Maternal and Child Health and the Architecture of Daily Life among Rural Nicaraguans: A Biocultural Investigation

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Background

Each year millions of pregnant women, mothers, and children experience severe illness or death, largely from preventable or treatable causes. Ninety-nine percent of these deaths occur in the developing world. Attention to maternal and child health (MCH) has been growing, and improving MCH is seen as critical to fostering economic development. The urgency of this issue is reflected in the fact the MCH is the number one international development priority for the Canadian government and one of the three main global health goals of the United States government. It was also reflected in two of the Millennium Development Goals (MDGs); MDG 4-reduce child mortality and MDG 5-improve maternal health. Of the eight MDGs, by the 2015 deadline these two goals were the furthest from being met. In 2015 these goals have were combined in the the UN's Sustainable Development Goal 3-Good Health and Well-being - Ensure healthy lives and promote well-being for all at all ages.   Achieving improvements in MCH Achieving this requires a clear understanding of both health status and cultural variables which influence health. Medical anthropology, by synthesizing data on both health outcomes and cultural context, is well suited to inform our understanding of both health outcomes and culturally-appropriate public- health interventions. Toward that end, in collaboration with Comunidad Connect and front-line health workers in the region, this project is designed to document health outcomes and causes of these outcomes among rural women and children who inhabit two of Nicaragua's poorest regions. The health outcome variables explored in this study include nutritional status, mental health, blood pressure, and biomarkers of immune function, stress, and metabolism. The causal variables explored in this study include, among others, food insecurity, the network of friends and family upon which one can rely (social capital), digestive system function, and other cultural and demographic factors. **The immediate outcome of the project will be the identification of barriers to maternal and child health in this region, which in the long term should lead to the development of new evidence-based and locally-relevant solutions.**

Data collection and analysis in 250 households in Los Robles commenced in 2015 and is ongoing. Below we provide a summary of findings to date. Appendix A provides a summary of two analyses which are in preparation for publication.

Child Health

As the growth of a child is sensitive to environmental challenges, it is a widely validated measure of child well-being. In Los Robles, 14% children are very short for their age (stunted). This is most likely due to long-term stress often due to a poor diet or disease. The implications of this are concerning; stunted children are more likely to drop out of school, earn lower wages, and remain in poverty. Table 1 juxtaposes these findings with other regions.

Table 1: Height for age in children

Where?	When?	Rate of moderate to severe undernutrition (HAZ<-2SD)	Source
Los Robles	2015	14%	NA
Nicaragua	2008-2012	22%	https://www.unicef.org/infobycountry/nicaragua_statistics.html
Latin America & Caribbean (excluding high-income countries)	2015	11%	https://data.worldbank.org/indicator/SH.STA.STNT.ZS?locations=XJ&page=4
Lower-middle-income countries	2016	32%	https://data.worldbank.org/indicator/SH.STA.STNT.ZS?end=2016&locations=XN&page=4&start=1966&view=chart
United States	2012	2%	https://data.worldbank.org/indicator/SH.STA.STNT.ZS?locations=US&page=4

Another line of growth data is indicative acute dietary or disease stress; 8% of children have body mass indices that classify them as too thin. As with low height for age, being too thin has been found to compromise educational ability, immune function, and earning power later in life. How these findings compare to other regions of Latin America is unclear as we are unable to locate comparable data. On the other end of the spectrum, 13% of children in Los Robles are overweight or obese children. This rate of child overweight or obese is below the 2007 rates for the region of 19-37%.

Maternal health

Nicaragua, in common with most Latin American countries, is in the midst of both a nutrition and an epidemiologic transition. A nutrition transition is characterized by a shift in diet from traditional foods, such as maize, to high-calorie, processed foods often in association with a decline in physical activity. Not surprisingly, the nutrition transition is further associated with a change in patterns of disease – the epidemiologic transition. The epidemiologic transition is characterized by a shift from high rates of infectious disease to high rates of non-communicable chronic diseases such as diabetes, cardiovascular disease, cancer, and chronic respiratory disease. Among other health outcomes, our project is designed to see where mothers fall in this transition.

We find that 66% of non-pregnant mothers can be classified as overweight or obese, putting them at risk for diabetes, hypertension, heart attack, and osteoarthritis (Table 2).

Table 2: BMI of mothers who were not pregnant (n=234)

BMI Classification (*BMI cutoffs*[1])	Prevalence
Underweight (<18.50)	1%
Normal (18.50-24.99)	32%
Overweight (25.00-29.99)	36%
Obese (≥ 30.00)	30%

[1] http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

The rate of overweight and obese in Los Robles is high compared to the rest of Nicaragua where 49% of adults are classified as overweight or obese and similar to the high rates (64%) observed in Mexico. An elevated BMI may initially seem incongruous with the high rates of food insecurity found in Los Robles. However, causes of elevated BMI are not limited to excess dietary intake; rather, poverty, and stress experienced en utero, in early childhood, and adulthood are all predictive of overweight and obesity. A caveat here is that our BMI values do not control for body composition. As 84% of the women surveyed were engaged in two or more hours of intense physical labor every day, they likely have elevated muscle mass (lean body mass) which could lead us to misclassify them as obese when it is their muscle mass and not fat (adipose) tissue which explains their relatively high BMIs. Hence, the BMI values reported here may inflate the apparent rates of elevated BMIs. That said, when we look only at waist circumference, a validated measure of disease risk, we find a startlingly high prevalence of mothers at risk for metabolic complications (Table 3).

Table 3: Waist circumference of non-pregnant women and risk of metabolic complications (n=234)

Risk of metabolic complications[2]	Prevalence
none (waist circumference 80.1-88.0 cm)	11%
substantially increased (waist circumference >88.0 cm)	89%

[2] Metabolic complications may include type-2 diabetes mellitus, prediabetes, and gestational diabetes, and hypertension (Pederson, SD. 2013. Metabolic complications of obesity. Best Practice & Research Clinical Endocrinology & Metabolism 27(2):179-193) and cancer (Esposito K, P Chiodini, A Colao, A Lenzi, D Giugliano (2012), MD, PHD5Diabetes Care. 2012. Metabolic Syndrome and Risk of Cancer. Diabetes Care 35(11):2402–2411).

The BMI and waist-circumference findings may point to a population in the midst of a nutrition and epidemiologic transition. Their non-fasting blood glucose levels, likewise suggest a relatively high frequency of women at risk for diabetes (Table 4). The prevalence of prediabetes is low relative to the United States (35%), but greater than found in Mexico (22%). The diabetes prevalence is low relative to both the US (9%) and Mexico (15%) (Menke A, S Casagrande, L Geiss, C Cowie. 2014. Prevalence of and Trends in Diabetes Among Adults in the United States, 1988-2012. JAMA. 314(10):1021-1029).

Table 4: Blood Glucose Classifications for Mothers in Los Robles

Blood Glucose Classification[3]	Prevalence
Normal (blood glucose from <140 mg/dL, 1 hr post 50g OGTT)	71%
Pre-diabetic (blood glucose from 140-199 mg/dL, 1 hr post 50g OGTT)	26%
Diabetic (blood glucose >200 mg/dL, 1 hr post 50g OGTT)	3%
average blood glucose	131 ± 26

[3] http://www.who.int/diabetes/publications/Definition%20and%20diagnosis%20of%20diabetes_new.pdf

Maternal Mental Health: A robust body of research persuasively argues for more attention to be paid to mental health in developing countries, noting that social factors known to be linked to poor mental health are on the rise throughout the developing world. We are particularly interested in understanding the relationship between maternal mental and physical health and household-level food security. To assess mental health, we used the widely-validated Self-Reporting Questionnaire 20 (SRQ-20), a 20-question symptoms checklist which accounts for symptoms over the previous three months. The SRQ-20 has successfully been used in León, Nicaragua by members of this research team and in studies of domestic violence in Nicaragua. Further, the SRQ-20 was piloted with focus groups in Los Robles prior to use to ensure that it's questions were locally relevant. Findings from our 2015 survey indicate that **44% of mothers in Los Robles** met the criteria for probable cases of common mental disorders. This includes anxiety-related, depressive, and somatoform disorders. A study conducted in **Leon**, that used the same screening tool and cut-off score, found a prevalence of **20.7%.** (Isaksson et al. 2016. Associations between psychiatric symptoms and cortisol levels in Nicaraguan school-age children. Psychiatry Research 240:376-380). On a **global** level, it is estimated that **20% of individuals worldwide have experienced a common mental disorder in the previous 12 months**. This estimate is based on pooled meta-data from 174 surveys in 63 countries. However, there are differences between sub-regions, as Latin America and the Caribbean had the highest 12-month prevalence rate at 22.2%, compared to low to middle income countries in East Asia and the Pacific at 13%. (Steel et al. 2014. The global prevalence of common mental disorders: A systematic review and meta-analysis 1980-2013. International Journal of Epidemiology, 43(2): 476-493). Downstream, poor maternal mental health is a risk factor for increased frequencies of illness and elevated obesity for the mother and compromised health in her children.

Food Security: The USDA defines food insecurity as a state in which "consistent access to adequate food is limited by a lack of money and other resources at times during the year." Good shorthand terms for food insecurity are "struggling to avoid hunger," "hungry, or at risk of hunger," and "hungry, or faced by the threat of hunger." Our measures of food insecurity reveal what is likely part of the explanation for the prevalence of children in Los Robles who exhibit growth faltering. Our findings for Los Robles can be seen in Table 5.

Table 5: Food Insecurity in Los Robles

Category	Prevalence
Food secure	7%
Mild insecurity	74%
Moderate insecurity	15%
Severe insecurity	5%

By comparison in Leon and its peri-urban area, 25% of households with young children were food secure, with 50% mildly food insecure and 25% moderately/severely food insecure (Schmeer KK, BA Piperata, A Herrera Rodríguez, VM Salazar Torres, FJ Centeno Cárdenas. 2015. Maternal resources and household food security: evidence from Nicaragua. Public Health Nutrition 18(16):2915-2924). Hence, the rate of food insecure households in Los Robles is 72% below the level found in and around Leon. Clearly, there is a lot of room for improvement in Los Robles! Indeed, food insecurity is associated with elevated risk of iron-deficiency anemia in children and adults, sexual risk taking in adult women and associated sexually transmitted diseases, chronic disease, poor maternal mental health, and child growth faltering, among others.

In conclusion, what do our preliminary analyses reveal?
1) 1 in 6 children are chronically stressed,
2) 1 in 12 children is too thin and 1 in 8 is obese/overweight,
3) 93% of households are food insecure,
4) pre-diabetes and diabetes rates are high,
5) 44% of mothers met the criteria for a probable case of common mental disorders.

What's next?
Our analyses are ongoing. We are currently combining all markers of immune function measured in blood with all other measures of health, such as those described above, to better understand overall health in Los Robles. We will then compare the resulting measure of overall health with an array of possible causes, such as household wealth, access to arable land, educational attainment, the extent of one's social networks, and reliance upon government programs to determine the most important causes of overall health. As well, in 2017 we collected more data to better understand the impact of having livestock in and around a home on child health. We expect to have completed the analysis of the data collected in 2017 by May 2018.

What to do with these findings?
Per the background provided above, our goal is to use these data to develop evidence-based and locally-relevant solutions to public health challenges facing Los Robles. Toward this end and immediately after the first round of data collection in 2015, we took the first steps toward addressing a clear public health concern; the high rates of women at risk for anxiety and depression. In this, April Pojman, a counselor from Boulder, Colorado with extensive experience in Latin America, including Northern Nicaragua, gave

her own time to spend one month in 2015 and another in 2016 meeting with those women most at risk and running workshops to train local health workers and interested citizens in interventions to reduce the risk for poor mental health. While we lack quantitative data on the impact of Ms. Pojman's work, anecdotal evidence consistently indicates that her work has had an extremely beneficial impact. Funding permitting, we will bring Ms. Pojman back to Los Robles in 2018. Further, we are committed to translating these findings in a manner which has relevance to the local stakeholders in Los Robles. Toward that end we have reported our findings in the community and to Nicaragua's Ministry of Health (MINSA) in 2016 and 2017 (see Appendix B) and secured funding to bring the North American principal investigator and co-investigators to Los Robles in May 2018 to describe and discuss the findings with local stakeholders.

Appendix A

Analyses completed and in preparation for publication:

Linking growth and gut function: Environmental enteropathy in children under 2 years in rural Nicaragua

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Abstract: Malnutrition remains one of the deadliest childhood ailments, with reports that 56% of childhood death in developing countries can be attributed to malnutrition and its sequelae. Studies suggest that up to 40% of malnutrition may be caused by compromised intestinal function in the form of environmental enteropathy (EE). In order to elucidate the role of EE in rural Nicaragua, we aimed to explore the relationship between intestinal function and growth outcomes in children under 2 years. We hypothesized that gut function would be a predictor of nutritional status. Urine samples and anthropometrics were collected from 53 children. Urine was analyzed for lactose and creatinine concentrations; and a ratio of these molecules provided a measure of intestinal function. Height-for-age, weight-for-age, and BMI-for-age *z*-scores (HAZ, WAZ, BAZ) measured nutritional status. Spearman's correlations and Wilcoxon rank-sum tests assessed the relationships between variables. Participants were 47% female with a mean age of 12.04 6.45 months. 11% were stunted (HAZ < −2) and 2% were wasted (BAZ < −2). The median lactose to creatinine ratio was 0.10 (IQR = 0.16). Gut function was not significantly correlated with WAZ or BAZ. A statistically significant difference was found in the median lactose to creatinine ratios between the groups with HAZ above the 50th percentile (HAZ > 0) compared to those with HAZ below the 50th percentile (HAZ < 0), with taller children showing worse gut function (*P* = .0492). These findings are unexpected as they suggest a low prevalence of environmental enteropathy and an opposite relationship between linear growth and gut function than usually reported in the literature.

Social support and maternal mental health in rural Nicaragua

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Abstract: Mental-health problems are a major and growing public-health challenge worldwide and are exacerbated in low-to-middle-income countries where mental health-care is practically non-existent. The protective effects of social support for mental health are well-documented and appear to have evolutionary roots. This cross-sectional analysis of mental health and social support among 229 mothers from rural Nicaragua evaluates the hypothesis that increased perceived social support (PSS; measured using a locally developed instrument) is associated with improved mental health (assessed using the Self-Reporting Questionnaire). Regression analysis controlling for potential confounders revealed that PSS is not associated with maternal mental health. This may be explained by the instruments used, the fact that this analysis, (unlike others on the topic) controls for multiple potential confounders, or the cultural context in which participants live. This study provides a grounded consideration of this public-health crisis in a population neglected by almost all other studies on the topic.

Appendix B

Health report card distributed and discussed by Natasha Hoehn in meetings with stakeholders in each sector of Los Robles in June-July 2017.
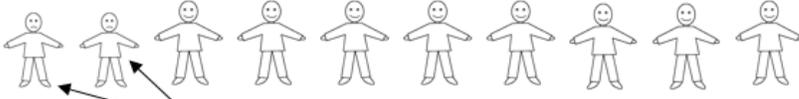
Salud de niños y madres en Los Robles

Informe preliminar de junio de 2017

Warren Wilson (Universidad de Calgary), Barbara Piperata y Kammi Schmeer (Universidad de Estado Ohio), Jason DeCaro (Universidad de Alabama)
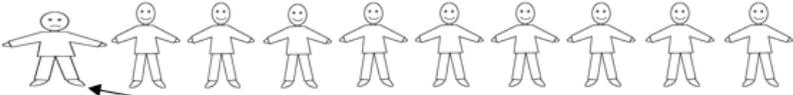
1) Niños: los niños no crecen bien

Aproximadamente 2 de cada 10 niños están creciendo más lentamente de lo que deberían. Esto es probablemente debido a una dieta pobre. Esto puede hacer que sean más propensos a enfermarse como adultos.

2) Niños: niños que son demasiado gordos

Aproximadamente 1 de cada 10 niños es demasiado gordo. Ser demasiado gordo puede causar diabetes u otras enfermedades cuando el niño crece.

3) Niños: sistema digestivo de los niños - prueba de orina

Nuestro análisis de la orina de niños menores de 2 años encuentra que la mayoría de los niños tienen un sistema digestivo de la salud.

4) Madres: seguridad alimentaria. ¿Creen las madres que su hogar tiene suficiente comida?

sí no no no no no no no no no

Solamente 1 de cada 10 madres dijo que su familia siempre tenía suficiente comida para su familia.

5) Madres: diabetes

en riesgo de diabetes

Aproximadamente 3 de cada 10 madres están en riesgo de padecer diabetes. Si no se trata, la diabetes puede dañar sus riñones, la vista y la capacidad de oír, causar dolor nervioso y entumecimiento u hormigueo en las extremidades.

6) Madres: salud emocional

tener mala salud emocional

Aproximadamente 4 de cada 10 mujeres tienen mala salud emocional.

Comuníquese con Warren Wilson si tiene preguntas. Por What'sApp: ▓▓▓▓▓▓ o Por correo electrónico: wwilson@ucalgary.ca