usually by living in multi-generational households with their adult children and grandchildren; or they move-in to love with one of their adult children. In our surveys we saw many examples of the first scenario, where multi-generational families live together in a single-family unit (extended household), or as two or more separate nuclear units living on the lot and sharing facilities (kitchen, cooking spaces). All this makes the study of housing and health even more salient.

The wider survey, our interviews and focus group discussions, together with the insights formed by five intensive case studies provide fresh evidence of the importance of looking to the micro (dwelling and lot) environment and the ways in which the physical fabric and the environmental context interact and shape people's health and wellbeing. Household and individual behavior can mitigate or accentuate risks. Our research has also complemented the literature by providing a more nuanced understanding of the physical and behavioral interactions in poor rural pueblos in Mexico.

Infrastructure Water and Drainage

- Likely low chlorination and the alternative water provision practices means that water should be systematically boiled and/or filtered, and wherever possible refrigerated, before drinking.
- 2) Bottled drinking water is rarely consumed in the poorer pueblos, although it is more widely used in the better off peri-urban pueblo of Santa Ana, and in urban *colonias* and neighborhoods. Cost is the primary mitigating factor.

<u>Sanitation</u> is generally through pit latrines and septic tanks. In such conditions it seems probable that close proximity to farm animals and animal feces will be a likely contaminant (direct or indirect) of water tanks and therefore of household water usage such as washing, bathing, cleaning, etc.

Many streets lack formal paving, and this inhibits access and mobility especially for the elderly and infirm.

Household Behaviors with the Home:

Our surveys and sampling while interviewing revealed poor air quality levels using measurements of particulate matter in the air (pm2.5 and pm10.0). While communities periodically suffered from deposits of ash from the active volcano Popocátepel (depending upon the wind direction), most of the poor-quality air derives from cooking practices that use wood or carbón (charcoal). This is especially true in the two rural pueblos where wood is widely available and is culturally preferred for cooking. We also found that plastic cups are often used

as an accelerant when starting the fire. Cooking is generally done away from the house in a lean-to or in a single room of *lámina de carton* with little ventilation.

In Santa Ana and Flores Magón, propane gas is widely used, posing a lesser threat to health.

A primary challenge, therefore, is the need to improve air quality via:

- Ensuring greater (or more adequate ventilation) around wood burning stoves and ovens. And to promote the adoption of safer fire lighting procedures (I.e. not using plastic as an accelerant).
- Keep children away from the smoke and cooking area since their lungs are less capable of resistance to damage and inhalation can exacerbate asthma, and other respiratory diseases in younger children.
- Increase awareness about CO2 (how it is produced through exhaling, car exhaust etc.), and the widespread existence of above poor air quality due to (unseen) CO2 levels. Ventilation is key here, especially in bedrooms and enclosed spaces.
- Avoid storage of chemicals and fertilizers close to, or in spaces that are used for sleeping or dining. They make for poor or even hazardous air quality.

On the dwelling structures and lot management

Unlike in the USA and in most urban areas where people spend a large part of their daily lives indoors, rural populations such as those we observed in Puebla, spend most of their time outside – either in the fields, or in the outside patio -- cooking, playing, relaxing, and eating. They use the indoors far less, and rarely for cooking unless they have electric and gas stoves.

Housing Structures and Health Hazards and Risks, namely:

- Some rooms still have dirt floors.
- Most dwellings mixed materials (permanent and temporary) walls and roofs.
- Kitchens are often separated from the house itself and are made of *lámina de cartón* which pose fire risk and poor physical conditions (pests, earth floors, difficulties to keep clean, etc.).
- Attention to minimize damp and high humidity especially in sleeping spaces.
- Improve ventilation and air circulation by ensuring that windows and openings provide for a throughflow of fresh air.
- Increase natural lighting in rooms, especially where there is none.
- The dangers from uneven floors and walking areas that impede mobility and pose a threat to falls. The same applies to external lot surfaces which often hazardous to mobility.
- Maintain a healthy level of separation between farm animals and household sleeping and eating and food preparation spaces.

Overall, as well as health implications arising from the dwelling and micro environments (poor water and air quality; dampness; exposure to cold and heat; bites from insects and pests, etc.), downstream mobility challenges are likely to become more salient especially for the elderly.

Final Thoughts

Much of what we have described and analyzed in this report provides a snapshot of health and housing conditions in the summer of 2019, at the beginning of the rainy season, and as households began planting their crops. (It was real pleasure to return in mid-October and to see these crops when they were ready for harvesting.) Collectively we are enormously thankful to the households themselves, many of whom held back from going out to their field for a couple of hours in the morning in order to spend time with us.

Our work has begun to provide important baseline information about these four communities, and especially about the three rural and agriculturally based communities. We believe that these findings will provide wider insights since such communities are rarely studied systematically from a health needs perspective. Nor are they studied in such depth. As we underscore in Chapter 3 and above, mental health is a key part of good health and wellbeing, yet as is so often the case elsewhere, it is stigmatized and poorly understood by community members, researchers and by formal health professionals and providers – especially the latter. In contrast, we saw that health providers are sensitized and active in providing appropriate attention in the arena of reproductive and female health care.

Looking to the future, further research is required alongside policies inter alia to:

- Improve transportation access to health care facilities and/or to promote weekly ambulatory services to the villages.
- Accelerate national campaigns designed to reduce consumption of sugary drinks and to ensure that campaigns permeate into rural communities, and to residents who can least afford the costs.
- Improve access to medicines at low cost either through public health providers or through pharmacies, or both.
- Encourage the creation of support groups within the community to address minority health needs such as those with disabilities (Downs Syndrome children for example); pre- and post-natal maternal care; those suffering from with hypertension and diabetes; and those with mobility challenges, etc.
- Develop greater awareness of mental health needs of low-income communities and to better understand the stressors that trigger the presentation of mental health problems, as well as to research how populations self-medicate (if they do) to overcome mental health challenges (alcohol, drugs, etc.)
- Improve housing conditions such that residents have greater control over the internal climate of their residential space.

- Reduce exposure to poor air quality (especially wood smoke), especially for young children. Clean up the micro space on the lot to minimize falls through tripping, and especially to consider ways of ensuring mobility for the elderly.
- Conduct systematic environmental sampling of potable water systems and provide guidance about chlorination and other household practices to ensure safe drinking water.
- Research how the proximity of animals on the lot can have implications for poor health or disease among household members at different ages.

From the outset we never intended for this Report to be the end of the story, even though the undergraduate team will graduate in Spring 2020. The University and we as faculty mentors are committed to using the PAGL experience as a platform for future collaborations with our partners at the Fundación Comunitaria Puebla and at the Fundación Mónica Gendreau. At Austin and in Puebla, Dr. Adriana Pacheco's leadership and guidance has been the major catalyst for both our engagement in the PAGL, but also in fostering our collaboration with the FCP. She is a Poblana (comes from Puebla herself), is a UT graduate (PhD), philanthropist with her husband Fernando Macias, and at the time of the study was the Chair of the President's International Advisory Board. We look forward to continuing to work with her on projects of mutual interest and to supporting her in her ongoing work on the Board and at the University.

Our intensive fieldwork collaboration with faculty and interns at the medical school of the Benemérita Universidad Autónoma de Puebla has laid the foundation for a formal interuniversity agreement which we hope will be put in place in 2020 and will provide the basis of future collaborations between the BUAP and Dell Medical School at UT-Austin. Working directly with the Secretaría de Salud Puebla, and through BUAP Medical School, it is hoped that several of the aforementioned research and policy ideas will be put into motion.

Several research papers co-authored by the students and the faculty have been accepted for presentation at major international conferences, specifically: The Consortium of Universities for Global Health (CUGH) annual meeting in Chicago in March 2020; and the Latin American Studies Association (LASA) congress in Guadalajara in May, 2020; and at the October 2019 meeting of Health Systems Global which is a precursor to a World Health meeting in Abu Dhabi in November 2020.

The PAGL study was also an opportunity to start thinking about how the AMPATH program (Academic Model Providing Access to Health Care), developed by Indiana University and its Kenya counterparts and the Kenyan government (<u>https://www.ampathkenya.org/mission-vision</u>) might be extended to communities in Mexico and Texas.

In 2020 also, our graduating students have ambitious plans to fundraise and collaborate with residents and friends in Xochiteopan and Colonia Agrarista in developing a small playground/exercise facility or some other small project proposed by the community. UT professor Dr. Benjamin Ibarra, who worked in parallel with the team in 2019 on projects of
church and monument restoration, has kindly offered to collaborate on these two projects by making these the centerpiece of his architectural students' class project in the Spring.

Finally, we are delighted that an undergraduate and faculty team wishing to work on Puebla have been successful in the second round of the PAGL awards competition. In part building off our project, that team will be investigating diabetes, working with patients in Puebla and Atlixco, and following patients and their families back into their homes. We look forward to following their PAGL research and engagement project, and especially to seeing how their work on diabetes – one the principal chronic illnesses identified in our study – meshes with the people and communities in which we found such a welcome and positive response.

References for Chapter 5

- Corburn, Jason, and Alice Sverdlik. 2016. "Urban Informal Settlement Upgrading and Health Equity Chapter Title : Urban Informal Settlement Upgrading and Health Equity Chapter Author (s): JASON CORBURN and ALICE SVERDLIK Book Title : Slum Health Book Subtitle : From the Cell to the Street Book Ed." (September).
- Ward, Peter. 2015. "Challenges of Latino Aging in the Americas." *Challenges of Latino Aging in the Americas* (September).
- Ward, Peter M., Edith R. Jiménez Huerta, and María Mercedes Di Virgilio. 2014. "Intensive Case Study Methodology for the Analysis of Self-Help Housing Consolidation, Household Organization and Family Mobility." *Current Urban Studies* 02(02): 88–104.
- Ward, Peter M., and Paul A. Peters. 2007. "Self-Help Housing and Informal Homesteading in Peri-Urban America: Settlement Identification Using Digital Imagery and GIS." *Habitat International* 31(2): 205–18.