

FROM CELL TO SYMBOL:
A BIOCULTURAL STUDY OF ANEMIA AND SUBJECTIVITY AMONG THE
POQOMCHI' MAYA IN GUATEMALA

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Abstract

Anemia afflicts nearly 2 billion people worldwide by reducing oxygen carrying capacity in the blood. Practitioners of Western biomedicine consider anemia to be an easily treatable ‘symptom’ that results from some other disease, injury, or pregnancy. Conversely, in impoverished communities anemia has multiple causes, goes untreated, and becomes chronic and endemic. Given anemia’s global prevalence and varied etiology, it stands to reason that anemia may be differently experienced biologically and culturally. A lack of contextual research has inhibited understanding of why anemia persists despite being easily treatable. This dissertation examines the experience of anemia in the Poqomchi’ Maya community of Onquilha’, located above a coffee plantation overlooking the Polochic valley in Tamahú, Guatemala. Blood samples show that 100% percent of school-age children are anemic (N=87). By framing anemia as ubiquitous in a single community, it can be contextualized through local discourse, behavior, and Poqomchi’ subjectivity. A major theme of this dissertation is the liminal thresholds in both human biology and culture. Analysis of these thresholds (e.g. between health and illness, normal and abnormal, or treatable and untreatable) charts how the Poqomchi’ navigate and accommodate illness. The Poqomchi’ mitigate the effects of mild-to-moderate anemia by managing behaviors that alter physiology in response to metabolic requirements. Anemia is normalized through a rich discourse on *fuerza* (force, an individual’s presence in life). However, severe anemia is abnormal and managed through a more urgent discourse on *energía* (energy, an individual’s essence in life). When *fuerza* and *energía* are lost, severe anemia leads to compounding illness and disease, the loss of individual subjectivity and death, and a narrative of social suffering shared by the community. Anemia is an age-old problem. It is deeply rooted in our mammalian constitution and reliance on blood and oxygen to produce energy and sustain life

in a variety of environments. For the Poqomchi', the experience of anemia is the continual experience of fuerza and energía —life and death, limited by oxygen carried in the blood. This dissertation contributes to global efforts to reduce the impact of anemia and to medical and biocultural anthropology by demonstrating how illness is accommodated.

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Chapter 1. Interpreting an Ambiguous Illness

During my first visit to Guatemala in the spring of 2003, I served as a medical interpreter for doctors from the United States treating Poqomchi' Maya. This period was marked by the collapse of the coffee market. The Poqomchi' are primarily tenant farmers who have lived and worked on the plantations for centuries, plantation owners could not make a profit and abandoned production. The loss of production resulted in a loss of wages. With no income and no rights to farm the land on which they lived, famine became widespread.

After several weeks interpreting for thousands of Poqomchi' I became very familiar with a cluster of ambiguous symptoms that I found myself repeating over and over again to the doctors: dizziness, lack of energy, loss of appetite, pale skin, headaches, faintness, and seeing stars. It was not simply an itemized list of complaints to the doctor; the symptoms were also contextualized in stories of daily life. Mothers would exclaim with deep urgency, "My child cannot tolerate walking, won't eat anything, is startled all the time, won't bathe in cold water, even passes out." Husbands who had accompanied their wives testified with grave concern, "My wife is very pale and weak, I worry a lot, I want her to be well." Women themselves explained how they had constant headaches and would pass out under the hot sun while working in the fields or simply from bending over. Even a few men, who rarely seek medical attention, complained of headaches, tingling in their legs, and pain throughout their abdomens.

Through the narrative redundancy and my repetitious interpreting of the symptoms of the Poqomchi', the ambiguity of each individual patient's experience became more clear in the aggregate—a subtle and yet widely debilitating illness afflicted this community. When I asked the lead doctor about these symptoms she replied after a reflective pause with a despairing look,

“They are probably all anemic.” Her statement, and the experiences reported to me by impoverished Poqomchi’, served as groundwork for this dissertation research.

My research site is located in the municipality of Tamahú nestled in the isolated Polochic valley in Guatemala’s Central Highlands (Figure 1.1). The valley is actually a deep fault line that divides the North American Plate from the Caribbean Plate, leaving two parallel ranges of steep mountains. This unique geological formation means there is no substantial level ground. There are only two ways to go, uphill or downhill. A one-lane road of eroded gravel enters the valley through a mountain pass and follows the accumulating waters of the Polochic River all the way to Caribbean coast. A 4-wheel drive vehicle or large truck is necessary to navigate this road. Almost all local travel is by foot. Along the valley walls above this often-impassable road, between uphill and downhill, live both Poqomchi' and Q'eqchi' Maya in distinct communities. Almost everyone’s first language in the valley is Poqomchi' or Q'eqchi' and the most Spanish is spoken down in the main town of Tamahú, at the health clinic, and government offices.

There are 12,000 people living in this section of the valley: about 1,100 in the main town and the remaining 10,900 in 26 surrounding communities. Dozens of foot paths ascend the slopes, passing through and beyond the plantations that line the more fertile lower areas of the valley. These trails not only connect the communities to the main road and town, but also to other communities and municipalities beyond Tamahú. In all likelihood, the trails connect to other trails extending throughout Guatemala, overlaying the country in an extensive honeycomb of indigenous pathways. The trails are considered sacred and forbidden to non-Maya. Unaccompanied non-Maya entering the trails are regarded as a threat. This perceived threat was heightened following years of intrusion by armed groups during the Guatemalan Civil War (1960-1996). A major concern for the Poqomchi’ is that non-Maya will bring terror and fear to

small children, either from the novelty of seeing an outsider or from hidden intent. The fear that is provoked in children can make them physically ill.



Figure 1.1. Map of Guatemala with Tamahú indicated by author (Universtiy of Texas, 2000)

There has been no scholarly research of the far eastern Poqomchi' and even within Guatemala very little is known about the population of this region, especially life along the mountain trails and communities. As the smallest municipality in the country, Tamahú is at the bottom of the list in terms of political importance. Most travel books recommend avoiding Tamahú, and the Peace Corps prohibits its volunteers from entering the region. Indices of infant mortality, malnutrition, and fertility are some of the highest in Latin America, serving as a reflection of how this region was left decades behind others in terms of development (MSPAS, 2001).

Given the ambiguous nature of the symptoms afflicting the Poqomchi' and the unknown context of those who suffer, the research needed to be epidemiologically situated along the secret trails in one of the remote mountain communities. In order to gain legitimate passage to these communities I worked on agriculture projects for over a year. My "Johnny Appleseed" endeavors carried me into all 26 communities. Through my language skills and a shared enthusiasm for agriculture, I was able to gain their trust. From my experience working with these particular communities and in consultation with the local field nurses I chose the small mountain community of Onquilha' as my field site. The population is approximately 500 people. They are primarily Poqomchi' with a handful of neighboring Q'eqchi' who married into the community. Onquilha' is just one community, but its social, economic, political, and ethnohistoric structural position is similar to that of other Maya communities throughout Guatemala.

Anemia, Poverty, and Marginalization

Anemia afflicts a quarter of the world's population and is most prevalent among those living in poverty (Benoist et al., 2008). Anemia is defined as an abnormally low level of healthy red blood cells needed to supply oxygen (O₂) to the body (Blanchfield & Longe, 2002, p. 288). It

is measured by examining a sample of blood and counting a molecule inside the red blood cell called hemoglobin (Hgb). Mild-to-moderate cases of anemia can be asymptomatic. However, if the condition worsens the symptoms will increase. The symptoms of anemia are numerous and complex. Things such as physical and mental stress, injury, disease, or poor diet cause anemia to worsen. Severe and even moderate anemia increases susceptibility to other diseases such as respiratory infections or kidney disease (Zarzecki et al., 2004, p. 1211). Untreated anemia can develop into more acute or chronic anemia—it is a slow descent down a slope, which becomes slippery with any added insult to the mind or body. Cognitive development, physical growth, and general well-being can all be affected. Chronically and more severely anemic individuals appear pale, sallow, and disheveled. They have an acute awareness of their own pulse and heartbeat. They feel fatigued, faint, and even succumb to a range of inabilities (e.g. to work, to walk, to lift, to sleep, to eat, to focus etc.). They appear cognitively slowed, have visions of floating lights, and suffer constant headaches. Those who are afflicted with anemia are visibly irritable, fearful, and can be easily startled. They are typically reserved and withdrawn, but when they do interact with others they often appear to be incoherent and irrational. Although anemia can be a temporary stressor, when it becomes chronic or recurring a full recovery is unlikely. Ultimately, both development and function of the mind and body are compromised due to a lack of O₂ (Blanchfield & Longe, 2002; Galton, 1975, p. 3; Garrison, 2003, p. 25)

At the experiential level of this biological phenomenon, this dissertation broadly frames anemia as a physiology of fragility and/or a fragile physiology. The physical sensation of precarious balances in the body, not all yet imbalanced, permeates the consciousness. The physiology of anemia is the story of how O₂ supply and delivery to cells is compromised throughout the body. The fragility of this continual process of supplying O₂ originates in the

homeostatic balance between O₂ and carbon dioxide (CO₂). Maintaining this balance and insuring sufficient O₂ in the deepest tissues of the body enables energy production, metabolism, and life. Energy is the basis for movement and thought. The ability to regulate metabolism, both consciously and unconsciously, is essential to the maintenance of life and the continual process of cellular repair and replication. This is why the study of anemia involves a physiological profile of the body and its surroundings—family, community, environment, and culture.

Given the global prevalence of anemia, it is unfortunate that more qualitative studies have not considered its physiological impact on daily life. Nearly a quarter of the earth's population would be considered too anemic to donate blood or undergo surgery. Despite the Western biomedical tendency to treat the mind separately from the body (Scheper-Hughes & Lock, 1987), my research revealed that the anemic individual's physical symptoms and mental perception of anemia, and subsequently its corresponding treatment, are inextricably bound together. In fact, the interpersonal theories of disease among the Poqomchi' reflects this. An important consideration in this dissertation is how anemia may impact the ways and extent to which the afflicted communicate their experience. The theoretical perspectives used in this dissertation need to provide the interpretive power and scholarly discourse capable of accounting for the Poqomchi's subjective understanding of illness, their objective understanding of a material environment marked by limited resources, and the socialization and enculturation of illness in a marginalized community. I employ a multifaceted theoretical framework that can explain the prevalence and consequences of a biological phenomenon, people's perceptions and actions in response (or inaction, as the case may be), and ultimately develop a more holistic understanding of anemia within this population.

Worldwide, with increasing population and scarce resources, the impact of anemia is rising despite global health initiatives (Balarajan, Fawzi, & Subramanian, 2013; Latham, 1997, p. 50). A complex relationship exists between anemia and *structural violence*, i.e., institutionalized social, economic, and political marginalization through a historical dialectic of hegemonic human organization (Farmer et al., 2004, p. 305). Structural violence deprives people of options, power, and resources and thus leads to the normalization of maladies or mooting of what would become crises in other communities. At the psychological level, crisis that is chronic manifests and impacts phenomenological understandings of the thresholds between health and illness. Commonalities of distress across individuals in a community produce an experience of social suffering (Kleinman, Das, & Lock, 1997). The experience of illness becomes codified in a society's worldview across generations, leaving the structural violence unchallenged and the malady undertreated. It is not anemia in and of itself that constitutes the experience of suffering but rather, it is the combination of structural violence and poverty that produces such anguish. People do not die from disease; they die because of the conditions that perpetuate the prevalence of disease. One of our jobs as medical anthropologists is to identify the causes and prevalence of disease, quantify the impacts of illness and death, interpret the meaning of the disease among the afflicted, publicize, and hopefully contribute to a remedy.

Anemia is one of those ubiquitous health issues that lacks the high profile visibility of infectious diseases but creates considerable costs to quality of life for the poor. A single Poqomchi' Maya community—the interaction between human beings and their environment—is an appropriate and novel place for examining anemia. A similar critical biocultural study has been done of anemia in Africa (Kent & Lee, 1992) and mild-to-moderate malnutrition in Guatemala (Martorell, Arroyave, Collins, & Roberts, 1988). But where these studies have tried

to insert a cultural discussion to a biological study, this project uniquely brings a cultural perspective in juxtaposition to a biological understanding of anemia. My data collection methods are broad and chosen to address an equally broad and complex problem. The framework is designed to raise and answer important questions about a pervasive yet understudied chronic health condition. This project establishes a model for the biology of chronic anemia and codes discourse data for qualitative analysis through local nosologies, symptoms, behaviors, and etiological categories. In particular, it explores the cultural meanings of anemia for the community of Onquilha', compares the meanings to biological data, and deciphers barriers to treatment originating from a misunderstanding between Poqomchi' and Western biomedicine (allopathic medicine).

Methodology and a Call for Research: Innovation, Interdisciplinarity, Contextualization, and Meta-Synthesis of Quantitative and Qualitative Data

The collective sociocultural management of particular symptoms, severities, and contexts of illness informs the individual's representation of the experience. Cultural beliefs and behaviors are readily observable and shed light on the biophysical processes of the body and vice versa. An awareness of not just the biology, but also the physiology of anemia helps interpret the rationale of Poqomchi' cultural practices that deal with, and normalize, anemia. This can validate data that might otherwise appear arbitrary. Where there is normalization of illness there is the cultural process of constructing and inverting positive and negative consequences, or trade-offs. The symptoms that come with chronic illness become part and parcel of human experience and therefore must be approached from both biological and cultural analyses. This is the essence of medical anthropology, the interpretation of how maladies are experienced physically, psychologically, and socially through particular cultural frameworks.

Lock and Nguyen (2011) call out attention to local biologies, characterized as unique geographical distributions and dynamic physical changes that gives the appearance of entanglement, but reflects “patterned variation in subjective bodily experience” (p. 1583). Given the global significance of anemia, its local endemicity, and discrepancies in our understanding of it, scholars have called for interdisciplinary and innovative research. At the heart of this call, even at the risk of inconsistencies and erroneous presumptions, is the need to bring in contextual clues and describe their meaning and significance. Medical anthropologists point out that local biologies are overly simplified in biomedicine through a systemic construction of “normal”, which creates arbitrary pathologies made to understand the nature of illness and disease (Lock & Nguyen, 2011, p. 1528). Biological anthropologists suggest that a research approach begins with the basic premise that anemia is a pervasive and complex illness requiring a locally-grounded cultural approach (Stuart-Macadam, 2006). Associated with the complexity of anemia is an often misunderstood, politicized, and convoluted conception of its etiology (Stuart-Macadam & Kent, 1992). Most explicitly, scholars have gone so far as to suggest we de-emphasize the role of diet, acknowledging its inefficacy in curbing the global increase in anemia and its potential to stifle new ways of thinking about this problem (Kent & Lee, 1992).

Scholars have suggested that innovation be driven by looking across disciplines in order to, “build on the foundations of previous anthropological, medical, and microbiological knowledge to explore the validity and implication of the anemia of chronic disease in a variety of past and present contexts” (Kent & Lee, 1992, p. 13). The clinical and biomedical literature presents inconclusive and contradictory findings. Authors and their reviewers consistently express dissatisfaction with the breadth of research frameworks and have called for broader approaches to biomedical modeling (Bridges, 1993, p. 1650; Sears, 1993, p. 639). One study on

the lasting effects of childhood anemia on cognitive ability noted, “[B]rain affects behavior and behavior alters brain. In addition, altered behavior affects environmental experience and vice versa” (Lozoff & Georgieff, 2006, p. 158), which emphasizes the need for inter-meshing research across disciplines.

Anemia is about blood and the distribution of O₂ to cells, the most basic unit of life; therefore, accounts of anemia are referenced in a broad range of disciplines, from romantic literature on the beauty of a pallid complexion to neuroscience and the limiting effects on cognition. Such ubiquity asks that research endeavors become, “cross-cultural, cross-temporal, or both, providing a greater depth and breadth of information than most papers examining acquired anemia” (Kent & Lee, 1992, p. 13). To answer this call this dissertation will consider broad themes such as environment, behavior, types of activity, time, energy needs, lifespan, stages of human development, worldview, ethnicity, and cosmology. The purpose of this dissertation is to contextualize biology as a means of offering a better understanding for future intervention, rather than being accusatory toward Western biomedicine or to promulgate accepted scientific expectations. In this way, I respond to the call of Farmer, Kleinman, Kim, and Basilico (2013) to reach the broadest audiences by shedding new light on scientific knowledge and public health through contextualization.

Researchers and medical practitioners are simultaneously aware of both the limitations within their own disciplines and the risks associated with stepping outside prevailing paradigms. Medical practitioners reviewing studies of anemia conducted in anthropology have simultaneously warned of, and called for, controversial assertions, challenging dogma, unorthodox views, and setting aside accepted scientific ideas. To provide a fresh perspective and provoke reflection, an open mind and big picture approach is required (Bridges, 1993, p. 1650;

Sears, 1993, p. 639). To the reader trained in customary logic, where the meaning appears on the surface by definition, this dissertation's confluence of biology, culture, behavior, language, history, and indigenous cosmology and nosology may be challenging. Stuart-Macadam's closing commentary in *Diet, Demography, and Disease* parallels the hope of this dissertation, that, "it compels the reader to reevaluate traditional views of health and disease. It illustrates the complexity of the body's response to physiological and environmental factors and shows that our interpretation of physiological status based on laboratory tests may be hindered by our lack of appreciation of this complexity" (1992, p. 267). The objective here is to identify indigenous pathologies that do not necessarily lend themselves to clinical assessment. In fact, biomedical categories of cause, symptom, and treatment of anemia, regardless of their validity, may miss pathologies and etiologies (or identifiable representations of biological and cultural logic) practiced by the Poqomchi'. By not understanding their representations of anemia, biomedical practitioners and Poqomchi' will not be able to communicate in order to collaborate and reduce anemia's impact.

I propose to answer this call through an investigation seeking synthesis between domains in the experience of endemic anemia in one Poqomchi' Maya community. To accomplish this, I incorporate meta-synthesis for theorizing about evidence-based models. These methods are widely used in health fields such as nursing or public health, where practitioners intervene directly with patients, problems, and unique contexts. Conventional methodologies may not be suited for things that cannot be easily measured or when the object of study spans several divisions of taxonomy (Dixon-Woods, Booth, & Sutton, 2007). A meta-synthesis is helpful for studies identifying causal chains, conditions of causality, factors of implied relationships, disconfirming cases, and in order to build an explanatory theory (Schreiber, Crooks, & Stern,

1997, pp. 312-316). This approach is characterized as integrative evidence-based theory. It is both an alternative to, and an extension of, controlled studies. For example, iron is an essential component of blood and O₂ transport. There is a peptide hormone called hepcidin, which regulates iron balance in the body, that was discovered relatively recently in 2000 (Ganz, 2003, p. 783). The discovery of a regulating process in iron homeostasis represents a paradigm shift that is leading to new understandings and classifications of the pathology of anemia, inflammation, disease, and is forcing interpretive revisions of recent studies on anemia. This new scientific knowledge from a diverse array of disciplines, such as the discovery of hepcidin, must be brought into this anthropological study. Synthesizing current understandings of anemia within disciplines and then analyzing across disciplines completes a picture of how anemia is experienced in daily Poqomchi' life.

Research has shown that mild-to-moderate anemia can occur without significant physical or psychological detriment. However, little is known about how culturally specific factors intentionally or unintentionally alter this routine degree of anemia or how communities such as the Poqomchi' survive more abnormal severe anemia, beyond normalized anemia. Also, there is no clear model of a causal chain connecting layers of multiple pathogeneses. Finally, there is no theoretical understanding of how people with a condition that limits productivity continue to do work and live sub-normal lives. The results of a meta-synthesis approach yield a theoretical model of a biological phenomenon as it is experienced by the Poqomchi'.

Contradictory Manifestations of Anemia

In order to unravel the complex relationship between biological anemia and social context, Kent & Lee advocate the examination of, “contradictory and even counterintuitive results,” in studies of specific populations (1992, p. 172). This section introduces eight types of

contradictions that manifest from anemia. While conducting preliminary research in Guatemala, a doctor at a regional hospital told me, “some women walking around here are so anemic that they should be dead, the walking dead!” Life defies a perceived logic of death. This is representative of many contradictions facing the medical community, contradictions that arise from the medical and scholarly construct of anemia. Doctors throughout the world are well aware of the high prevalence of anemia and survivability of severe cases, especially in impoverished communities. The chronically anemic person is bound by practical medical logic where discourse between life and death contradict. Recently, while working at a major medical school, I was approached by the coordinator of an annual surgical mission trip to Guatemala. It was suggested that many of the Guatemalan patients were in fact too anemic for surgery; and the American surgical team did not know what to do about this scenario of elevated surgical risk in a Guatemalan context. Beyond the practical world, the contradictory manifestations of anemia challenge our understanding of how the mind and body function in critical conditions and in particular contexts where one must weigh against a paradigm of potentially worse outcomes.

Second, from a public health perspective, how does anemia in one community become chronic, endemic, and life-threatening, while in more affluent societies it is easily treatable? The problem stems in part from perceptions in more economically developed societies in which anemia is perceived mainly as an easily treatable risk of pregnancy. This convention has guided how public health policy deals with anemia in less developed countries. However, in many local and indigenous communities such as those in Guatemala, the majority of anemic individuals are children, not pregnant women. In this context, anemia is not an easily preventable symptom of some other condition; rather, it is a chronic illness imbedded in childhood and recurring through adulthood. While anemia in affluent communities is an abnormal state that is temporary,

treatable, individually-experienced, and a symptom of some other condition—the anemia afflicting many underprivileged populations is normal, chronic, untreated, socially-experienced, and constitutes an endemic illness.

Third, there are certain paradoxes that stem from the taxonomy of anemia in Western biomedicine, in which anemia is a *condition* or *symptom*, but not an *illness* or *disease*. This means that anemia itself is not often the direct object of study. It is a symptom, which is linearly associated to another disease, condition, or dietary deficiency. Thus, the critical place for interpreting anemia as a disease of poverty and person—anemia that progresses due to multiple causes over a lifetime—is restrained to singular etiologies and an allopathic context.

Fourth, the role of anemia in terms of adaptation and accommodation of disease raises contradictions regarding its overall effect and function in the human organism. Many studies have shown that anemia may be beneficial because it damps the effect of other diseases, in particular infectious disease. Thus, anemia may be a disease, but it is also a defense against infections to which communities with a high degree of malnutrition are prone (Stuart-Macadam & Kent, 1992). Current research is finding that anemia plays an even greater role in defense against a broad range of diseases and conditions such as cancer and Alzheimer's (Weinberg, 2009; Weinberg & Miklossy, 2008; Weiss & Goodnough, 2005). When anemia is biologically both a disease and defense mechanism, there are going to be paradoxes and ambiguities resolved by culture between health and illness, function and dysfunction, and healing and hurting (McElroy & Townsend, 2009). It is this contradictory nature and meaning that studies on anemia have overlooked and to which I aim to draw attention through my research.

Fifth, many people are afflicted with anemia but are either unaware of or unconcerned with their symptoms and they go about their day as normal. Debates arise about whether

“normal” or non-anemic, should be biologically defined as having an Hgb level around 12 g/dl (grams per deciliter) (Lock & Nguyen, 2011, p. 1528). There are nearly 2 billion people currently below this level (Benoist et al., 2008) and it is likely that over half the global population has been below this level at some point in their lifetime. For many, anemia or near-anemic conditions persist throughout life, developing in utero, infancy, and early childhood, or during the hardships of adult life and carrying on into death. Anemia is not simply pathology—a deviation from the norm—but a factor variable of the human lifecycle. In global as well as local contexts, anemia may in fact be the norm. When the data from statistically significant studies fail to account for the generations of lived experiences due to narrow taxonomies then phenomenological accounts are the only way to access the missed data.

Sixth, the demographic complexity and variability in the expression of anemia is rarely considered. For example, in Western biomedicine anemia in males is seen as a rare anomaly resulting from some other disease. However, among indigenous communities in Guatemala there is a relatively high incidence of anemia among males (Herynk & Justice, 2008; MSPAS, 2001). This phenomenon points to a problematic contradiction facing global health intervention strategies when anemia is decontextualized and narrowly framed as an individual symptom. Outside the developed West, poverty leads to unique demographic trends in anemia. Anemia becomes an endemic illness experienced by the majority of community members. Also, individual and group biologies of anemia suggests that it cannot be easily formulated into controlled studies as Pollitt explains, “individual and group factors can moderate the effects of IDA [Iron Deficiency Anemia]: for example different states of iron deficiency involve different system changes, which in turn effect different psychobiological domains” (2001, p. 674s).

Seventh, contradictions arise from too narrow an etiologic focus. The primary cause of anemia is generally considered to be iron deficiency. However, research has demonstrated that iron deficiency is falsely and overly identified as the cause of anemia in most cases, leading to poor public health policy (Kent & Lee, 1992; Ramakrishnan, 2001; Raw, 1975; Stuart-Macadam & Kent, 1992; Tapper, 1999). Iron supplements are widely prescribed for prevention and treatment, but dietary iron in most local diets is usually sufficient and, “people almost never have severe anemia from strictly iron deficiency, this is very much an integrated problem and will require an integrated solution” (Stoltzfus, 2001, p. 700s).

Eighth, how people with anemia are perceived from both inside and outside the group presents discursive contradictions, especially when the symptoms are collectively experienced by a community. The expanded range of symptoms significantly affects how the Poqomchi’ view themselves and how outsiders view the Poqomchi’. Subjugation of this indigenous group may be tied to anemia through the ways in which outsiders perceive their appearance to be stereotypically “unhealthy” or “abnormal.” A chronic stigmatization of an “Other” can occur within the dominant sociocultural order. Practitioners within the local biomedical institutions pity the Poqomchi’ and are dismayed at what is believed to be their ignorance of how to maintain good health. The phenomenon of such widespread suffering in one indigenous Maya community, set against the prosperity of the non-Maya dominant social order, leads to contradictory perceptions that this study hopes to illuminate and resolve. Indigenous individuals and their communities are not ignorant. Chronic and ambiguous illness can become normalized as part of a social drama between acceptance and rejection of biological realities (Kohrt et al., 2005). Communities such as the Poqomchi’ employ health seeking strategies to navigate the brink of

illness in the context of economic, political, and environmental impossibilities that result from their subjugated status.

The contradictions of anemia presented above (life/death, treated/untreated, symptom/illness, disease/defense, normal/abnormal, isolated/variable, iron sufficient/deficient, healthy/unhealthy) all arise from a gap between what is known about anemia in Western biomedicine and what is experienced in a community where anemia is endemic and chronic. One final paradox needs mentioning regarding the process of researching this dissertation: anemia impairs narrative ability and yet this study relies in no small part on narrative analysis. What might be identified as contradictory or incoherent narratives in scholarly research may make sense to the anemic subjects. Also, these subjects may not have the energy to endure an intensive ethnographic survey. Such communicative ends are often found in powerful scripts that are repeated in specific contexts, but carry broad multivocal meaning and speak to broad generalities. Medical anthropologists have long been sensitive to the challenges of studying populations in which suffering is an everyday reality. They are also intimately interested in how people navigate the tensions that arise from the ambiguity illness presents (Navarro, 1985; Scheper-Hughes & Lock, 1987; Singer, 1995). Local discourse normalizing illness serves as a counterpoint to biomedical narratives of anemia being applied to Maya communities by non-Maya. Scholars have also called for an awareness of a biology contextualized within the broader social, political, and economic arenas when deconstructing objectified Western biomedical models of illness (Sievert, 2006). Anemia is ironically similar to obesity, in that both are thought of as “malnutrition” but are actually more complex than diet. Ultimately, both anemia and obesity are physical results and causes of cultural patterns in particular environments (Frisancho, 1993; Gremillion, 2005).

Navigation: Anemia Experienced as Processes in a Biological Matrix

Our theoretical contradictions regarding anemia point to a very real and contentious biological matrix. Those who are living with anemia in this tenuous space must resolve their biological dilemmas that arise as they move through life. The Poqomchi' do this through the cognitive play and process of culture. This is a process of acknowledging the matrix and ordering the space appropriately, thereby making illness livable. By studying the cultural representations of the spaces within this biological matrix, we can bridge divides and contribute a fresh perspective on anemia. To explore these tenuous spaces I emphasize the anemic as in motion, i.e., as movement and maneuvering. Anemia is something that moves and within which people move. I generally refer to this as navigation, which involves compensatory responses to maintain homeostasis in biological terms and the cultural influences for managing the body. For such processes informed by biology and culture, an interdisciplinary approach is called for. Clinical biological research on anemia has tended to immobilize the condition, reducing complex states of flux into static objects. Cultural research on anemia has also tended to freeze ever-shifting processes of anemia in order to interpret its abstract cultural representations.

As a chronic condition, anemia is experienced as perpetual tension or liminality, defined as being caught between binary oppositions of a culture's normative values (V. W. Turner, 1967). As symptoms of illness increase in severity the pertinent layers of codified local cultural meaning for interpreting the experience acquiesce to ambiguity, chaos, and disorder. Liminality captures the subjective experience of poor health and Poqomchi' awareness of their subjugated status within the broader social structure. There is acceptance of a "double consciousness" (W. E. B. Du Bois, 1903) in relation to a dominant non-Maya society, where the Poqomchi' recognize something is not as it should be and yet are resigned to it. Their awareness of this

disorder is reflected in their physical bodies, and they are cognizant of how their “othered” status affects the possibilities of health.

The liminal experience of anemia is grounded in very real biological processes. Biologically, this tension can generally be referred to as thresholds (Cook, Wells, & Herbert, 2011, pp. 2927-2928; V. W. Turner, 1986b, pp. 26-28). These thresholds correspond to the biological concept of setpoints, which are points at which the body begins to compensate for physiologic stress. This is where the body adjusts or compensates using alternative physiologic pathways, if possible, to maintain the function that has been driven out of homeostasis. The notion of biological thresholds is crucial because it incorporates the effect of the varied contexts in which the body is constantly navigating—or, “allostasis” the process by which dynamic equilibrium is attained. Individuals may or may not be conscious that these thresholds are approaching. This is where the cultural representations of the precarious passage through the thresholds and biological symptoms become critically interwoven.

Anemia can be broadly conceptualized as an anomaly in life’s most essential platform from which O₂ is delivered to the body and energy is produced. This platform operates differently in controllable ways from one individual or group to another. It is analogous to a single thread of experience weaving through all aspects of Poqomchi’ daily life. To trace this thread is to identify human patterns in what Janzen (2002) frames as the social fabric of health, a metaphor describing how people weave the chaos of life and disease into order and health. To examine this thread is to observe, analyze, and identify the movement of people with anemia across space and time, understand anemia in context, and deconstruct prevailing biomedical ideas of anemia.

For a community, shared symbolic interpretation of physiological and psychological experiences helps individuals navigate routine symptomatic expressions of illness, but also helps a community accommodate structural violence through social suffering. In the context of poverty and marginalization, the impact of widespread illness is found on many levels in the individual and social body. By acknowledging the tenuous liminality and compensatory thresholds of anemia the focus shifts away from the artifactual, objectified, and descriptive. In this interpretive biocultural anthropological approach, the emphasis is placed on the subjective process of navigating symptoms in context. I am examining how people, through anemia, physically and mentally move between contradictory states of normal and abnormal in unconventional ways, thereby turning our idea of normal and abnormal on its head. Therefore, this is an analysis of how culture and biology accommodate the ambiguous space in the biological matrix in which anemia occurs.

Research Question

What is the biological and cultural experience of anemia when it is chronic and endemic in a Poqomchi' Maya community? An assumption of this study is that a biological condition as ubiquitous as anemia has a significant role in Poqomchi' identity as recorded in their narrated life experience. The overarching goal is to understand why anemia is a life-threatening illness within this population when it is easily treatable in others. In answering this question, my research evolved into an iterative process between biological and cultural research domains. Critical awareness of the nature of anemia itself was gained by examining the contexts and processes by which its symptoms are symbolically expressed. When the symbols of anemia are considered alongside systematic analysis of its biology, the result is a complex story of how the

Poqomchi' integrate their daily struggle with anemia into their identity and thus accommodate illness.

A major component to this research question is identifying how the Poqomchi' express the experience of anemia and bring order to the chaos of disease. At a deeper level, how does the cultural codification and normalization of anemia bring order and/or prevent chaos to their world? Their vulnerability for anemia is one that is largely out of their control through transgenerational subjugation and structural violence. However, before fully understanding how anemia is experienced, it is essential to model its physical experience in the context of chronicity (see Chapter 7). A biocultural approach is crucial to understanding how and why individual physical symptoms become a social symbolic illness.

In essence, I am tracing the entropy related to the experience of anemia through dual processes of cellular degradation and symbolic construction. This presents an arrangement of measured order to the complexity of anemia. The sum experience of anemia is not entropy, but meaningfully linked biological and cultural forces. Somewhat reflective of postmodernism, this dissertation abbreviates a local discourse on anemia into particular scholarly discourse. My research traces how anemia threads through dichotomy and contradictions and proposes a model in which the Poqomchi' culturally navigate a biological matrix. Once we come to understand this aspect of Poqomchi' identity—the accommodation of pathology—we can conceive of more effective biomedical interventions.

Outline of Dissertation Chapters

Chapter 2 will provide background information on anemia: physiology, compensatory responses, debate over the medical taxonomy of anemia, signs and symptoms, global and Guatemalan prevalence of anemia, etiology, the biocultural concept of accommodation of stress,

and a conceptualization of structural violence. Chapter 3 introduces the details on the field site, local natural history and nature of anemia in the field site, local conditions and historical post-colonial foundation of structural violence, and the ancient archeological record of anemia. Chapter 4 presents a mixed-methods approach used in my research which includes previous applied agriculture work, early failed research approaches demonstrating an iterative research process, participant observation, sampling as a triage interpreter, focus groups, elicitations, blood sampling, meta-synthesis and synthesis of research across disciplines, and discourse data collection and analysis in a liminal context.

Chapter 5 presents biological data from blood samples showing the prevalence of anemia in the Poqomchi' community of Onquilha'. Chapters 6, 7, and 8 are each divided into two parts. These divisions reflect, what in reality is, a gradation between broad conceptual domains in my interpretation and presentation of the data (e.g. living to dying, proximal to distal, explicit to implicit, and/or empirical to theoretical/anecdotal). Chapter 6 shows how the Poqomchi' understand and discuss anemia as a liminal discourse on force and suffering. The second part of Chapter 6 examines a deeper social context and contradictions present in daily life due to anemia. Chapter 7 presents a pathophysiological model of anemia in the context of observed accommodative. The first part examines compensatory responses to chronic anemia and the second part examines what happens when those responses are insufficient and become detrimental to health. Chapter 8 links this pathophysiological model of anemia to ethnographic research on *susto* (fright or soul loss), which is a Poqomchi' nosology demonstrating the accommodation of anemia and social suffering. The second part of Chapter 8 examines broader phenomena and anomalies found in Poqomchi' culture and related to the context of anemia. This chapter places the cultural and biological experiences of anemia alongside one another in

domains that include: pH balance, diet, hot-cold duality, pica, *temazcals* ('sauna'), indoor cooking fires, and other behaviors that alter the body's internal environment. These highlight culturally accommodative means of maintaining homeostasis in the context of chronic illness where individuals and the community are bound by structural violence. Finally, Chapter 9 concludes and summarizes the findings of this dissertation on the experience of anemia, situates the experience within a theoretical framework, closes the response to the calls for research, and recommends the direction of future contextual community-based interdisciplinary research on the experience of anemia.

Chapter 2: Anemia, Accommodation, and Structural Violence

Anemia refers to such a broad range of biological phenomena and symptoms that it is difficult to define. In fact, the elemental nature involving blood and O₂ suggests any ‘definition’ is immediately inadequate. Anemia beckons questions of human existence involving broad inquiry into body, blood, air, environment, and motion. In this chapter, a working definition of anemia is given, but is immediately followed by a broad description of blood and its function in the body. I describe commonly known physiological compensatory responses to anemia. Then, I examine anemia via Western biomedical classificatory models i.e., anemia as a symptom, condition, illness, and/or disease. Following this background information, I describe the common symptoms of anemia and what its prevalence looks like globally and in Guatemala. I briefly discuss etiological considerations of anemia that help steer this dissertation away from identifying a cause. Finally, the concepts of accommodation and structural violence are presented as a way to allow a targeted discussion of biology and environment. Accommodation and structural violence together offer a guiding conceptual framework for understanding how a chronic illness is culturally managed in a marginalized community.

Defining Anemia

From its Greek root the term anemia means “without blood” (Galton, 1975, p. 17). Today, anemia is defined variably. The Iron Disorders Institute (Garrison, 2003) demonstrates this point in their signature 480-page guide, which offers a list of 25 definitions (pp. 23-24). Although the definition of anemia is elusive, there are areas of agreement. Definitions almost always include a decreased capacity of blood to carry O₂ from the lungs to body tissues (Wadsworth, 1992, p. 63) or, more literally as “no blood” (Garn, 1992, p. 33). Anemia also refers to an abnormally-low level of hemoglobin (Hgb) in the blood (Raw, 1975, p. 48), as a decrease

in red blood cells, and/or a decrease in Hgb (Garn, 1992, p. 33), and/or an increase in abnormally developed red blood cells or Hgb relative to the total blood volume (Kent & Lee, 1992, p. 2).

A good working definition of anemia is an abnormally low level of healthy red blood cells necessary to carry O₂ throughout the body (Longe & Blanchfield, 2002, p. 126). The reference to “abnormally low” and “throughout the body” in this definition is of interest for this research project because given environmental constraints, normalcy is relative to physiological thresholds for homeostasis, which are moderated by both cultural and biological accommodations (Frisancho, 1993, p. 218; Stuart-Macadam & Kent, 1992). Also, the central subject of this definition, “red blood cells necessary to carry oxygen,” is of most interest to the goal of broadening the framework and definition of anemia by examining what is considered necessary to a specific population.

Physiology, Blood, Hemoglobin, Oxygen, and Energy

Blood is plasma plus red blood cells that deliver O₂, performing a physiological task critical for cell function and survival. Blood also carries other types of blood cells, nutrients, gasses, heat, and energy. About 40-45 percent of blood is red blood cells (erythrocytes), which carry O₂ and CO₂. Adults have 20-30 trillion red blood cells in their bodies at any given time, constituting about a quarter of all cells that make up the human body. Red blood cells are made in the bone marrow from stem cells at a rate of about 2 million per second, taking 7 days to mature. Each viable cell circulates for about 100 to 120 days. It takes about 20 seconds to complete a cycle through the body. At that rate a single red blood cell can circulate between 432,000 to 518,400 times through the body.

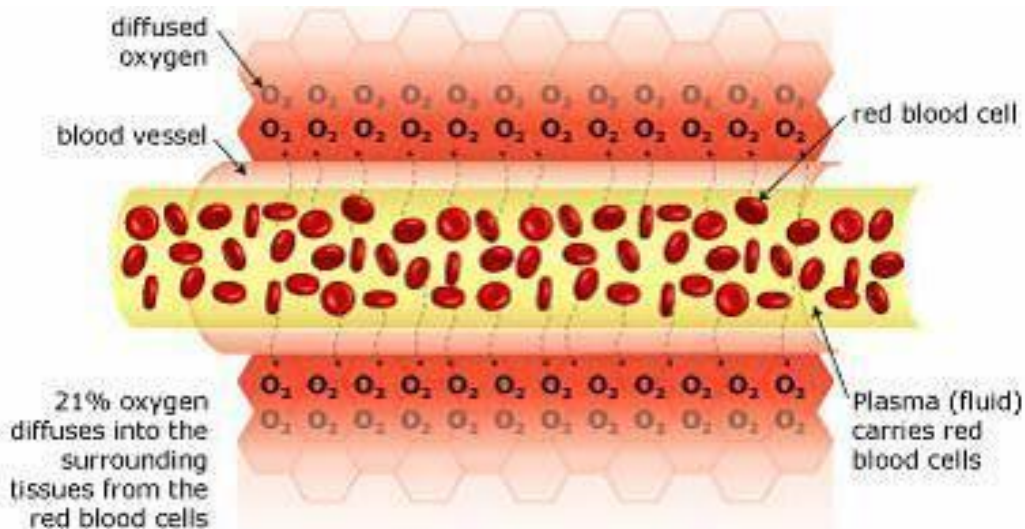


Figure 2.1. Blood vessel, red blood cells, and O₂ diffusion (improvinghealing.com, 2006)

Hgb is a protein inside the red blood cell that travels with the cell throughout the capillaries and into body tissue. Inside a red blood cell are approximately 270 million Hgb biomolecules. It represents about a third of the content of a red blood cell. Inside each Hgb molecule there are four heme groups. Each heme group stores one atom of iron. O₂ binds to the iron ion at the center of all four hemes. The key moderator of this process is allosteric cooperative binding. If one of the four heme structures of Hgb is bound to O₂ other O₂ molecules are likely to bond to the remaining hemes. Conversely, if one of the four hemes releases its O₂ molecule the other hemes are likely to do the same.

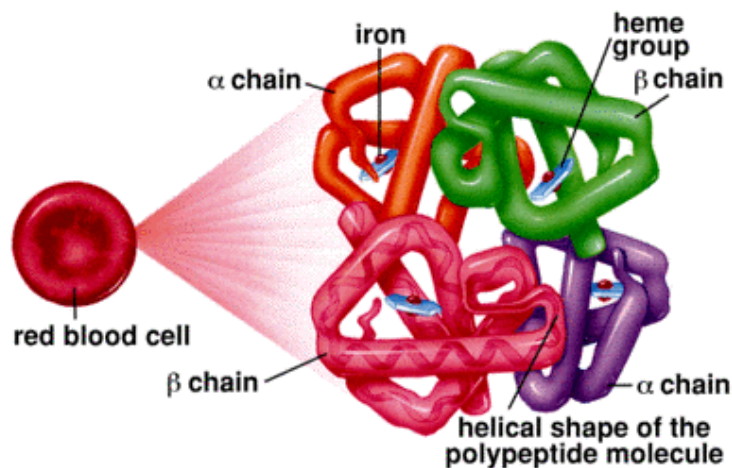


Figure 2.2. Red blood cell, hemoglobin, four heme with iron and O₂ (Jatin, 1997)

Inside the deepest parts of the lungs are alveoli imbedded in a web of blood-infused capillaries. O_2 , inhaled into the lungs through pulmonary respiration, dissolves across the alveoli membranes, where partial pressure of O_2 (PO_2) is high, and moves into the capillaries, where partial pressure is low. Once inside the blood plasma, O_2 is taken up by red blood cells suspended in the plasma and distributed to tissues throughout the body where PO_2 is lower. This process of circulation and pressure balance is arguably the most important of the human body. It supplies O_2 to all cells to sustain energy metabolism. Although it appears elementary, it is a complex balance that varies not only among individuals, but also between populations.

Life is energy, and energy in the human body is harnessed from chemical reactions. The metabolic processes that produce biochemical energy do so by moving electrons and protons. These are excited or calmed by their new positions. Biochemical energy results from adjustments in biochemical temperament. Millions of these chemical reactions take place in cells throughout the body and the energy produced within each cell is budgeted for that cell. Biologically, if it can be argued that there is a life force, supernatural or otherwise, it originates somewhere inside the cells—the most basic units of life.

O_2 in the human body is involved in the continual process of perpetuating life, guaranteeing that death in this moment is not certain. At the cellular level, O_2 regulates the threshold between life and death through a process called cellular respiration. In this process, O_2 passes into the cell and then into the mitochondria (the cell's powerhouse). Like other small neutral molecules, O_2 may freely pass through cell walls and membranes. Once inside the mitochondria of the cell, molecules of O_2 are constantly at work in oxidative chemical reactions. These O_2 reactions are pushing and pulling electrons and hydrogen from the food we eat across the membrane of the mitochondria. A gradient forms from the constant pumping back and forth

across the membrane. This creates the bit of potential energy needed to power the production of a larger mass of energy called ATP (adenosine triphosphate).

After the O₂ has been used by the cell as a final acceptor of electrons and hydrogen ions generated during metabolism of ATP, it binds with hydrogen to form water. These water molecules in addition to pre-existing water molecules inside the mitochondria react with ATP through catabolic reactions that cause hydrolysis in every cell in the body. Some of the water is metabolic water, but the rest has to come from the diet (water is an essential nutrient). The water breaks up ATP into ADP, which reduces the molecules' potential energy and releases energy. This process produces energy for all cells. It is the force behind all bodily tissue movement, function, growth, electrical impulses, etc, and has a significant influence upon the maintenance and repair of the cell. This process is metabolism, and maintaining it is homeostasis. Thus, two important functions of O₂ are to regulate the threshold between life and death by facilitating the creation of stored energy, and to liberate stored energy for the cell to do its work. This dynamic between water, O₂, and energy leads biomedical practitioners to assume people are dehydrated when they are actually anemic (two symptomatically similar conditions).

In the context of human physiology, the capture of energy is the calming of a phosphate electron. In physics, energy is quantified by Einstein's $E=mc^2$ (E=energy, m=mass, c=speed of light). In scientific terms, energy is only indirectly observable—not observable but calculable as the body's ability to do work. The heart beating, walking, thinking, feeling, lifting, and even resting are all work that requires energy. Force used in work varies through distance, velocity, and time. The term 'force' is used to refer to work in the context of space and spatial relationships between objects. Energy in human beings is functionally the force with which one can exert work upon other objects in a shared space. Energy is the currency of life and the ability

to do work. Force is the physical and tangible experience of the ability of each individual's energy, because force is tested by the objectifiable world.

Compensation for Anemia

There are four ways the body compensates for anemia. First, the quantity of blood pumped through the heart increases due to changes in vascular tone and blood viscosity. Second, more blood flows into certain organs such as the heart and brain and away from other areas such as the skin and kidneys—blood circulates more quickly because less of its volume travels out to the extremities. Third, certain tissues increase the amount of O₂ extracted from blood. Fourth, and only seen in patients with chronic anemia, an increase in the organic phosphate 2,3-Bisphosphoglyceric acid (2,3-DPG) inside the red blood cells decreases the affinity between O₂ and Hgb, such that more O₂ is released at a given PO₂. Ultimately, these are changes in breathing and circulation that are unconsciously controlled by the central nervous system (Guyton & Hall, 2006, p. 427; Uthman, 1998, pp. 14-17).

These four involuntary responses restoring homeostasis may succeed in mild-to-moderate anemia—and if the body is at rest and all other conditions are held constant, requiring no physiological adjustments, and no increase in energy needs. However, constancy is never the case for bodies in motion and the four responses restoring homeostasis may fail in more severe anemia—and when people are attending to their daily tasks, psychoemotional pressures, and other sicknesses. Changes in the body's energy requirements or in external environments often involve more complex and specialized mechanisms to restore homeostasis. In addition, this dissertation explores how culturally specific behavior, intentionally or unintentionally, compensates for anemia in the short term or even throughout a lifetime. The construction of a model of accommodation of chronic anemia must be grounded in ethnographic research.

Classifying Anemia: Symptom, Condition, Illness, or Disease

In my research I was struck by how immediately and consistently I was corrected by biomedical practitioners when I referred to anemia as a disease or illness. In Western biomedicine anemia is considered to be an easily treatable “condition” and sometimes a “symptom”. This is arguably due to the nature of anemia, which is often caused by an etiology that is, “complex and requires multiple considerations in finding the appropriate mix of remedial measures” (Ramakrishnan, 2001, p. 2). Western biomedicine and its manifestations in global health operate within a positivist construct: disease is knowable by isolating the cause to a single origin—the dogmatic doctrine of the single etiology (Spitzer, 2007, pp. 2-3). This singular lens is focal and permeates all layers of medicine such as classification, quantification, qualification, treatment, and legitimacy, to the exclusion of contextual dimensions that deviate from the pathological model (Kostka, 2001, pp. 172-173).

Therefore, in a clinical or hospital setting, treatable anemia results from an individual’s experience with some other condition, disease, injury, pregnancy, or nutritional deficiencies. Only sometimes is anemia classified as its own non-infectious disease. Generally, this classification appears when the cause can be reduced to either nutritional or heredity, e.g. genetically driven *sickle cell* anemia or B₁₂ deficiency driven *pernicious* anemia (Wagner, Vichinsky, Lande, & Pennathur-Das, 1989, p. 145).

Foster argues that disentangling disease etiology is essential for cross-cultural studies of illness (1976, p. 777). The difference between disease and condition is ambiguous and mostly semantic. A definition of *disease* frequently begins by stating that it is a condition. For example, Merriam-Webster defines disease as, “a condition of the living animal or plant body or of one of its parts that impairs normal functioning and is typically manifested by distinguishing signs and

symptoms” (“Disease,” n.d.). Conversely, definitions of *condition* frequently begin by stating that it is a disease, or any other sort of medical pathology.

Linguistic anthropologists use the concept of stance as a way to tease out the social and subjective meanings of words and phrases. The “idea” of anemia as a disease or a condition exists in language, texts, community discourse, and medical discourse (J. W. Du Bois, 2007, p. 140). It is presented as packages of meaning manifest from diverse agendas, different ontologies, and constitutions of the subject/self in relation to the “Other” (Marková, 2003). For example, looking further into the nature of “condition”, Merriam-Webster’s definition describes “something essential to the appearance or occurrence of something: an environmental requirement: a restricting or modifying factor: a usually defective state of health: a state of being” (“Disease,” n.d.). This suggests that a condition is i/elusive, essential, and unavoidable in and of itself. Such conceptualizations would not be helpful in developing cogent public health initiatives preventing an illness that is left reduced to, “a state of being.”

Another way to analyze stance is to look at the titles of current books related to anemia. Searching any library, there are not many books available that even have anemia in the title. There are less than 5 books on general anemia. Adding books specific to female health brings the total to 10, dietary suggestions to 15, clinical/diagnostic/hematological to 25, sponsored governmental organizations and non-governmental organizations to 45, and specific types of anemia to 65.

Some stances evident in titles confirm the comprehensive, complex, and systemic impact of anemia, such as in *Anemia: From Molecule to Medicine* (Raw, 1975) or simply stated *Understanding Anemia* (Uthman, 1998). Stuart-Macadam and Kent’s edited volume, *Diet, Demography, and Disease: Changing Perspectives on Anemia*, demonstrates the broad

implications of anemia and how our understanding of it is in constant flux (1992). As early as 1899, the ambiguous association between anemia and the disease concept was articulated in the book titled *Anemia and Some of the Diseases of the Blood-Forming Organs and Ductless Glands* (Bramwell, 1899). Other titles emphasize the language and rhetoric specific to processes of disease, such as *Anaemia: a Guide to Causes, Treatment and Prevention* (Davies, 1993). The most notable example of the controversy of how to classify anemia—as a disease or a condition—stands out in Galton’s book titled *The Disguised Disease: Anemia* (1975) and conversely in *The Iron Disorders Institute Guide to Anemia*, which is subtitled, “Anemia: A symptom, not a diagnosis” (Garrison, 2003).

Practitioners of Western biomedicine set out to determine an ultimate and singular cause of a condition, a diagnosis. In a clinical setting, there are tests available to determine the causes of anemia, including nutrient deficiencies. On a global scale, the singular cause of anemia is almost universally perceived to be a lack of dietary iron. While iron deficiency is a significant contributor to anemia, there is little evidence to suggest that iron deficiency is ever actually a singular cause or even always the best target for treatment (Kent & Lee, 1992, p. 3). The purpose of this discussion is not to argue that anemia is either a disease or a condition, but to dissect the role stances about anemia play in public and medical discourse. Both classifications of anemia are tenuous. Designation as a condition may inadvertently shift treatment to single causes. I propose, supported by cross-cultural etiological analysis, that anemia is much more than a condition or symptom; it is a life set dangerously close to the tipping point of disease, particularly in communities where it is endemic and chronic.

Symptoms of Anemia

There are many clinical symptoms of anemia that range from acute to chronic and may be more psychological or physical. The most notable symptoms (e.g. fatigue, pale complexion, and headache) were presented in the introductory chapter from what I observed as a medical interpreter. A more detailed list of symptoms is reported below (Table 2.1). However, chronic anemia is often accompanied by other illness and disease, which can blur the line in distinguishing the effects of anemia from the effects of compounding illness and disease.

Table 2.1.
Symptoms of anemia presented as roughly separated (Blanchfield & Longe, 2002; Galton, 1975, p. 3; Garrison, 2003, p. 25)

Psychological Symptoms	Physical Symptoms
chest pain, often accompanied by a choking sensation that provokes severe anxiety	tingling in the hands and feet
fearfulness	damage to the spinal cord
irritability	shortness of breath
confusion, depression, and memory loss	faintness or dizziness
inability to concentrate, memory loss	pasty, sallow, and pallid skin, palms, gums, nails, and eyelids
does not want to work	tingling in the legs
cannot walk	stand-on-end-hair
does not want to bathe	inflammation of the mouth or tongue
headache	irregular or rapid heartbeat
insomnia	loss of appetite
problems with movement or balance	nails that are dry, brittle, or ridged
weakness, fatigue, and listlessness	rapid breathing
cravings for ice, paint, or dirt (pica)	sores in the mouth, throat, or rectum
see stars	sweating
poor vision	swelling of the hands and feet
ringing in the ears	thirst
	unexplained bleeding or bruising
	problems with movement or balance

Beyond the more apparent symptoms, research has shown many deeper neurological and developmental symptoms of anemia. Detecting such effects requires more complex research methods for evaluating domains such as cognitive function, expressive and receptive language, motor skills, and other psychometric assessments. Many of these studies have focused on iron

deficiency and others on iron deficiency anemia (IDA), with iron levels as the independent variable. The emphasis on iron appears to be arbitrary and debatable (Stoltzfus, 2001), but generally researchers have great difficulty separating iron deficiency, iron deficiency anemia, and anemia (Lozoff, 1989, p. 652) . However, evidence suggests that it is the combination of severe anemia with iron deficiency that results in permanent cognitive and developmental effects (Stoltzfus, 2001). When anemia was not present the impact of iron deficiency was far less; and when anemia was severe or moderate the effects of iron deficiency was far greater and had long-term impacts on the individual (Carter et al., 2010; Lozoff, 1989; Lukowski et al., 2010; Pollitt, 2001).

The cause of such long-term neurological impacts is likely due to, “chronic reduction of cerebral oxygenation secondary to decreased O₂-carrying capacity of the blood linked to anemia” (Chaves et al., 2006, p. 1433). Additionally, acute reduction in O₂ supply to areas of the brain can result in ischemic strokes, causing lesions to form on the brain, and leading to chronic episodic seizures. Ischemia, which causes brain lesions, commonly occurs with anemia, and—were it not for the seizures there would be little noticeable effect. It is only across time and through refined assessments that these symptoms can be isolated. Children with anemia have been found to exhibit decreased motor development, exploratory behavior, and orientation-engagement (Lozoff, Klein, & Prabucki, 1986). They initiated more body contact with their mothers, fewer breaks in close contact, and more reestablishment of contact, while mothers spent less time away from their children. These behaviors were connected to increased fearfulness, unhappiness, fatigue, wariness, hesitance, and inactivity (Lozoff et al., 1986). Detailed studies of the neurological impact of anemia and iron deficiency are illuminating, especially considering the behavioral and cognitive functions that are actually heightened or remain the same with

anemia. Carter et al. (2010, p. 432) found that higher measures of socioemotional function could attenuate the effect of IDA (iron deficiency anemia) on cognitive function. Such research might suggest how populations socioculturally accommodate the detrimental impact of anemia in tandem with neurobiological processes.

Prevalence of Anemia Globally and Nationally in Guatemala

According to the WHO, anemia affects 1.62 billion people, or 24.8% of the global population (Benoist et al., 2008, p. 7). This is according to an extensive survey of rates of anemia using data collected from 1993-2005; estimates for distinct demographic groups were also calculated. An estimated 47.4% of preschool-age children, 25.4% of school-age children, 41.8% of pregnant women, 23.9% of elderly, 30.2% of non-pregnant women, and 12.7% of men suffer from anemia (Table 2.2).

Table 2.2.
Estimated global rates of anemia by demographic groups (McLean, Cogswell, Egli, Wojdyla, & de Benoist, 2009)

Population group	Prevalence of anemia		Population affected	
	%	95% CI ^a	# (millions)	95% CI ^a
Preschool-age children	47.4	45.7-49.1	293	283-303
School-age children	25.4	19.9-30.9	305	238-371
Pregnant women	41.8	39.9-43.8	56	54-59
Non-pregnant women	30.2	28.7-31.6	468	446-491
Men	12.7	8.6-16.9	260	175-345
Elderly	23.9	18.3-29.4	164	126-202
Total population	24.8	22.9-26.7	1620	1500-1740

^aA regression model predicted anemia based on other variables from locations where data on the prevalence of anemia was available to generate confidence intervals of 95%. To review these models see McLean et al., 2009.

At a quarter of the global population the prevalence of anemia is notably high, especially when compared to lesser public health issues garnering far greater attention. However, the story

of anemia's impact is not complete with current prevalence alone. It becomes more significant when anemia is considered in the context of a lifespan. Prevalence is a measure of illness at any given time point; therefore, the number of people who have been affected at some point in their lifetime may be far greater. The Iron Disorders Institute's medical advisor, P.D. Phatak, M.D., states that, "More than half the world's population will experience some form of anemia in their lifetime" (Garrison, 2003, p. 1). Even temporary afflictions of anemia have permanent physiological impacts that extend far beyond a single point in a lifetime. Recovery from anemia is never complete and the quantity of damage done is in truth well over the estimates of current prevalence for any given demographic sample in any given population. If nearly half of all preschool-age children are afflicted with anemia, then at least that many people in the world go forward experiencing the physiological and psychological repercussions to growth and development. Additionally, whereas people are more vulnerable to anemia in various stages of life, they may be afflicted throughout their entire lifespan. Thus, it may also be assumed that anemia affects many people not once, but multiple times. This way of rethinking prevalence and the global impact of anemia is particularly relevant when considering that anemia disproportionately burdens the most impoverished continents, countries, and communities. South America, Africa, and Asia are all more affected by anemia than North America and Europe (Figure 2.3). Thus, reported prevalence of anemia does not come close to reflecting its lasting impact on all those previously afflicted.

Anaemia as a public health problem by country: Pregnant women

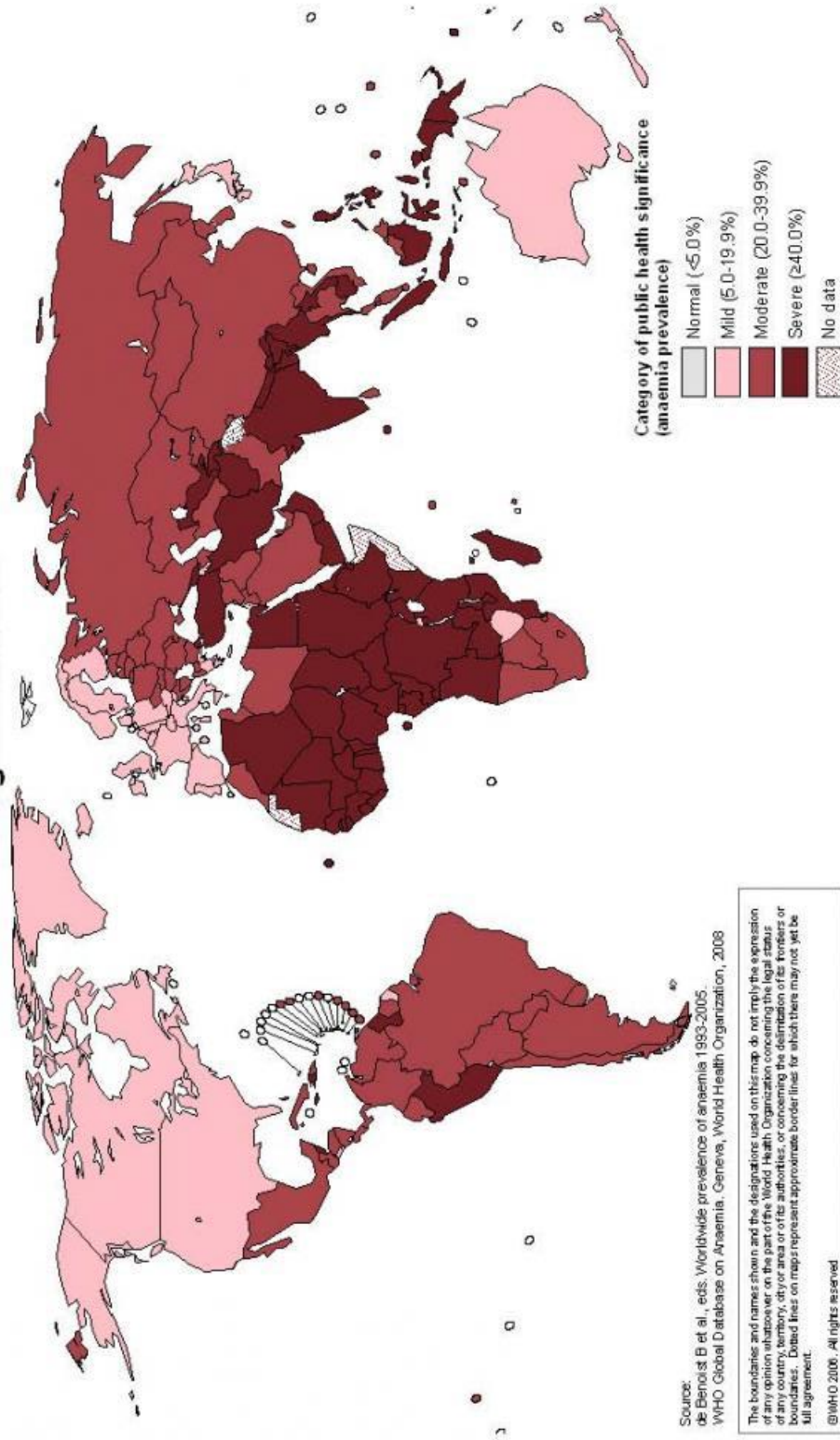


Figure 2.3. Anemia as by country: preschool-age children (Benoist, McLean, Egli, & Cogswell, 2008, p. 6).

The WHO reports that Guatemala ranks 4th among Latin American Countries, with an anemia rate estimate of 38.1 percent for children under 5-years (Benoist et al., 2008, p. 21) (Table 2.3). In 2002 the WHO estimated that 65.3 percent of children between 6 months and 1 year of age were anemic and 55.6 percent of children between 1 and 2 years of age were anemic (Table 2.4). According to the Ministry of Public Health for Guatemala (MSPAS), anemia is the leading cause of morbidity indicated in primary consultations, which are a sort of triage for initial visits to a doctor for determining the early interventions required to improve health (MSPAS, 2001, p. 1). In 2001, there were 393,818 initial doctor visits that resulted in a diagnosis of anemia, out of a total population of 11,676,411 (Table 2.5). Roughly 3.3 percent of all primary medical visits resulted in a diagnosis of anemia. Of these patients, approximately 70 percent were female and 30 percent were male. These early triage data are significant because as patients' illnesses progress, anemia becomes a lagging co-occurrence and is no longer documented. It is not treated as a primary illness in a clinical setting, but rather as a baseline or preliminary observation. From there, doctors try to get at the "actual" disease or whatever is classified as the primary cause.

Geopolitically, Guatemala is divided into 22 departments. Within the departments there are 332 municipalities. This research is set in the department of Alta Verapaz and in the municipality of Tamahú. Alta Verapaz ranks 6th out of 22 departments in terms of primary consultations for anemia (Table 2.6). Anemia is also the leading condition diagnosed during primary visits (Table 2.7). It is surprising that given the global prevalence of anemia, there are few studies on specific communities. There is also a lack of research among specific demographic groups.

Table 2.3.
Children Under 5-years with anemia in 2006: Top 5 continental Latin American countries
(Benoist et al., 2008, pp. 20-24)

Rank	Country	Population with Hgb<11 g/dl estimates (%)
1	Brazil	54.9
2	Bolivia	51.6
3	Peru	50.4
4	Guatemala	38.1
5	Ecuador	37.9

Table 2.4.
Prevalence of anemia in Guatemala among children under 5-years (Benoist et al., 2008, p. 21)

Child Age (years)	N	Population with Hgb<11 g/dl (%)	Population with Hgb<11.1 g/dl (%)
.50-.99	442	65.3	--
1.00-1.99	895	55.6	--
2.00-2.99	923	--	38.5
3.00-3.99	865	--	30.1
4.00-4.99	890	--	21.4

Table 2.5.
Cause of morbidity at primary consultation, Guatemala (MSPAS, 2001)

Rank	Cause	Total	Base Population 2001
1	Anemia	393,818	11,676,411
2	Injuries from accidents	75,513	11,676,411
3	Malnutrition	74,208	11,676,411
4	Trauma/multiple trauma	30,797	11,676,411
5	Arterial hypertension	13,515	11,676,411

Table 2.6.
 Primary consultations for anemia by department for Guatemala 2001 (MSPAS, 2001)

Rank	Department	Total per 10,000
1	Peten Sur Oriente	1313.12
2	Ixlan	1,217.08
3	Retalhuleu	907.86
4	Baja Verapaz	793.58
5	Peten Norte	783.05
6	Alta Verapaz	741.41
7	Chiquimula	631.51
8	Peten Sur Occidente	615.57
9	Ixil	571.57
10	San Marcos	553.12
11	El Quiche	514.71
12	Izabal	486.86
13	Solola	391.94
14	Escuintla	381.60
15	Santa Rosa	357.50
16	Suchitepequez	326.31
17	Zacapa	320.84
18	El Progreso	295.75
19	Quetzaltenango	273.25
20	Jutiapa	268.05
21	Totonicapan	241.72
22	Huehuetenango	239.11
23	Chimaltenango	190.27
24	Jalapa	133.84
25	Sacatepequez	38.14

Table 2.7.
Cause of morbidity at primary consultation, Alta Verapaz (MSPAS, 2001)

Morbidity	Cause	Total	Base Population 2001
1	Anemia	62,897	848,340
2	Injuries from accidents	7,947	848,340
3	Trauma/multiple trauma	3,851	848,340
4	Malnutrition	2,890	848,340
5	Snake Bites	1,291	848,340

Etiology of Anemia

The difficulty of defining anemia stems from the interrelated and confounding causal relationships that affect the way red blood cells are either produced, function, or die. At the broadest level there are two categories of anemia, related to etiological origins that are relevant to this dissertation. The first is nutritional anemia resulting from nutritional deficiencies. The second, a category that has gained salience with recent scientific discoveries, is anemia caused by chronic inflammation (or disease) (Guralnik, Eisenstaedt, Ferrucci, Klein, & Woodman, 2004, p. 2263). The latter is most commonly seen in Western biomedicine because it primarily develops as a symptom of some other disease. However, nutritional deficiencies may also lead to inflammation and/or infection, which in turn may worsen nutritional deficiencies by affecting absorption. I refer to anemia as “chronic” in terms of anemia’s symptoms being long-lasting, not as a symptom of a specific chronic disease such as kidney disease. This sort of “chronic anemia” can be recurrent in totality or in degree of severity, and vary in etiology. Where anemia is chronic and endemic, both nutritional anemia and anemia of chronic inflammation are likely occurring. For young children, anemia advances alongside development. With limited resources and compromised health, opportunistic infectious disease such as tuberculosis, pneumonia, or parasites further compound the inability to metabolize nutrients and repair the body.

Nutritional anemias result from insufficient intake or bioavailability of nutrients essential to red blood cells and Hgb synthesis. The need for such nutrients is often increased due to excessive blood loss or early red blood cell destruction. Iron, folate, and vitamins B₁₂ and B₆ are four of the most essential hematopoietic nutrients. Vitamins C, A, and E are also important, especially for the utilization of both iron and vitamin B₁₂. Riboflavin deficiency may also cause anemia as it plays an important role in the utilization of iron (Ramakrishnan, 2001, pp. 9-17). In most cases, the cause of nutritional anemia can be isolated as a single nutrient deficiency. However, there is a growing awareness of the synergistic multi-causal or variable pathways of anemia.

In a recent meta-analysis of the effects of iron supplementation on anemia in developing countries, the authors conclude that “there is a suggestion in the data, not well documented except in a couple of studies, that something other than iron may be operating to limit Hgb response and anemia control.” While the majority of anemia in the world is caused by iron deficiency it is important to consider, prevent, and treat other micronutrient deficiencies that could limit Hb response to iron supplementation (Ramakrishnan, 2001, p. 17 citing Beaton and McCabe, 1999).

Accommodation and Stress

When I speak with biomedical practitioners in Guatemala or in the United States about anemia among Maya, they often attempt to simplify its significance by suggesting that the Maya have “adapted”. This is suggested in an almost fatalistic way that dismisses the negative consequences of anemia in exchange for a story of human success. Expressed in this way, biomedical practitioners misuse the biological notion of adaptation and a misunderstanding of how anemia impacts daily life. The term adaptation emphasizes general functional change, not

the momentary dysfunctional changes in an organism that result from failing compensation for illness and disease in the context of harsh sociostructural pressures. Applying the concept of adaptation in a broadly excusatory way ameliorates the political and economic variables that promote anemia, sweeping under the carpet daily injustices that ensure that anemia among the Maya remains chronic and endemic. More complex theory is required for understanding anemia among the Poqomchi'.

In common usage, 'stress' is an external force on the individual person. In contrast, from a biological perspective McElroy and Townsend et al. argue that stress is an "internal, defensive process" (2009, p. 268) and "*physical responses of the body to environmental demands that threaten an individual's well-being*" (2009, p. 269). Stress is the experience of disturbance in homeostasis from both the physical and social environment to which the human body responds with "hormonal, neurological, and immune system defenses" (2009, p. 269).

McElroy and Townsend et al. subdivide stress into "acute stress" and "chronic stress" (2009, p. 269). Acute stress is best explained as temporary. In order to cope with these moments of insult to the status quo (homeostasis) and the inadequacy of allostasis to return to homeostatic balance, people use, "physiological differences in emotional flexibility" (McElroy & Townsend, 2009, p. 269). However, there is a paradox in that prolonged defense against perceived pressures can compromise the immune system and increase risk of disease. Consequently, bodily defense against crisis can become increasingly detrimental to the human body. Whether the induced stress is unexpected or expected and acute or chronic, the human body will do what is necessary to cope. The coping mechanisms required to respond to stress produce what McElroy and Townsend et al. term "residual effects" (trade-offs). These broadly defined residual effects can on balance be positive or negative. For example, the stress of jogging and that of office work

produce varied residual effects, one positive and the other negative (McElroy & Townsend, 2009, p. 271).

Accommodation is when an, "individual's response to a stressor enhances survival but also entails some loss in functioning...the term has been used mostly to describe physiological changes under conditions of deprivation or unusual demands on the body, as in pregnancy" (McElroy & Townsend, 2009, p. 270). Frisancho (1993), borrowing from V. R. Young and Marchini (1990, p. 283), defines accommodation as, "responses to environmental stresses that are not wholly successful because, even though they favor survival of the individual, they also result in significant losses in some important functions" (p. 485). In other words, accommodation may be sustaining but is not adaptive in the long run (Frisancho, 1993, p. 7). Accommodation may allow for immediate survival, but in the long-run it reduces life expectancy and reflects biosocial workarounds to the severe symptoms of anemia (Uthman, 1998, pp. 17-19).

In the concept of accommodation, balance and imbalance are essential to evaluating bodily alterations. Those alterations that produce an imbalance accommodate stress but lead to reduced function. Cultural anthropology recognizes the differential nature of concepts such as "imbalance" across cultures and groups and thus turns to narrative to determine more particular, local understandings that are rooted in specific contexts. In context, populations collectively, historically, and culturally determine their own degrees of imbalance. These biological imbalances can be identified through discourse on accommodative strategies.

Stress leads to strain on the physical body, as well as delayed strain that impacts growth, development, and often long term-organ function. This bodily damage leads to an expanded response range to stress. Responses to stress that lead to strain may enhance survival (what may be confused with the concept of adaptation), but entails some loss in functioning.

Simultaneously, an ethnomedical diagnosis and treatment may be deemed positive to strain in a specific etiological model; however, in another model it could actually be negative for the individual organism. An example of this dilemma would be providing iron supplements to a mildly anemic pregnant woman who is also infected with parasites thriving on iron.

There are several ways to operationalize or measure stress in both individuals and populations. There is a significant cultural component to stress and correspondingly a strong relationship with medical rituals. In medical anthropology, stress is frequently discussed as negative, positive, generally historically adaptive, or all three. This perspective goes against a strictly clinical or biomedical interpretation of stress, which finds its effects to be negative or detrimental, but also interprets the signs of stress as isolated phenomena.

Anemia is particularly interesting as a research topic when examining the relationship between disease and culture because it remains fairly constant and recurrent from birth to death in populations where it is endemic and chronic. The physical signs of anemia and its constructed meanings are tenuous. Community members share their subjectivity through narration, in which the emplotment varies with interpersonal relationships, age, sex, and degree of anemia. Most diseases and illnesses used in research to exemplify a relationship with culture have more finite start and end points, are restricted to a singular cause or event, or if considered chronic, are frequently concerned with ongoing psychological stress rather than physiological insult. Other examples of continual physiological accommodation such as altitude hypoxia demonstrate more straightforward cause-effect relationships.

An entire population may experience life-altering trauma which could last a generation or more. Populations most at risk include those that have experienced routine marginalization and physical violence. McElroy & Townsend et al. refer to the term *historical trauma* as a

cumulative harmful collective experience, the results of which can be seen years later in, "self-destructive behavior, substance abuse, suicidal thoughts and gestures, depression, anxiety, [and] low self-esteem" (2009) citing (Heart, 2007, pp. 177-178). McElroy & Townsend (2009) emphasize singular, temporary, destructive past events, but what happens to a population under stress for generations? Can historical trauma be inherited? Such populations do indeed exist as in the case of those who experienced slavery, feudalism, colonialism, classism, apartheid, and other systems of domination. Under a model of adaptation and accommodation, it does not seem possible for self-destructive behaviors such as substance abuse, suicide, and depression to continue within a population over hundreds of years. Therefore, there must be a sociohistorical concept of stress that can be embodied and accommodated across generations. I propose that when structural violence creates extensive conditions of stress lasting hundreds of years the subjectivity of that stress will be complex and multivocal. The multivocality of symbols connects various planes throughout the fabric of society (V. W. Turner, 1969, pp. 45-53).

Examination of cultural accommodation requires specific tools for discursive analysis and a broad theoretical framework to interpret and contextualize the experience. This project is founded upon the recognition of a rich synergistic relationship between biology and culture (Goodman & Leatherman, 1998). The research also critiques the biomedical construction of "normal," which neither captures the reality of illness nor reduces disease (Garn, 1992; Lock & Nguyen, 2011; Ritenbaugh, 1982; Wadsworth, 1992). This project also addresses the ways in which the ambiguity of chronic illnesses is normalized through accommodation (Kohrt et al., 2005). In a community that shares a common culture and environment, the accommodation of disease (Ellison & Jasienska, 2007; Frisancho, 1993; McElroy & Townsend, 2009) and the process of normalization constructing illness can be observed together (L. Cohen, 1998; Scheper-

Hughes, 1992; Sievert, 2006). In research such as this, an awareness of the reciprocal relationship of biology and culture is paramount to understanding experiences, perceptions, and constructions of normal and abnormal (L. Cohen, 1998; Dettwyler, 1994; Fernandez, 1990; Scheper-Hughes, 1992; Sievert, 2006; A. Young, 2008). This research contributes specifically to a call (Stuart-Macadam, 2006; Stuart-Macadam & Kent, 1992) for a sociocultural approach to the study of anemia that recognizes its politicized and complex etiology and decenters the role of diet and biology without discounting their effects entirely (Kent & Lee, 1992). Finally, the study adds to scholarship in the medical anthropology of Guatemala (Barrett, 1997; Hawkins, 2007).

The Poqomchi' perception, classification and normalization of anemia can be explained in part by the adaptation approach of biological anthropology. Mild anemia may be beneficial as a natural response to harsh environmental conditions (McElroy & Townsend, 2009). The body's response to environmental insults such as poor diet, stress, and infectious disease results in anemia. Stuart-Macadam (2006) and Stuart-Macadam and Kent (1992) demonstrate how anemia might be thought of as a disease *and* a defense against parasitic infections which thrive on iron in the body. The ambiguity of whether anemia is disease or defense (Piperata & Dufour, 2007; Ritenbaugh, 1982) is in fact often echoed in local discourses that normalize illness (Becker, 1997; Honkasalo, 2001). "Accommodation," is a term I invoke from biological anthropology in order to capture the ambiguity, dilemmas, and contradictions that arise when physical change is advantageous for a given environment but otherwise disadvantageous to health (Frisancho, 1993). Where normalization or long-term accommodation occurs, cultural investigation, as provided in this dissertation, is called for (McElroy & Townsend, 2009; Stuart-Macadam & Kent, 1992).

Accommodation of anemia is ultimately expressed through language, identifiable in discourse, and related to identity, embodiment, and social narrative (Good 1994; Janzen 2002; Kleinman 1988; Mattingly 1998). We would hope this expression is fluid and cogent, at least for the sake of our research, but individuals do not always find the words. In the context of structural violence, opportunities to improve health are limited and so too is expressive meaning in the indicative form. Since anemia is biologically ambiguous as disease and defense, the experience of this chronic illness appears to drift between normal and abnormal (Becker, 1999; Cohen, 1998; Csordas, 1994; Rapp, 1999; Turner, 1968). The lived experience of anemia is thus a fluid state of being-in-the-world, a world shaped by the rigid walls of structural violence (Becker, 1994, 1997; L. Cohen, 1998; Csordas, 1994; Rapp, 1999; Schackt, 1986; Taussig, 1993).

Structural Violence

People hold worldviews that are shaped not only by their environment, but also in and through their social organization. In the context of endemic anemia, worldview shapes and is shaped by the experience of anemia. Impoverished persons living in highly inegalitarian societies, like many Maya in Guatemala, are often treated as second-class citizens. That the Poqomchi' experience of anemia and its causes are different from "affluent societies" is not particularly revealing. Yet practitioners and research in biomedicine often ignore these very real economic, social, and cultural contexts in which people live. Furthermore, the allegation that local cultural constructs of anemia are problematic or that they impede treatment is a denial of the economic and political situation that has caused this illness. Instead, I argue that attention must be given to these local systems of understanding because in actuality, the local community plays a vital role in understanding how to heal itself.

The problem stems in part from a reality that people living in impoverished communities have more immediate and pressing needs than post hoc treatment of illness. Obtaining food, water, and work, as well as more intangible states such as security, safety, social legitimacy, and status may win out over an unaffordable visit to a doctor. Meeting these needs may contribute to disease, or it may reflect best practices for ad hoc and preventive strategies to maintain health. If the community were unable to meet these needs the consequences would be much more widespread and deadly than individual disease. In cultural survival, illness becomes imbedded and is experienced as a normal part of daily life and identity. The phenomenon in which illness and identity become linked is well documented in studies of structural violence (Farmer, 1999, 2001; Farmer et al., 2004). Farmer explains that, “history and its erasure are often embodied as bad health outcomes” (2004, p. 315). A focus of contemporary medical anthropology has been to detail the embodiment of structural violence at the personal, physical, social, and political levels (Scheper-Hughes & Lock, 1987).

Structural violence involves ascribed inequality in power relations leading to institutionalized and systemic othering and ultimately diminished life chances of the violated. In Guatemala, all the components of human organization throughout different layers of society that conceptually and physically divide indigenous from non-indigenous is one example. The indigenous have historically been socially subjugated in domains such as land, labor, tribute and power. Their disadvantages continue to be reinforced by the Ladino-dominated state and global hegemony, and are expressed materially in human health (Farmer, 2005). For Farmer, the materials of structural violence are based in historical ideologies that inform the immediate political economy and subsequent environment in which people live at the brink of illness and death. The coupling of clinical medical phenomena and continuity of structural inequality is not

such an obtuse relationship according to Paul Farmer (2005; 2013). Imagine a doctor treating a patient with biomedicine and yet seeing little to no results. Now imagine the same doctor observing the same illness across the entire community—ubiquitous and endemic. Wherever enduring, widespread illness is passively accepted or treated with half-hearted, broad, vague explanations, then according to Farmer, history is being erased. Farmer writes, “We will therefore need to examine, as well, the roles played by the erasure of historical memory and other forms of desocialization as enabling conditions of structures that are both ‘sinful’ and ostensibly ‘nobody’s fault’” (Farmer et al., 2004, p. 307).

Structural violence is the fold of history; a process of erasing historical memory about how current suffering came to be. Whether passive or active, it results in violent social structures by eliminating an oppressed community’s ability to narrativize alternatives to the current social order. “Erasing history is perhaps the most common explanatory sleight-of-hand relied upon by the architects of structural violence. Erasure or distortion of history is part of the process of desocialization necessary for the emergence of hegemonic accounts of what happened and why” (Farmer et al., 2004, p. 308). In order to correct this erasure, we must trace sociocultural relations beyond the historical facie. Speaking both figuratively and literally, the thread of structural violence begins with the wounds it lays upon the body:

The erasure of history is subtle and incremental and depends upon the erasure of links across time and space. We know, too, that forgetting is also natural—indeed, biological—process. Time heals all wounds, including those which, never drained properly, are waiting to burst open again, to the ‘surprise’ of those who have forgotten. (Farmer et al., 2004, p. 308)

A risk for anthropological research is the ubiquitous distortion of meaning. It is a trap, an effect of structural violence to be avoided by anthropologists. Specifically, geographic breadth and historic depth must be sought out and elaborated in the description of current events; otherwise the significance of the event is a distortion of depth, benefiting the hegemon:

Anthropological inquiry often starts with current events and the ethnographically visible. When we study the social impact of a hydroelectric dam, of terrorism, or of a new epidemic, we run a great eliding risk. Erasures, in these instances, prove expedient to the powerful, whose agency is usually unfettered. Imbalances of power cannot be erased without distortion of meaning. Without a historically deep and geographically broad analysis, one that takes into account political economy, we risk seeing only the residue of meaning. We see puddles, perhaps, but not the rainstorms and certainly not the gathering thunderclouds. (Farmer et al., 2004, p. 309)

In reference to academic disciplines and the conceptualization and study of structural violence,

Farmer argues further:

...specialization and subspecialization have yielded great rewards in biological sciences. The rewards are less evident, alas, within the “social sciences,” where increasing specialization has often brought with it the erasure of history and political economy. The erosion of social awareness is readily detected in modern psychology, epidemiology, and many branches of sociology. Desocialization is evident even in anthropology, held by many to be the most radically contextualizing of the social sciences. Complex biosocial phenomena are the focus of most anthropological inquiries, and yet the integration of history, political economy, and biology remains lacking in contemporary anthropology or sociology. An anthropology of structural violence necessarily draws on history and biology, just as it necessarily draws on political economy. To tally body counts correctly requires epidemiology, forensic and clinical medicine, and demography. The erasure of these broad bodies of knowledge may be seen as the central problematic of a robust anthropology of structural violence. If we set for ourselves the cheerful task of coming to understand pestilence, death, and destruction, let us look at how the erasure of history—indeed, of temporality itself—and of biology comes to hobble an honest assessment of social life. (Farmer et al., 2004, p. 308)

While the most historically deep contextualization of anemia lies in the ancient archeological record, analysis of structural violence associated with anemia recalls its social evolution in human organization. Especially in the case of post-colonial societies, those who live on the edge of a structural surface along the folds are placed in the margins of history. These are pockets of people and communities who through economic, political, and social development have been folded into the same structural positions. The Poqomchi’ Maya are such a community of indigenous people living at the margins of a *ladino* (non-Maya) and post-colonial hegemon (Fischer & Benson, 2006; Green, 1999; Hale, 1997; Metz, 2006; Nelson, 1999; Warren, 1993).

The Maya hold what C. D. Thompson (2001) refers to as a double consciousness. It is an

awareness of the world they create for themselves and the dominant world they must navigate. Their lives are a continual reorientation between semi-overlapping cultural systems that signify structural violence. Wolf (1959) identified centrifugal relationships between groups under colonization, where populations are pulling away by force but are held by structure. Reflecting on such relationships, structural violence became the dominant theory of underdevelopment (Galtung, 1971). In Guatemala, the origins of structural violence can be traced back over 2,000 years to incipient Mayan states and pre-colonial Spain, which is mostly beyond the scope of this dissertation (Carmack, 2007; Glick, 2005). A selection of founding colonial feudal policies in Guatemala called *encomienda*, *corregimiento*, and *repartimiento* are sufficient for grounding these ethnographic data in a historically broad context (Handy, 1984; C. D. Thompson, 2001). These policies established the violent structures that shape the experience of indigenous Maya in relation to land, labor, and power in Guatemala today (Brysk, 1995; Comaroff & Comaroff, 2006; Fassin, 2007; Kane, 1994; Pestritto & West, 2003, 2005). Entrenched and systemic political and economic neglect is both a local phenomenon and a product of national and global forces and warrants continued research in the Guatemalan Maya experience of structural violence and health.

Chapter 3. Poqomchi', Endemicity, Colonialism, and Archeological Record

There are an estimated 115,000 Poqomchi' Maya living in Guatemala (ALMG, 2011). The Poqomchi' language branches off from the Quichean branch of Eastern Mayan. There are between 3-5 distinct dialects. The primary dialects are Eastern Poqomchi' and Western Poqomchi', each having approximately 50,000 speakers. Tamahú Poqomchi' is a third dialect of which there are only about 4,500 speakers and among whom this research takes place. This chapter describes the research population. It contextualizes the population in their current demographic, economic, structural, epidemiological, and historical state.

The Poqomchi' Community of Onquilha'

The community of Onquilha' is situated on a mountainside along the narrow Polochic river valley (Figure 3.1 and 3.2). Geopolitically, Onquilha' is in the municipality of Tamahú in the region of Alta Verapaz, Guatemala (Figure 1.1). The northern side of the valley is inhabited primarily by Q'eqchi' speakers. Onquilha' is on the southern side of the valley, and is inhabited primarily by Poqomchi' speakers. It is one of 26 Poqomchi' and Q'eqchi' mountain communities in Tamahú. At the valley floor is the only town, which serves as the seat of local municipal government. Both the town and the municipality share the name Tamahú. In Spanish the 26 communities that surround the town are referred to as *aldeas* or *caseríos* (similar to villages or hamlets). These terms are vestiges of labor organization in the early colonial period and can even be traced back to early Spain and the origins of feudalism (Glick 2005, 242). Today, similar to feudalism, these communities are tied to the nearest *fincas*, or large plantations that have been owned for centuries by the same families. People living on or near fincas have varying degrees of rights to the land ranging from none at all to complete autonomy. Most people living in the communities are still bound to the fincas in some form or another. This is very much a tenant-

farmer relationship that is maintained despite long-since outlawed colonial institutional structures that controlled land, labor, and corporate community power—greatly limiting health seeking options.

The Poqomchi' of Onquilha' associate with the finca called *Baquelito*, which mostly produces coffee, but also cardamom and lumber. These products are crucial to their livelihood and participation in the capital economy. Shifts in the global market of any of these products, especially coffee, have a great impact on the community. Poqomchi' working on the finca earn about 15 quetzales (1.90 USD) for a 12-hour day of work. Although the wages are meager, they provide much needed income for purchasing basic necessities such as salt and cooking oil. Following the Cold War, instability and the eventual collapse of the global coffee market made it economically disadvantageous for the finca owners to pick the coffee and bring it to market. This meant, even as tenet farmers, there were no jobs for the Poqomchi' and thus no source of money to purchase necessities. Additionally, some Poqomchi' manage to find spare land that they use to produce a small amount of cash crops, usually coffee, to sell on the global market and make a little extra income. As the market collapsed and then became volatile, the work at the finca became unreliable. Men and even women started finding employment with traveling contractors. The contractors pass through the valley from the coast in large trucks to carry workers back to coastal fincas producing bananas or pineapples. They offer between 15-50 Quetzales for a 12-hour day in a contract for 30 days. Typically, the women stay at home and are left with between \$10-\$100 USD to run the entire household for a month while the men are away. Many women find some work at the finca or sell vegetables at the local market. Currently, most of the men divide their time between harvest seasons at the local finca and more distant coastal locations.



Figure 3.1. Looking east over the municipality of Tamahú along the Polochic river valley. The town of Tamahú is toward the center, the Q'eqchi' speakers live mostly to the left (north), and the Poqomchi' speakers live mostly to the right (south) (Herynk, 2006b).

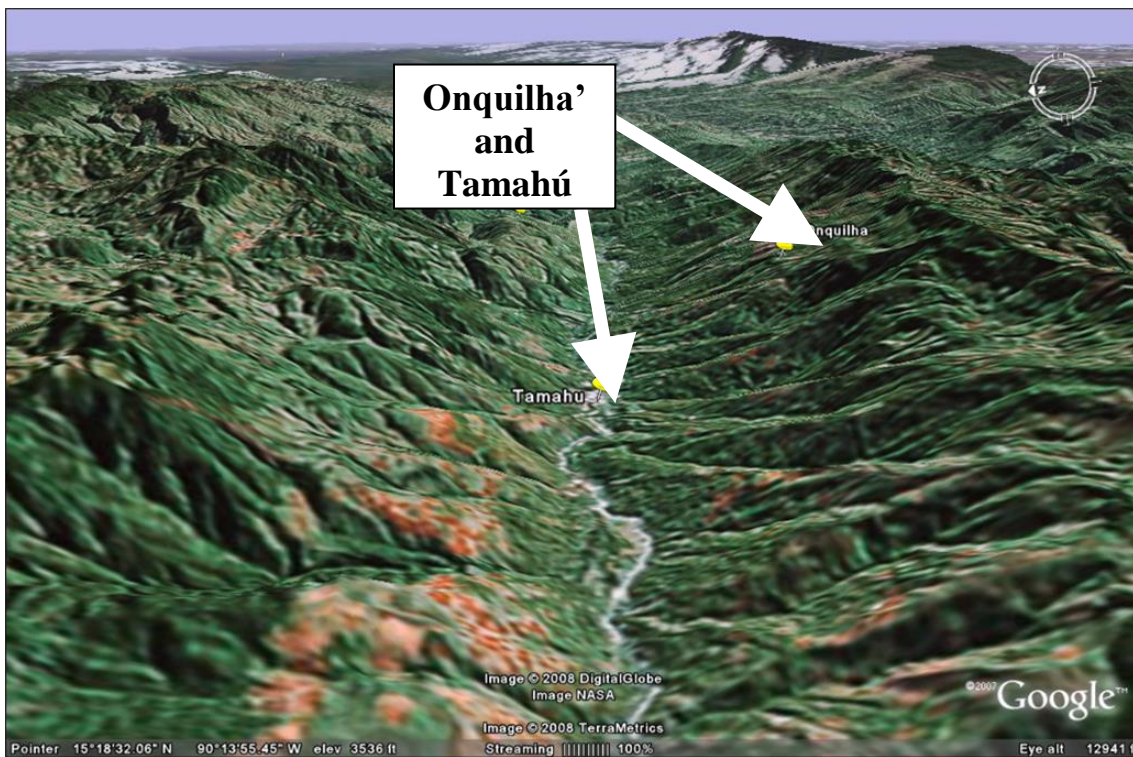


Figure 3.2. Looking east over the municipality from a higher vantage point than Figure 3.1 with the location of the town of Tamahú and the community of Onquilha' indicated (Google, 2008).

The Poqomchi' are subsistence farmers, primarily in corn and beans, but time and land are painfully scarce because of wage labor demands. This tension of survival shifts to a defensive crisis mode in times of famine, environmental disasters, plagues, or threats to their land rights, which come all too often. The Poqomchi' are accustomed to tension and accommodative shifts. They have a philosophical belief that tension is an underlying continual vibration throughout earth, the space of human beings—what Wolf refers to as “sons of the shaking earth” (1959). The contents of a shaken object move in variable ways relative to location and intensity. The parts are not all moving equally. Human life and experience is composed of the variation brought on by shaking across the span of time. The Poqomchi' believe that throughout history, certain elements of life remain more rigid. At times, the Poqomchi' need to harness their collective energy and the energy of their ancestors in order to disturb and destroy a rigid order through protest.

Such an upending of order occurred in Onquilha' in 1999. The owner of the Baquelito finca passed away at the height of the coffee market collapse. The instability allowed Don Abelino Catun to fight for the Poqomchi' of Onquilha' to be granted title to the land where their houses were located. Don Catun wanted community projects such as education, healthcare, and access to basic resources. The government was not authorized to implement such services, on private finca lands. After winning the land, which enabled the community to establish a government sponsored school and receive health services Don Catun stated in reference to his community members, “*Cuantos tiempos trabajaron en la finca; eso es su herencia,*” translation: “So much time they worked on the finca; this is their inheritance.” Gaining land rights means incorporation. Incorporation into Guatemalan governmental institutions is a major step toward receiving infrastructure and services such as healthcare, education, and basic utilities. However,

establishing legitimate incorporation into a larger political body is a slow and painful process. The end of one aberrant form of structural inequality does not mean an end to structural violence. For example, in the United States, the abolition of slavery only led to other forms of sociostructural violence (Alexander, 2012). Sociostructural legitimacy moves much more slowly than legal rights to land. Also, about a quarter of the community still belongs to the finca. An area of the community known as *Comonoj*' was not incorporated. Those residents are still bound to the finca for the right to live and practice subsistence agriculture. They receive none of the benefits of incorporation for education, healthcare, and resource development.

Prior to gaining partial independence from the finca the community of Onquilha' would have had only one person representing them if needed. Now, they have a broad structure of governance. The central body consists of a hierarchy of committees (not individuals), a secretary and vice secretary, a treasurer and vice treasurer, two spokes persons, and a representative to the municipal mayor of Tamahú. Currently, there are four commissioners that represent four areas of development including potable water, latrines, education, and health. The community's governing body must now engage with the municipal and regional government as well as international organizations to obtain and win approval to support development projects. The community has also focused heavily on improving the access trail so that it can be used by 4x4 trucks. They believe that, "you cannot carry development projects on your back." The widening of the trail is considered by many local experts to be impossible in engineering terms: there is a widely held fear that this project will lead to landslides.

Onquilha' is perched on a steep mountain slope. There is a small dirt soccer field in the center, which comprises about 2 acres of the most level ground (at 4,500ft in Figure 3.3). Surrounding the soccer field there is a 3-room school to the south built in 2008,

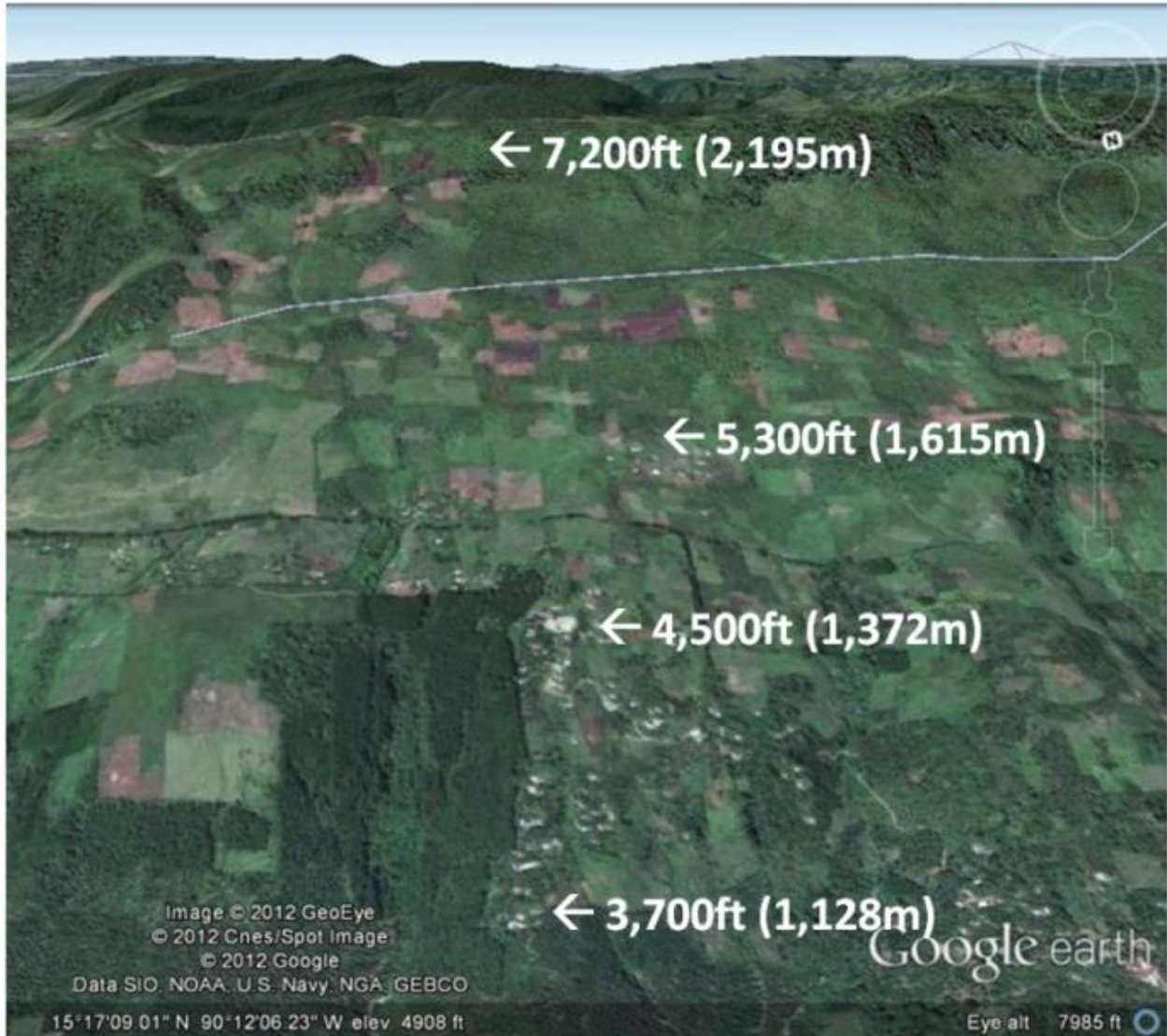


Figure 3.3. Altitudes from bottom to top of image show the lowest house, community center, highest house, and highest cultivated ground. The core area of finca Baquelito is the darker vertical rectangle area in the lower left of the figure. The boundary line of the entire finca can be seen in the narrow dark band of trees that intersect horizontally and vertically in the center of the figure (Baquelito is to the lower left of the center intersection) (Google, 2012).

a small Pentecostal church on the east side, and the north and west sides open to the steep valley.

The houses of Onquilha' surround the upper-most limits of the core of the finca Baquelito

(Figure 3.3). The altitudes at various locations in the community were read with a global

positioning system (GPS) device. The soccer field is just over 4,500 feet in altitude (1,372

meters). The house with the lowest altitude, also at the border between the coffee plantation and

the community, is just over 3,700 feet (1,278 meters). The house with the highest altitude is at 5,300 (1,616 meters). Thus, there is a difference of almost 1,600 feet in elevation between the highest (5,300ft) and lowest (3,700ft) houses (Figure 3.3). There are about 40 households and a total population of around 300 people. There are no amenities such as electricity, running water, or roads. The fertility rate is approximately 7 births per female (nationally 5.4), and maternal mortality rates are some of the highest in Guatemala (MSPAS, 2001; Tamahú, 2007). Literacy rates are also very low (less than 5%). The majority of the community's members speak Poqomchi' as their first language and many have a functional use of Spanish.

Presently, the Poqomchi' have begun moving to higher elevations, even reaching into the southern bordering department of Baja Verapaz in search of "peace and tranquility," according to those who are moving to higher elevations. They are effectively distancing themselves from four threats: land insecurity, institutional oppression from the municipal government, abusive labor practices from the coffee plantation (which they are now free to leave), debt peonage, and crop theft from members of neighboring communities. Many subsistence crops are hidden throughout the higher altitudes where they are cultivated and vigilantly guarded by men and boys living in makeshift shelters. The area claimed by young, expanding families in the community ranges between 5,300 and 7,200 feet in altitude (approximately 1,616-2,195 meters).

Onquilha' is the perfect population for studying navigation and accommodation of illness under structural violence. Although it is relatively insulated and did not experience the extreme Civil War violence and pressure of colonization of other indigenous groups, it has the highest index of social exclusion and the lowest index of human development in Guatemala, which is largely a heritage of Guatemalan's colonial mindset. Onquilha' is just beginning to emerge from a feudal-like structure into the broader political economy where different dynamics of structural

violence are at work. This is requiring dynamism by the Poqomchi' to absorb the impacts and even engage in rebellion. According to area doctors a high incidence of anemia is common in similar rural mountain communities associated with fincas across Guatemala. Due to the evolving community independence in the presence of chronic illness, the symbolic discourse reflecting anemia and structural violence is intensifying. Their paternalistic relationship with the finca has faded and they must do for themselves. It is a discourse about what is possible and impossible in the face of widespread illness and diminished entitlement to land, education, healthcare, and basic human dignity.

The population was relatively insulated from the extreme physical violence and pressure of colonization experienced by other larger indigenous groups closer to Guatemala City (King, 1974). Despite avoiding the heaviest physical blow of colonization, today the population has the highest index of social exclusion and the lowest index for human development in Guatemala (MSPAS, 2001). In Guatemala, communities on plantation lands still experience implementation of the European feudal system. The Poqomchi' community of Onquilha' presents an opportunity to examine the process by which structural violence shapes the experience of anemia and vice versa, the phenomenon in which illness and identity become linked (Farmer, 2001).

Observations on the Occurrence of Anemia in Onquilha'

The anemia that the Poqomchi' of Onquilha' experience is predominately of mixed etiological origin. There are countless causes of red blood cell abnormalities that typically interact synergistically and may result in numerous classifications of anemia (Krapp, 2002, p. 126). Different abnormalities result from specific nutritional deficiencies. Individuals living in poverty can easily become deficient in all of the essential hematopoietic nutrients (iron, folate, and vitamins B₁₂, B₆, C, and A) and more. However, in a Western clinical biomedical setting,

anemic individuals tend to have only one nutritional deficiency stemming from another pathology, not from the environment. A multitude of anemias is generally simplified to one, which is predominately iron deficiency anemia (IDA). My collection of blood samples (Chapter 5) revealed that over half of the study participants had at least 3 types of red blood cell abnormalities, the most prominent being normochromic anemia, hemolytic anemia, microcytic anemia, and/or hypochromic anemia. Other erythrocytic abnormalities included poikilocytosis (enlarged size and shape) and anisocytosis (variable size and shapes). The experience of anemia among the Poqomchi' is in fact an experience of anemias, which coincidentally is how they frequently refer to the condition, as *las anemias* (the anemias). Each of the anemias reflects a cellular abnormality, which reflects a nutritional deficiency, with each having its own etiology and pathology.

The mixed etiology of anemia is evidence that this illness has multiple horizons that are not strictly limited to nutrition. It is true that their diet is likely insufficient in bioavailable hematopoietic nutrients for Hgb and red blood cell synthesis. The daily diet for men consists of about fifteen small corn tortillas with salt, chile pepper, and almost always beans. A few times a week they eat eggs, fruit, and stewed greens. On paper this diet actually comes close to meeting the basic hematopoietic nutrients needs. However, nutritional baselines are not necessarily fixed; as Ramakrishnan points out, “need is influenced by environmental factors” (2001, p. 1). In Onquilha', standard nutritional baselines may never be met and mild-to-moderate anemia is likely to be a normal state of affairs. For the purpose of understanding the contextual experience for the Poqomchi' we have to lower our expectations of what constitutes a “normal” baseline. Thus, realistic interventions should be more focused on preventing severe anemia across the population than on eliminating anemia completely in a targeted demographic group.

Kent & Lee point out that researchers, “may not agree on the nature and etiology of anemia—that is, dietary-induced, disease-induced, or a combination of both” (1992, p. 13). Disease-induced, mild anemia can be a defense against infection and inflammation. However, in severe anemia the infection can worsen and overwhelm the body. This in turn can exacerbate anemia, which leads to a spiral of more systemic chronic illnesses. In Onquilha’, there are numerous macronutrient deficiencies that may aggravate anemia, including inadequate carbohydrate, protein, and fat. Relatively little is known about iron metabolism in relation to other hematopoietic nutrients, nutrients not thought of as hematopoietic, and numerous factors of human physiology, especially in an uncontrolled non-clinical environment.

Also, a particular individual’s most apparent cause of anemia can change in a matter of years, months, and even days. It was not uncommon for a single Poqomchi’ child to have anemia coupled with both iron and B₁₂ deficiencies (indicated by abnormal red blood cell types), visible signs of protein deficiency during seasonal famine, parasitic infection with internal bleeding, impetigo, and an upper respiratory infection. Thus, the etiology of anemia is ambiguous in the same individual across a lifespan. The severity, timing, and sequence of both nutritional deficiencies and other illnesses vary in each person over the course of development and adulthood—all of which contribute to the holistic experience of anemia.

Even when iron deficiency can be identified as a main contributor, research shows that “intraindividual, interindividual and intergroup differences...can moderate the effects of IDA: for example different states of iron deficiency involve different system changes, which in turn effect different psychobiological domains” (Pollitt, 2001, p. 669s). This makes the psychobiological and group (experiential and contextual) levels all the more relevant. The symptomatic patterns of all types of red blood cell abnormalities are consistent enough to be

simply referred to as *anemia*. It is only in clinical contexts where specific physiologic causes of anemia are isolated. Among the Poqomchi' of Onquilha', the causes are so variable that such classifications are nearly impossible. Most types of anemia present very similar symptoms; however, certain types can present particular symptoms and severity of symptoms, as is briefly discussed in Chapter 8.

Endemic anemia is largely a phenomenological experience for the Poqomchi'. The neurological effects of stress, especially during chronic or recurring anemia, affect cognitive functions. Therefore, the sensory perception of experience varies with anemia symptomatically. Even mild anemia in early childhood has been found to show lasting impact on cognition and behavior into adulthood (Algarín, Peirano, Garrido, Pizarro, & Lozoff, 2003; Lozoff & Georgieff, 2006; Lukowski et al., 2010). This occurs over the course of human development in predictable and similar ways across individuals in social groups. In reference to IDA, research demonstrates, "there are multiple biological, physical and social-psychological factors that reorient the trajectory of different psychobiological domains in early life after intense and prolonged stress" (Pollitt, 2001, p. 669s).

It is important to consider Poqomchi' constructs of illness, often referenced as "psychosomatic," given the strong neurobiological component to chronic anemia discussed above. The Poqomchi', like many other Mesoamerican indigenous groups, have nosologies of health such as *mal de ojo* (evil eye), *brujería* (bewitching), *susto* (fright or soul loss), *vientos y aires* (winds or airs), *nervios* (nerves), *awas* (a series of spiritual cause-and-effect relations), *caliente y frio* (hot/cold duality), *biles* (biles), and many more (García, Sierra, & Balam, 1999; R. Wilson, 1995). Much of the research on psychosomatic illness among the Maya either does not consider biological phenomena, or considers anemia to be only a secondary symptom (Luber,

2002). In part, this is due to the fact that once anemia has worsened, it is overshadowed by deficiencies in carbohydrate, protein, or fat, or becomes marked by psychosis, behavioral abnormalities, infectious disease, kidney stones, chronic kidney disease, cardiovascular disease, stroke, seizures, or any number of sickness that are aggravated by severe anemia.

Structural Violence: Anemia in Relation to Land, Labor, and Power

Anemia as a mixed etiology is a consequence of structural violence, which positions the Poqomchi' at the threshold between health and illness. Their health is an indicator of how their environment is marked by their social inequality, which determines access to food and healthcare. This occurs in ways that echo the early colonial period, resonating throughout the hierarchical postcolonial society. Climate change, drought, famine, and the collapse of the global coffee market have led to a significant increase in uprisings against this rigid order. There has been a significant increase in reclamations by Poqomchi' to regain land. Reclamations, referred to as invasions by the government, have in fact increased throughout Guatemala in the early 2000s (Granovsky-Larsen, 2013, pp. 339-341). Throughout my fieldwork in Guatemala roads were frequently blockaded, plantations were taken over, land managers were held hostage, and even the municipal government building was taken over in an uprising. All were demonstrations to reclaim land in order to provide food and income for a people in crisis.

This condition of exclusion is reflected in the divergent outcomes of health and well-being. A divergent society is often referred to as being bifurcated. Social bifurcation is maintained by seemingly enigmatic "structures" of human physical and ideological organization. These structures of bifurcation resulting in divergent outcomes are referred to as structural violence (Farmer, 2001; Galtung, 1971). Paul Farmer's admonition for anthropologists is that they are reverent of the impact of structural violence on culture. Farmer's premise is that

structural violence develops through the erasure of history. Historical erasure is a collective forgetting of the original confluence and purpose of established structural relationships—it is a recollection of broad historical boundaries between human organization and organismal biology. Therefore, structural violence ought to be barely perceptible. Farmer reminds us that structural violence is more a result of the confluences of cultural constructs in the history of all humankind, not a malicious directive by a single culture in a particular period in history. This suggests that research needs to show structural violence as a condition, instead of a superorganic force, and deeply imbedded in connected histories. Finally, Scheper-Hughes (1992) and Farmer (2001) contend that structural violence is ultimately identified and measured in a body count and existence at the brink.



Figure 3.4. Men attempt to reclaim an area of land for their village confront local authorities at the trailhead leading to their village, a 3-hour hike up the mountain (Herynk, 2006b).

Colonial History and the Erasure of Structural Violence

In the case of Guatemala, there are three recurring themes that weave through the country's past, present, and future. These themes are land, labor, and power; underpinning these themes are the actors and ethnic identities that constitute social roles. The three themes represent actual topic areas discussed by current politicians and the media as well as ways in which academics and historians organize their presentation of Guatemala (Carmack, 2007; MacLeod, 1973; McCreery, 2000). The prominence of these themes is taken for granted in Guatemalan discourse, but they did not simply appear from nowhere, and it would be erroneous to assume they first appeared in Guatemala at colonization. Rather, the factors that have directed human attention to these themes began 1100 years prior to 1492 among Spain's indigenous Hispano-Roman tribal communities. Only a few sources on the anthropology of colonial Guatemala provide at most, brief introductory comments on Spain prior to 1492 (Carmack, 2007; MacLeod, 1973; McCreery, 2000). Taking into consideration this expanse of history of more complex societies expanding across the Iberian Peninsula and the European continent would greatly enhance our understanding of Spanish colonialism. The structures of this process continue to inform current Guatemala, including national identity and culture. The question remains of how and why these themes have come to be such a permanent part of Guatemala's social, political, and economic landscape. As noted above, the roots of the answer lie in the long history of human organization, the foundation of modern geopolitical relations.

For the people of Guatemala, issues of land, labor, and power color and encapsulate daily life. The social instructions used to navigate these structural issues are articulated and reiterated analogically in the narratives of daily life. These communicative scripts inadvertently reconstruct a framework, which provides the platform from which to (pre and per)form political, governmental, and institutional appearances of the contemporary. Together, these processes of

(re)construction inform identity and subsequently roles, statuses, and current representations of a society's hierarchical structure. These structures and/or representational forms of structure are actually in flux by the hands of processual movement by human actors. Flux, appearing as chaos, is in reality ordered. There is always a pattern to chaos and in this pattern is the reconstruction of structural form woven and/or unwoven by people who carry with them elements such as culture and biology, but also kinship, ethnicity, politics and memory. Even though a society or social structuring on one level may give an appearance of stagnation, this is only a perspective of a contextualized time continuum, or a periodization bound by intellectually shared cultural makers. However, the appearance of structural stagnation, its reality and relativity, is the discussion of structural violence and the contrived human experience of our social limitations. Structure is not unlike its more temporal representations or appearances in that both are subject to change but also continuity. In this analysis I am primarily interested in the continuity of structure (not appearances) and ultimately in the potential for change of structure.

Requerimiento 1512-1556

Pedro de Alvarado was the Guatemalan equivalent of Hernán Cortéz in Mexico, who sent Alvarado to conquer Guatemala in 1523. Alvarado, who was born in Spain, served as the governor of Guatemala through the early colonial period when he died. Alvarado's legacy was to solidify opposition to any notions of "protecting" Indians. His primary apparatus of control was as a representative of Spain to introduce the practice of war, slavery, and threatening death to Indians who, "did not submit" to God, the Catholic Church, and Spain. This was not mere rhetoric. It was an institutionalized policy known as the *requerimiento*, in English the 'requirement' or 'demand'. The intent by Spain was to forbid enslavement of indigenous so long as they, submitted to Spanish authority and to God (Handy, 1984, p. 21). This law was presented

to all indigenous and Alvarado is reported to have done it in such a way that the Indians would resist (Handy, 1984, p. 21).

El Requerimiento (The Requirement), was a document that laid out the sovereignty of Spain over all the resources, Indians, and lands of Guatemala (Hanke, 1938, pp. 25-34). Its origin is thought to date back to the Islamic world's conquest of Spain in the 800s and its submission to Islam (Michael 2006, 903). The *requerimiento* was more than a declaration of authority and procedures. Rather, it was the establishment of power inequality between the Spanish and the Indian. This dynamic within the codependent Indian-Spanish relationship laid the framework for the providence of lands and material objects within Guatemala. The Indians' duty was to surrender these objects, not only willingly, but automatically, unconditionally, and voluntarily. Like most human inhabitants, Indians likely identified with the land and material resources of Guatemala. As well, the Spanish likely acknowledged that the Indians, the land, and its resources were synonymous. The object of conquest was not simply space if the definition of that space includes people and resources. Rather, the Indians as well as the Spanish objectified the conquest in such a way as to conflate humanity with the land and its materials. Thus, the *requerimiento* had the effect of asserting Spanish sovereignty of not just the land and its resources, but also the Indian bodies as objects acting for the dutiful delivery of those resources.

The *requerimiento* was meant to indoctrinate the Indians into the origin of human beings according to Christian doctrine. It detailed a cosmic and geopolitical order. It described the hierarchy and the need for Indians to practice obedience and submit to servitude if needed. If these requisite ideologies were not "obeyed" then servitude, the usual hideous interpretation of the document, was the only recourse:

But, if you do not do this, and maliciously make delay in it, I certify to you that, with the help of God, we shall powerfully enter into your country, and shall make war against you

in all ways and manners that we can, and shall subject you to the yoke and obedience of the Church and of their Highnesses; we shall take you and your wives and your children, and shall make slaves of them, and as such shall sell and dispose of them as their Highnesses may command; and we shall take away your goods, and shall do you all the mischief and damage that we can, as to vassals who do not obey, and refuse to receive their lord, and resist and contradict him; and we protest that the deaths and losses which shall accrue from this are your fault, and not that of their Highnesses, or ours, nor of these cavaliers who come with us. And that we have said this to you and made this Requisition, we request the notary here present to give us his testimony in writing, and we ask the rest who are present that they should be witnesses of this Requisition. (Handy, 1984, p. 21)

Literally, if Indians did not “submit” then they were to be forcibly enslaved and, if need be, killed. The problem lay in the interpretation of adequate “submission” by the Indian, which tended to, or was intended to favor enslavement as the end result. In response to this abuse the Spanish Crown attempted to curb Alvarado’s treatment of the Indians. What ensued was a theme that would play out over the next century and debatably into present-day Guatemala. That is, the loose interpretation and violation of the intent and spirit of literal mandates established to improve the lives of Indians. Thus, it was not the mandates themselves or the ideology behind the mandates, but their despotic interpretation and instantiation outside of an Iberian context. These are policies or plans implemented by colonial proxy distantly removed from Spain, which gave the Crown little to no ability for oversight. Due to opposition to this loosely interpreted declaration, the Church convinced Spain to abolish its use by 1556.

The *requerimiento*, written and issued by the Crown and the Church and its application interpreted by despotic conquistadores, introduces one of the first social divisions in Guatemala. This is the division between the proverbial Indian and the distant aristocratic Spanish, and a few generations later, the enduring mixed blood Ladino. Also, because the social hierarchy mirrored a geographical urban-rural order, it marked a distinction between urban centers and rural outposts; both of these geopolitical entities jostled to maximize resource extraction from the Indians. Elements of this colonial geopolitical order can still be seen today in Guatemalan

political structure. Finally, because maintaining pure Spanish bloodlines in rural outposts was nearly impossible, this geopolitical order marked the creation of the space and sociopolitical role of the Ladino. Human beings do not tend to stay divided unless physical or cultural borders are placed between populations. Otherwise, the biological imperative is to interbreed. The effect of the *requerimiento*'s Indian-Spanish dynamic, an artificial, ideological, and socially constructed division was to recreate social hierarchy and carve a marginal space for Indians.

Encomienda: 1501-1542 and 1545-present iterations

The *encomienda*, or commission, was the primary structural form used by Spain to regulate objects, subjects, and social relationships within a given territorial space. However, there are differences in how the *encomienda* was initially established in Spain, Guatemala, and across the rest of the Spanish colonies. Thus, the “appearance” and implementation of the *encomienda* form varied, but the basic form and intent was the same. In Guatemala its apparent function was to regulate land, labor, and power. In early Spain, its function was to push back the Moors over hundreds of years. Carmack summarizes the origin of the *encomienda* below:

Spain's rulers rewarded successful conquerors with rights to tribute in goods and labor from the native people. This reward system, which had precedents in the Reconquista, was called *Encomienda*; an individual who held an *encomienda* grant was an *encomendero*. *Encomenderos* comprised a colonial aristocracy that from the beginning found its interests often in conflict with those of both the Spanish Crown and the Church. *Encomenderos* were officially charged with seeing to the religious instruction of the native peoples entrusted to them. (2007, p. 156)

Therefore, the *encomienda* originated in Spain to consolidate power over hundreds of years of war with the Moors (Kramer, 1994, pp. 1-2). It served the basic need of the Crown to protect newly won territory.

It is difficult to identify the precise meaning of the *encomienda* as a fixed object based on the conditions of a particular point in time and space. In Spain the *encomienda* served to distribute land, governance, labor, and tribute. Going back to as early as the 900s it is apparent

that in some ways this structural form of human organization and ideology was mostly identical across time and space. In the New World, the carryover of structures was hidden over time by modifications, which were driven by the intentions of the colonial elite in a Guatemalan spatial context. I point this out to continually call up history that is erased to perpetuate structural violence. Komisaruk (2010) begins with an interesting premise that the establishment of early colonial structure was designed to enslave the Indians; however, this resulted in death from disease. Therefore, colonial elite in Guatemala borrowed and quickly implemented the Spanish models with absolute authority and a perception of critical necessity.

A precursory example of what would play out on the mainland of the New World took place in the islands only a few years earlier. By the 1520s, the New World islands were lacking gold and economic production. The Indian labor was in grave decline from disease and slaves were brought in to supply new labor. Encomenderos were forced to find new ways to extract more from the land, thus, “Spanish settlers, descendants of the original encomenderos, came to constitute a landed gentry, a small, elite group living off the work of a large subject population” (Carmack, 2007, p. 159). The early disinterest in occupation and working the land by the Spanish quickly turned into an interest in controlling the land and its production and the populations living on these lands.

Regardless of the appearances, the *encomienda*'s structural form was relatively the same on many levels. In Spain and Guatemala it was literally an award or reward to an individual for their loyalty to the Crown. The *encomienda* in Spain was more an award of people on particular tracts of land to govern and collect the “tax” due to the Crown. In Guatemala the *encomienda* was an award of Indians to an individual Spaniard. The Spanish could extract labor and/or tribute. Tribute could take any form, such as agricultural products, minerals, materials, and

money (the range of objects of tribute expanded later on in the mid-1600s of the colonial period). Of greater importance is that the original *encomienda* system was designed to allow for the retention of territory in a long war with the Moors in the Iberian Peninsula—a design that would prove to be devastating in a Guatemalan context where there was no ongoing long war.

Perhaps the best definition of the *encomienda* is that it granted the authority over a population or populations whether previously autonomous or subject to another authority:

The *encomienda* was of central importance to the Spanish conquest and colonization of the New World. Also sometimes called the *repartimiento*, the *encomienda* was an institution designed to channel Indian labor and produce into Spanish hands after the conquest of an area. It was considered by the conqueror to be his just reward from the Crown for his services at arms, which had been rendered at his own expense. Charles Gibson describes the *encomienda* as ‘a formal grant of designated Indian families, usually the inhabitants of a town or of a cluster of towns, entrusted to the charge of a Spanish colonist, who thus became the *encomendero*.’ In turn, the *encomendero* was obliged to see to the Christianization of his charges, and to maintain his horse and arms in good condition so that he could defend the Crown's sovereignty. An *encomienda* grant did not confer the right to own land, but went beyond the right to collect tributes, entitling the *encomendero* to deploy the Indians in mines and agricultural enterprises. (Kramer, 1994, p. 1)

The *encomienda* was complementary to the Spanish ideological claim to divine right and the subtle power relationships, or checks and balances that the Crown established between local, regional, and central authorities.

Despite attempts by scholars to clearly define what the *encomienda* was or was not in the broadest of applicability, the attempts seem inapplicable to understanding very specific dynamics of the modes of production. The description below by Kramer (1994) does not bode well for the argument of a clear and purposeful social context lending stability to a definition of *encomienda*. Also, it suggests that laws or policies regulating the implementation of the *encomienda* in the New World had or would have very little consequence:

Many of these men [Spaniards] were more interested in quick riches and a passage home than settling and working the land. Those more inclined to settle found manual labor distasteful—in true Iberian *hidalgo* tradition—and were reluctant to perform it unless

forced to do so. The labor needed to exploit the land was what the invaders, arriving in ever-increasing numbers, demanded and seized. The Indians, who are loath to perform these functions voluntarily, had to be enslaved and forced to provide food and gold for the Spaniards. Overworked, mistreated and dying in large numbers from the virulent Old World diseases, the Indians reacted by rebelling, fleeing or taking their own lives. (Kramer, 1994, p. 2)

The Spanish simply were not interested in the land until later; only then did the *encomienda* become associated with land ownership. The control over labor required to make the land productive was considered an absolute and/or divine right. This incursion devastated the Indian population both physically and mentally, but most importantly, structurally. In the least, this suggests a historical process of blurring the literal or legal *encomienda* with local particular realities and interpretations.

In the *encomienda*, much like the *requerimiento*, we see Indians as material resources, property, and possessions of Spain and select Spanish individuals, not just the enigmatic Spanish kings-lords-saints. Thus, rule over the Indians was constructed as a divine right, although lacking the divinity and moral philosophical underpinnings that carried Spain in Europe into the Golden Age (post-1492). Herein lies a primary source of continual volatility and conflict between non-Indian and Indians today.

The *encomienda* was the Spanish enactment and interpretation of the *requerimiento*. It was a reiteration of a model dating back to the Spanish confrontation with the Moors in Spain. The *encomienda* was law and its function was to establish order and structure so as to facilitate extraction of “resources”, not expulsion of Moors. It is here where the foundation and subsequent institutionalization of violence that is systemic, or structural, first occurs. Overarching this sentiment of Indians as objects is the notion that Indians were the wards of a spiritual trustee.

The *encomienda* established a chain of power that made Indian communities beholden to the whims of a local authority. It transferred the Crown’s right to the tribute from Indians into the

hands of some 200 individuals (Handy, 1984, p. 22). The Indians were not citizens of a state, but beasts of burden, and in effect, wards of the state. The Indians were and remain structural objects of Guatemala rather than being contained and benefiting from the structures of citizenship and nationality.

The encomienda solidified a process of Guatemalan state formation where by citizenship is not fully extended to the Indians. They are subjects to the authority of a local despot, not the authority of the state. It accomplished this by mandating that the Indians pay tribute to an individual designated by the Crown. This functioned to channel paternalistic power and control over the Indians, to a Spanish designee, who was supposed to be faithful to the Crown.

This effectively localized authority and control into a single figure, not protected by the governing structures, institutions, or laws. In this respect, such marginalization is a form of structural violence. Here, the structural design excludes Indian avenues of power and defense, which is reserved for an elite class. The abuses evident in such a system were apparent to the Crown, which is why the encomienda was officially (although not always) abolished with the New Laws.

The New Laws and the repartimiento: 1542-evolving into the hacienda system

Following Alvarado's death in 1541 the Spanish crown set out to establish control of the Guatemalan colony and privilege the interests of the Spanish Crown over that of the conquistadors. Control over labor and subsequently land was of utmost importance in extracting the resources of this New World. The New Laws of 1542 in theory were for the better treatment and preservation of Indians in the Americas. In reality, the economic conditions in Spain and the extraction of resources from the New World were poor. The New Laws were established to regain control and slavery was abolished as well as the encomienda, at least in theory. This kept alive the goose that for hundreds of years had been laying golden eggs for Spain.

Combined with the previously mentioned theme of loose interpretation of law established by Alvarado during the *requerimiento* (officially abolished in 1556), the new laws formed an enduring foundation for structural violence, and deepened the erasure of historical human social dynamics on which the Guatemalan government continues to build its institutions.

We have noted that before the population decline in Europe, land was scarce and men were cheap. A similar situation obtained in pre-conquest Mesoamerica, and a similar reversal took place. After the third great epidemic series of Matlazáhuatl plague in the 1570s, Indian labor became increasingly scarce, and new attempts were made to coerce Indian workers and force them to stay in one place. (MacLeod, 1973, p. 20)

Given the serious conditions of the Spanish economy and the diminishing supply of Indian labor, it is difficult to consider the New Laws from a romantic notion of Indian protection as opposed to reappearance of the same modes of production.

The most apparent representation of this structural reiteration is the *repartimiento*, in English the ‘distribution’. The *repartimiento* mandated groups of Indians to be assigned to work in specific places for specific people. Rather than the *encomendero* being in control of the Indian, the Crown now supposedly had more control over the Indian. The idea was that the individual person was not a slave, but the labor capacity of the individual was subject to slave-like conditions.

Carmack writes, “In the 1550s, Indian slavery was abolished, and that act, together with a new policy that prevented *encomenderos* from demanding labor from the Indians they held (they could still receive goods), presented the crown with a serious dilemma” (Carmack, 2007, p. 187). This dilemma was resolved by basically recreating the same labor obligation outcome but in a different institution known as the *repartimiento*. This system, “was essentially a system of forced labor” (Carmack, 2007, p. 187). Within this new system there was sweeping abusive interpretation of the policy leading to indebtedness, manipulation and intensification of the

tribute burden, and pressures upon specification of domestic production for the Indians (Carmack, 2007, pp. 187-188). Komisaruk (2010) also elaborates on the abuse:

In the first system, royal grants of tribute labor (*encomienda*) were given in reward to individuals conquerors. As the Spanish population grew, *encomienda* gave way to *repartimiento*, which amounted to distribution or allocation of tribute work gangs among various employers. Estate owners appealed to their regional colonial governments for a *repartimiento* of native workers, and the governments sent orders to native communities. Workers were then drafted at the local level by indigenous officers. (Komisaruk, 2010, p. 41)

Komisaruk (2010) points out two crucial impacts of the reiteration of early Spain's labor structure. First, this is the beginning of a process of privatization of labor including the future implications of wage labor. Second, the *repartimiento* and any subsequent appearances of similar form are at any time the best alternative to unacceptable slavery.

The *repartimiento*, or allotment, mandated that a certain portion of a Maya community work for a designated individual during a period of time subject to the interpretation of that individual (Simpson, 1982). It required sending a large portion of a community to labor away from their own lands for very low wages or compensation. Handy (1984) citing Martínez Peláez (1973) states that the *repartimiento* "imposed the basis and determined the character of colonial Guatemalan society," and that it was "the mechanism that guaranteed the subjugation and exploitation and hence their [the Indians] position of inferiority" (Handy, 1984, p. 23). The *repartimiento* worked in conjunction with the *reducción*. The *reducción* concentrated Indians to be more easily exploited in the *repartimiento*.

Handy reports that by 1601, the Crown institutionalized the relationship by, "demanding that any new Indian community be created near *haciendas*, or estates to provide a labour force" (Handy, 1984, p. 25). The procedures for founding a new community and gaining legitimacy and possibly incorporation are still dominated by the *haciendas*. The clusters of Indian homes are affectionately referred to as *comunidades* by the residents of the municipality. The *comunidades*

are made up of *aldeas* and the smaller *caseríos*. Both types of communities are tied to the fincas. The caseríos consist of 10-30 homes that typically do not have access to healthcare or education. These communities are almost exclusively dependent on the finca. The aldeas tend to have some status as well as access to education and healthcare apart from the finca. The degree of community autonomy is largely determined by the fincas, and to a lesser degree by the Municipality of Tamahú.

The subtle shift from the encomienda system of the early conquerors to the reducciones and the repartimiento in the late 1500s and early 1600s is significant. It demonstrates the normalization of Indian subjugation under the primacy of economic extraction, labor control, and the Indians' place in the colony. The relationship of non-Indian to Indian stirs up themes of protector, secularity, and conditional citizenry of the Crown. The new relationship is one of normalized policy where by the Indian is subjugated for labor and his land is appropriated for the growing agricultural economy.

When gold and other sources of easy wealth did not pan out for the colonizers, they quickly turned to agriculture. The themes of land, labor, and power played out alongside the changing waves of agricultural ventures by the colonial system. The temperamental agricultural economies left the indigenous vulnerable; it meant that the three themes of land, labor, and power vacillated along with agricultural product demand. Several crops were of great importance to the colonial economy. These crops would serve as the justification for exploiting Indians for hundreds of years. The first crop of consequence was *cacao*, or cocoa. Under the encomienda, tribute was paid to individuals in either the form of cacao-growing lands or in cacao itself. Because of the arboreal nature of cacao, production was not subject to volatile whims of the encomenderos. Cacao is a tree which is stationary for some 50 years of production, and the tree

bears fruit throughout the year, not all at once. The indigenous producers were left on their own to farm the cacao. However, the quantity demanded to pay tributes slowly increased.

Indigo, another crop of the colonial period was much more volatile. The rise of indigo production through the 1700s was mostly centered about the South and East of Guatemala where control of Indian labor was already well established. Its production was much more labor intensive. The harvest was concentrated into two months and was followed by an equally intensive processing period. This appears to be one of the earliest moments where colonizers made serious complaints about the availability of labor. In part, this was because the Crown eventually forbade the use of Indians on the indigo haciendas, because they were so disease-ridden and deadly to Indians.

In one telling case about the violent structures that were established during the colonial period, an ecclesiastical judge in 1723 declared that without indigenous labor, the production of indigo was “morally impossible” (Handy, 1984, p. 25). Martínez Peláez (1973) writes, “Land without Indians wasn’t worth anything, but the great worth of the Indians as creators of wealth counseled the acquisitions of great extensions of land” (pp. 165-166). Debt-bondage and sharecropping were additional ways in which indigenous were tied to a particular hacienda, because the haciendas always wanted more labor than provided by the repartimiento (Handy, 1984, p. 27). Handy (1984) writes, “the Indian was a valuable, scarce commodity ‘carefully rationed out’ to landowners through a variety of colonial structures, principally the *Repartimiento*” (p. 27).

Reducción: 1518-?

In order to facilitate the encomienda structure, the Spanish introduced the *reducciones*, or “reductions” in English (also referred to as the *congregación*, or “assembly” in English). Due to the high incidence of death and disease, the Indian population declined dramatically; therefore,

the encomiendas that were awarded often fell short of the amount of Indians a Spaniard expected to receive. The reducciones were designed to concentrate Indian bodies in one location under the “trusteeship” of one encomendero. Carmack writes:

Among the most disruptive of the Spanish institutions was the program of congregación or reducción. These forced resettlement programs were instituted throughout New Spain in the sixteenth century. They were intended to aid the clergy in ‘civilizing’ previously dispersed native populations by congregating them into new, densely populated villages where the activities of the natives could be more easily monitored. (2007, p. 189)

In order to extract labor and material tribute from the Indians it was far easier to have them organized into a central community rather than scattered throughout the mountains, where they wished to be nearer to their crops. The reducción was a policy of the Church, because it also facilitated evangelization, and was supported by the Crown. Throughout the latter half of the 1500’s the church reduced the Indian dispersal into a reported 700 recognized communities (Handy, 1984, p. 29).

The Church argued that this was necessary for conversion and protection from abuse. The reality was that without the reducción, the enforcement of encomienda and eventually the repartimiento were limited. Here, in this dynamic lay a continual double-edged sword, a strong indicator of the presence of structural violence. The very structure said to help the Indian is also the one most damaging to him. Thus, rather than improving or worsening the condition for Indians, it is simply the application of structure dynamics between non-Indians and Indians.

The system also placed Indians in proximity to the finca or other immediate areas where the labor was most needed. On the issue of structural violence, the reducciones did more than simply support the encomienda. The reducciones also freed up Indian land to be claimed and used by commercial agriculture. Remember, the encomienda was only an award of Indians and not of the land. The encomienda was not a land grant; however, the encomenderos generally gained control over the Indian lands, especially as populations declined. The effect of reducing

the Indians down to one area was to free up their territory for the taking. In the Polochic Valley today and throughout Guatemala, anyone who might put “unused” land to work has rights to it that trump any formal property rights and/or generations of inhabitation by Indians.

Also, the removal of the Indian from a familiar organic community environment to the contrived settlements came with a new political structural model. The *reducciones* identified one Indian to act as the overseer and representative of that *reducción*. Their selection was based upon a mix of native nobility, allegiance to the *encomendero*, and arbitrariness. Developing in the same period was an alteration of the role of the *caciques*, or Indian community leaders who were motivated by freedom from tribute and other colonial demands. The *caciques* often filled the role of overseeing the *reducción* or general relations with non-Indians (Handy, 1984, p. 28).

Therefore, customary roles of leadership among Indians were diminished while the ability to interpret a non-Indian agenda by a few Indians was privileged. Other structures of community authority and hierarchy were eliminated and leaders killed, such as the royal families: “the always tenuous cord that had tied individual communities to larger Indian empire had been decisively cut” (Handy, 1984, p. 28).

Over time the *caciques*, unlike royal families, achieved authority more through ascription and ‘elections’ than family lineage. Thus, *caciques* were more compliant and tolerated by the colonial establishment as long as they served to maintain internal order in the communities. The *caciques* ensured that tribute and workers were supplied and that order was maintained in the community. In turn, the *caciques* were permitted to, “ride horses, own land, wear Spanish clothing, bear arms and were often exempt in practice from the demands of the *repartimiento*” (Handy, 1984, p. 28).

The caciques were originally motivated by their own community's needs and served as a representative to external community agendas. Over time that allegiance was corrupted and the caciques came to represent the needs of the land owners, Ladino society, government and church. The caciques could be appointed or retracted by the church or government and were eventually associated with the colonial establishment and not the indigenous community (Handy 1984, 28). Eventually, the *cabildo* or *ayuntamiento* system (locally elected government) would slowly undermine their hegemony.

In current Guatemala, *gerentes*, or managers, regulate the labor and use of land by Indians living on land claimed by *fincas*. The land manager's primary responsibility is to coordinate the indigenous that reside within and around the *finca*. These *gerentes* achieve an almost mystical power in that they are typically the only individuals that have any contact with the actual land or *finca* owner. Conversely, they are often the only non-Indian to have contact with the Indians living on the property. The owners do not usually live near the *finca* but rather reside in Guatemala City or the luxurious vacation towns of Antigua or Panajachel. In disputes between the *finca* and the workers, it is the manager that is called to negotiate. The manager is almost always a ladinoized indigenous person, physically indigenous and multilingual. They live and dress in a "white" lifestyle. In return, they do not experience the public scorn that "traditional indigenous" experience.

The role of animals in the Tamahú valley provides an interesting comparison to the *gerente/cacique* association that comes to negotiate and variably represent both the interest of the non-Indian and the Indian. To this day, poultry or livestock non-native to Guatemala in many Maya languages carry a prefix or adjective such as *kaxlan*, meaning white, Spanish, and non-Maya. This grammatical structure is predominately used with household technologies, clothing,

and animals. During a land reclamation in the summer of 2005 the gerente of the finca was taken hostage and the land occupied. While the Indian group occupied the land, they destroyed the “kaxlan” organic items. Over 100 fruit and nut trees were cut down and a herd of about 40 goats and an equal sized flock of geese were killed. The goal of the Indian occupation was to replace the objects of kaxlan structure with those of Maya life such as homes and rows of corn. The construction of such objects began immediately in the night. Thus, the Indians are well aware that the gerente/cacique figure represents primarily the Spanish or Ladino interest.

Summary of the colonial period

Relocating and concentrating Indians away from their native lands destroyed social relationships at the level of the local community and regional Indian populations with a shared culture. Any social network of meaning based on community and geography would have been compromised in the process of relocation. The reducciones made the indigenous so vulnerable to the Church that these reducciones were also referred to as *congregaciones*, or congregations. The Indians were more easily subjected to the labor and resource supply expectations of the tribute laws of the encomendero. Removing Indians from their lands disrupted the food supply and subsistence production, which forced the Indian to be even more dependent on the Spanish systems of commerce, trade, and debt. The Crown’s supposed intent was to eliminate the encomienda with the repartimiento:

The Crown repeatedly tried to eliminate the encomienda system, but with little success. In some areas the Crown was successful in revoking encomiendas; in these cases an Indian town or province became, in effect, an encomienda of the Crown. In other areas, however, encomiendas held by generation after generation of Spaniards persisted until well into the eighteenth century. (Carmack, 2007, p. 187)

This quote demonstrates the variability in the encomienda implementation and retraction. This means that putting narrow interpretation in the appearances of such institutions in order to understand contemporary Maya conditions in Guatemala’s modes of production are misguided.

In fact, Carmack illustrates how the structural forms of early Spain are reiterated in more modern agricultural ventures:

With the gradual demise of the *encomienda* in many parts of Mesoamerica, Spanish access to large tracts of land shifted to outright ownership of landed estates called *haciendas*. ...In many regions, the growth of the *haciendas* was achieved at the expense of the native communities as Spaniards took control of what were formerly Indian lands. (Carmack, 2007, p. 189)

In theory this was illegal, but Spaniards had little trouble acquiring large or smaller tracts of Indian land. Grants of supposedly vacant land were also made to Spaniards even if there were Indians living on or utilizing the lands. By this point in history the Indian population was so decimated that their presence on land was easily ignored by entrepreneurs. This *hacienda* system of production brought about debt-servitude, share-cropping, and the establishment of unincorporated Indian communities living on the *hacienda* or *finca* land (a land/living space exchange for labor obligations to the *hacienda*) (Carmack, 2007, p. 189).

In conclusion, it is important to imagine and approach the subject of land as more than an object. Supporting this, Bobrow-Strain (2007) writes, “[Y]et I reject economic determinism, posing landed production as a social and spatial relation; not a thing, but rather as a set of relational practices operating on multiple material and discursive levels that order space in particular ways” (p. 7). For example, one possible effect of the *encomienda* and *repartimiento* was to make tribal, community, and familial affiliation a significant detriment in one’s life as a labor group, over the individual. We must also remember that, “*encomenderos* were officially charged with seeing to the religious instruction of the native peoples entrusted to them; the *encomenderos*’ frequent indifference to this demand was one source of friction between them and their rulers” (Carmack, 2007, p. 156). This demonstrates what Bobrow-Strain refers to as an essential social discourse that is directly related to and yet deceptively distant from land.

Ancient Occurrence of Anemia among the Maya

Preface: Divergent Planes that Converge in the Experience of Anemia

Part of this dissertation's methodology is to place side by side divergent geographical and historical planes of anemia in which its experience *has been* shaped. Farmer et al. (2004) warns that without this we risk only seeing shallow reflections of truth, “puddles” and evaporated meaning, “residue” and that we will miss the warnings on the horizon of “rainstorms” and “thunderclouds” (p. 309). This section on the ancient archeology of anemia and the preceding section on structural violence are purposefully juxtaposed for this reason; because, by keeping the horizons of these planes in view we might see where they converge. The archeological record and the colonial foundations of structural violence are historical reference points that converge in the experience of anemia among the Poqomchi'. Such a positioning of divergent themes risks an uncomfortable sensation for the reader that something is not in the right place—that these subjects do not go together. However, by hypothesizing across broad intersecting planes the reader is able to pull in their own cultural conceptions of his or her place in this universe, and regain a thread of his or her history unraveling from the entropic forces that erase memory.

Creation: Corn, Body, Person, and Bone

For the ancient Maya the shift to sedentary agriculture led to monoculture. They depended on *maize* (corn) to meet their energy and nutrient needs. Here, I examine current research on human remains, the evidence of anemia found in human bones, and interpretations of ethnohistorical context of the ancient Maya and post-Neolithic monoculture in the Americas. I am exploring diet and disease as a historical context for anemia. This helps to develop a deeper history of anemia and raise new questions about agricultural transition, cultural formation, and nutrition/health among the Maya. Archaeology and its subfields allow insight into historical relationships that reveal the complexity of anemia. In bringing together the results from multiple

studies, this analysis highlights anemia's complexity by demonstrating difficulties in interpreting the data shared across the research. Understanding the ancient occurrence of anemia is analogous to finding the needle in a haystack. There are many variables and intersecting horizons to consider, which calls for synthesis across studies as Danforth points out below:

Those who study Maya skeletal remains will always be plagued with the problem of small sample size related to poor preservation. Given this circumstance, it is only through continued aggregation of information from a number of sites, regardless of whether the sample size is 10 or 1000 and whether one or many disease and nutrition indicators are observed, that we can begin to test the broad statements concerning health. (1997, p. 137)

Another way to gain clarity is to aggregate the ethnohistorical contexts from the time and place where skeletal remains were found. Maize consumption among the Maya has a very complex relationship with population demographics, political turmoil, environment, and infectious disease. The small sample size and speculative interpretations of the meaning of certain archaeological remains seem only to lead to more ambiguities. However, when these data are coupled with ideas that come from the historical ethnology of the Maya they provide a more complete picture of processes that took place in human and cultural evolution. Linking historical ethnological and archeological discussions enables us to understand the relationship between Maya cosmology, maize agriculture, and health.

Maize was domesticated at about 5,500 years B.P. in Mesoamerica. The major maize complexes of the region developed into semi-states. These early maize consumers include the Olmec and later the Aztec and Maya (Bogin, 1998, p. 103). The early dependence on maize is evident in ancient texts and accounts by the Maya today. The creation story of the K'iche' Maya, the *Popol Vuh*, illustrates how gods created human beings (Tedlock, 1985). The first attempts at genesis were from animals, mud/clay, and the third from wood, however, these elements failed to produce the desired intelligent beings subservient to the gods. The fourth attempt used maize, but

not simply the seed. Creating human beings required working the seed by hand to produce flesh, blood, and fat.

Two metaphors from this story connect the ancient and modern Maya relationship with maize. The first is the creation of human beings from maize through the process of uniting maize, earth, water, and human labor. The gods created a world where human beings originate from a food that requires complex human and material relationships; this is the mythological origin of social relationships, home and garden, and labor. The second metaphor is the tie between food and god. In the Maya creation story the relationship produced by food is subservience, suffering, sacrifice, and most significantly the capacity for symbolic communication. Gods and human beings, the unknown and the known, foster a reverent relationship. The question remains, is human dependence on corn and subservience to the unknown only a metaphor, or does this reflect a biological reality for ancient Maya that can be found in their bones. For today's Maya, exploring how a maize diet and cultural cosmology evolved together increases our understanding of how anemia is accommodated from cell to symbol.

The Gatherer-Hunter Neolithic Transition

Prior to the advent of maize, one might argue that the human diet was complete. Bogen compares several studies of gathering and hunting peoples and finds that the diversity of their diets was far greater than agriculturalists:

Today, 99.9 percent of people derive their food from some form of agriculture. However from the time of *Australopithecus* until about 10,000 years ago, a time period that covers 99 percent of human evolution, all hominids lived by foraging—gathering, scavenging, and, more recently, hunting of wild foods. (1998, p. 114)

Their food came from gathering a variety of species often numbering in the hundreds. In comparison, the diet of most modern *Homo sapien* agriculturalists across the globe has been

reduced down to about four species of plants and an equal number of animals. The sedentary mode of production also increased dependence on underground foods such as roots, stems, bulbs, and tubers—plant foods with their own unique nutritional value relative to the variety of plants that were historically gathered (Harding, 1981). Today, the dominant plant species are wheat, rice, potato, and maize followed by sorghum, sweet potato, barley, millet, and cassava.

The decreased variety of foods had serious repercussions on human evolution, including: nutritional deficiencies due to a limited food base, an inadequate supply of energy in over half the world's population, and grossly unequal energy use by more affluent societies (Bogin, 1998, p. 124). Nutrient deficiencies are a uniquely human experience. Most animals are dependent upon their environment to provide food; all things being equal the animal should evolve a symbiotic relationship with the environment to maximize health. Agriculture is dependent on the mass production of a few choice sources of energy. This destroys the symbiotic relationship of human metabolism and the foods naturally available in the environment. Relinquishing our dependency on the environment for food greatly expanded the realm of possibilities for human beings. Unfortunately, it appears that we may have sacrificed our own general health and well-being in the meantime. One of the best indicators of poor health in ancient populations as well as modern peoples is the incidence of anemia, which in archeological research is specifically studied as IDA.

Archaeologists commonly use two indicators in cranial remains to identify anemia: porotic hyperostosis and cribra orbitalia. Porotic hyperostosis is identified by porotic lesions in the external table of the cranium. These lesions are produced when an anemic individual's hemopoietic tissue expands for the purpose of producing more red blood cells. As the tissue expands it puts pressure on the thin external cranium which then becomes thin and porotic. New

bone grows around the tissue, causing vault thickening (Aufderheide, Rodriguez-Martin, & Langsjoen, 1998, pp. 348-351). For infants, this process first occurs in the orbital roof or the cribra orbitalia. However, older infants experience porotic hyperostosis in the parietal bosses, occipital squama, and frontal squama. Upon death, active lesions are visible on the skull in the porotic external table, and healed lesions appear as dense bone grown to fill in the porotic external table (Aufderheide et al., pp. 348-351). Anemia leaves its mark on crania throughout the individual's life. In the living, these changes are noticeable in head shape and hair that pokes up and out. These visible signals in the living are often found in indigenous diagnosis of illness throughout the world. Today, among the Poqomchi' and other Maya groups, I found that individuals with pokey hair are thought to have fright, soul loss, and/or an inadequate sense of hunger.

Case study of the agricultural Transition

Although not a Maya site, the Dickson Mounds of the Illinois River Valley provide the best known example of a shift to a corn diet similar to that of the Maya. From A.D. 950 to 1300 the human population of that area changed from mobile foragers to sedentary, intensive maize agriculturalists. During this short time period, the shift in subsistence led to a fourfold increase in IDA (evidenced by porotic hyperostosis) and a threefold increase in infectious disease (evidenced periosteal reaction). The frequency of individuals with both iron deficiency and infections lesions increased from 6% to 40% (Goodman & Armelagos, 1988, p. 180). This increase reflects the synergistic relationship between anemia, nutrition, and infectious disease. However, what is interesting is that the age of onset of porotic hyperostosis and periosteal lesions indicated that infection typically came first, followed by iron deficiency.

This suggests that a slippery slope begins with infection and is followed by iron deficiencies, lowered immunity, and further pathogenic infection which may result in an

irreversible wasting or infection and eventually death. The majority survived childhood, but health and development were compromised as children narrowly escape the mono-agricultural developmental gauntlet. The bones of children recovered from the Dickson Mounds demonstrate iron deficient children under 10 years of age lived an average of 6 months less than children not showing pathology of porotic hyperostosis. Armelagos demonstrated that:

The population at Dickson Mounds suffered biologically from the shift to intensive agriculture. The success of the cultural system occurred at the expense of individuals and the population. The ability to reduce birth spacing allowed the population not only to meet the increase in mortality but also to meet the increased labor needs for intensifying agriculture. But there was an increase in nutritional and infectious disease load that affected all segments of the population but especially women, infants, and children. (1990, p. 140).

It is unclear whether changes in scale, population, environment, or culture led to maize-based agriculture or if agriculture enabled shifts in scale and cultural relationships. Food surpluses allowed for increased population and density. The potentially lethal combination of sedentism and density would lead to increased infectious disease and dietary deficiencies (Armelagos, 1990, p. 128). Whatever happened led to a decline in overall health that began at the start of the Neolithic period. In retrospect, synergistic relationships best describe what caused the rise of agricultural populations that coalesced into compromised diets that collapsed into infectious and nutritional diseases—one promoting the other.

Evidence of anemia in Maya sites and samples

The Dickson Mounds are just one example of how maize and health played out in prehistoric communities in the Americas. Throughout the Maya world, archaeologists have attempted to establish nutrition and disease frequency from the remains of ancient, colonial, and modern populations. In this section I highlight and summarize the few samples there are in this field of research where anemia was evaluated in ancient and colonial Maya shown in Table 3.1.

At Caracol, archaeologists found 83 internments with over 300 individuals, 80 of whom were found in formal tombs. Occupation at the site was between 300 B.C. to A.D. 1100 with a population peak around A.D. 650 (Chase, 1997, p. 16). Porotic hyperostosis was identified in seven adult and sub adult individuals at this site. Additionally, it appeared that these cases were within particular households (Chase, 1997, p. 24). At Santa Rita Corozal there were a total of 160 burials representing 194 individuals. There were only three cases of porotic hyperostosis. This site has been continuously occupied since 1200 B.C. (Chase, 1997, pp. 16-24). At Tayasal there were no cases of porotic hyperostosis among some 51 burials of 56 individuals (Chase, 1997, pp. 16-24). At the preclassic site known as Cuello, 2 of 49 individuals displayed the pathology of anemia (Chase, 1997, p. 35). At Preclassic Altar, porotic hyperostosis was found in five of seven individuals. At Preclassic Seibal the pathology was found in two crania and could not be determined in another four crania (Chase, 1997, p. 35). Márquez and Ángel (1997) point out three locations of Maya bone samples where the majority diagnosed with iron deficiency anemia: 32 of 36 at Altar de Sacrificios, 24 of 36 at the Peabody Museum, and 52 of 54 at the National Museum of Anthropology in México. Unfortunately, Márquez does not provide more information about the samples. The three Late Classic sites showed a much higher incidence of anemia. The site of Barton Ramie had a rate of 22 percent and Seibal, 41 percent, both were from sample sizes that were not cited but numbered over 200 hundred individuals (Danforth, 1997, p. 136). Astonishingly, the colonial site of Tipu reveals that over half of the 547 skeletal remains showed signs of anemia (M. N. Cohen, O'Connor, Danforth, Jacobi, & Armstrong, 1997).

Table 3.1.
Summary of samples across study sites

Site	Incidence	Pop.	Pathology or Description of Illness	Time Period
Caracol ¹	7	300	Porotic Hyperostosis	300 BC–1100 AD
Santa rita corozal ²	3	194	Porotic Hyperostosis	Preclassic
Tayasal ³	0	56	Porotic Hyperostosis	Preclassic
Cuello ⁴	2	49	Porotic Hyperostosis	Preclassic
Altar ⁵	5	7	Porotic Hyperostosis	Preclassic
Altar de Sacrificios ⁶	32	36	Anemia	
Peabody Museum ⁷	24	36	Anemia	
National Museum Anth. ⁸	52	54	Anemia	
Seibal ⁹	2	6 ¹⁰	Porotic Hyperostosis	Preclassic
Tancah ¹¹	4	11	Anemia	
Playa del Carmen ¹²	37%		Cribra Orbitalia or Porotic Hyperostosis	
Copan, 2 year olds ¹³	9	10	Periosteal Reactions	Late Classic
Barton Ramie ¹⁴	22%		Porotic Hyperostosis	Late Classic
Seibal ¹⁵	41%		Porotic Hyperostosis	Late Classic
Copan ¹⁶	44	157	Cribra Orbitalia or Porotic Hyperostosis	unknown
Tipu ¹⁷	304	547	Periosteal Reactions	1544–1707 AD

¹ (Chase, 1997)

² (Chase, 1997)

³ (Chase, 1997)

⁴ (Chase, 1997)

⁵ (Chase, 1997)

⁶ (Márquez & Ángel, 1997)

⁷ (Márquez & Ángel, 1997)

⁸ (Márquez & Ángel, 1997, National Museum of Anthropology in Mexico City)

⁹ (Chase, 1997)

¹⁰ Porotic Hyperostosis was found in two crania and could not be determined in another four.

¹¹ (Márquez & Ángel, 1997)

¹² (Márquez & Ángel, 1997)

¹³ (Storey, 1997, p. 124)

¹⁴ (Danforth, 1997, p. 136)

¹⁵ (Danforth, 1997, p. 136)

¹⁶ (Whittington & Reed, 1997)

¹⁷ (M. N. Cohen et al., 1997)

Critique of the data

A limiting factor is the nature of the data; it is cross-sectional and not longitudinal. The samples can only tell us about severe anemia and/or iron deficiency at death, not about mild-to-moderate anemia. Less severe anemia does not cause these manifestations in the bones. Therefore, the evidence of severe anemia and iron deficiency speaks to what Farmer et al. (2004, p. 309) referred to signals on the distant horizon—it warns us that less severe anemia likely afflicted ancient populations ubiquitously and consistently. We are only able to detect the severe pathologies and hypothesize about the causal socioenvironmental context.

The sample sizes are limited mostly because of the humid environment and poor preservation of remains. Also, the data that were collected in the past were not well documented, such as the remains at the museums at Harvard, Smithsonian/Altar de Sacraficios, and Mexico City. If their provenience is lost a great deal of understanding is lost too.

In the literature, the presentation of the data can be troublesome as it is often unclear if samples are coming from the same time and space. This makes it difficult to form conclusions about the data. The only pattern that we might be able to suggest is that the incidence of anemia increased as Maya civilization (human organization) became more complex. Additionally, ancient and modern maize-based diets can provide sufficient iron. Thus, maize is not the cause of iron deficiency anemia—everything that comes with maize-dependent populations is the cause of iron deficiency anemia (Wardlaw & Hampl, 2007).

Armelagos found that infection was followed by anemia, which would reflect a causal relationship between infection and anemia, not between maize and anemia. There are hundreds of other variables that have synergistic relationships that prevent the bioavailability of iron. We cannot ascertain from such small samples what nutritional deficiency may have caused anemia. Also, Márquez and Ángel (1997, p. 59) mention several factors that influence nutrition,

including age, gender, socioeconomic status, work burden, and technological development, not to mention environmental destruction, which destroys gathering and hunting reserves. These research problems result in a series of contradictory findings, which I will identify below.

Contradictions in the record

There are several examples in which research exposes contradictions that add to our understanding of the complexity of anemia. These include assumptions about rural/urban health, class and social status, and the relationship between infection and anemia. In the first contradiction, Danforth concludes that smaller sites suffered less anemia coupled with less infections and overall better health. By comparing the three Late Classic Maya sites in the Petén (Table 3.1), Danforth found that smaller or rural settlements were healthier; illness in more densely populated areas likely led to the Maya “collapse” (Danforth, 1997, p. 137). However, Whittington & Reed found a higher incidence of anemia in rural than in urban populations (1997, p. 167).

Second, Whittington & Reed’s analysis of the remains from Copán showed no significant difference in anemia between social statuses, whether or not they died before or after the political collapse, and between rural and urban burials. Only sex was significant with a higher incidence of anemia in adult females (1997, p. 168). In contrast, the child samples collected from this site signify that class may have played a role in a child’s ability to survive multiple pathologies but did not indicate the ability to escape illness (Storey, 1997, p. 125).

Third, research at Tipu diminishes the relationship between infection and anemia: “We found no correlation between cribra orbitalia or porotic hyperostosis and the presence of systemic infection” (M. N. Cohen et al., 1997, p. 85). This only shows that no skeletal remains displayed both of the markers in the bone simultaneously, which happens based on age of onset. Also, the types of infection analyzed are more common in adults. In contrast, at the Dickson

Mounds, Armelagos and Van Gerven (2003) found that infection was followed by anemia. White (1997) proposes two possibilities; concentrated Maya populations either grew increasingly dependent on maize or were increasingly subjected to general and parasitic infection. Both would have produced a “collapse” of sorts. Conservatively, White concludes that there are not enough samples to determine either hypothesis (White, 1997, p. 180).

A final variable of interest is not so much contradictory as it is forgotten. Only the research of Whittington and Reed (1997) at Copán suggests that fertility rate is more closely linked to age-at-death, and subsequently, the incidence of porotic hyperostosis. Thus, a larger population would have a higher incidence of anemia evidenced by porotic hyperostosis and cribra orbitalia (Whittington & Reed, 1997, p. 167). This fits with what Armelagos found at the Dickson Mounds—an increased birth rate with intensive agriculture. This brings us back to our Maya maize ideology of a labor intensive and subservient population. If agricultural shifts coincide with increased fertility and a culture of subservience required in a complex society—then anemia, IDA, porotic hyperostosis, and cribra orbitalia may be the end result.

Conclusion: The Diet and Disease Dilemma in Sedentary Monoculture

Manuel Gamio, a founding figure in Mexican anthropology, compared the people’s relationship with maize to “enslavement on many levels” (Gamio, 1935, p. 89). The nutritional dilemma which human beings face was brought on by agriculture. Population density, specialization, labor, and many other modern anomalies of augmented scale compounded the problem by further reducing variety in diet. If we assume that Maya semi-states consolidated power and the scale of societal relationships became more complex, perhaps we can identify the rhetoric for this process within the ideological framework of the *Popol Vuh* (Tedlock, 1985). The two lessons taught, as explained above, were that human kind is formed through work and

subservience, which resembles a doctrine of unequal power relationships and poor health. What the archaeological record can tell us is how the ideology of maize as a gift from God, meant to represent human kind as the subjugated worker, is reflected in the remains of the Maya.

Archaeology, when combined with ethnohistorical indigenous records is a powerful tool for understanding how human relationships evolved and devolved through time and space. Comparative analysis of the osteological record provides little definitive conclusions about change in the experience of anemia between ancient and modern Maya (Armelagos 1990; Chase 1997; Cohen 1997; Danforth 1997; Márquez 1997; Whittington 1997). This discussion is crucial to dispel dismissive attitudes within academia that reference anemia simplistically and generally as a mere side effect of adaptation to a corn-based diet. A survey of this archeological and osteological literature demonstrates that particular sites may show conclusive results, but when compared they show no definitive patterns. Similarly, there has been little comparison until now (Armelagos 1990 and Whittington et al. 1997 are exceptions), which demonstrates that anemia has been treated too simplistically as a biomedical paradigm, even in ancient populations.

Chapter 4. An Iterative Process of Qualitative and Quantitative Methods

My research framework uses a mix of methods in order to trace the impact of anemia through layered yet interconnected biological and cultural contexts. This approach applies a combination of quantitative and qualitative strategies. Johnson et al. describes this mixture of quantitative and qualitative methods as a “third paradigm” (Johnson, Onwuegbuzie, & Turner, 2007, p. 129). This approach is useful in subject matter where many paradoxical or contradictory paradigms exist. Mixing methods expands narrow and potentially misleading perspectives by allowing the research to take place at multiple social and biological levels. Through a sort of triangulation of data and analysis, a mixed methods approach aims at a broad contextualization of the research subject. Validity is established when there is coherent logic in the conclusions that result across methods (Creswell, 2013; Greene, 2006; Johnson et al., 2007).

In my effort to understand the experience of anemia by tracing its biological and symbolic expression I spent over two years in Guatemala undertaking applied agriculture work, language studies, and fieldwork. I made 6 trips to Guatemala between 2003-2009, the longest being 6 months and the shortest 3 months. About half of my time was spent in the main town of Tamahú, where I coordinated much of the research effort and met and interviewed officials from the health clinic, local government, and the judiciary office. The other half was spent in the 26 surrounding mountain communities. The majority of this time was spent in 15 of the 26 communities, one of which was Onquilha', the site of this research. In my last three trips to Guatemala my focus was primarily on field work in Onquilha'. There, my fieldwork focused on (1) visits to 6 households to interview members as well as observe and shadow their daily activities, (2) attending 3 town meetings to record and observe discourse regarding issues relevant to structural violence and community health, (3) regular trips on extensively used

mountain trails to opportunistically converse with and interview people, (4) attending church services to record discourse where the emotional drama of suffering was expressed, (5) collecting blood samples from school children, and (6) participating in healthcare activities at a small clinic outpost.

I took field notes, recorded verbal interactions, and video-recorded group settings for later analysis. The three languages spoken in the community are Spanish, Poqomchi', and Q'eqchi'. Interviews in Spanish were conducted by me. Interviews in Poqomchi' and Q'eqchi' were assisted by a key informant, interpreters, or family members of the interviewee.

Applied Agriculture Work

After my first visit to Guatemala (March-April 2003) working as a medical interpreter with the Poqomchi' I was compelled by their illness narratives to return later that year (June-December 2003). Given my background in international development work, I was intent on developing agricultural projects with the goal of improving nutrition. Also, the agriculture projects were a way for me to see what was happening in the 26 communities above the main town of Tamahú. An applied approach with practical implementation of agricultural projects seemed like the most logical way to gain access to the communities and better understand daily life, food procurement, and the widespread illness. One project aimed to encourage the use of new varieties of poultry. A second project aimed to establish more diverse vegetable gardens.

Neither of these projects got off the ground. I approached both the Catholic and Evangelical organizations within Tamahú, who showed no interest. These were the connections I thought I had secured to what would eventually become my field site. Without the cooperation of either of these entities I could not enter into the mountain communities. However, after speaking with Peace Corps volunteers, citizens of Tamahú, and church and community leaders, it became

clear that similar projects had failed. Getting people to shift their traditional food ways is a delicate and often futile venture. The projects were not going to work. I had to gain a better understanding of the local situation and a more subtle approach to identify farming projects of interest to the communities.

My opportunity to improve nutrition and witness illness in the context of community life had vanished. With years of study in sustainable development, I found myself distanced from the Poqomchi'. I needed to find key informants. Luckily, a good friend with whom I stayed as an interpreter had nine brothers and sisters who were all deeply involved in different capacities throughout Tamahú. One of the brothers was the coordinator of a group of 10 field nurses who worked out of the Tamahú health clinic. The nurses, all of whom were Poqomchi', visited the communities regularly providing basic health services. They had an extensive network of healthcare associates in the communities. I met with the team and explained what I had observed as an interpreter and that I was interested in anemia. They were very familiar with widespread chronic illness, but their job was primarily to vaccinate children, and they felt powerless in addressing larger problems. They also knew that my work as an interpreter had not shown me the reality of illness in context. The team granted me *entrée* and allowed me to accompany them into the communities. I told the team I was interested in starting some sort of agriculture project. Their excitement of the possibilities, willing input, and introduction to key community leaders would prove crucial.

After several weeks accompanying the team of nurses I observed their conversations and gained a greater awareness of the situational complexities through patients' stories of illness. The trips with the field nurses provided a chance to understand how the Poqomchi' live and farm. The Poqomchi' have come to understand *proyecto*, or "project", as beneficial. It provides an

alternative and innovative input unlike the structural rigidity of the government and wealthy land owner control. What the projects would be I had no idea. The crucial factors that would affect implementation of any project in all the communities was the unavailability of land, the importance of corn, and the limited time available to experiment with risky projects that could impact their subsistence-level diet. With corn planted on every available piece of soil, the project needed to utilize precious space and require virtually no maintenance. The specifics of the project were still unclear.

On a weekend visit to the bordering municipality of San Juan Chamelco I accompanied a Peace Corps volunteer working in similar mountainous communities of Q'eqchi' Maya. Her job was to vaccinate cattle, pigs, goats, and other animals. She entered the communities easily and did not need to be accompanied by a local indigenous person. She conversed with people about their animals, and they were happy with the simple veterinary services she provided. There was a common denominator for herself and the people in the communities—a reason for her being there. I myself had a background working the farm animals and the veterinary needs of these communities were affordable and simple to administer. To understand the local process of agriculture would prove to be a way to understand the lives of the Poqomchi', who are after all farmers. Although I had previous agricultural knowledge, I expanded my repertoire to include crop and soil management, castration, and butchering. I visited area universities, experimental stations, and other project sites to become familiar with contemporary Guatemalan agriculture.

The practical application of these skills established my role as “field veterinarian” and “farming consultant”, which granted me independent and welcome access to the mountain communities. Through these interactions I was exposed to cultural beliefs about animals, and more broadly, about agriculture as my informants divulged their thoughts about issues

concerning their animals and food procurement. They explained the quantity of animals and crops their land could hold and that there was not enough land to support their families. They expressed concerns about their neighbor's animals invading and destroying their crops. They were eager to learn about new species to farm such as fish, snails, geese, and quail. They raised a crucial point; they could never gain access to new types of animals and plants because they could never secure capital, space, and transportation needed for such a venture. I began to consider issues of structural violence and subjugation by the finca system as I grew more aware of the complexity of how the Poqomchi' could even begin to go about acquiring innovative agriculture techniques. The farmers explained their concern for the health of their wives and children, which in turn exposed how they identified themselves in opposition to *them*—a broad term used to reference all others who did not live in the mountain communities on or near finca lands. In 2003 the coffee growers in Latin America were in crisis as the market collapsed. The Poqomchi' had earned a meager income from working as tenet farmers. With no demand for Guatemalan coffee production, the Poqomchi' lost a critical source of survival. They were anxious to try alternative techniques for procuring food and livelihood. This was the context in which I was to formulate projects with their approval.

I outlined two projects to benefit the Poqomchi' communities and provide an opportunity to understand the challenges to overcoming micronutrient deficiencies. The first project was based on my observation that all communities had unused common space around their schools and that children consumed very little fruit. Communities were invited to receive an orchard consisting of about 30 trees of 10 varieties of fruit. Fifteen communities participated. In the first phase of this project, I surveyed the area where the community wanted to plant the trees. Then,

we arranged a day for planting. Finally, I made a follow-up visit to check on the status of the orchards.

The second project was designed to utilize fallow fields and provide milk and meat from dairy goats. The health clinic identified five interested families with extreme need. These families were typically large and malnourished. In the first phase of this project, I became acquainted with the families and their home environments. In the second phase we arranged a day for members from all five families to meet in the main town and receive their goats and training on how to care for them. Each family received one goat. Finally, over the next several months I visited the families and assessed their health and use of the dairy goats.

All together I made over 80 trips into the mountains and visited 23 of 26 communities. I departed up the trails at dawn and returned late in the afternoon. Almost six hours of every trip consisted of hiking with about three hours left for observation. The majority of the 80 trips were to fifteen communities that participated in the orchard project. On these trips I planted trees with the community members or checked on the orchard's status. I made more than 20 all-day visits to the five families participating in the second project. During home visits I interviewed families and helped them learn about raising dairy goats. Those visits, spanned over an 18-month period, afforded intimate longitudinal observations.

Iterative Process

In the early stages of framing my research I took a rigorous semiotic approach aimed at examining how anemia was constructed in language. My expectation was that the symbolic representations and its grammatical context would reflect the proximal causes and treatments of specific symptoms of anemia. Then, I expected that this discourse would shift toward more distal and abstract expressions in domains such as poverty, subjugation, marginalization, cosmological

beliefs, or psychosomatic illness. Along with this discourse data I had planned on collecting blood samples from adults to determine their severity of anemia. The goal was to correlate individual severity of anemia in biomedical measures of Hgb with Poqomchi' narrative about symptoms. My hypothesis was that the language used to talk about anemia would become increasingly abstract as anemia became more severe. I hoped to identify the point at which biological severity converged with cultural chaos; the point at which the experience of anemia became unmanageable; the point at which a meaningful experience became meaningless.

However, in early interviews the complex and often elusive nature of anemia proved daunting given my limited understanding at the time. I imagined the Poqomchi' would be able to reference causes, treatment, and symptoms in specific and isolated ways that would provoke even deeper conversation. They could not, and our conversations about illness were short-lived. Instead, their responses quickly condensed into broad absolutes—worldviews about seemingly abstract ideas of the body, behaviors, identity, and what seemed to be psychosomatic concepts of illness and health. Their answers were several steps removed from the biological variables of which I was inquiring. It was as though the normalcy of such variables (e.g., parasites, lack of meat in the diet, headaches) meant that they were not worth talking about.

It was only after I had gained a better understanding of the physiology of anemia and spent more time in the field observing and talking with key informants that the framework for this dissertation became clear. The Poqomchi' in these early interviews were not discussing anemia as it is understood within Western biomedicine—an interpretation of lab reports, deviation from the norm, or isolated symptoms. What I had expected to be framed as a linear discourse on the proximal cause, treatment, and symptoms of anemia was actually quite nonlinear and at times tangential to its experience. And, what I had expected to be more distal

domains of daily behaviors were actually salient expressions of the biological experience of anemia.

The Poqomchi' were tuned to deeper, physical and mental, systemic levels of the pathophysiological experience of anemia. Anemia is ultimately a condition that affects the entire working body, movement and thought. This is why it is crucial to study and understand anemia in context. In clinical settings only static biological measurements are captured and typically while the body is at rest. Where anemia plays out is in how the body and cultures manage movement (e.g. energy, metabolism, and O₂ balance). In biomedicine anemia is classified as normal, mild, moderate, or severe, which correspond with exact Hgb levels. For the Poqomchi', anemia is either a normal reality, or severe. It is this differentiation, or balance, that became the new focus of my dissertation. For the Poqomchi', the daily struggle consisted of maintaining normal anemia and avoiding the descent into a severity that is a potentially fatal illness—the point where all is lost.

Participant Observation

Participant observation is a common ethnographic approach where the researcher is directly involved in daily life in order to observe and communicate with people about their reality in context (Agar, 1996, p. 163). Due to the difficulty participants had in speaking about their illness (Das, 2006, 2007), this method was crucial to my research. It was primarily used during my agriculture work with the Poqomchi' and while accompanying the field nurses. With the fruit tree project I was able to participate in broader community institutions including church, school, and governance. In the dairy goat project I was able observe and participate in the daily activities of 6 households. Additionally, I spent hundreds of hours walking the trails that connect communities where encounters are often rewarded with what the Poqomchi' refer to as the essence of their language—small talk. Participant observation establishes comfort, which allows

the researcher to gain experiential, effective and positivistic knowledge, “the kind that can move the levers of the world if it gets into the right hands” (Bernard, 2006, p. 342).

Triage: Exhaustive and Selective Sampling

In my first visit to Guatemala serving as a medical translator with the Poqomchi’ I was privy to a systematic sampling of symptoms reported by over 1,000 individuals. Medical triage is a process of prioritizing patients based on the severity of their symptoms in a field clinic setting. This process was selective in that the individuals were seeing the doctor because they were sick. It was an exhausting method because their symptoms became overtly repetitious. Because my Poqomchi’ language skills are minimal, I mainly translated from Spanish to English and another translator worked from Poqomchi’ to Spanish. The clinic was organized by a Catholic group known as the Missionaries of Charity in the Order of Mother Teresa. The mission has been present in the area since 1996.

Focus Groups

After I obtained a deeper understanding of community life and food procurement I needed to acquire a more refined understanding of how the Poqomchi’ understood anemia. I conducted three focus groups with women because women are more affected by anemia and the health of their children. With help from the health clinic in Tamahú I selected three groups of women and conducted semi-structured interviews at the clinic. The first two groups consisted of Poqomchi’ midwives. The midwives assist women in childbirth and potentially have more knowledge about the conditions and symptoms afflicting women in the communities. During a monthly midwife training session of 40 midwives, the nurses randomly selected 12 women. The third group of Poqomchi’ women had no medical training and were unfamiliar with anemia. They were chosen from the pool of women sitting in the waiting room of the health clinic. They

were the first six women in line to see the doctor. All women readily agreed to participate in the survey.

Elicitations: Native Linguists, Women, Men, and Healers

Elicitations are a linguistic tool for mapping grammar, vocabulary, semantics and other areas of communication in a specific language (Chelliah, 2001). While this dissertation is not a linguistic research project, my understanding of how symptoms and health were grammatically constructed in Poqomchi' was a key factor in identifying the cultural symbols and metaphors most reflective of anemia. I studied with native Kaqchikel, Q'eqchi', and Poqomchi' linguists in Guatemala for three months, each with assistance from the Foreign Language and Area Studies Program with the U.S. Department of Education. This allowed me to identify and map meaningful phrases associated with the symptoms of anemia. I also conducted 4 elicitations with lay persons in Guatemala about specific symptom sets. Mapping terminology about health through language helps to prove and disprove where anemia fits with broader belief systems. Through this preliminary linguistic work, I gained sufficient knowledge of Poqomchi' health to conduct crucial elicitations with four Poqomchi' healers in the community of Onquilha'. These elicitations with the healers focused on the nosology, interconnectedness, and worldview of themes related to anemia, illness, life, and death.

Blood Samples

In line with a mixed methods approach, the collection of blood samples was the biological foundation for this dissertation framework. In a nonprobability purposive sample, all school-age children in the community of Onquilha' participated (N=87). This method was used as groundwork for the major research question, which needed to begin with an idea about the local prevalence of anemia. This established the endemicity and ubiquity of anemia in the community. This methodology is described in Chapter 5. In previous fieldwork I also collected

samples from women and men; however, due to the limitations of this dissertation I only discuss analysis of the results from children.

Analysis from Meta-Synthesis

Referring to the subject of anemia, Stuart-Macadam and Kent stated, “A lack of interdisciplinary communication means that what may be common knowledge in one field is little known or understood in another” (1992, p. 263). To control for this lack of interdisciplinarity, findings from meta-synthesis of qualitative and quantitative studies were used in several areas. This method also belies a central focus of medical anthropology:

For any particular outcome or phenomenon to be explained, a great many interrelated factors are at work. In practice this means that medical anthropologists are likely to collect a great deal of data about economic features, social relationships, cultural belief systems, political processes, and other aspects of a community (Sargent & Johnson, 1996, p. 274).

It was particularly useful in my preliminary investigations in which I filtered through many early iterative approaches to framing my research. In the area of the biology, this method was used to model the physiology of chronic and endemic anemia. I conducted an extensive review and synthesis of research from many different disciplines by searching PubMed and Google Scholar for the keyword “anemia” combined with keywords that were revealed through my ethnographic research. This allowed me to hypothesize how anemia that is recurrent and endemic affects the body and its fundamental differences from acute anemia, anemia from chronic disease, and non-anemia in populations with higher average Hgb levels. For understanding the symbology of shared illness through the framework of liminality, I synthesized the work of Victor Turner (2006; 1957, 1961, 1967, 1968, 1969, 1974, 1986a, 1986b) and its current application in a range of disciplines and conditions of illness and disease found through a search of the keyword “liminality” in PubMed. I was particularly interested in the ways by which liminality becomes perpetual and disease accommodated through the navigation and normalization of illness through

symbolic meaning. Finally, I analyzed and framed a long history of analogous social structures in early pre-colonial Spain (300-1492 AD) through colonial and contemporary Guatemala (1492-2013 AD). This was done to identify the themes of structural violence that resonate most strongly through history, manifest in the current conditions of human organization that negatively impact the health of indigenous Guatemalans. The purpose of a long history of structure was to understand the experience of anemia in the broader context of structural violence and to specifically identify the “erasure of history” (Farmer et al., 2004).

Discourse and Liminality

The experience of anemia and its accommodation is ultimately expressed through language and identified in discursive analysis (Bernard, 2006; Good & Del Vecchio Good, 1994; Janzen, 2002; Kleinman, 1988; Mattingly & Garro, 2000). Basic methods for collecting discourse data include participant observation, interviews, surveys, elicitations and identifying the employment of particular cases. This method approaches language associated with illness through discourse that conveys the experience with respect to the embodiment of anemia, especially where speech is not always explicitly or consciously associated with illness (Good & Del Vecchio Good, 1994; Hydén, 1997; Janzen, 2002; Kleinman, 1988; Mattingly, 1998). As discourse is situated, the culturally codified and constructed significance of anemia to identity can be found by identifying redressive accommodative symbols. Since anemia is biologically ambiguous as disease and defense, the experience of chronic illness appears to maintain a tension between normal and abnormal (Becker, 1997; L. Cohen, 1998; Csordas, 1994; Rapp, 1999; V. W. Turner, 1968). This research methodology is focused on the lived experience of chronic illness, which is a fluid state of being-in-the-world that floats between normal and abnormal (Becker, 1994, 1997; L. Cohen, 1998; Csordas, 2002; Rapp, 1999; Schackt, 1986; Taussig, 1993).

Chapter 5. Approaching the Prevalence of Anemia in Onquilha', Guatemala

During my first visit to Guatemala in March of 2003 as a medical interpreter, I became well aware of a broad spectrum of related symptoms and the possibility that they suffered from anemia. Having observed this in a minimally equipped triage setting, where diagnosis and treatment was not possible, my understanding was limited. I needed to gain access to a remote Poqomchi' community and systematically sample the population in order to determine if anemia was prevalent. But first, I wanted to find out if local Guatemalan medical practitioners had similar suspicions about anemia afflicting indigenous people. At the regional hospital in Cobán, 2 hours away, I met with the Director of Women's Health. He walked me through a large room with 75 patient beds, all full. As we passed by the foot of each patient's bed he lifted the attached clip boards, scanned the many bits of information, and zeroed in on the Hgb levels that indicated anemia. After sampling about a dozen bedside data sheets the doctor paused holding a clipboard. His stare reached across the room as he articulated a paradox, "some women walking around here are so anemic that they should be dead, the walking dead." It was understood that he was referring to women throughout Guatemala and the enormity of the problem. As I followed his gaze across the room, the rather boring Hgb data points filled the empty space. There were at least a hundred people in a rough line camped outside the doors to the hospital waiting for a chance at admittance, which was restricted by available beds. I imagined their Hgb levels floating above their heads, like how a bad pharmaceutical commercial tries to animate disease on the body.

He brought me to one patient who was sitting up eating canned beets. Her hand moved slow and methodically between a plastic partitioned tray and her face. Bright red juice dripped from her mouth. Her movement was slow, but it was her eyes that first told me to prepare

myself. The centers were pure white. Corneal ulcers had left her blind, likely the result of malnutrition and infection. My greeting her in Poqomchi' brought her amusement. She formed a wide red smile full of beet. The sallow shadows between bone and skin momentarily lit, giving great life to her pale complexion. Relative to none, the demonstration of force she harnessed for a smile was enormous. Her clip board indicated an Hgb of 2.3 g/dl. This is not considered survivable, as "normal" Hgb levels are 12-16 g/dl. However, she was living, moving, eating, communicating, and smiling.

The doctor continued showing me the other three patient rooms in the hospital. There were a few cases among the men. The infant room had 20 newborns, 5 of which were born with anemia. In the children's room anemia was again ubiquitous. We spoke with one mother who was sitting beside the bed of her 2-year-old daughter. The girl was being treated for general malnutrition. Her clipboard indicated she had severe anemia with an Hgb of 5.2 g/dl. The mother sat, breast-feeding a newborn while a 4-year-old boy clung to her ankle at the base of the chair. She took the opportunity to ask when they would be able to leave. The doctor explained that it would be several days. Her eyes fluttered as she stared into her thoughts. I had seen this scenario before—a mother breastfeeding a newborn, a relatively healthy 4-year-old, and a floundering 2-year-old. Part of my job as an interpreter was to go out along the line of mothers and triage the youngest children who were always swaddled tightly in cloth and snug in a sling. I would blindly reach my hand into the bundles and get as close to their heads as possible. The ambient temperature would roll across the back of my hand. If it felt hotter than the ones before then the 2-year-old had a temperature. The family was moved to the front of the line—the mother, the baby, the 2-year-old, and the 4-year-old. Anemia wedged itself into reproduction's ratchet, breaking the pawl that gives the guise of a linear pace to life, family, and community. I left the

hospital shortly after, but the next day I returned for a follow up conversation with the mother whose eyes had fluttered. I was told that she and all three children had left during the night, freeing up one more bed.

The severely anemic blind woman, who had wandered down from her community, was found unconscious in a nearby town and brought to the hospital to get her off the streets. Meanwhile, the severely anemic little girl, whose mother was forced by local authorities to bring her to the hospital due to her malnourished state, slipped away back into her normal routine. Almost all cases of anemia presented in the hospital come by chance—by reason of other illness or disease. Treatment for the malnourished is only available to children, when funds are available. It is not considered a primary disease that is treated in a clinical setting. Moreover, the severe cases that do appear in the hospital must be coming from places where there are others, much like themselves, living in difficult environments, and suffering from various degrees of anemia.

In order to get a general idea of what the prevalence and severity of anemia might be in a single community, I needed data from a subset of the population. This data from the Poqomchi' community of Onquilha' presented in this chapter showed that 100% of school-age children were anemic (N=87). A later study in the same community (not part of this dissertation) showed that 78% of adult females and 43% of adult males were anemic (N=94) (Herynk & Justice, 2008). Environmental factors that cause Hgb results to be adjusted are described. A brief discussion section addresses the interpretation of Hgb cutoff values used to classify the severity of anemia in the context of a specific population and environment. In Part II, I present and interpret data on the prevalence of anemia in Guatemala and globally. To address the way anemia is not directly treated in hospitals or clinically, as shown in the above observations, I provide a discussion

analyzing how anemia is variably defined as a symptom, condition, illness, or disease. A goal of this chapter is to show the prevalence of anemia at the local, national, and global levels.

However, an overarching goal is to provide a qualitative interpretive context for how these quantitative data are shaped by physical environments and contentious classification.

Methods

All students from the only school in one community were selected for sampling. The sampling took place over a 4-day period in the early morning at the start of school. Under a purposive sampling approach, sampling was completed when all who were attending the school were sampled (N=87). There were two 6-year-olds from whom specimens could not be collected due to advanced edema symptomatic of Kwashiorkor (Protein and possible calorie deficiency). The two children were immediately referred to the local hospital for treatment of malnutrition. The sampling design, methods, and collection were approved and carried out with assistance by the Guatemalan Ministry of Public Health and Social Assistance (MSPAS; Ministerio de Salud Pública y Asistencia Social). Informed consent was obtained by the community and individuals at a community meeting where participants were informed of the purpose of the study. Field nurses trained in phlebotomy collected 3ml specimens. Blood was drawn by syringe and transferred to vials containing the anticoagulant ethylenediaminetetraacetic acid (EDTA) to prevent clotting. The specimens were placed in coolers and transported to the laboratory. Counting was performed manually on prepared slides with peripheral blood smears under microscope. A complete blood cell count (CBC) was conducted at the nearest national laboratory by the primary lab technician at the hospital in Tactic.

Adjustments to Hgb Values Due to Altitude and Indoor Cooking Fires

Estimates for “normal” Hgb values, also referred to as cutoffs, vary according to population averages based on age, sex, the condition of pregnancy, and to a lesser degree by

ethnicity (Table 5.3). Adjustments can be made to either the cutoff values used to classify anemia or to the individual Hgb measurements by subtracting or adding the appropriate adjustment. For this analysis, adjustments were made to each individual Hgb value. The first adjustments to cutoff values were made based on age. From an N=87, 85 children had a cutoff of 11.5 g/dl. Individual adjustments for two participants were made based on age and sex in order to place them under the same cutoff level. A 15 year-old male had 1.5 g/dl added to his value and a 15 year-old girl had .5 g/dl added to her value.

An additional adjustment of -1 g/dl was made to all samples based on environmental variables that affect Hgb measurements and their interpretation (N=87). These adjustments account for changes in the functioning of Hgb, O₂ requirements, O₂ transport, or all of the above. The effect is that Hgb values appear higher than they are in reality. Hgb values are, “higher at high altitude, they are higher in trained athletes, they are higher in the morbidly obese and they are higher in individuals (and groups) exposed to atmospheric pollution of the particulate type . . . levels are also higher in individuals exposed to carbon monoxide including both traffic policeman and cigarette smokers” (Garn, 1992, p. 47). Normal Hgb values are factored for an environment with good air quality at or near sea level. When blood is sampled in an environment that affects the validity of the Hgb normal measurement, adjustments must be made to Hgb based on research that demonstrates the amount to which the environmental variable misrepresents the actual Hgb value. In this study, Hgb values for all participants are adjusted according to altitude and smoke from indoor cooking fires.

Altitude Adjustments

At high altitudes there is lower O₂ pressure. The body compensates for the decreased force of environmental O₂ by increasing blood Hgb content. Only partial adaptation is possible as the kidneys release an enzyme called entropoietin, which increases red blood cell production

when O₂ pressure is low (Raw, 1975, p. 39). The altitudes at various locations in the community were read with a global positioning system (GPS) device. The house with the lowest altitude, also at the border between the coffee plantation and the community, is just over 3,700 feet (1,278 meters). The house with the highest altitude is at 5,300 (1,616 meters). The school and soccer field are just over 4,500 feet in altitude (1,372 meters). The majority of houses are near or above the school. Therefore, an altitude of 1,500 meters was used to determine the Hgb value adjustments. For this analysis, the altitude adjustment was made by subtracting 0.5 g/dl from each individual Hgb score from the reported Hgb value. This corresponds to the WHO recommendations for Hgb adjustments for populations living near 1,500 meters in altitude (Table 5.1) (WHO, 2001, p. 4). For example, if a participant's reported Hgb value was 10 g/dl, it was adjusted to 9.5 g/dl to account for altitude.

Table 5.1.
Hemoglobin adjustments for altitude per individual for all populations (WHO, 2001, p. 4)

Altitude (m above sea level)	Hgb adjustment (g/dl)
<1000	0
1000	-0.2
1500	-0.5
2000	-0.8
2500	-1.3
3000	-1.9
3500	-2.7
4000	-3.5
4500	-4.5

Indoor Cooking Fire Adjustments

People exposed to smoke inhale a greater amount of carbon monoxide (CO). CO has an affinity to Hgb approximately 240 times greater than O₂ (West, 1995, p. 76). The result of CO bonding to Hgb is carboxyhemoglobin (HgbCO). Because HgbCO is already tightly bound to CO it has no carrying capacity for O₂. The HgbCO, useless for delivering O₂, remains in the

blood several hours after exposure (Weaver, Howe, Hopkins, & Chan, 2000, p. 803). Therefore, smokers or people exposed to smoke and air pollution have artificially higher hematological values. Most understanding of the HgbCO effect comes from studies on smokers and urban air pollution. In any study of blood, smokers should always be separated from the sample or their values should be adjusted (Garn, 1992, pp. 47-48). Indoor cooking fires present a similar problem, as levels of CO in the residential environment are elevated. Studies suggest that there is a link between indoor cooking fires and elevated Hgb concentration (Neufeld, Haas, Ruel, Grajeda, & Naeher, 2004, p. 110). The houses in Onquilha' are typically single room structures made of mud, bamboo, and thatch. They utilize an open fire for cooking and for heat, which is either located on the ground or slightly raised on a table of bricks or mud. There are no chimneys in any of the houses, which by design keeps the inside of the house warm, the thatch roof dry, and dries the corn stored in the rafters. The entire household sleeps in this elevated CO environment with a smoldering fire and during the day women and children may spend as much as 5 hours exposed to a heavier smoky indoor environment (Engle, Hurtado, & Ruel, 1997, p. 408; Smith-Sivertsen et al., 2009, p. 211). While the effect of indoor cooking fires on Hgb levels is unclear and not well studied, the effect of cigarette smoke and air pollution is well understood. Environmental circumstances and their effects on physiology are difficult to measure, as is CO exposure from smoke in an uncontrolled environment. The purpose of factoring in an adjustment value for smoke in this population is to capture the environmental impact of extensive exposure to CO in homes that were observed during fieldwork. Neufeld et al. (2004) found that Hgb concentrations among Guatemalan women using traditional fires had .52 g/dl more Hgb than women using smokeless cooking fires (p. 115). This corresponds with a WHO recommended adjustment of -0.5 g/dl in Hgb for those who smoke 1-2 packs of cigarettes per day (Table 5.2).

Thus, total Hgb values were adjusted for all individuals by subtracting 0.5 g/dl to factor for elevated levels of HgbCO from exposure to indoor cooking fires.

Table 5.2.
Hemoglobin adjustments for smokers (WHO, 2001, p. 5)

Smoking status	Hgb adjustment (g/dl)
Non-smoker	0
Smoker (all)	-0.3
½-1 packet/day	-0.3
1-2 packets/day	-0.5
≥2 packets/day	-0.7

Adjustments were first made to Hgb values for two individuals based on age and sex. Then, all 87 individual Hgb value were adjusted by -1 g/dl (-0.5 g/dl for altitude and -0.5 g/dl for smoke). The primary presentation of the data is from adjusted Hgb levels, however unadjusted levels are also provided.

Analysis

The potential prevalence of anemia was analyzed in four ways and using frequencies and basic measures of central tendency. First, the mean, median, mode, and standard deviations of Hgb levels were calculated using statistical analysis. Second, the classification of anemia based on degree of severity was shown using WHO cutoffs for classification (Table 5.3). The severity of a public health problem was categorized based on WHO standards of prevalence (Table 5.4). Finally, Hgb level samples were sorted into quintiles.

Table 5.3.
Hemoglobin cutoffs (Benoist et al., 2008, p. 4)

Population (age)	Anemia thresholds Hgb in g/dl			
	Non-Anemic	Mild	Moderate	Severe
Children 0.50 – 4.99	11	10 – 10.9	7 – 9.9	<7
Children 5.00 – 11.99	11.5	11 – 11.4	8 – 10.9	<8
Children 12.00 – 14.99	12	11 – 11.9	8 – 10.9	<8
Non-pregnant women >15.00	12	11 – 11.9	8 – 10.9	<8
Pregnant women	11	10 – 10.9	7 – 9.9	<7
Men >15.00	13	11 – 12.9	8 – 10.9	<8

Table 5.4.
Classifications of public health significance related to Hgb levels (Benoist et al., 2008, p. 4)

Category of Public Health Significance	Prevalence of anemia (%)
Severe public health problem	≥40
Moderate public health problem	20.0 – 39.9
Mild public health problem	5.0-19.9
No public health problem	≤4.9

Results

The central tendencies and standard deviations of the sample population (N=87) are presented in Table 5.5. The mean adjusted Hgb was 9.74 g/dl and ranged between 6.5-11.3 (SD=.849). The mean unadjusted Hgb was 10.74 and ranged between 7.5-12.3 (SD=.849). All school children, or 100%, had adjusted Hgb levels below the cutoff for classification of anemia.

Table 5.5.
Adjusted and unadjusted Hgb in school children in 2005

	Mean	Median	Mode	SD	Range
Hgb Adjusted	9.7391	9.8	9.5	0.84940	6.5-11.3
Hgb Unadjusted	10.7391	10.8	10.5	0.84940	7.5-12.3

Second, the distribution of cases in each of the WHO classificatory categories of degree of anemia is presented in Table 5.6. Severe anemia affected 2.3% (N=2), moderate anemia

88.5% (N=77), mild anemia 9.2% (N=8), and no children had no anemia. Moderate anemia (Hgb 8-10.9) afflicts the majority of children according to the adjusted and unadjusted Hgb values.

Table 5.6.
Prevalence of anemia according to degrees of severity with percent of the population

	Non-anemic	Mild	Moderate	Severe	Total anemic
Unadjusted	14 (16.1%)	21 (24.1 %)	51 (58.6 %)	1 (1.1%)	73 (84.0%)
Adjusted	0	8 (9.2%)	77 (88.5%)	2 (2.3%)	87 (100.0%)

Results indicate that anemia is a severe public health problem among the population of school-age children in Onquilha'. An anemia rate of 100% is well above the prevalence rate of > 40% required to be categorized as a severe public health problem. This categorization would also be true for the unadjusted values.

Data were grouped in quintiles according to adjusted and unadjusted Hgb (Table 5.7). This analysis shows how the distribution of Hgb levels falls across the population. The mean and median of Hgb levels (Table 5.5) fall within the 3rd quintile (Table 5.7). Quintiles describe a 1 in 5 chance that a new sample would fall into any of the Hgb ranges shown in the quintiles. The most notable result is that over half the population (60%) has adjusted Hgb levels below 10.04 g/dl and unadjusted levels below 11.4 g/dl. This sort of analysis is most relevant to understanding where the Poqomchi' fall within the range of "normal" Hgb levels, not for cutoffs of degree of anemia classification. This is discussed further in the discussion section.

Table 5.7.
Hgb level distribution presented as quintiles

Quintile (%)	Hgb Adjusted	Hgb Unadjusted
20	9.20	10.20
40	9.50	10.50
60	10.04	11.04
80	10.40	11.40
100	11.30	12.30

Discussion

Hgb levels for school-age children in the Poqomchi' community of Onquilha' are low. The range of Hgb was 6.5-11.3 g/dl with a mean of 9.74. These low levels of Hgb reflect a severe public health problem. The data from the Poqomchi' becomes more telling when it is compared to the range of "normal" expected in Western countries. Normal Hgb levels for children in Western countries ranges from 11-16 g/dl. Thus, Hgb levels are far from a biomedical expectation of normal.

There is a significant jump in the number of children classified as moderately anemic between the adjusted and unadjusted Hgb levels. The percentage of children with moderate anemia jumps from 58.6% to 88.5%, a nearly 30% increase. Also, adjustments double the number of children with severe anemia from 1 to 2, which is significant when severe anemia puts an individual in grave risk of other complications. Both of these children and their families were immediately given medical attention and longer-term care options through the local health clinic.

This jump in prevalence after adjusting Hgb levels for CO and altitude underscores the role environment plays in the experience of anemia. Environmentally dependent thresholds affect prevalence. This environmental context, as broadly as it can be imagined, affects the severity of anemia, the function of the body, and ultimately behavioral and cultural responses to a given context. This space, where the inherent value of Hgb waivers due to routine changes in altitude and air composition, demonstrates the contextual thresholds through which the entire community navigates.

In one Poqomchi' community the overwhelming majority of people experience a lifetime of anemia. Poqomchi' come into this world bearing the signs of a condition that will ultimately cause their death. Anemia begins in early childhood and for many in utero. It will exist to

varying degrees throughout life and until complications arise from another related, possibly fatal health abnormality. The individual, as well as the community is situated within the barely tolerable threshold of illness, structural violence, and eventually death. Illness inauspiciously controls the daily rhythm of life. The World Health Organization estimates that 1.62 billion people, or 24.8% of the global population is anemic (Benoist et al., 2008, p. 7). In Guatemala, anemia is the leading cause of morbidity (MSPAS, 2001). In the community of Onquilha', where my research is based, I found that 100% of children are anemic. When data from another study on adults, which is not reported in this dissertation, is combined with data from this study it is estimated 74% of the population is anemic (N=140 and Hgb levels < 12 g/dl): 100% of children, 78% of women, and 43% of men (Herynk, 2006a). By focusing on a single community, this project identified what is potentially one of the highest prevalences of anemia ever recorded within a population of children not undergoing abnormal crisis such as war or famine.

Chapter 6. *Fuerza* (Force) and Discourse for Navigating Daily Life, Subjectivity, Movement, and Space

Imagine feeling a palpable sense of weakness such as when you have just recovered from the worst part of a cold or the flu. You return to normal activity but feel as though your strength to push through the next moment is tenuous at best. Controlling that sensation of weakness, not “overdoing it,” becomes a conscious effort. It is not simply a thought, but become a concerted effort to change your behavior based on a perception of the physical self and the challenges ahead. Self-awareness of a fragile physiology and the behavioral modifications that may result are informed by culture, but also come to shape culture when the cause of fragility is chronic and endemic. Anemia is one such fragile physiology shared across community members. Experiences of fragility and the severity of its effect on both the mind and body vary among individuals, but in ways that are collectively known. Accommodation of anemia takes place at both the individual and social level.

An expectation of this research project was that the experience of anemia could be observed in discourse related to its cultural accommodation and that this discourse would demonstrate a process by which anemia is individually and collectively expressed in specific symptomatic categories. This expectation was grounded in two key symbolic expressions used by the Poqomchi’ when they explained their symptoms to a doctor: *fuerza* (‘force’) and *sufrimos* (‘we suffer’). While working as a medical translator, I observed women expressing abnormalities related to walking, dizziness, seeing stars, chest pain, and headaches. They did so with a tone of looming concern that these signals were indicative of something worse yet to come. However, following these complaints they commonly declared in a stronger confirming tone, “*¡Tengo fuerza!*” (“I still have force!”). The women then explained their situation in broader terms related

to a lack of money, medicine, or food. Their objective description of their reality was followed by a subjective expression, “*¡Es que sufrimos!*” (“It’s that we suffer”).

This sequence: from symptom, to confirmation of force, to testimony of hardship, to witnessing the self through the social body, represents Poqomchi’ resilience to the experience of anemia through a process of accommodation. Between symptoms and surroundings and from the individual to the community they are aware—even if in scripted expression—that the sum of illness is not “I,” but is the condition in which “we” live. In Spanish, the Poqomchi’ construction of *sufrimos* is as an expression that opens the universe to the subjunctive mood of hypothetical impossibilities in an attempt to contrast and evaluate the real possibilities of what they can control. Their lives and this expressive phrase require the subjunctive mood. These were confidential suggestions, disguised as statements explaining how things might be different if it were not, “*por quien somos*” (“for who we are”). In effect, they were describing their symptoms as normal, related to structural violence, and part of their collective memory.

Methods

Language is one of the mediums through which anemia, and the underlying circumstances of structural violence that give rise to it, are normalized and accommodated (Fassin 2008, 225; Scheper-Hughes and Lock 1987). Therefore, examining discourse sheds light on the ways and extent to which anemia has become analogous to Poqomchi’ subjectivity and a manifestation of social suffering. Conducting triage during the medical mission afforded me the opportunity to conduct over 2,000 “semi-structured interviews”. However, I was not able to leave the immediate area of the clinic or conduct any inquiry beyond the symptomatology that characterizes the patient-doctor relationship. To gain a deeper understanding of the discourse surrounding anemia I conducted three focus group discussions with Poqomchi’ women (N=18, 6

women per group). One group consisted of midwives from Onquilha' attending training at the local clinic. The other groups consisted of women from Onquilha' who had come to town to sell vegetables during market day (they had no special health training). There was no noticeable difference in the data between the two groups. In analyzing this discourse I pay attention to the four qualities mentioned earlier but also allow flexibility for analysis to move outside of these parameters:

1. multivocality: varied contextual meaning of the same symbol (Sebeok, 2001; V. W. Turner, 1969)
2. subjectification: a range in expression of symptoms in relation to the body between subject and object (Biehl, Good, & Kleinman, 2007; Estroff, 1993; Honkasalo, 2001)
3. personhood: a range in expression between first person singular (I) and third person plural (we) (Honkasalo, 2001; V. W. Turner, 1969)
4. subjunctive mood: grammatical or expressive tactics to express imaginative or hypothetical alternate realities to the present circumstance (Good & Del Vecchio Good, 1994; Jackson, 2005; V. W. Turner, 1986a)

Results

Part I: Living with Fuerza

In their discourse, the women in the focus groups (N=18) described a common sequence of symptoms in which they recognized anemia as when a person is debilitated, confined to their bed for months, eventually bloats, and dies. However, death is not necessarily caused directly by anemia but it is the conclusion of a sequence of illness and disease. This sequence, and subsequent death, can be avoided by identifying any problems with the blood (e.g. lack of, low, lowering, lost, watery, and hot). This is perceived to be especially important for young children

and women. The Poqomchi' describe the start of anemia as when a person, "*ma'xta akik'eel*" (Sp. *no tiene sangre*, Eng. 'has no blood'). A lack of blood causes weakness and leads to a decline of fuerza. For the Poqomchi' any abnormality with the blood is equivalent to a subsequent *bajando de la fuerza* (lowering of force). According to the Poqomchi' this early stage of blood abnormality and tenuous hold on fuerza is normal, especially for children under three years old who are teething, weaning, or beginning to walk, children 3-5 years old, and for women following pregnancy, sickness, or over-exertion. Because this cluster of symptoms is considered normal, the Poqomchi' also consider this experience to be physical, or "of this world".

Many themes used to describe fuerza by the Poqomchi' revolve around a concept of physical abnormality based on a deficiency of some critical substance, such as a lack of blood leading to a lack of fuerza. Fuerza can be interpreted as an individual's potential and ability. It serves in discourse as a summative measure of health. The Spanish *fuerza* is conceptually similar to the English term "force". Force denotes physical and/or emotional strength and is mostly thought to come from the muscle and brain. For the Poqomchi', fuerza exists exclusively in blood and is considered the ability to harness energy to do work, to be a human being, and to exist in time and cycles of life. They translate fuerza from the Poqomchi' word *ansil*, which is the potential energy and spirit of the individual. This force is borrowed from across a threshold that is a cosmic gateway to creation and the unknown. The gateway opens up to the other world where energies originate. There, ancestors at play with gods channel energies through the blood of an individual on the other side. Similarly to blood, fuerza derived from *ansil*, in various states, can be demonstrated in expressive discourse such as gone, already gone, lacking, left, or lowering. Like abnormalities in the blood, these states of force are also considered normal. Life

is a tenuous loan in which the conditions are uncertain and the only certainty is nothing—it is the result of play between ancestors and gods.

The expressive use of *fuerza* and *sufrimos* together provide insight into how the Poqomchi' experience the embodiment of anemia through the processes of collective suffering. The expression of *fuerza* was always in first person singular (except when a parent referred to a child) and *sufrimos* in the first person plural. Also, *fuerza* was often used in conjunction with *pero* ('but') or *todavía* ('still'). This phrasing, "but I still have force," indicates that *fuerza* is a transient entity that holds a tenuous place marker for the Poqomchi' between health and disease. A declaration of having *fuerza* preceded by a list of symptoms is tantamount to saying, "I am sick but otherwise healthy." *Fuerza* is in the blood and blood is essential to maintaining homeostasis as well as how life is experienced physically. By alluding to a precarious ontological homeostatic balance the Poqomchi' belief in a tenuous spiritual existence is confirmed.

Fuerza in Context

Fuerza should not be confused with strength. It comes closer to the idea of the endurance required to perform normal day-to-day activity. But, the primary perspective from which the Poqomchi' view the term *fuerza* is as a measure of fragility in discourse. This is especially true for women and children during certain experiences or phases of daily life and human development. In the context of sickness, emphasis is placed on how a sickness affects the inherent or normal fragility of the individual. For example a woman experiencing her menstrual cycle is considered sick, but sick in the sense that she is fragile and must take great precaution to avoid any troubling states. The Poqomchi' do not emphasize the cause of sickness nearly as much as the affected body. It is also important to emphasize that this is strictly about the *body* and the given *fuerza* it can contain, not about the quality of the *person*.

It is not that the Poqomchi' claim to be tough; it is that they are fragile and must act accordingly. Perhaps this shared fragility—though individually a weakened state—is a collective source of strength. Perhaps knowing they are not alone in their fragility lends a feeling of acceptance of one's condition, or even the strength to cope with one's condition. An individual and collective sense of fragility has a biological basis, but perhaps it also reflects the embodiment of broader sociopolitical forces of structural violence.

The sections that follow show how women described the nutritional cause of losing fuerza, confirmed their symptoms, and expressed intent to prevent a loss of fuerza. Then, it shows how they claimed not to know of anyone currently suffering from lost fuerza, but then defined lost fuerza as death. I have attempted to analyze the data to highlight general themes relevant to anemia and fuerza such as diet and nutrition. Most importantly, the data demonstrates the progression of symptoms beginning with what women did not necessarily see as anemia or lost fuerza, but only as the sensory threshold to abnormal loss of fuerza. The data then shows what symptoms women found more serious, definitively described as anemia and lost fuerza, which ultimately could result in death.

“There is nothing to eat but tortilla, salt, and chili.”

A desire to eat, a sense of hunger, and a strong appetite are prominent signs that someone has fuerza. The Poqomchi' demonstrated a strong awareness of shifts in dietary habits by those with lowered fuerza. The interviewees claimed that when fuerza is lost, people start to desire “strange” things to eat or nothing at all. One woman stated that, “women don't want to eat simple things; they want to eat meats and no longer want to eat grain.” A second woman responded, “when they have no fuerza they don't eat anymore.” A third stated, “They don't want to eat anymore and just drink water.” A fourth woman stated that women with lost fuerza, “don't

want to eat and just want to sleep.” Several women commented on how women and children start eating ash and dirt.

In general, the women connected their inability to obtain food to the loss of fuerza. One interviewee stated that, “The cause of bad blood is that people want to buy and eat whatever but they can’t, the only thing they eat is salt and chili, this doesn’t give fuerza and because of this, blood lowers and you get bad blood, if one eats well then one has good blood.” A second woman stated that, “when our blood turns to pure water [*pura agua*] it is because we have nothing to eat; only chili, salt, and coffee so the blood lowers and turns to water, you don’t receive vitamins...they left.” A third woman stated that, “the force of the blood begins to disappear [*se va perdiendo la fuerza de sangre*], the blood becomes bad because one wants to eat good food but there is no money; only salt and chili and tortilla and with this you can’t get vitamins.” A fourth woman stated that, “bad blood begins because right now the corn is expensive...you only find expensive corn...vegetables are expensive...you can’t get meat...so we can’t get meat or vegetables because there is no money.” The fifth woman stated, “right now because of the economic situation you only find corn, coffee, salt, beans and with all this you don’t get enough vitamins.” The Poqomchi’ use *vitamin*, a Mayanization of the Spanish word *vitamina*, to describe “vitamins” that come from medicine. They use *aliment*, a Mayanization of the Spanish word *alimento*, to describe their own diet as “nutritive”. As these statements demonstrate, for the interviewees, there was a clear relationship of causality between poverty, inadequate diet, and ultimately the loss of fuerza.

“I can’t walk.”

All the women interviewed complained of a variety of symptoms similar to those expressed when I worked as a medical interpreter. Most cases of anemia are mild, but even mild anemia can cause weakness and fatigue. Symptoms progress with severity. Moderate and severe

anemia can also cause shortness of breath, rapid heart rate, lightheadedness, and headaches. Most of the women shared the same symptoms reported by one interviewee who stated, “Sometimes I see cloudy or white and sometimes I can’t walk because I get a headache.” Another woman expressed common symptoms; “when I walk I always get dizzy...with sun and heat I get headaches... I see stars, and I have pain in my heart.” Most of the women expressed concern that their heart rate drops frequently, they have heavy breathing, they have headaches that are more constant than not. In general the women consistently confirmed that they experienced a variety of symptoms known to be associated with anemia and expressed by the Poqomchi’ as an indication that fuerza was in flux.

“She passes out.”

As anemia progresses and becomes more severe the risk of losing consciousness from a lack of O₂, hypoventilation and/or hyperventilation, becomes greater. This occurs when the energy required by the body exceeds the volume of O₂ available to produce the required energy. The Poqomchi’ consider passing out (syncope) as a very serious and common sign that a person’s fuerza is perilously low. It was a commonly observed phenomenon by all the women interviewed. One woman stated, “Yes, I have seen it when a woman doesn’t have forces of the blood she passes out.” A second woman responded, “When a woman does not have forces she starts to pass out and sees stars, maybe in the field while working.” A third woman stated that, “when a woman passes out it is because she has anemia, perhaps because she doesn’t eat well, works too much, doesn’t nourish herself so she begins to pass out and be tired.” A fourth interviewee stated that she had witnessed, “A woman who had given birth went down to the ground... all of the sudden she fell to the ground.” She continued that, “when one is pregnant is when they most get anemia they start to pass out and be tired.” Another woman added, “After a pregnancy a woman loses lots of blood and if they don’t eat well the blood of the mother goes.”

“It is normal, especially if you are doing things.”

A lack of fuerza can be acute or chronic. An acute case occurs during particular situations when an activity and/or environmental conditions become overwhelming. For example, lifting a heavy load while the noonday sun shines on their heads would result in a temporary loss of force. The women explained that the pressure in the blood drops rapidly, both the heartbeat and pulse become palpable, breath is lost, and *se va la fuerza* (force leaves). All the women in the focus groups reported experiencing an acute lack of fuerza on a daily basis. To avoid a loss of fuerza they hold to the rule that noonday sun should be avoided, especially when lifting, carrying, walking, planting or harvesting. For the Poqomchi', this is within the range of normal. The Poqomchi' say, “It is normal if you are doing things and especially if you are also sick.” These acute instances can be prevented with caution, and if not prevented, then treated by adhering to known precautions going forward. Through these episodic slippages across a threshold, the acute loss of fuerza, the Poqomchi' are given confirmation of still having fuerza. Therefore, the conscious awareness of having fuerza in part depends on its partial loss.

“Yes, some die.”: Dilemma of living at risk with terminal disease

Lost fuerza and anemia present a dilemma. Most Poqomchi' women are anemic and expressively aware that they are suffering, but they do not see this suffering to the extent that it may be lost fuerza or abnormal—because absolute lost fuerza and anemia is seen as death. Women were asked if they knew of anyone that had lost fuerza and/or had anemia. This was a more explicit and direct approach, which associated the entirety of the disease (not just symptoms) directly with a person they knew. Almost all the women said they had known someone who had lost fuerza or had anemia. One woman stated, “A neighbor had anemia, lost her fuerza, and she bloated and turned yellow.” Another woman claimed that, “several of my neighbors have the anemias.” Several had difficulty remembering a specific person, and a few

women claimed to have never known anyone but had heard of these diseases. A third woman in her late teens stated, “I always hear about anemia but never seen anyone that bloats or gets pale.”

Women were later asked if it was possible to die from lost fuerza or anemia. This provoked a far greater response than the previous question as to whether they knew anyone with lost fuerza or anemia. It might be comparable to how people in Western societies are socially aware of chronic and terminal illnesses such as cancer; it seems many people know someone who died, but fewer know someone currently afflicted. Despite being somewhat taboo to ‘call up’ the dead in conversation, almost all of the women had seen someone die of anemia. Several casually stated that, “it happens from time to time.” One woman stated, “Yes, some die, what happens is that in women the stomach bloats, the feet bloat, you get pale and yellow.” A second woman stated, “Yes, a woman died from losing fuerza after 4 months in bed.” A third woman responded, “I knew of a woman that bloated, had other sicknesses, and died but died of the anemias.” The Poqomchi’ believe, as one interviewee stated, “If it [lost fuerza] is not cured you die.” There was a clear indication that this death might happen over a long period of time but bloating while bedridden was a final sign that death was certain. Bloating may be an indication of septicemia (a condition where the body is taken over by bacteria), cirrhosis, renal or heart failure, and other conditions involving the liver or venous return.

The claim by several interviewees not to have known anyone with lost fuerza or anemia was peculiar, because they had unanimously explained their own experience of a wide range of symptoms related to lost fuerza and anemia. One reason for the distinction rests in the differing severity of symptoms. The most severe case of lost fuerza and abnormality may be marked by the widely observed sign of women passing out. A second reason is that being knowledgeable of people who had lost fuerza or anemia shifts discourse to themes of death. To really have lost

fuerza and ‘suffer anemia’ as a disease, it must be thought to result in death—it is chronic and sends signals of disability; it is not simply the acute situational fluctuation of metabolism and symptoms. A third is the nature of lost fuerza and the symptoms associated with severe anemia, which is often not recognized or “known” until it is too late. This is part of the reason why the Poqomchi’ convey two somewhat contradictory ideas: 1) “death is certain” and 2) “if nothing is done, they will die.” For the Poqomchi’, actually “having” the disease is centered on death as the definitive feature.

What does it mean to really “have”/have lost fuerza? There seems to be a distinction made here between expressing symptoms of fuerza, and being *defined* by it. Exhibiting symptoms does not mean one is “owned” by their diseased state. Rather, it is the line between life and death that determines the loss of ownership over oneself to fuerza. The perception of “having” the disease is what signals the need to cure/treat it. But the social diagnosis is made post-mortem. They recognize that it can be treated and prevented. Thus, in this population, living with the symptoms of the illness, which is not perceived as actually “having” the illness, does not call for actively pursuing treatment in the way Western biomedical practitioners expect. The difference here is in the perception that one lives with “symptoms” rather than that one lives with “disease”. Losing fuerza over time and its total loss are cognitively binary, or a bipartite perception of the experience.

Part II: If Fuerza is Lost

Signaling the bodies of the lost

The Poqomchi’ word for “point” is *ehtalanik*, but the behavior, function, and cognitive experience for the Poqomchi’ is closer to “signal.” The small distinction is the difference between indicating directionality, i.e., signaling the direction toward a stimulus, versus indicating an object or an exact referent sign. The Poqomchi’ point with a sweeping arm gesture and never

hold the position. Signaling is always done with the finger with two exceptions. They do not signal toward people and they do not signal toward themselves or their own body parts. If the Poqomchi' need to signal toward an area of the body then a gesture is made whereby the hand is moved over the area on the body and the index finger is slightly raised and pointed away from the body. Other than the body, pointing is only done for directions, objects, or places. This distinction reveals an important clue as to how the Poqomchi' objectify and subjectify person and illness. It is acceptable to point at illness on one's own body or on the body of others. Illness, disease, and abnormalities are symbolically represented as separated from the subjectivity of the person. These symbols may include invisible objects and/or objects that in reality may not exist such as cysts, balls, frogs, threads, dolls, ulcers, joints, or internal pain.

When people lose their fuerza/health and succumb to the anemias, they do not use any of the expressive scripts mentioned above regarding fuerza. There are no Poqomchi' who would declare, "I have no force." When fuerza is gone, the subjectivity of the individual is gone, demonstrating that fuerza is an idiom for consciousness and subjectivity. Their bodies are the objects of illness and disease and the lost person's body can be referred to directly, just as pointing to an injury on the body. The community refers to these individuals as *perdidos* ('lost'). This signaling name indicates that they are without force. The subjectivity of the *perdidos* is transferred on to the collective consciousness and absorbed by the community's narrative of suffering. The community's liminal position and systemic marginality is played out through the *perdidos* in the most violent of ways, slowly and unnoticed. This is the violence of time and forgetting described in structural violence in which the death of individual identity comes before the death of the body only because you are Poqomchi'. The *perdidos* may no longer be the subject of force and health. But, in this way, the narrative identity of illness in which the

community is the subject is uninterrupted by absorbing the loss of individuals as part of daily reality. The question remains, as a social organism, is individual well-being sacrificed for the good of the collective; or, are they powerless, fatalistic, and forced to accommodate disease at the social level.

Finding reason

If an individual slips across the threshold and does not return, than their *fuerza* is lost. The body becomes the object through illness and disease, personhood is lost along with subjectivity, and death is imminent but not absolute. The acute loss was considered normal, unless, as explained by one informant, “you find something behind the sickness.”

Provocation is the idea that something happened beyond the sickness or something created an imbalance that is preventing restoration of *fuerza* and health. Looking for and identifying some provocation drafts a line between normal physical illness and the chaotic unknown, abnormal, intangible, and the possibility of an unfathomable death with time. In a chronic and provoked lack of *fuerza*, recovery is doubtful. One woman interviewed described such provocation, “Yeah, I have seen anemia, it started with a dog that was in heat...my son began to play and the dog came over...two weeks after playing with the dog he got really pale and clumsy. I went the health clinic and they gave me pills for anemia.” The Poqomchi’ believe that menstruation is a very hot and dangerous sickness. It can cause an energy imbalance and transfer to nearby objects. The sickness can easily transfer to children, who are inherently weak.

This is a retrospective illness, which is not known until it is too late and reflection is required to identify a cause. The cause could be anything, a whole classificatory system of taboos, sins, and prescribed behaviors that are beyond the scope of this dissertation. It is not simply that customary precautions were ignored; there is something more that must be identified. In the social construction of illness, discourse begins in the subjunctive past as people sort out

the possible causes. *Uhtik* is to worsen; for example, when a sickness gets worse. The sickness can get worse to the point at which the person starts doing things alone, talking to themselves, and in general isolating themselves from the community. A person as such is considered *ahqaal*, or crazy, falling into the range of abnormal and therefore provoked. They are beyond the ability to *uhik* ('pull themselves up' from the sicknesses). A person who is crazy is someone who does not want anything (*no quiere nada*); that is, they are not wanting to be involved in the community. This is a tension between the individual and the community. Subjectivity is derived from being recognized as a social counterpart. In the loss of *fuerza*, when that person is no longer participating in the community, they have lost their subjectivity. Thus the individual sacrifices his/her health in order to contribute to the well-being of the community in exchange for belonging. Or, the community builds a narrative that accommodates everyday suffering.

Eventually, they will identify a specific event that brought on the disease prior to recognition of a complex of symptoms such as paleness or clumsiness. It may appear that the causative focus for the Poqomchi' is not on an object, but instead on a subjective experience. However, it is the quality of the object, the nature of the taboo, sin, or behavior violation that is not so well understood by outsiders to the Poqomchi' culture. Their codified meaning of how objects come to be is the privileged logic and perspective of the Poqomchi'. In some cases a claim of provocations may reflect the social dynamics of the individual. In such cases *brujería*, ('witchcraft') is often tied in as the source. However, they do not use this explanation casually. It is very important to acknowledge that the idea of provocation is only partially applied. In general the Poqomchi' have a firm grasp that their conditions of poverty are the cause for their suffering. However, if lost *fuerza* is recurring or chronic it is said to convert to *susto*, (fright or soul loss), which is the subject of Chapter 8.

Variation: Children, women, men, and elderly

At the social level, there are different courses the bodies of the lost might take depending on age, sex, health, and social support. Progression to a more severe illness is partly dependent upon life stages, and each life stage in the context of lost fuerza or anemia has a particular discourse. For children, the discourse is focused on growth and development. Children are expected to have the best outcome based on the belief that there is no reason a child should lose fuerza. A child completely losing fuerza brings a sense of disorder as stated defiantly by one woman, “*¿en donde va a perder fuerza un niño de 2-6 años?*” (“Where’s a 2-6 year old kid going to lose energy?”). This statement does not mean that children do not lose fuerza, but it reflects the urgency of caring for children and the high probability that there is a physical cause such as nutrition. The woman informant stated, “When they [children] are teething they are weak, their weight drops, they don’t eat much...when kids don’t get breast milk they fall into a lack of fuerza, they cannot recuperate their fuerza on their own, they can’t carry a chair or they drag their feet.” With children, there is awareness that poverty causes the problem coupled with an awareness of an absurdity: children should not completely lose their force but often do. The death of children cannot be normalized; it thus becomes an ultimate provocation of the supernatural.

For women, lost fuerza and anemia becomes a discourse in daily life, work, reproduction, or poverty. The discourse largely surrounds an individual female’s burden that is shared among women. The course of anemia for women is also dependent on their spouses. While conducting fieldwork men commonly brought their wives to the house I was renting because they had heard about my research. They were deeply concerned and showed reserved frustration as they showed me their wives bodies lacking fuerza and pale in color. The women interviewed agreed that their

husbands worry about their health and take care of them quickly. One interviewee who was not married expressed a sentiment shared by other unmarried women, “I worry about myself.”

For men, the discourse concerning fuerza seems to concern social roles, but more importantly what happens when individuals neglect to participate in the community. There is no recovery from lost fuerza for men because they tend not to seek treatment and nobody is likely to seek treatment for them. Often, lost fuerza for men is attributed to sexually transmitted infections due to infidelity. Men often fall permanently into *uhtik* and *ahqaal*, (Eng. ‘worsen’ and ‘crazy’) where they are lost and alone. In another study, three men were diagnosed with severe anemia. For all three of these men there was tension between themselves and their community because they were not participating in three projects. Because the social status of men is so public, the line between having and not having fuerza may be more easily detected.

For the elderly, the discourse is broadly about a life lived, the normal course of events to come, and a comical levity of belief, fate, and inevitability. The elderly express and represent to the community a sense of *angor animi*, as stated by one healer, “*hay casos que ancianos son convencidos, que van a morir por constricción y palpitaciones del abdominal arriba,*” (“There are things of which the elderly are convinced, that they are going to die from constriction and palpitations in the chest”). This experience of angina pectoris among old people can be a clear sign of disease and it can be a specific symptom of anemia and a sign of losing fuerza. Similarly, systolic hypertension is a serious health risk, especially among the elderly and the severely anemic. It produces irregular heart rates, palpitations, racing heart rate, and/or spikes in high and low pressure. The condition may ultimately lead to stroke. The local discourse on this marker is private, perhaps because this marker is so common and observable in the physical gestures of clutching the chest and facial grimaces.

Who gets urged treatment

By the time an individual has lost force completely, they are usually unaware. There is an understanding that for children, by the time lost force becomes serious it is too late and, little can be done. Improvement of the physiologic symptoms of anemia may alter the perceptions and experiences evinced in symbolic language. Treatment is a transformative process not typically experienced in this community. Seeking treatment for oneself is taboo, although individuals may seek support for their loved ones outside of the community—it is a private matter. In the community setting, as anemia causes the body to succumb to other diseases, severely anemic individuals die of natural causes—the life expectancy is around 50. Pregnant women may receive some intervention, but the nonpregnant majority does not. Despite the taboo of seeking treatment, individuals may be treated if someone from outside the community brings them for treatment. By law teachers are obligated and authorized to take custody of children that appear malnourished; however, this rarely happens.

Contradiction of hygiene and health

Poor hygiene was strongly perceived to be a significant cause of anemia, which ultimately may mean that they would be ashamed to talk about it for and among themselves. One woman explained, “People lose fuerza always from bad hygiene.” Hygiene was described in association with paludismo, “anemia is when you bloat, and when kids turn yellow, and comes from dirtiness.” Hygiene was associated with a broad range of symptoms, “when you bloat, you don’t want to eat anymore, you get pale, and the stomach doesn’t work well anymore, all this in addition to being dirty.” Poor hygiene was also associated with normal daily activities, “the kids play with dogs, at times they have their finger nails full of dirt, don’t wash, and they get pale yellow skin when anemia beings.” The association with hygiene was also expressed socially as a criticism, “anemia is when a woman does not take care of her kids, because of dirtiness the kids

get anemia.” It was also relayed in scripts more common in Western biomedicine, “you bloat and anemia occurs when you don’t wash your hands.” However, when the women were asked if either hygiene or anemia could be more problematic in certain households, they all confidently denied the possibility, aware that this could happen to any of them. This is significant because it suggests that they are all equally at risk of poor hygiene and therefore illness. This sentiment was expressed by several women complained about how they hate going to the doctor because, “when we go to the doctor he only tells us that we are dirty and need to bathe and nothing more of how to cure.” The woman concluded her comment by stating in an exasperated tone, “but what can we do,” to which the other woman nodded in agreement. This expression of hygiene, its local association with disease, and the inability to maintain externally imposed standards of cleanliness are equally shared across the entire community and underscores an awareness that there are standards of appearance that could only be met if they were not who they are—Poqomchi’. Thus, being Poqomchi’ carries with it the inevitability of disease and therefore suffering. In the context of structural violence, the symbolic violence expresses the slow disappearance of factors underlying their perception of themselves. It is this erasure of history that has obfuscated the causes and effects of both chronic anemia and their marginality. Experiences such as anemia are inevitable and therefore acceptable and accommodated.

Contradiction of symbol and diagnosis

Pale or yellowing of the skin (jaundice) is an important sign that a person lacks fuerza and/or has bad blood and anemia (Guyton & Hall, 2006, pp. 863-864). The expression paludismo, a yellow or pale coloring of the skin, is frequently expressed as a symptom of anemia. The Poqomchi’ go so far as to insist that paludismo is anemia. However, the World Health Organization and most biomedical practitioners working in Spanish-speaking countries interpret paludismo as malaria. In my fieldwork and interviews, malaria did not appear to be a

common disease among the Poqomchi'. There was no mention of episodic high fevers, chills, vomiting, or sweats—the telltale signs of malaria. Instead, they believe paludismo comes with a lack of force. The Poqomchi' women insisted that anemia was not confused with another disease and that paludismo is anemia and is different from malaria. However, because pale or yellow skin may have various causes, it is also indicative of how anemia may become conflated with other sicknesses. Or, perhaps for the Poqomchi' paludismo only refers to having skin change in color to palidez (an adjective describing skin that is pale and yellow), not to malaria as a known disease. The relationship becomes more ambiguous because the Poqomchi' simultaneously express paludismo in terms of being a cause, equivalent, and effect of anemia. There is no doubt that parasitic infections such as malaria contribute to a yellowing of the skin among Poqomchi', but most school-age children classified as anemic do not also have malaria. There is strong evidence suggesting that anemia, malnutrition, and other interrelated chronic diseases such as kidney failure or sepsis define the experience of paludismo as a result of anemia for the Poqomchi'.

Conclusion

Anemia is a real phenomenon in the Poqomchi' community of Onquilha'. Clearly both food and healthcare are inadequate. Their discourse on anemia speaks to a tenuous hold on energy, metabolism, and homeostasis through the discourse on fuerza, which is always in flux. Their fragile bodies are in motion through their environment, which puts them at a constant risk of upsetting the delicate balance they may have just achieved. The Poqomchi' are also navigating their internal bodies through a sensory perception of the blood. Both Western biomedicine and the Poqomchi' healers attempt to construct the experience of insufficient blood in a temporal singularity, a definitive point of divergence. For the former it is a restrictive etiological

diagnosis, for the latter it is an unrestricted emplotment setting the stage for the necessity of a broader discourse related to anemia. This offers the possibility of demonstrating what is possible. It is helpful, but it is not an objective reality for each and every individual body in motion, in context, and with varied symptoms. At the cellular level, with endemic disease, each person is a unique complexity of present and potential interrelated etiologies.

The Poqomchi' are also witnessing and interpreting the fuerza of others like themselves. They are receiving signals from other persons' bodies within their community. There is a whole worldview built around this experience, which is a codified symbol system. This is the way they communicate within their world and with the outside. Fuerza is the level at which the Poqomchi' interact and intersect with non-Maya. Because outsiders do not understand that this symbol system revolves around the embodied experience of malnutrition, disease, environment, and culminates in the subjectivity of chronic anemia—they become even more marginalized because of who they are—Poqomchi'.

The discourse data were often delivered in a manner that was disjointed, which is why I hesitate to use the term narrative. Anemia is a condition that produces pathologies of speech and communication that impact the ability to express and narrate personally meaningful stories (Brady 2007). Another symptom is that people become closer and more socially dependant (Yelp 2008). At certain stimulus thresholds the expression of disorder, a reflection of the severity of anemia, gives way to socially codified scripts, phrases, and discourse. Therefore, collective sociocultural structures can be observed through individual behavior (Greenwald; Langer). Victor Turner's understanding of the liminal process was about how things come into being in consciousness (1967). Turner was concerned with individual navigation and collectively experienced processes, which can only be identified through symbols. Symbolic objects are clues

to the subjective and perpetually incomplete meaning and meaninglessness of life. This is how one's being is understood. This is how the Poqomchi' experience being anemic. It offers testimony from the Poqomchi' of how structural violence is ultimately embodied. Political and economic modes and neglect—a local phenomenon as well as a product of national and global forces and foundational structure of the nation state—at once underlie and frame the Poqomchi' experience of anemia, structural violence, and social suffering (Fischer & Benson, 2006; Green, 1999; Metz, 2006; Nelson, 1999; Warren, 1993).

Anemia is tolerated to a certain degree, but severely anemic individuals fail to meet expectations of participation in their own community. They cannot physically or mentally integrate into the community and are thus pariahs. Additionally, in the context of another dominant postcolonial institution, the community is seen to be entirely sick. For the community, this is the identity of a *sufrimos* or “we suffer” often expressed in individual narratives and performed in religious ceremony. If the community cannot put its best foot forward to the postcolonial superstructure, then it too is denied status and treated inhumanely as a problem community and as merely a source of agriculture labor. Exclusion from the normative structures of postcolonial elite culture coalesces into chronic ambiguity, insecurity, and fear. In this context beginning with the individual, one will view oneself in a variety of ways, but layers of society will view that individual as it pleases—as polluting perhaps. This suffering is discussed in both the “I” and “we” as well as the past and present as if suffering were the human burden to carry through time and eternity and in one's identity. From a biocultural perspective, the experience of anemia and structural violence begins with the individual's physical body full of symptoms and symbols. It then flows into the subjective self, positioned objectively in a community that marginalizes its own chronically ill. However, that community is contextualized against the

backdrop of the community's own marginalization of its indigenous personhood. With these relationships examined, our interpretations of oppressive structural violence from beyond the community are a bit more lucid.

Chapter 7. The Pathophysiological Navigation of a Biological Matrix

Free oxygen, the plant kingdom's unique gift to this planet, is a highly reactive, dangerous substance capable of lysing waste the delicate molecules that form the basis of life. How peculiar that we, as aerobes, have traded the security of a languid existence in a reducing milieu for the high-stakes, fast-lane life of free-flowing ATP, the dear currency that gives us the strength, speed, and mental facility to profoundly alter our world. (Uthman, 2012)

While doing fieldwork in Guatemala, I was presented with a very curious question from my friend and informant. We were just beginning the 3-hour hike up the mountain to the community of Onquilha'. After hopping off a truck and kicking through an embankment of crushed gravel, we stepped onto the soft shaded mud in an open area that marked the trailhead. Only a few steps in, with a joking tone, he asked, "Aren't you going to capture the air?" My immediate response after already being winded was an exasperated, "What?" He then explained that the women here hold their breath when they walk. A thought came to my mind, which would eventually shape my research question. How can someone not breathe on a 3-hour vertical climb, especially someone who is anemic, whose body is struggling to secure O₂? Lost in the preverbal formulation of my questions, my informant added, "They do it so they don't sweat. They don't like to sweat. It's bad." I was again stumped. "How could people who work so hard not appreciate, and even avoid, the trophy of sweat?" I was only a few minutes into the hike and had already succumbed to my pattern of semi-controlled gasping and uncontrolled sweating. I tried holding my breath as was suggested, but only felt the immediate sensation of suffocation. I was encouraged by my informant to try again: "Hold your breath for a bit, as long as you can, then slowly let the air escape." I tried again and failed as chemoreceptors in the carotid body sent a signal of suffocation to my brain and commanded my body to gasp for air.

We continued our hike in regular fashion and completed the day's fieldwork. Months after leaving Guatemala I was haunted by this experience. Every chance I got I raised the questions with medical doctors. No one could explain the behavior. The seemingly illogical and

impossible congruency was nagging. The idea that breathing and O₂ didn't matter threatened to blow a hole in my research question. It was not until I had finished transcribing interviews with Poqomchi' healers that clues to the logic were revealed. This chapter provides analyses of the physiology of chronic anemia. It originates from the observations described above by examining why the Poqomchi' hold their breath and find sweating taboo. It demonstrates a model of pathophysiological significance by identifying the physical accommodation of anemia, which is consciously experienced and observable in culturally codified behaviors. The chapter is divided into two parts. Part I is thematically organized around holding one's breath and the effects of limited O₂ supply due to anemia. Part II is organized around the taboo of sweating and the impact of more chronic and/or severe anemia.

The previous chapter established how vital the concept and control of force is for the Poqomchi' in their experience of chronic illness. Force is a discourse of health and illness in fragile balance with identity. It is a Poqomchi' experiential expression of biological processes with an insistence that force is the ability to do work and live "healthy", both of which are constantly moderated by the tacit control of underlying illness. The pathophysiology of anemia varies in relation to individually fixed factors such as anthropometrics, age, sex, pregnancy, childbirth, or comorbidity. These variables aside, both force and the significance of individual Hgb levels are most pronounced in the context of work. Both force and Hgb are meaningful relative to each individual's energy needs, at a given time, and under unique metabolic conditions. Thus, the true impact of anemia is best understood as an individual organism's ability to harness the force needed do the work of living and maintain the baseline energy required for life.

Anemia, as discussed in Chapter 2, is defined as a low level of healthy red blood cells necessary to carry O₂ throughout the body (Longe & Blanchfield, 2002, p. 126). A major determinant of the health of a red blood cell is the amount of Hgb it carries, which also determines the clinical severity of anemia. Each Hgb is composed of four heme groups where O₂ picked up in the lungs binds through allosteric cooperative binding. O₂ is carried throughout the body where it is released and dissolves into tissue and into cells to produce energy. The supply and balance of O₂ is driven by the pressure of arterial blood gas. Arterial O₂ tension (PaO₂) works in tandem with CO₂ tension (PaCO₂) and both are highly regulated by acidity (pH) in blood and tissue. This relationship balances the supply of O₂ available for cellular respiration and producing energy. It is this ability to harness energy at the cellular level that determines force. This chapter examines this process in chronic and recurring anemia as a diminished O₂ delivery platform where it is endemic and observable in behavioral and cultural accommodation.

Methods

The absence of literature and medical practitioners able to explain these questions led me to pursue alternative methodologies. This chapter incorporates meta-analysis techniques for theorizing across evidence-based models (Dixon-Woods et al., 2007; Whitemore & Knafelz, 2005, p. 546). This method is widely applied where clinical assessment and taxonomy prove insufficient for identifying causal chains of illness (Dixon-Woods et al., 2007). This is a way of sampling disconfirming cases and contradictory observations. The approach is important because controlled studies related to anemia present ethical barriers. In fact, much of the awareness about detrimental bioethical outcomes resulting from such controlled studies originated from research on nutrition in Guatemala (Barrett, 1997).

This research connects the findings from many different disciplines, such as behavioral science, chemistry, biology, medical pathology and physiology, neurology, hematology, anesthesiology, nursing, and sports science, in order to understand chronic anemia in the Poqomchi' context. It is known that people with anemia may not have a compromised supply of O₂, primarily because of compensation through increases in circulation and respiration. Also, the enzyme 2,3-DPG increases. However, little is known about how culturally specific behavior intentionally or unintentionally alters these patterns. Also, there is no clear model of a causal chain that describes the layered and connected pathogenesis that occurs under conditions of endemic anemia. Finally, there is no theoretical understanding of how people with moderate anemia, a condition that limits the physical property of force (F), continue to do work and live normal lives.

The results of this methodology have allowed me to posit a theory of the physiology of anemia and pathophysiology of illness in a causal model. The themes in this chapter and subjects covered may seem qualitatively different, but in terms of the effects of anemia they are quantitatively similar. I attempted to balance the thematic organization by dissecting the qualitative thread of the experience of anemia throughout this discussion of physiology.

Results

Part I: Capturing the Air, Balancing the Threshold, O₂ Delivery and Hypoxia

The body can temporarily adjust to anemia and acute symptoms by increasing blood flow, redirecting blood flow, increasing O₂ extraction in specific tissue areas, and by increasing the organic phosphate 2,3-DPG, which regulates the affinity between O₂ and Hgb (Guyton & Hall, 2000, p. 390; Uthman, 1998, p. 13). However, these four known responses to anemia are a compensatory a central nervous system response. They do not answer the question of why the

Poqomchi' hold their breath. This accommodative behavior is active and conscious, whereas the four compensatory responses are clinically described as involuntary bodily responses. The four known compensatory responses largely depend on the balance between O₂ and CO₂ in the body. The simplest of these responses regulating the O₂-CO₂ balance is blood circulation and pulmonary respiration. O₂ is inhaled, transported via arteries, released and diffused into tissues. Once metabolized by cells to produce energy, the CO₂ byproduct diffuses out of the cells and into the blood where it is transported through veins and exhaled. Only an increase or decrease in breathing or blood flow is needed to maintain the O₂-CO₂ balance when is disturbed.

The Poqomchi' demonstrate two behaviors essential to understanding additional ways culture accommodates anemia through the body. Central to these behavioral accommodations is what I refer to as the O₂ delivery platform, which is compromised by anemia. Anemia is indicative of a physiological foundation or internal environment characterized by a decrease in total O₂. At play on this platform is strength of the bond, or affinity between O₂ and Hgb. The separation of this bond is known as “dissociation” between O₂ and Hgb. These concepts illustrate the delivery platform through which O₂ is supplied to tissue throughout the body and CO₂ is removed. The biochemical nature of Hgb is at the core of these compensatory mechanisms uniquely evolved to regulate the O₂-CO₂ balance, especially in the case of a reduced O₂ delivery platform. The allosteric response of Hgb to changing conditions regulates thresholds of energy production in metabolism. Therefore, analysis of the role of the Hgb molecule in an active dynamic process, as an allosteric response, and part of a discourse between the mind and body in its environment should prove more revealing than a model of anemia based on static properties under ideal homeostasis. It illuminates how the body experiences accommodation of continual change through thresholds rather than simply a reduction to functional design.

Establishing the capacity of threshold: O₂ delivery platform and O₂ concentration

The first condition establishing the threshold is the quantity of Hgb, which also determines the severity of anemia in the body. The amount of Hgb in the arterial blood determines the O₂ content (CaO₂ mL/100mL). The O₂ content is the sum of O₂ bound and unbound to Hgb. It can be calculated from the known amount of Hgb in the blood. The relative difference, or relationship, in O₂ content based on Hgb levels is depicted below in Figure 7.1 on the y-axis. The shape of the curve reflects how the concentration of O₂ that goes from high to low is utilized in the body as blood moves along the arterial pathway between the lungs and the furthest tissue. This drop in content due to arterial diffusion is measured as the partial pressure of arterial O₂ (PaO₂ mmHg) shown on the x-axis in Figure 7.1. The PaO₂ is separate but affected by the partial pressure of O₂ in the environment.

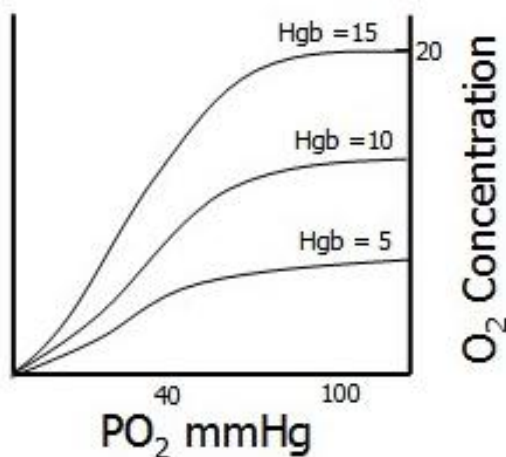


Figure 7.1. O₂ content by Hgb level (Sharinginhealth.ca, 2014)

Most graphs depicting O₂ content such as Figure 7.1 show an O₂ concentration and curve for a person with “normal” Hgb of 15 g/dl, which equates to about 20 ml/100 ml. The Poqomchi’ population in this study has a mean Hgb of 9.74 g/dl. Using a standard formula to calculate O₂ content based on Hgb, the O₂ content equates to 13.6 ml/100 ml (Formula 7.1). The curve for Poqomchi’ children would start just below the curve for Hgb=10 shown in Figure 7.1. This

means that their starting point for arterial O₂ content is 32% less than what is expected—deviating from the “normal” model.

$$CaO_2 = 1.36 \times Hgb \times \frac{SaO_2}{100} + 0.0031 \times PaO_2$$

CaO₂ represents the total number of O₂ molecules present in arterial blood, both bound and unbound. The constant, 1.36, is the amount of O₂ (ml at 1 atmosphere) bound per gram of Hgb. The exact value of this constant varies from 1.34 to 1.39, depending on the reference and the way it is derived. Hgb represents the concentration of blood Hgb in g/dl. SaO₂ is the percentage of Hgb saturated with O₂. The constant 0.0031 is the O₂ solubility coefficient and represents the amount of O₂ dissolved in plasma. PaO₂ represents arterial blood oxygen partial pressure. The dissolved O₂ is generally small relative to the Hgb-bound O₂, but becomes significant relative to very high PO₂ (as in a hyperbaric chamber) or in severe anemia.

The graph in Figure 7.1 depicts how the O₂ concentration decreases when Hgb is lower (e.g., Hgb=15, Hgb=10, Hgb=5). Note how the curve in Figure 7.1 flattens at the upper and lower limits. An Hgb range of 5-15 g/dl is the range of most interest to human physiology due to the allosteric effect of Hgb. At the upper end of the curve, O₂ will be tightly bound to Hgb and very stable. At the lower end of the curve, O₂ will be loosely bound to Hgb and unstable. This behavioral difference in association and dissociation, at the upper and lower ends, reflects how Hgb ≥ 15 or ≤ 5 will have very little noticeable physical or functional variation. Beyond Hgb of 15 g/dl, more O₂ does not improve bodily function simply because there is more O₂ content. Conversely, below Hgb = 5 g/dl, O₂ content is already extremely low and the metabolic situation already critical. At any point this low level could result in ischemic stroke, seizure, or death. Thus, the most relevant physiological variation is observable in the Hgb range between 5-10 g/dl. Therefore, an average decrease in O₂ concentration of 32% among Poqomchi’ children is

proportionally more significant in terms of physiological functioning, i.e., work. Hgb of 9.74 g/dl reduces the O₂ content by over 50% relative to the functional range of 5-10. This lowered O₂ content is, or induces, a state of hypoxemia, low O₂ in the blood. Hypoxemia is a delicate O₂ status that may or may not lead to hypoxia, short and/or long durations of critically low O₂ in tissue. This delicate balance between hypoxemia and hypoxia will be discussed in a later section. Below, I examine differing O₂-CO₂ equilibria at points along the curve.

Navigating along the threshold: Oxyhemoglobin dissociation curve and O₂-CO₂ balance

The second concept relevant to our discussion of O₂-CO₂ balance is the relationship between O₂ and Hgb. Moving O₂ in, around, and out of the body is much more difficult than moving CO₂. The chemical bonds that position O₂ to Hgb are about 20 times stronger than those of CO₂, which can more easily diffuse from Hgb (Guyton & Hall, 2000, p. 459). In fact, the coordination chemistry that results from the geometry of these bonds is the reason blood is red and referred to as *oxyhemoglobin* (HgbO₂), Hgb with bound O₂. If we can loosen the bond between Hgb and O₂, then we can free up that O₂ to be dissolved into tissue for cellular metabolism, making energy, doing work, and curbing hypoxia.

One method of understanding this O₂ balance is the oxyhemoglobin dissociation curve (Figure 7.2). This curve is theoretically similar to the O₂ content curve discussed above (Figure 7.1). However, on this graph the y-axis is the percent of bound O₂, Hgb that is saturated with O₂ in arterial blood (SaO₂). The x-axis is the same PaO₂ as in Figure 7.1. The concept of saturation percentage demonstrated by the curve is required knowledge for students in clinical sciences. Practitioners of biomedicine look for arterial saturation point to be high in patients undergoing treatment and expect it to be an indicator of stable O₂ supply throughout the body. However, this is not actually the case under certain pathological conditions. The measurement of saturation using a point-of-care instrument known as a pulse oximeter in a clinical setting does not provide

good information about the use of O_2 by tissue among anemic individuals. First, in clinical settings an oximeter usually measures the body at rest and not at work where the impact of anemia is most felt. Second, the oximeter only measures at a few key points on the body such as the ear lobes or finger tips when in reality SaO_2 is varied and localized throughout the body. Third, a high oximeter read of greater than 95% saturation would be considered healthy in non-anemic individuals (Guyton & Hall, 2006, pp. 506-507). However, for anemic individuals O_2 content is already low. A high read would emphasize how much O_2 is not being released from Hgb to dissolve into tissue and nourish cells. A high read may or may not indicate that tissue is becoming hypoxic as Hgb refuses to give up its O_2 . Biomedical practitioners rely on this point-of-care instrumental reading of SaO_2 as an objective measure with the assumption that high saturation equates to a higher probability of oxygenated tissue. For the purpose of understanding anemic individuals with compromised O_2 content, lower baselines, and different tissue O_2 requirements, we must analyze the process and movement of O_2 demonstrated on the graph.

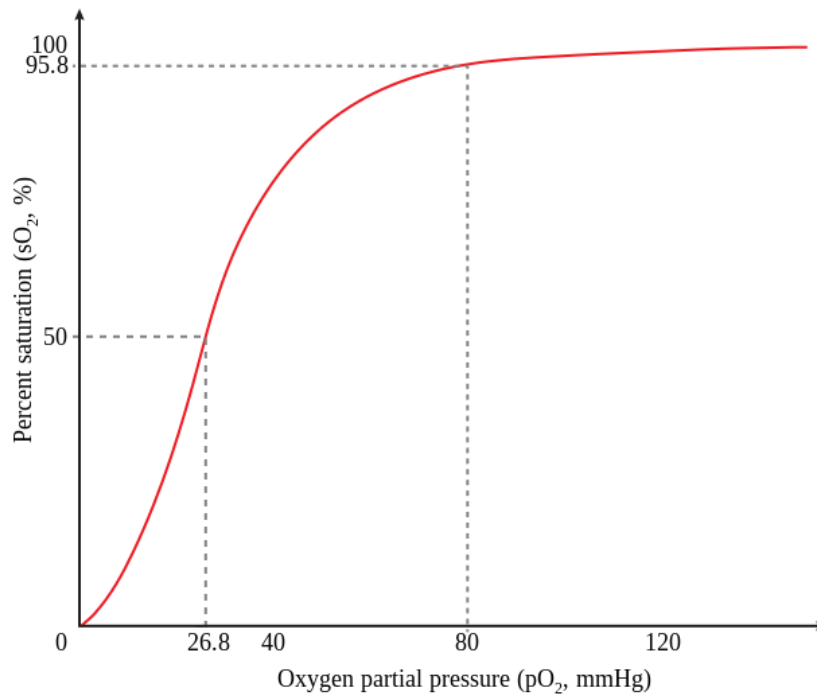


Figure 7.2. Oxyhemoglobin dissociation curve (Hazmat2, 2014)

On the flip side of SaO_2 is the percent unsaturation, i.e., dissociation of oxyhemoglobin. This concept is more useful in cases of anemia, indicating how much O_2 is dissolved into the blood and available for tissue and cellular metabolism. The curve graphically demonstrates how blood releases O_2 along the arterial pathway. The steepness of the curve at the point of any given O_2 - CO_2 equilibrium is an indicator of the willingness of each heme structure within Hgb to give up its O_2 molecule. Therefore the curve reflects a range of equilibria between available and unavailable O_2 , and predicted behavior. This means, that a small change in PaO_2 at a point in the curve where the slope is greatest, results in a large change in SaO_2 . Conversely, where the slope is least, the same change in PaO_2 results in a smaller change in SaO_2 . The curve demonstrates the amount and volatility of available O_2 for tissues and cellular respiration. Available O_2 reflects a general idea of where and to what extent Hgb is loading or unloading O_2 . In the lungs (upper part of the curve with a PaO_2 99) there is a high affinity of O_2 to Hgb, which favors loading. In the tissue (slightly lower and to the left with a “normal” PaO_2 90-99) there is a lower affinity of O_2 to Hgb, which favors unloading. In some instances, the affinity of O_2 for Hgb can become very weak (middle of the curve where it becomes steep with a PaO_2 50-90). This makes O_2 available to starved tissue but at a risk of upending the balance. This is theoretically indicated by a PaO_2 below 50, meaning there is more pressure from CO_2 than O_2 , either throughout the entire body or more likely in specific tissue areas. Affinity of O_2 to Hgb is the primary physiological condition that can be altered in response to change. Affinity is linked to diffusion, the process for moving O_2 and CO_2 in and out of the cells.

The points of SaO_2 along the curve moving down the y-axis in Figure 7.2 reflects increasingly less O_2 bonded with Hgb—all the way down until no more Hgb is carrying O_2 in the circulatory system. In anemic or non-anemic individuals nearly all Hgb in blood picks up O_2 in

the lungs. The y-axis SaO_2 from top to bottom is also suggestive of blood moving in the arteries from the lungs (high O_2 saturation) to the furthest tissues (where O_2 saturation is at its lowest levels). On the upper end of the Y axis, saturation levels do not vary significantly between either higher or lower Hgb levels. Physiological models for clinical application of SaO_2 are calculated and represented with an estimated “normal” Hgb of 15 g/dl, far greater than the normal for the Poqomchi’. In anemic or non-anemic individuals nearly all Hgb in blood picks up O_2 in the lungs. Assumptions about the curve, metabolism, and pathology are made based upon this “normal” model (Hgb of 15 g/dl). Because of this, I introduced the abnormal content position in this section.

Passing through the threshold: Hypoxemia into hypoxia and the body in motion

In an earlier section I discussed how anemia induces a state of hypoxemia, low O_2 in the blood. Hypoxemia may lead to a condition known as hypoxia, short and/or long durations of critically low O_2 delivered to the entire body or a specific area of tissue (Frisancho, 1993, p. 220). Hypoxia is critical because it is literally O_2 starvation of cells.

It has been said that all damage to the body from any pathologic state in the end is caused by hypoxia at some level. If this is true, the story of pathology is the story of hypoxia. Preventing or correcting hypoxia is then the ultimate goal of all medical specialties. Pulmonologists and cardiologists deal with hypoxia at the gross mechanical level, but hematologists do so at the finer cellular and molecular levels. The physicochemical properties of hemoglobin and biochemical housekeeping in the erythrocyte are both in their purview, but what hematologists contend with at the grossest level is anemia. (Uthman, 2012)

The risk of hypoxia was discussed in the previous section in reference to the middle and lower parts of the curve, wherever it becomes steep. Figure 7.3 below better illustrates where hypoxia (labeled as hypoxemia) becomes increasingly severe along the oxyhemoglobin dissociation curve.

In the idealized model set for homeostasis, the hypoxic body can prevent hypoxia by signaling for an increase in respiration. Wadsworth argues that anemia does not always result in diminished O₂ delivered to body tissue, but that anemia may result in more O₂ utilized: "The body is able to adapt to the anemic state. One of the mechanisms of adaptation is an increase in the amount of dissociation of oxygen from oxyhemoglobin at the cellular level" (Wadsworth, 1992, p. 63). However, this adaptation is not a complete and clear solution to anemia. The differentiation between hypoxemia and hypoxia is largely unknown, undefined, and probably not a relevant question. In part, this is because hypoxia is localized in the body and its occurrence and/or the damage it may cause can go undetected. The other component to this ambiguous distinction is likely due to the fact that outside forces determine this threshold (i.e., outside of the idealized model based on rate of respiration and circulation).

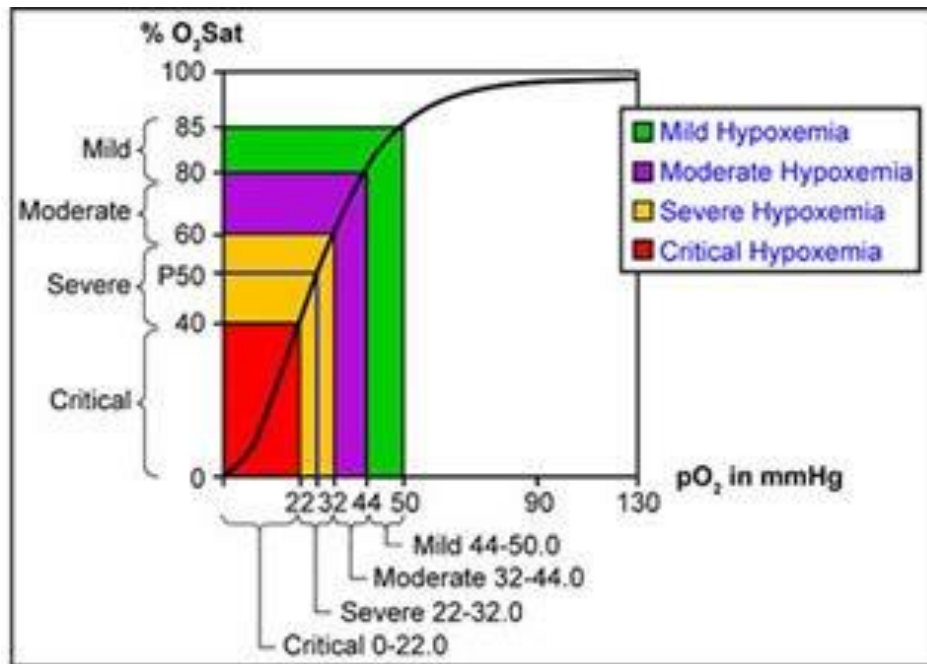


Figure 7.3. Increasing severity of hypoxia as SaO₂ descends along the curve (MNIMBS, 2010)

When HgbO₂ reaches an area of the body low in O₂, indicated by a low partial pressure of O₂ in the surrounding interstitial fluid, it releases the O₂, which then moves into the cells in the

tissue. Under “normal” homeostatic conditions this is sufficient; however, under conditions of anemia the process is insufficient. Models demonstrating the onset of hypoxia are also based on the idea of “normal” Hgb of 15 g/dl, similar to the O₂ content curve and the oxyhemoglobin dissociation curve. At Hgb of 15 g/dl the discourse in clinical medicine suggests that hypoxemia becomes serious at a PaO₂ of around 60 mmHg (Figure 7.3). The reasoning is that at this point of saturation, there is lower arterial O₂ content, the oxyhemoglobin dissociation curve starts to become steep and the fear is that Hgb will unload too much O₂ too quickly. If pressure drops lower than PaO₂ of 30 mmHg then there is no longer enough pressure to push O₂ into cells and “insufficient” O₂ supply becomes “absent” supply, or no supply at all. In this theoretical range between 60-30 mmHg, the curve is thought to steepen. This significance to the threshold is that it becomes very sensitive to movement in the O₂-CO₂ equilibria. Any small physiological change, be it brought on by activity, emotions, or whatever, can dramatically shift the balance. This range is the graphic representation of the threshold. However, the range idealized in a clinical model is theoretically designed from a “normal” Hgb of 15 g/dl. The range for an anemic individual will be much different and the body will compensate in different ways.

Anemia puts the body in a state of hypoxemia and/or it puts the body in a state of accommodation where it passively produces a chemical effect on oxyhemoglobin allowing slightly better utilization of O₂. Overall, it reduces the vertical range of the curve (i.e., hypoxia threshold and volatility of the O₂-CO₂ balance) such that a critical depletion of tissue O₂ can occur more quickly. Certain situations that put pressure on cellular metabolism push the hypoxemic body into hypoxia: energy requirements increase (e.g., sudden movement or work); environmental conditions change or become adverse (e.g., altitude, air quality, or temperature); physical insult to the body requiring repair (e.g., blood loss, stress, injury, or disease); emotional

states (e.g., anger, excitement); or physiological stress (e.g., homeostatic imbalance or fluctuations affecting the cardiopulmonary system). Such changing conditions have the simultaneous effect of requiring more O₂ to produce energy and affect the strength of the oxyhemoglobin bond (also diffusion, affinity, and loading). This determines how much O₂ is released into tissues by the dissociation of Hgb and O₂. However, these compensatory responses can only produce a limited effect without upsetting the O₂-CO₂ balance to a point where O₂ content becomes critical, making supply impossible.

Two types of hypoxia are crucial to understanding anemia. The first is anemic hypoxia, which is caused by decreased O₂ delivery to the body and results specifically from anemia. This sort of hypoxia is systemic and the body uses a sort of preprogrammed allocation or conservation of O₂ to deliver limited supply to the most important tissue (e.g., brain and heart). Crossing the threshold or an unfavorable O₂-CO₂ equilibria results from the trade-offs with reduced O₂ supply to less essential tissue and an increased supply to other essential organs. Overall, O₂ delivery in all cells in all tissue is compromised. The second type of hypoxia important to this discussion is termed *stagnant (ischemic) hypoxia*, which will be discussed below.

Moving the threshold: Shifting the curve

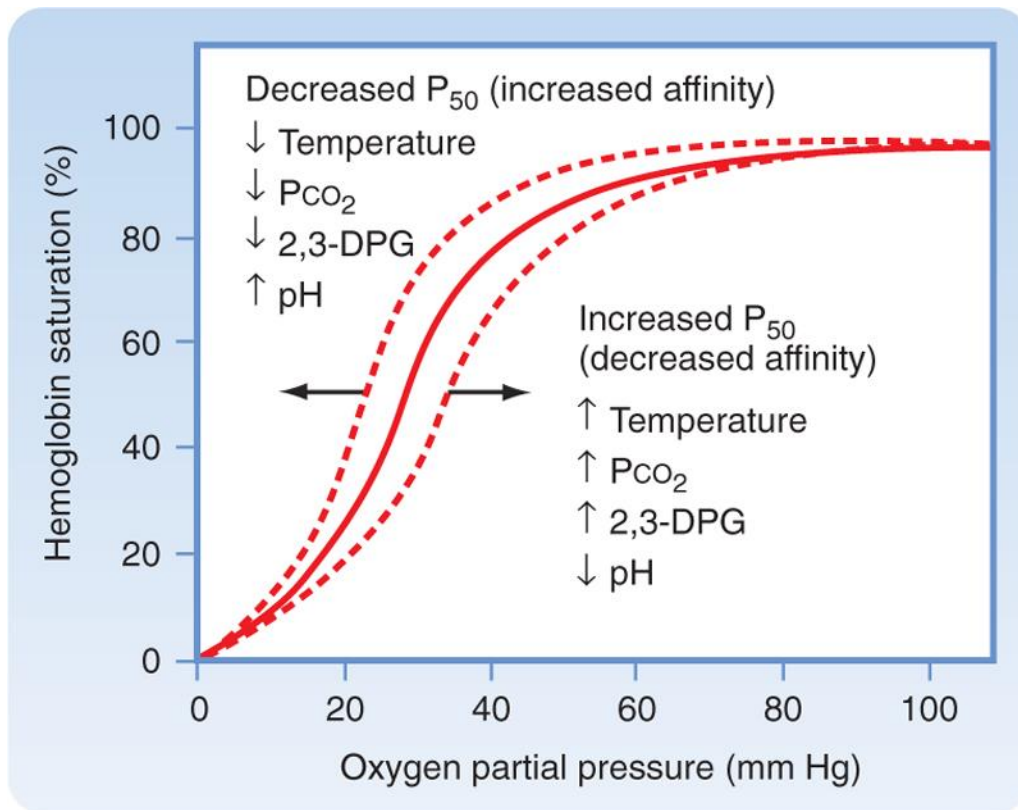
Any accommodative solution invoked by the Poqomchi' must avoid hypoxia, maintain energy, prevent the O₂-CO₂ balance from upending, and avoid a circulatory and metabolic systems crash. Under normal conditions, the compensatory responses are sufficient to maintain homeostasis. However, under conditions of anemia and where Poqomchi' must carry out energy-intensive daily activities and may suffer from compounding illness, the process is insufficient. Passive and normal mechanisms of regulation may not always be a sufficient response to changing internal/external environments, activity, and even emotional states. During exercise or physical activity a sort of progressive, protective, and active hypoxia will occur (Michael &

Sircar, 2010, p. 355). The precariousness of this systematic accommodating response would become even more pronounced if the person with mild-to-moderate anemia, at this hypoxia-threshold, also fell victim to any other disease or injury that might push them into stagnant hypoxia (reduced blood flow). Accommodation must establish a workaround to control against strengthened oxyhemoglobin bonds, diffusion, affinity, and loading. This must allow the individual to somewhat manage how much O₂ is released into tissues by the dissociation of Hgb and O₂. In these states, if nothing is done to shift the O₂-CO₂ balance avoiding progression toward stronger O₂ affinity, the symptoms of anemia would become visible whenever the body attempted to return to homeostasis. The strategy to prime the body to avoid the symptoms of chronic anemia must be anticipated and preventive, not passively compensatory as with temporary anemia. Thus, the Poqomchi' must have cultural behaviors that accommodate this fragile physiological balance. To achieve this, the Poqomchi' do not try to control where they are on the curve. Rather, they control where the curve is and they are able to shift the entire curve to the right, at which point Hgb has lower affinity for O₂, raising the baselines and avoiding the thresholds of hypoxia.

In clinical settings it is understood that there are four main ways the oxyhemoglobin dissociation curve shifts to the right. These include an increase in body temperature, an increase in the amount of CO₂ dissolved in the blood (PaCO₂), an increase in the acid 2,3-diphosphoglycerate (2,3-DPG), and a decrease in blood pH (increased acidity) (Guyton & Hall, 2000, p. 468). A shift to the right indicates that O₂ is more readily released to tissues and available for cellular metabolism. These conditions are described in Table 7.1 below and on Figure 7.4. Conditions such as decreased temperature, decreased PaCO₂, decreased 2,3-DPG, and increased pH will increase O₂ binding to the Hgb and limit its release to the tissue.

Table 7.1.
Oxyhemoglobin dissociation curve shifting factors.

Shifts to the Left	Shifts to the Right
CO ₂ decrease	CO ₂ increase
pH increase	pH decrease
2,3-DPG decrease	2,3-DPG increase
Body temperature decrease	Body temperatures increase
Carbon monoxide decrease (COHgb)	Carbon monoxide increase (COHgb)
Low altitude	High altitude
Environmental temperatures decrease	Environmental temperature increase
High Hgb (normal, P ₅₀ decrease, affinity increase)	Low Hgb (anemia, P ₅₀ increase, affinity decrease)



Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.
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Figure 7.4. Shifts in the oxyhemoglobin dissociation curve (Koeppen & Stanton, 2008).

To my knowledge there is no scholarly research relating these shifting mechanisms to purposeful cultural behaviors. What is known about these shifts mostly comes from examples of athletes, pregnancy, intense activity in a controlled environment, adaptation to altitude, animals, or as a result of some other disease, disorder, or condition. Anemia is known to be a condition that by default shifts the curve slightly to the right as an early compensatory mechanism. Shifting curves have not been examined systematically, in depth, or under conditions of chronicity with behavioral and cultural accommodations, i.e., where anemia is normal.

The curious behavioral observation is that the Poqomchi', who live in a steep valley, begin walking uphill by "capturing the air," repeatedly holding their breath and slowly exhaling. It is fairly straightforward to understand how this behavior synergistically activates the four mechanisms clinically known to release O_2 into the tissue and shift the curve to the right. Holding one's breath increases CO_2 in the blood and the overall partial pressure of CO_2 ($PaCO_2$). The captured CO_2 dissolves into blood plasma forming carbonic acid (H_2CO_3). The carbonic acid lowers the pH of the blood. The production of 2,3-DPG increases in the red blood cells in response to lowered pH. The 2,3-DPG bonds with Hgb and displaces O_2 .

Creating an environment artificially high in CO_2 is simple. The ease with which CO_2 moves out of the body relative to O_2 is the same ease with which CO_2 moves into and around the body. The partial pressure of CO_2 is completely dependent on exhaling and CO_2 easily diffuses into plasma. This process would explain the pleasure that comes from drinking carbonated beverages, lighting candles, extended mouth-to-mouth kissing, sleeping with others or as a family, sleeping in environments with increased CO_2 , and cupping the mouth with a towel or blanket. The production of 2,3-DPG in the red blood cells increases in several ways. One way is through conditioning over several weeks. This is what allows for acclimatization to altitude and

increased performance for athletes. Another way 2,3-DPG production increases is temporarily in response to pH change. During chronic and/or temporary hypoxia 2,3-DPG increases due to higher levels of carbonic acid, which has bonded to form carboxylic acid-phosphate. The 2,3-DPG bonds with Hgb and releases O₂. The crucial clue to how this systemic response works is that the concentration of 2,3-DPG varies inversely with the pH; pH is a primary inhibitory factor of 2,3-DPG (Jensen, 2004, p. 217).

If the amount of dissolved O₂ in the blood drops below the normal range of 80-100 mm Hg, the slope indicating the amount of Hgb that is carrying O₂ plummets at an exponentially greater rate. The entire system is at risk of losing total O₂ content, both dissolved in blood and carried in Hgb. By pushing the curve further to the right, an individual with anemia can increase the amount of O₂ dissolved in the blood and the total amount of O₂ that binds to Hgb moving through the body, i.e., the utility of Hgb (the O₂ deliver platform). This can prevent the initial symptoms of hypoxemia such as dizziness, passing out, or shortness of breath. They are forcing a drop in O₂ saturation (the amount of O₂ unbound to Hgb) in order to maintain a more constant pressure of dissolved O₂ in the blood. They are simultaneously maximizing the arterial saturation point but also enhancing the offloading of O₂ in the body as PaO₂ declines.

Shifting the curve has a pronounced effect on the transport of O₂. Even small shifts significantly reduce O₂ affinity for Hgb. The effects of CO₂ and pH are strongly correlated and therefore indistinguishable. Also, the concentration of 2,3-DPG varies inversely with the pH, which is the inhibitory factor for 2,3-DPG (Guyton & Hall, 2000, p. 468). There is no significant impact on the ability of Hgb to pick up O₂ in the lungs due to elevated 2,3-DPG. A shift in the curve to the right may cause only an insignificant reduction in O₂ binding in the lungs because the PO₂ in the lungs is as high as the environment, which forces bonding to Hgb.

In addition to increasing the utilization of a smaller O₂ delivery platform, there is another benefit gained from increasing 2,3-DPG in the blood. It facilitates the dissociation of O₂, but it also dissociates carbon monoxide (CO) from Hgb, which is carboxyhemoglobin (COHgb). The effect of CO on Hgb from indoor cooking fires, smoking, and air pollution was discussed in a previous chapter covering adjustments to estimating the prevalence of anemia. The affinity between CO and Hgb is very strong. It is potentially 250 times greater than that of O₂ and Hgb (Guyton & Hall, 2000, p. 469). The effect of COHgb on the oxyhemoglobin dissociation curve can be seen below in Figure 7.5. The curve shifts to the left because the Hgb already bound to CO cannot carry O₂, raising blood pH. In a typical environment only 1% or 2% of Hgb binds to CO. For people who live near traffic pollution or smoke as much as 10% of Hgb binds to CO (Guyton & Hall, 2000, pp. 469-470). After a long night in smoky indoor environments, COHgb accumulates, which cannot carry O₂ for several hours. The CO must disassociate from Hgb in order for the Hgb to be used to carry O₂. When the Poqomchi' hold their breath, increasing CO₂ in the circulatory system and increasing 2,3-DPG, the allosteric effect of 2,3-DPG releases both O₂ and CO. The Hgb previously bound to CO is now free to circulate to the lungs and bond with O₂. When the CO is released into the blood plasma it also will convert to an acid lowering pH and further stimulating the production of 2,3-DPG. In this way, it may be that the Poqomchi' store CO in the body in order to further maximize O₂ release during morning work. This effect of holding one's breath to gain O₂ saturation in the tissue would be greater and more noticeable in individuals with a high level of carboxyhemoglobin in their blood. Thus, manipulation and regulation of CO accumulated from cooking fires may be another accommodative strategy for the Poqomchi'. There are also significant implications for the evolution of human beings in relation to fire. There is a definite physiological advantage for energy production and cellular

metabolism upon leaving a smoke filled dwelling and setting out on a long hike along a trail (Piantadosi, 2008, p. 155; Thom, 2008).

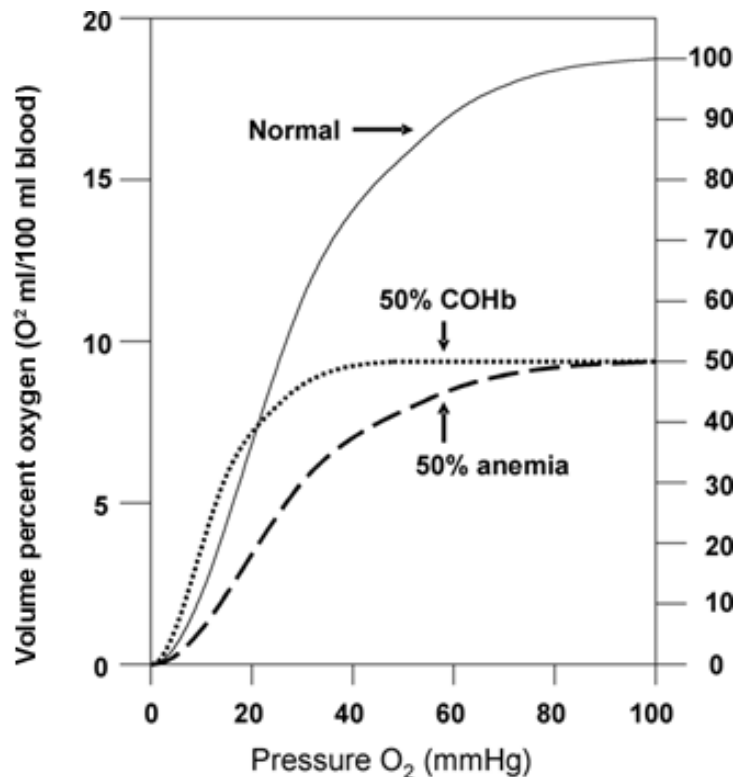


Figure 7.5. Carboxyhemoglobin's effect on the oxyhemoglobin dissociation curve (Thom, 2007).

Hyperventilation and hypoventilation: A vignette on the two paths to unconsciousness

A helpful way to imagine this balance is between the two extremes of hyperventilation and hypoventilation. Both are precursory signs to the slippery slope and the thresholds of imbalance. For those suffering from anemia these are dual threats that signify just how narrow the biological threshold is for the Poqomchi'. The function of these dichotomous involuntary responses is demonstrated on the upper (hyperventilation) and lower (hypoventilation) extremes of the oxyhemoglobin dissociation curve, and/or in corresponding extreme left shift and extreme right shift in the curve.

Hyperventilation is too much ventilation, which pumps the circulatory system full of O₂. This causes CO₂ levels to drop (alkalosis) (Guyton & Hall, 2006, p. 396). Certain levels of CO₂

in the system are needed to encourage O₂ to release from Hgb; without this release there is insufficient O₂ diffusing into the tissue. The blood is saturated with O₂ but it all remains bound up in the heme structures of Hgb because the PaO₂ is too high. On the oxyhemoglobin dissociation curve this would be represented by a person whose arterial pressure point stayed toward the upper right of the curve throughout the arterial pathways. Headaches, dizziness, and fainting will eventually occur as blood vessels in the brain constrict reducing blood flow, and resulting in the possibility of localized ischemic stroke. This is significant because an anemic individual is susceptible to hyperventilation if the initiation of activity requires more O₂ than what is immediately in the system (VO₂ max) (Frisancho, 1993, pp. 144-246). For those suffering from anemia, this threshold comes very quickly.

Hypoventilation is the opposite of hyperventilation. Hypoventilation is too little ventilation (e.g. breathing into a bag or holding one's breath), which causes CO₂ to rise (the byproduct of cellular respiration of O₂ and cause of respiratory acidosis) (Guyton & Hall, 2006, p. 530). Too much CO₂ causes too much O₂ to be released from Hgb until there is little to none left to continue being released. The blood is saturated with CO₂ and deoxygenated Hgb, because the PaCO₂ is too high. The system is replete with CO₂; without the pressure of O₂ in the plasma no O₂ will bond to Hgb. On the oxyhemoglobin dissociation curve hypoventilation is represented by an arterial pressure point along the middle and lower left part of the curve. Hypoxia occurs with possible cyanosis (bluish discoloration of skin), headache, fatigue, and shortness of breath. In the brain, blood vessels dilate to allow for greater flow, conscious awareness declines or alters, and there is abnormal electrical activity leading to possible seizure. Again, seizures are widely reported and common phenomena among the Poqomchi'.

This is where the concept of fuerza discussed in the previous chapter becomes so important. For a population suffering from chronic anemia, dizziness and passing out from hyperventilation are common. Something as mild as bending over, increased activity, or even a sudden fright can lock in O₂ to Hgb reducing blood flow to the brain. This has a good chance of bringing to a halt whatever was causing the hyperventilation, motor or cognitive.

Hyperventilation, the subject behavior of this analysis, primes the body for increased activity and even heightened emotional states. In addition, cooking fire smoke exposure is another element of life that benefits daily functions. For women busy with domestic work in the house a smoking indoor cooking fire may be just what's needed to complete domestic tasks. In the early phase of exposure it would elevate CO₂ in the blood and release O₂. In later phases it would create COHgb, somewhat reducing the O₂ available for tissue release just in time for reduced activity in the later evening.

Holding one's breath results in an altered oxyhemoglobin dissociation curve. Lowering of the upper end of the curve in deviation from the normal physiological model, or "sagging" is indicative of this altered state. Ineffective ventilation results in loss of consciousness due to an increase of pCO₂ (p carbon dioxide) and a decrease in pH as well as less O₂ available to diffuse into tissues. Even though a decrease of pH allows for greater release of O₂ from Hgb, insufficient O₂ is available to allow continued consciousness. On the other hand, excessive ventilation results in less O₂ getting into tissues due to an increase in pH and diminished release of O₂ by Hgb. As a result of diminished O₂, continued consciousness is not possible. These are essentially the two different ways of losing consciousness. When the oxyhemoglobin dissociation curve deviates from normalcy, loss of consciousness returns it to normalcy, the body's way of returning to homeostasis. With respect to anemia, the curve is on a threshold and is malleable. While working

as a medical interpreter, the most common symptom that raised alarm for the Poqomchi' was a loss of consciousness from bending over, walking, exposure to direct sunlight, or working. This loss of consciousness may be a better predictor of their contextual "severe" anemia than iron levels.

Part II: Sweating is Bad, Acidosis, Shock, and Points of No Return

Sweat is the sign that the Poqomchi' are dangerously high in PaCO₂, and too much acid is accumulating in the body. They are concerned just as much about the ongoing accumulation of acid as they are about what all that acid is going to do to their bodies when they begin to cool down. Some acid is lost through sweating, but so are vital salts and minerals. When they cool down the body will become very cold and the curve will shift back to the left and will overshoot preferred homeostatic balance. The body will starve tissue of O₂ and cellular repair of damage caused by oxidation and acidosis will be impossible. Sweating for the Poqomchi' occurs at specific points along the curve, which is a critical threshold for anemic individuals.

Review of the symptoms of anemia

The early signs of anemia include: weakness (asthenia), palpitations, shortness of breath (dyspnea) with exertion, enlarged spleen (splenomegaly), hepatomegaly (enlarged liver), petechiae (red and purple blotches on the skin surface caused by hemorrhaged blood vessels), bruising, and/or jaundice.

The advanced signs of anemia may include tachycardia (rapid heart rate), marked dyspnea (shortness of breath), angina (chest pain from ischemia in the heart muscle tissue), intermittent claudication (difficulty walking), gastrointestinal dyspepsia (indigestion), dysphagia (inability to swallow), anorexia (poor appetite), diarrhea, and/or neuropsychiatric, depression, mood swings, and irritability.

If there is also acute hemorrhage (a sudden loss of blood), internal bleeding, and blood vessel leaks, then the predominant symptoms are vascular instability, hypotension, vasoconstriction, signs of hypovolemic shock such as confusion, Kussmaul breathing (deep and laborious breathing), sweating, and tachycardia.

Acidosis: Crossing the threshold and descending the curve to the P50 and acid accumulation

As discussed earlier, chronic anemia has lowered the total O₂ content causing hypoxemia and increased the urgency to balance O₂-CO₂. The margin into the threshold of hypoxia is closer than in normal physiological models and its risk of negative outcomes is more severe. The body is passively compensating in some ways but may still lack sufficient means of producing energy from O₂ and preventing hypoxia. Meanwhile, the body is continually in jeopardy of being pushed toward these critical thresholds by increased energy demands. The environment, mental states, activity, and possible disease, injury, or even nutritional deficiencies may produce seconds of hypoxic spikes in certain tissues or systematically. The Poqomchi' have accommodative strategies, actively initiating a behavioral and cultural custom that lowers pH, assuring that the maximum amount of O₂ is utilized. The increased utilization of O₂ and the lowered pH both have their drawbacks.

The first drawback in response to increased O₂ release is that the balance between O₂-CO₂ approaches the P50 area on the curve. Specific tissue areas and/or the entire system moves down the oxyhemoglobin dissociation curve to the P50, the point at which there could be more partial pressure from CO₂ than O₂. The result is that Hgb develops a lesser affinity for O₂, increasing the amount of O₂ available to the tissues. The precariousness of the P50 mark is explained by the shape of the curve and its physiologic significance. The nature of the curve is a sigmoid shape. The middle area is steep. The top and bottom of the curve are more level due the way one O₂ molecule bonds with one of the four heme structures through allosteric effect and

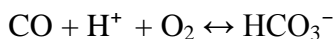
cooperative binding. When O_2 bonds to any one of the four hemes, the other three bond more easily. Conversely, when 2,3-DPG bonds to any one of the four hemes thereby releasing O_2 , the other three hemes release O_2 more easily.

This ability for the O_2 - CO_2 balance to shift rapidly in either direction explains why this part of the curve is as precarious as a threshold. The oxyhemoglobin dissociation curve reflects the partial pressure of O_2 in the arterial blood as it leaves the lungs—the maximum point of saturation. If the pressure drops below P90 mm Hg there will be some impact of hypoxemia and possibly hypoxia. When total capacity is compromised by anemia, this descent down the curve and beyond a threshold of homeostatic balance can come more quickly and severely. The risk of critical disequilibrium is much greater and closer than in non-anemic individuals. Preventing systemic collapse is crucial. If the pressure drops below P50 mm Hg, hypoxia will be significant. If pressure drops below 20 or 30, there is no longer sufficient O_2 pressure to diffuse O_2 into cells and into the mitochondria (Lambertsen, 1974, p. 1372). Spikes or drops into hypoxia and below the P50 are transgression across the threshold. It only takes a few seconds to do serious damage, resulting in stroke, seizure, syncope (fainting), organ damage, and more. Much of the damage that occurs to the brain and other major organs goes undetected, although permanent cognitive or physical damage is common.

The second drawback is the lowered pH, which causes acid to accumulate in a process broadly referred to as acidosis (Figure 7.6). This is highly related to the first drawback discussed above because CO_2 and pH are inversely related. Any movement down the curve or rightward shift corresponds with a decrease in pH. Normally, the lungs and kidneys buffer and balance acidity and alkalinity. But, a Poqomchi' is purposefully holding her breath to decrease pH, and kidney function is decreased due to hypoxemia.

Increased CO₂ levels result in *respiratory acidosis*. To counteract acidity due to increasing CO₂, the kidneys release sodium bicarbonate. Over time or due to hypoxia, the kidneys cannot adequately buffer the acidity resulting in *metabolic acidosis*. If the energy required for the work being done (force) exceeds what normal aerobic metabolism can sustain, *lactic acidosis* will occur as certain tissue areas shift to anaerobic energy production. For individuals who stop eating due to anemia or a lack of access to sufficient carbohydrates during periods of famine, ketones may elevate inducing *ketoacidosis* (Guyton & Hall, 2000, p. 809).

The four types of acidosis mentioned above are well known. However, three additional sources of acid accumulation are worth mentioning that are specific to chronic anemia and Poqomchi' behavior. First, similar to respiratory acidosis, is the CO₂ captured by holding your breath. It dissolves into the blood plasma and is converted to carbonic acid (H₂CO₃), lowering pH. Equation 7.2 below is the chemical equation showing the various acidic forms of CO₂ in plasma. Second, the carbon monoxide (CO) captured could convert to an acid but it could also neutralize acid (Equation 7.3). It may be that the slow release of CO during the day followed by overnight exposure to indoor cooking fires neutralizes acidity by taking up free H⁺ ions. Finally, there is a greater likely hood of an increase in acidity due to a weak gradient in the cell membrane that allows H⁺ ions to leak.



The accumulated acid occurs during hypoxemia, hypoxia, and where O₂ is inadequate for sustaining aerobic metabolism. This stimulates anaerobic metabolism resulting in an increase of both lactate and hydrogen ions (acid or H⁺), which then form lactic acid. It also regenerates NAD⁺ for glycolysis and the electron transport chain. The transition between aerobic and

anaerobic metabolism is yet another interpretation and example of the accommodative thresholds in which the Poqomchi' navigate. On the “normal” idealized model of O₂ content with an Hgb of 15 g/dl, the sigmoid curve is more gradual and sweeping than a curve reflecting low Hgb. For those with chronic anemia the steep area of the curve is steeper still and shorter, easily allowing areas of tissue to spike into hypoxia, anaerobic metabolism, and produce lactic acid. It is curious that in a Western biomedical framework, anemia is typically listed as a symptom of lactic acidosis. However, for those who are chronically anemic, it is actually the cause of lactic acidosis. Moreover, it is more probable when confounding illness, infection, or injury push the individual closer to the threshold where conditions that might normally be accommodated now become life threatening.

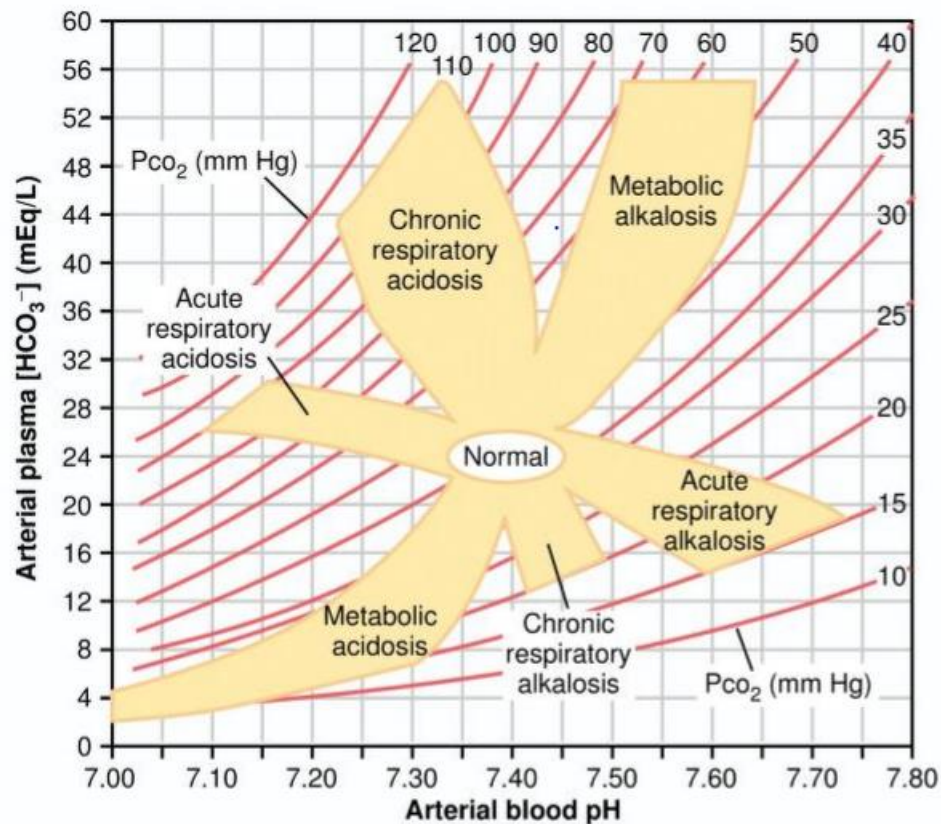


Figure 7.6. Lowering pH (bicarbonate, y-axis) and raising pH (PaCO₂, x-axis) beyond “normal” leads to acidosis and alkalosis, which can lead to shock (Guyton & Hall, 2006).

Insufficient O₂ affects the electron transport chain and the Krebs cycle by causing pyruvate to accumulate and convert to lactate. When the pH is too acidic, the cells lining the stomach and small intestines and the cells in the pancreas that are responsible for producing and releasing digestive enzymes dysfunction resulting in indigestion, gaseousness, bloating and abdominal cramping. Not enough nutrients get absorbed from the food and the entire body can experience malnutrition. Also undigested foods ferment in the intestines causing toxicity. Metabolic acidosis in chronic kidney disease goes hand in hand in the majority of cases. Calcium bicarbonate concentrations in the plasma help to ameliorate the acid load but not if they are insufficient (Kraut & Kurtz, 2005, p. 978).

Sweat and homeostasis

During physical activity the human body warms up. This decreases O₂ affinity to Hgb, which means more O₂ is released into tissue. Increased temperature increases a process of vasodilation bringing warm blood close to the cool surface in the skin. The oxyhemoglobin dissociation curve is shifting to the right. If body temperature continues to rise, sweat will begin to form. The primary effect of sweat is thought to be further cooling of the skin as the water evaporates drawing out heat, but heat is actually lost through pH balance. Sweat has a low pH, between 5-6, which produces the effect and sensation of cooling (Patterson, Galloway, & Nimmo, 2000, p. 871). Sweat carries acidifying protons and amino acids, lactate and minerals out of the body. It also carries out sodium (Na). If left in the body, Na could theoretically be taken from the sodium bicarbonate released from the kidneys to control acid. This would leave only bicarbonate to control acidity—it could bond with any H⁺ ions and form carbonic acid (H₂CO₃), which is a better buffer of acid than when it is bound to Na. This buffering would put pressure on the oxyhemoglobin dissociation curve to shift back to the left, or hold constant. This is not what an anemic Poqomchi' woman wants to happen while walking up a steep mountain.

After the process of sweating, if depleted minerals are not replenished a wide range of problems regarding restoring balance could precipitate. If control over thermoregulation is lost, restoring balance for an anemic person would be difficult during or after work (acidosis or alkalosis). However, a person with a higher Hgb and O₂ carrying capacity could more easily accommodate lowering body pH, increasing O₂ dissociation, increasing body temperature—sweating—and then lowering body temperature, while increased pH and O₂ dissociation lag before decreasing rapidly as well loss of water, minerals, and precious tissue oxygenation. Individuals with higher average levels of Hgb have a physiology high on the oxyhemoglobin dissociation curve, where a secure excess of O₂ is carried by strong affinity for ample Hgb.

Among the Poqomchi' sweating is taboo. Women appeared to show the greatest concern over sweating—men and children avoided sweating to a lesser degree but seemed equally aware of its taboo. Under conditions of chronic anemia, or generally lower Hgb levels, there is good reason to avoid sweating. It begins at the cellular level where cell membranes are weakened, then have difficulty maintaining equilibria, which causes cellular damage all due to a lack of sufficient O₂. The energy needed to establish the gradient between inside and outside the cell is greater, producing more heat. Where O₂ supply is limited, there is no ATP to form, and more heat is produced. Acidic protons used to create ATP may simply leak from the cell membrane as result of this limited supply. Sweating would signify that this detrimental process was at a critical juncture. Water would be taken from blood plasma, reducing the total volume of blood and its flow. Na would also be drawn from the plasma, which might cause the red blood cells to take in more H₂O if Na loss is more significant than H₂O loss. The result is a swell in size of these red blood cells (dilutional hyponatremia). Protons that are safely suspended inside cells may be drawn out into the extracellular fluid where they could do damage before exiting as sweat. An

increase in bicarbonate might help buffer some of the acid, or perhaps push the oxyhemoglobin dissociation curve back to the left decreasing O₂ available to tissue. However, this would come at a tremendous cost of lost Na and the risk of overheating and hyperthermia.

For the individuals with chronic anemia, it is far more difficult to control body temperature, salt balance, and extracellular protons—unlike the individual with abundant Hgb. Sweat is a sign that heat and pH balance are beyond a manageable threshold. The higher energy needs indicated by sweat could quickly burn up all available O₂, sending the partial pressure of O₂ to critically low levels. Energy is not utilized efficiently, ATP is wasted, and tissues suffer from deeper hypoxic conditions. For an anemic individual, with the curve shifted to the right, sweat is a strong signal that the O₂-CO₂ balance is in jeopardy and the threshold is about to be crossed. Sweat signals a steeper descent into acidosis and hypoxia with possible progression into overheating, deeper hypoxia and acidosis, and altered or lost consciousness. Sweat indicates that the body has lost control of both energy (metabolism or thermoregulation). By invoking an oxyhemoglobin dissociation curve shift to the right by pH decrease rather than temperature increasing and the individual can continue to increase the work capacity.

In Western notions of physical activity, “working up a sweat” is often the goal. Among Poqomchi’, avoiding sweating may be a function of desire, but it likely indicates navigation of the acceptable threshold of O₂ use and energy metabolism. The Poqomchi’ are much more concerned with the internal precursors to sweat. They may be more in tune with the body’s homeostasis as it affects the distribution of O₂ as an accommodation of lower levels of Hgb. This physiological model of pH, temperature, and sweat under conditions of chronic anemia can be understood in observed behavior. For the Poqomchi’, due to the fragile physiology of anemia, not getting too hot is important. But what is even more important is not cooling down too quickly

after being overheated. Only during extreme laborious activities, which the Poqomchi' consider to be "HOT" due to the after effects, is sweating acceptable. For example, activities such as childbirth or carrying a lot of weight produce sweat and a HOT condition. Following this activity, COLD things should not immediately be introduced. The body must be maintained in that HOT condition, then brought down to a less HOT condition, and only gradually brought to "COOL". In extremely "HOT" activities such as childbirth, this process could take weeks.

Sweat is a form of thermoregulation but in this model it is an indicator that the body has lost control of thermoregulation by shifting from less harmful means of regulating temperature to more catastrophic ones. However, sweating does have the beneficial result of releasing acidity from the body and increasing internal buffering of acidity. Thus, if there was a way to produce a controlled sweat after physical activity it would be of great benefit. The Maya and the Poqomchi' use sweat lodges called *temazcal*. Little is known or understood about their purpose. Based on this model of physiology under chronic anemia, a sauna would allow for a controlled sweat and release of acidity after intense energy expenditure. A sweat in a *temazcal* is a good way to keep the body warm as it was during work, simultaneously lower acidity, shifting the oxyhemoglobin dissociation curve back to the left. Sweat evaporation then reintroduces the body to a cooler temperature, resulting in a less acidic body and a restored balance. Sweating this way avoids threat of hypothermia and hyperthermia as well as excessive vasoconstriction or vasodilation.

Further research should investigate the relationships between potassium (K), calcium (C), vasoconstriction and vasodilation, energy expenditure under chronic anemia, and sweat. Also, the *temazcal* exposes the user to high levels of CO, which is known to offer great benefits to cellular repair. Thus, there are many other possible benefits to controlled sweats for chronically anemic individuals. Additionally, many of the customs regarding who should use the *temazcal*,

how they should use it, and for how long correspond with much of what is known about exposure to carbon monoxide, physiology, growth and development, and conditions such as pregnancy.

Shock

The way acidosis becomes deadly is through a continual accumulation of acid that goes uncorrected. Shock is a serious condition that occurs due to a lack of O₂ in tissue and accumulation of acid (Sinniah, 2012, p. 129). Generally, in Western biomedical clinical settings, shock results from acute blood loss. In children, who are more vulnerable to shock, it is also common with injury or disease. However, the conditions of chronic anemia mimic acute blood loss, only the blood supply is continually limited. Metabolic needs are not met due to inadequacies responding directly to a particular environment or bodily state. This leads to both chronic and episodic shock. Figure 7.7 below demonstrates a theoretical model of how shock progresses through different components crucial to metabolism.

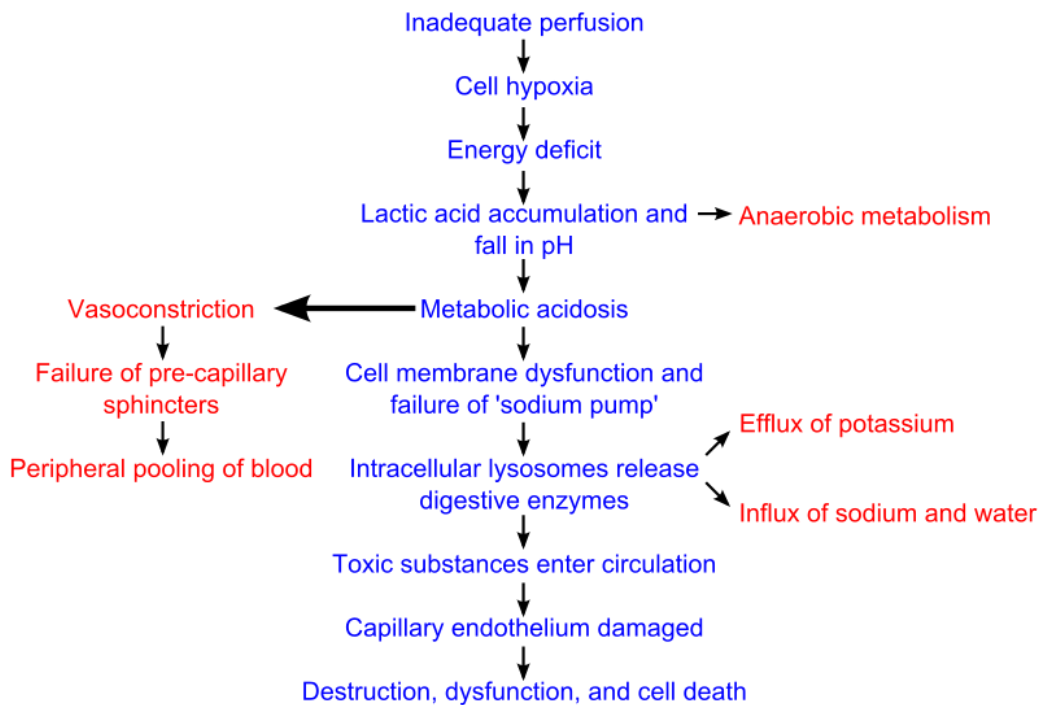


Figure 7.7. Progression of shock (Chaos, 2012).

Shock is highly relevant because it can cause significant permanent damage, especially in young children. One of the most important things to know about shock is that it is a positive feedback mechanism, which means shock begets more shock (Guyton & Hall, 2000, pp. 253-255). It can lead to stroke and even death. At the onset, it may appear only as deeply altered states of consciousness. The circulatory system, i.e., blood pressure, pulse rate, and heart rhythm may all become irregular. In Figure 7.8 below the advancing stages of shock are shown in five levels of severity. Signs of shock during the first two stages are barely noticeable. In the third and fourth states of shock, the pulse and blood pressure will be the most obvious clues. By the fifth stage, there is very little that can be done and the heart rate may drop to a slow thud, especially in the case of children (Sinniah, 2012).

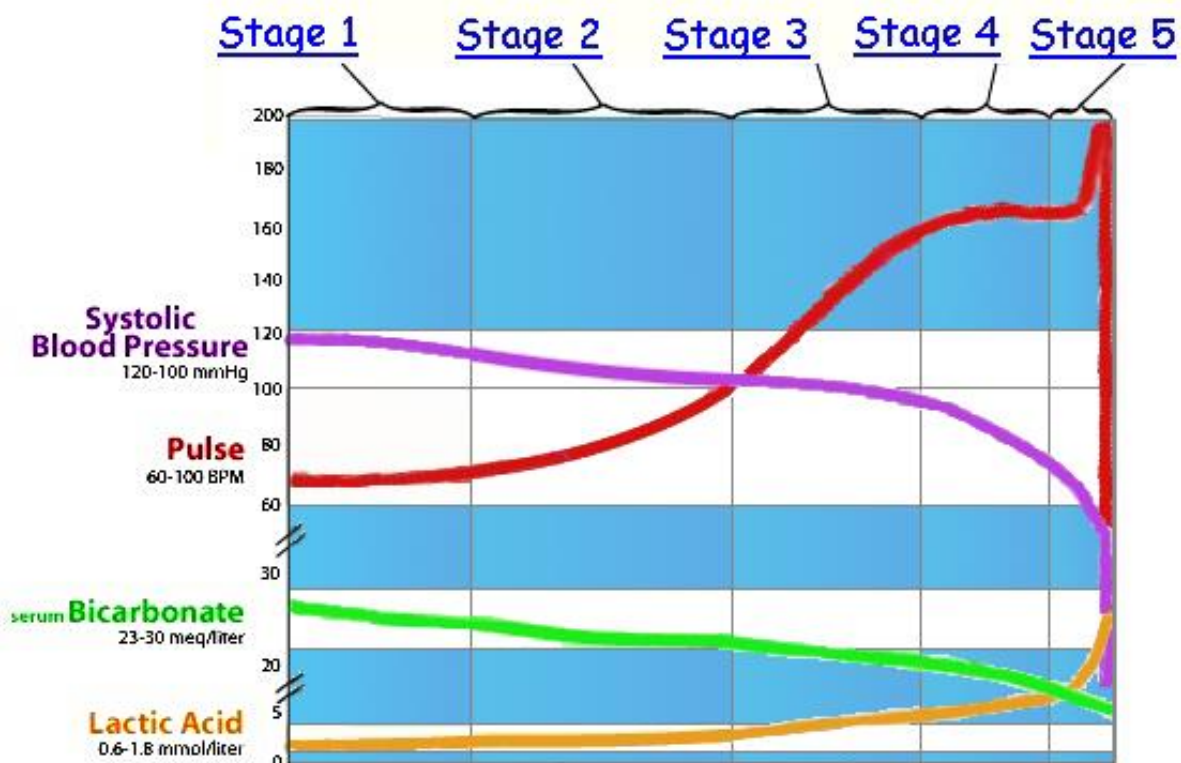


Figure 7.8. Stages of shock advance as acidosis increases, bicarbonate decreases, pulse rises then plummets, and blood pressure drops then plummets. The later stages are irreversible and lead to death (Stagesofshock.com, 2014).

Shock might also be categorized into two types, which may become one and the same. The first form of shock is slow, chronic, and/or episodic. It is brought on by acidosis and more readily in chronic anemia and children. This type of shock can be treated. The second form of shock is a more acute and systematic, and reflects deep dysfunction in the circulatory system. An imbalance between ATP and ADP in the cells becomes overwhelming. The pulse increases then drops suddenly and the pressure of the pulse is best described as a sluggish thud. This latter type of shock is more severe and can be irreversible under the positive feedback mechanism. The body is in self-destruct mode.

In the process of developing shock the deeper stagnant hypoxia becomes increasingly relevant. It can be systemic or localized and is not specific to anemia. It is the sort of hypoxia that may be brought on by shock or syncope (fainting). Stagnant hypoxia may be acute or chronic. Thus, there appears to be a threshold between routine anemic hypoxia and stagnant hypoxia. This threshold reflects the extremes of chronic anemia, between a systematically lower O₂ content throughout the body and organ failure due to O₂ deprivation and inadequate blood flow from the heart.

Chronic anemia doesn't necessarily cause complications. It is a combination of anemia, disease, and other environmental factors that increase energy demands beyond what a limited O₂ delivery platform can provide (e.g. emotions, activities, or foods). Thus, complications presented by shock may occur more gradually or more quickly depending on the insult to the body. Shock is not easily identified, "Delayed recognition and treatment result in progression from compensated reversible shock to uncompensated irreversible shock with widespread multiple system organ failure to death" (Sinniah, 2012, p. 129). Even a sudden fright would be enough to push an anemic child's energy requirements beyond equilibrium leading to acidosis and shock.

Death for biomedical practitioners in a clinical setting is caused by a specific pathology in which anemia is typically only a symptom. In the context of an impoverished community where anemia is endemic, death is caused by a recurring variable mix of anemias that allows the slow accumulation of stress and strain to insult to the body. In field medicine, biomedical practitioners may not have the vantage point or diagnostic equipment to see the timeline and identify shock from endemic and chronic anemia, especially when compounded by other pathologies. Under recurring chronic anemias, sustained shock that progresses quickly due to a sharp increase in energy demands will resemble other primary causes of death such as general malnutrition, specific nutritional deficiencies, or heart failure. However, more acute illness such as pneumonia, diarrhea, malaria, or the onset of seizures or stroke will signal medical practitioners to follow an appropriate shock protocol. These practices signal that appropriate shock protocols should be followed under anemia conditions as well.

Cell death

If there is a smaller amount of O₂ inside the cell, the mitochondria has less ability to push hydrogen across the membrane and bring in electrons. This decreases the potential energy in the gradient, which reduces the capacity to produce ATP. O₂ enables the mitochondria to repair cells. Without O₂ the degradation of the cell occurs more quickly and a new cell also forms sooner than normal. This process is poetically described by Uthman (2012) below:

Aerobic respiration, for all the complexity of the chemical reactions of intermediary metabolism, simply boils down to the body's need to find something to do with the spare electron left over from the destruction of the glucose molecule. This orphaned lepton, bereft of binding energy by its repeated violation at the hands of the cytochrome gantlet, finds no comfort in the carbon dioxide rubble of its former hexose home. Should it not find the succor of oxygen, it would escape to a feral existence of unsavory chemical reactions, where it would find itself in the company of the opprobrious Free Radicals, miscreants whose only purpose is the steric vandalism of the macromolecular cathedrals of life. (2012)

The lifespan of cells for individuals suffering the hypoxia of anemia is shorter. This makes life altogether shorter. There are a finite number of cell divisions possible because telomeres shorten with each division. In conditions of chronic anemia, the added stress on cells from heat, nutrient deprivation, infection, calcium concentration, or hypoxia may accelerate the process known as apoptosis, programmed cell death (Cotran, Kumar, Collins, & Robbins, 1999, pp. 19-21; Mattson & Chan, 2003, p. 1041). Interestingly, in Western medical practice many diseases are caused by suppression of apoptosis, diseased cells that continue living and perpetuate disease (C. B. Thompson, 1995, p. 1458). Either accelerated or suppressed apoptosis is an indication of underlying pathology. In chronic anemia, accelerated apoptosis results from the stressors mentioned above. However, early death of diseased and damaged cells may mitigate or prevent disease, inflammation, and infection (C. B. Thompson, 1995; Yang et al., 2003, p. 831). Thus, accelerated apoptosis brought on by metabolic imbalance and anemia may have some benefit; but at the cost of accelerating telomere shortening, depleting a finite number cellular divisions, and shortening life. Life expectancy among the Poqomchi' is reported to be around 56 years, other research reports life expectancy for Maya to be as low as 45 (Phillips, 1998, p. 51).

Discussion

One way to imagine the significance of chronic anemia and physiology is to draw a mechanical analogy. Cellular metabolism is an engine. There are different system sizes that can be fed by different mixtures of fuel. Some engines, although small, can produce a greater amount of energy by running at a higher capacity or threshold. This higher capacity will require different input and produce different output. Maintenance requirements will be different from other larger slower burning engine systems. A high use engine must be appropriately maintained or it will easily overheat and seize up. Once seized, and engine is finished. In this analogy Hgb is the size

of the engine, O_2 is the fuel, CO_2 allows for the fuel to release into the engine, energy requirements determine how much fuel is consumed, and additive factors such as salts, phosphates, pH, and temperature can regulate different parts of this process.

Another way to think about anemia is the oxyhemoglobin dissociation curve. However, for chronic anemia it is not about where on the “normal” curve people should be in order to be "normal." Rather, it is about understanding where the curve is under normal conditions where anemia is chronic, recurring, and endemic. Now that the curve has been redrawn; the question remains, would people with normally low levels of Hgb gain a physiological benefit from managing moves down the curve during work. In a Western biomedical clinical context people are expected to remain up in the flat, leveled off zone above around P90 even during heavy exercise. But the reality of a sigmoid curve is that normal is within the curve, not at the top or at the bottom. Moving along the arterial pathways and along the curve toward the middle would indicate a greater release of O_2 to tissue. People with higher amounts of Hgb may never reach the middle part of the curve; it may be difficult for them to fully oxygenate tissue. However, persons with lower Hgb levels appear to be navigating several balances in order to keep the engine from seizing. Table 7.2 below outlines accommodative balances that those with lower Hgb levels must make, especially when young, sick, or requiring more energy.

An increase in heart rate is explained in its simplicity as a compensatory response to lower Hgb circulating more blood throughout the body to alleviate hypoxemia or hypoxia in specific tissue. However, another way to understand heart rate is that it increases due to higher Hgb O_2 affinity (O_2 is available but not released). If O_2 freely dissociates from Hgb it can meet tissue needs, lessening the need to increase heart rate. The idea that strong than necessary Hgb O_2 affinity increases heart rate is alluded to by Jensen, “changes in RBC oxygenation may mediate

appropriate release of effectors that control local blood flow, and cause modulation of ion transport mechanisms that are involved in the control of RBC pH and volume” (2004, p. 217).

Physiology Conclusion

Death from anemia comes in many forms, like kidney failure, stroke, and heart attack. Attributing death to these causes forgets the critical role of metabolism. It is not that people historically did not understand disease and that modern medicine is an advance from ignorance. Rather, modern medicine emphasizes new diseases and a forgotten recognition of our metabolism and historic adaptations to O₂ and CO₂ platforms. Understanding this new model of chronic anemia and the baselines of metabolism is crucial to understanding required nutrition and nutritional balances and how imbalances affect such a metabolism of chronic anemia. The Maya expand the parameters within which they are taking in O₂ and releasing CO₂.

Dissolved O₂ in the blood is a means of counteracting severe hypoxemia because there is more loose O₂ available to diffuse into O₂ starved cells. And to date, there is no known reporting of population-wide behavior or practices that specifically counteract the threat of hypoxemia and or the risk of hyperventilation, acidosis, and possible shock. It has been studied as intentional homeopathic practices but mostly viewed as skeptical and unscientific. The closing commentary in *Diet, Demography, and Disease* parallels the hope of this chapter, that:

It compels the reader to reevaluate traditional views of health and disease. It illustrates the complexity of the body's response to physiological and environmental factors and shows that our interpretation of physiological status based on laboratory tests may be hindered by our lack of appreciation of this complexity (Stuart-Macadam & Kent, 1992, p. 267).

There are accommodative biological mechanisms that adjust for anemia; therefore, corresponding behavioral accommodations are to be expected.

Rather than focus on respiration and circulation, a model of chronic anemia must focus on the association between O₂ and Hgb, or oxyhemoglobin dissociation (also referred to as oxygen dissociation). Reframing the model demonstrates a shift in understanding compensatory mechanisms and accommodation of anemia that is chronic. This analytical depiction of physiological processes is exclusive to chronic anemia, where bodily change occurs overtime, similar to slow acclimatization of altitude. This biochemical juncture, the accessibility and utility of O₂ at the tissue and cellular level, should be considered the starting point for any discussion about evolution and adaptation to chronic anemia. The unique biophysical accommodation of chronic anemia has not been systematically studied, nor have correlating behavioral and cultural accommodations. Single disciplines shed light on parts of these processes as “abnormal” and “atypical” deviations from the ideal model, but a multidisciplinary effort to construct a complete model of chronic anemia has not yet been attempted.

Anything decreasing cellular metabolism is a pathway for shock. The strong connection between cellular metabolism and shock has been demonstrated in a recent study showing detection of metabolites to be an effective method of clinical evaluation of shock (Mickiewicz et al. 2013). However, these tests are not practical for everyday medicine. Preventing shock from advancing requires, “a strong index of suspicion, early recognition, timely intervention (Sinniah, 2012, p. 129). This dynamic onset of shock with delayed expression and recognition of symptoms explains the retrospective diagnosis typical in a condition the Poqomchi’ call *susto* (fright or soul loss). This illness is retroactively diagnosed when parents begin to notice that their children appear less conscious or present. The parents will think back to a recent event that might have scared the child such as a violent dog, an angry drunk, or a bad dream. The symptoms of anemia include the appearance of fear and frightfulness. This will be covered in the next chapter.

Table 7.2.

Possible fragile physiological thresholds that can more easily become “imbalanced” with lower Hgb levels and require biological or cultural accommodation

Mild-to-Moderate Anemia at Rest	Mild-to-Moderate Anemia at Work and Severe Anemia at Rest or Work
Aerobic	Anaerobic
Hypoxemia	Hypoxia, stagnant hypoxia
Hyperventilation	Hypoventilation
PaCO ₂ decrease	PaO ₂ decrease
PaO ₂ increase	PaCO ₂ increase
High ambient PCO ₂ desired	High ambient PO ₂ desired
Normal Pulse	Irregular Pulse
Consciousness heightened then lost	Consciousness diminished then lost
Vasoconstriction decrease	Vasoconstriction increase in kidneys and skin
Vasodilation increase in skin and surface	Vasodilation decrease in heart and brain
Decrease effort to reduce vasoconstriction	Increased effort to reduce vasoconstriction
Rest	Work
Cool	Excited
Health	Illness
Tortilla	Leafy greens
Indoor HgbCO associates (smoke)	Outdoor HgbCO dissociated (no smoke)
Iron	Magnesium
Alkaline	Acidic
Pulse rate stable	Pulse rate increase
Shock controlled	Circulatory shock
Temperature controlled	Hypothermia
Extracellular pressure and accommodation	Intracellular pressure and accommodation
Extracellular imbalance	Extracellular balance
Intracellular balance	Intracellular imbalance
Bohr effect (pH/CO ₂ on Hgb to O ₂ affinity) decrease	Bohr effect (pH/CO ₂ on Hgb to O ₂ affinity) Increase
Haldane effect (HgbO ₂ saturation on H ⁺ /CO ₂) Increase	Haldane effect (HgbO ₂ saturation on H ⁺ /CO ₂) Decrease
Intracellular net charge controlled	Intracellular net charge negativity increased
Apoptosis suppressed	Apoptosis accelerated
Respiratory acidosis	Metabolic acidosis and beyond
Cold to Hot (acidifying to alkalizing)	Very Cold to Very Hot (acidosis to alkalosis)
ATP	ADP

Chapter 8. *Energía* (Energy) and Social Narrative for Navigating Knowledge, Fear, Death, and Time

The Origin Story and Cosmology of Illness, Death, and Suffering

A community's shared myths about the origin of people, earth, and the universe are often a discourse in themes such as the theory of being human, sameness and difference, etiological conditions, suffering, and death (Knowlton, 2010, p. 122). Thus, the Poqomchi' experience of anemia can be better understood by knowing a little about their creation story. Most of this story is shared throughout Mesoamerica and can be read in an actual ancient text called the *Popol Vuh* (Tedlock, 1985), recovered from the neighboring Quiche Maya. An important part of this story for the Poqomchi' involves a place called *Xib'alb'ah*. Often translated as the "underworld," *Xib'alb'ah* is more analogous to the notion of another parallel dimension than the Christian idea of hell. The entrance to *Xib'alb'ah* is believed to be a cave that is less than a day's walk from Onquilha' (p. 109). This belief is still shared by many indigenous communities across Mesoamerica and is especially salient among the Poqomchi'. Today, many of the story's objects are often combined or replaced with Christian objects, but the subjects and conceptual ideas remain the same.

Xib'alb'ah is the place of false perception and unknowns. It is the place of factors and outcomes that are determined in games of chance. This game can result in disease, death, and suffering for human beings. *Xib'alb'ah* is the place of fear. In the story, it is described as a kingdom ruled by 12 Death Lords. There are two rulers named One Death and Seven Death. There are 10 Lords who work in pairs to cause death in specific ways: House Corner and Blood Gatherer, Pus Master and Jaundice Master, Bone Scepter and Skull Scepter, Trash Master and Stab Master, and Wing and Packstrap (pp. 106-109). Their names reflect common threats to Poqomchi' life. The Lords may cause death by stealing blood, causing disease, inflicting pain,

pus, malnutrition, emaciation, edema, yellowing, bloating, heart attack, stroke, or even by quickness, slowness, dirtiness, location, and inobservance. These 12 dimensions of death are related to a sort of 13th dimension, which is represented as a mortal road where human beings live. The Lords determine who lives, who dies, and the manner in which this comes to pass along this road. The 13 conceptual areas of death are complemented by 13 heavens. For the ancient Maya and many Maya today both the underworld of death and the 13 heavens are necessary and complementary energies.

The creation story tells an epic tale of how two brothers, followed by the twin sons of one of those brothers, make two separate journeys to Xib'alb'ah. In the first journey, two brothers named One Hunter and Seven Hunter were summoned to Xib'alb'ah. Before leaving, they proclaimed to all who were concerned, "We're going, we're not dying" (p. 110). However, the Lords of Xib'alb'ah tricked, trapped, and made the brothers suffer eternally. The head of One Hunter was severed by the Lords and placed in the fork of a tree. The fluids and fibers of the head and tree grew together causing the tree to flourish and allowing the head to retain consciousness (p. 113). Blood Woman, the daughter of Blood Gatherer (the Lord who takes blood) visited the tree with the head of One Hunter. He gave her his essence by spitting in her hand. He explained that the saliva was a symbol of his spiritual energy that never dies (pp. 114-115). Blood Woman became pregnant causing the Lords to want her killed. The Lords sent Blood Woman away with several owls to kill her, but the owls did not want her to die. Blood Woman told the owls to trick the Lords by taking them tree resin (*copal*) to serve as a ruse for her blood and heart. When the *copal* ruse was burnt its sweet vapor deceived the Lords into thinking Blood Woman was dead (pp. 116-117). She ascended to the dimension of human beings where she gave birth to twin boys known as the Hero Twins.

The second journey tells the story of how Hero Twins avenge their father's One Hunter's death, distinguish the known from the unknown, and demonstrate why the cosmos are the way they are today. The Hero Twins were fairly self-sufficient and not well cared for by their human kin. They hunted all day to feed their indulged half-siblings with meat. The twins did not receive love or meals. They only had hunger (p. 120). They longed to live with their grandmother and be fed from the garden. Eventually, by outsmarting their kin the twins won love and meals from their grandmother and the garden. The twins soon discovered that they were ball players like their father who died in the underworld (p. 128). The twins began playing ball and were also summoned to the underworld just as their father. Before departing, each twin planted corn in the center of their house as a symbol to their grandmother so she would know the boys were alive as long as the corn plants lived (p. 133).

As they descended the road to Xib'alb'ah they sent Mosquito ahead with the order to sting each of the 12 Lords one at a time, so that each would scream in pain, and so that another lord would call out to each by name asking what happened (pp. 134-136). Mosquito returned and told the twins the names of the Lords. By knowing the names of the 12 Lords the Hero Twins were able to conquer Xib'alb'ah. Upon victory the Hero Twins made the Lords know their names and their ancestors' names. The Lords were told they could no longer attack the innocent and must take petitions on their behalf receiving only resin, trinkets, and the most worthless and wretched of people (pp. 155-158). Human suffering was diminished through the control of knowledge. Sacrifices become symbolic. The powerful fear of the underworld was reigned in and its Lords no longer required worship. The Hero Twins never returned; instead, they ascended into the heavens and formed the moon and the sun—night and day (pp. 158-159). However, the corn they had left continued to grow again and again bringing happiness and comfort to their

grandmother who sacrificed copal by the corn.

These journeys are an allegory for how the Poqomchi' experience the inevitability of mortality through illness, health, death, blood, and anemia. The journeys demonstrate the subjectivity and objectivity of pain and suffering, symbolic knowledge, and human agency over the unknown. However, the story also identifies the vigilance, reverence, and behaviors required to stave off threats to human life.

Two Types of *Susto* (Fright): Losing Force and Losing Energy

In a focus group, one Poqomchi' woman explained what happens to those individuals who lose their fuerza. After a moment of thoughtful struggle she stated, "Sometimes they don't die, they die with time." Conceptually, for the Poqomchi', time is an arbiter and expression of personhood experienced along a path. When one dies with time, identity is slowly lost as the physical markers of consciousness and personhood driven by energy diminish. The physical body will soon follow. Similar to the notion of "terminal" illness, time and the base energy constituting personhood wane together, and yet the body may still live. For the Poqomchi', the individual who loses too much fuerza comes to exist in a form they refer to as *ya perdido* (Eng. 'already lost'). This chapter examines how the Poqomchi' navigate between the uncertainty of life and the certainty of death.

When referring to the supernatural, the Poqomchi' avoid explicit terms such as heaven, hell, the underworld, or the other side. Instead, they generally refer to "there" or "the ancestors." Or, they might simply point toward the sky without looking and swirl their arm around once above the head. They use these implicit references because they conceptualize this other realm at a deeper and possibly metacognitive level. The Poqomchi' mentally process and theorize about this realm as an infinite unknown, which is the origin of all that comes to be perceived, known,

and experienced. It is a spatial rationale for the origin of all, most notably the order and disorder of life and corollary normal and abnormal effects here on Earth. However, the Poqomchi' hold onto one key piece of knowledge about this infinite unknown—they claim to know the names of the people and beings that inhabit the other side. A final way the Poqomchi' refer to this conceptual dimension is as “the 13 names.” By ‘knowing that they know’ the names, they are empowered to establish control of the unknown. By knowing the names they can communicate with the other side, building hypotheses, narratives, and storied identities. In this realm, it can be difficult to remember kinship lines or the names of more distant family members. Blood relatives have been held accountable for the debt, peonage, and tribute of their kin. Debt peonage, an artifact of structural violence, has meant that knowing their living kin could be detrimental knowledge by making them responsible their kin's debt. The relationship with the other realm and the ancestors is at times a deeper personal relationship than with the living.

Part I and II of this chapter describe how healers diagnose, treat, and conceptualize an illness locally known as *xowanik*. The term *xowanik* comes from the root *wanik*, which means time, day, energy, and *nahual* (the unique energy or soul of an individual). Together, these reflect the basis of all symbolic meaning and the cosmological view that the quality of meaningfulness is derived from nothing (the “other” side into the unknowable). Meaningful elements are translocated from the unknown and make up the foundational shadow of an individual's purposeful identity here on earth. Elemental qualities of *wanik* are borrowed from the spiritual world by each Poqomchi' who then comes to be meaningfully known and shaped in the physical world and by the Poqomchi' community.

The Poqomchi' interpret the sickness *xowanik* in Spanish, both linguistically and conceptually, as *susto*. *Susto*, also known as *asusto*, is well known throughout Latin America. It

is often described in English as ‘fright’, ‘shock’, or ‘soul loss’. For the Poqomchi’, individuals who are afflicted with *susto* are referred to as *asustados* (the frightened ones) or *tiene susto* (has fright). The Poqomchi’ use Spanish expressions when communicating with non-indigenous but among themselves use their own Poqomchi’ terms. When I first asked my Poqomchi’ informants about *susto* they frequently jumped with enthusiasm, held up two fingers, and exclaimed, “There are two types of *susto*!”

Susto has been studied extensively in anthropology, especially medical anthropology (Trotter, 1982), primarily as a psychosocial or psychosomatic “folk illness” (Gillin, 1945; Authur J Rubel, 1964; Arthur J Rubel, O’nell, & Collado, 1985; Trotter, 1982). McElroy and Townsend concluded that *susto* is the result of the individual stress accumulated from being unable to fulfill one’s communal responsibilities, and argued that there is a connection “between emotional and physical debilitation, each reinforcing the other in a downward spiral of distress” (McElroy & Townsend, 2009, p. 292). Research on *susto* has mainly focused on the social context, narrative, and identifying symptoms. The common symptoms of *susto* include, “loss of appetite, listlessness, loss of weight, apathy, depression, and withdrawal. . . diarrhea, pain, swelling of the feet, nightmares, and headaches” (McElroy & Townsend, 2009, p. 292). It affects, “emotions and will” (García et al., 1999, p. 232). Research shows *susto* usually afflicts children under 3, children 3-5, pregnant women, and lactating mothers (Balick, De Gezelle, & Arvigo, 2008, p. 114; Nash, 1967, p. 134; R. Wilson, 1995). In newborns, *susto* is carried in the blood from the mother and, “if it goes unattended in young children they will stay weak and grow up to be easily frightened, or may die” (García et al., 1999, p. 232).

Although research has shown that children are those mainly affected, the majority of research and currently accepted hypotheses focus on how *susto* reflects social role inadequacy of

adults (McElroy & Townsend, 2009). Also, while some studies have correlated biophysical symptoms and outcomes (Collado, Rubel, O'Neill, & Murray, 1983; Jezewski & Poss, 2002; Thomas, Vandebroek, Van Damme, Semo, & Noza, 2009), very little research has examined a biological cause (Bolton, 1981). Susto, anemia, and related diseases and illnesses are commonly reported among Maya healers to be diagnosable by palpating the pulse (Balick et al., 2008; Nash, 1967). The broad consensus across research is that susto is a magical psychosomatic folk illness that manifests physical symptoms of stress, and is related to social pressures regarding roles and responsibilities.

Because chronic anemia, acidosis, and shock share all of the same symptoms as susto, I examine susto as one interpretation of the experience of anemia and chronic illness by the Poqomchi'. There is no research on susto in the context of chronic anemia and the fragile physiological states anemia produces in individuals, especially young children and women. This is likely because one needs to first understand the physiology and metabolism of anemia to grasp how shock could occur as easily as does susto. Also, there is no research on susto that identifies two types, or levels of severity, curable and incurable, which is also the case for shock. To diagnose susto (xowanik), the Poqomchi' healers are primarily focused on the pulse and the combined notions of conditional weakness and inherent fragility of the body. Shamans try to prevent and heal susto with a rich discourse of *fuerza* (force) and *energias* (energies).

Methods

In order to better understand xowanik and its two manifestations, I conducted linguistic elicitations with 4 key informants and semi-structured interviews with 5 individual healers known to work with xowanik. Two informants were instructors affiliated with the Academia de Lenguas Mayas (Academy of Mayan Languages) and two were Poqomchi' field nurses affiliated

with the local clinic. The 5 healers were all individuals working with healing in Onquilha'. The Poqomchi' in Onquilha' do not use specific titles to refer to people who treat disease and illness, only men or women that, "know medicinal plants." Most community members know of such titles in both Spanish and Poqomchi' but do not use these terms. The healers did not claim any special powers or qualities that allowed them to heal. They stated that any elder could heal so long as they knew the plants that could be used in treatment.

The claims and descriptions of physical symptoms were not bound to strict nosological categories, but did follow a general pattern of dichotomous structure. The most general and consistent dichotomy was between 1) a loss of force that is treatable, physical, survivable, normal, and an individual disability with 2) a loss of energy that is mostly untreatable, spiritual, unsurvivable, abnormal, and a cosmic and social disorder. This implies that most illnesses are not rooted in spiritual disorder. They are a continuum of human-made imbalances at risk of giving way to chaotic unknowns, i.e., spiritual death and disease. Each healer worked within this dichotomy, representing the two levels of xowanik. The healers varied in their particular focus on a few corollary diagnoses. I refer to "corollary diagnoses" because at a more refined biological level there are etiologically distinct classifications of anemia with unique symptoms. Many Poqomchi' suffer in varying degrees from various types of anemia simultaneously. When someone is more afflicted by one class of anemia than another, those symptoms may be more apparent and result in corollary diagnoses. Ultimately, the common symptomatic experience of all anemias is predominantly by some form of hypoxia. Other diagnoses that were described by the healers were interrelated, sequential, identical, or specific to an anemia in the context of other disease, a specific age, gender, or other condition such as pregnancy.

Because the Poqomchi' nosologies are often dismissed as "superstition" and therefore

illegitimate, I want to state clearly that most of the healers did not admit to believing in *warinik* (to curse with witchcraft, Esp. *brujería*) or *yohb'saneel* (the devil that causes the fright). One of the healers interviewed stated, “I personally believe that some people say there are witches and witchcraft to look for their sicknesses outside of themselves. There are a lot of people that say it is witchcraft but for me it is not.” The healers suggested that accusations of witchcraft were really about personal and interpersonal conflicts and even explicitly stated, “There are no witches.” Only one of the four healers thought that witchcraft was possible but admitted that in most situations it was not the real cause of illness. In some cases the discourse of witchcraft was used to explain the origin of illness, but the Poqomchi' healers use this term metaphorically to suggest something is fatal, abnormal, should not happen, and internal to the body and therefore not of this world. They did not think of witchcraft as a literal cause of illness or try to treat witchcraft in any way. This is significant because there are practitioners located in the larger town who claim to engage directly with the curses of witches, but they are sharply stigmatized.



Figure 8.1. Poqomchi' healer in kitchen area filled with smoke (high PCO₂) (Herynk, 2006b).

Part I: Diagnosis by Healers

In order to make a diagnosis of xowanik the healers primarily rely on palpating the pulse at four points. These include the radial artery in the wrist and the brachial artery above the elbow in first the right and then the left arms. If the radial pulse is not detected, they look for a brachial pulse. They are specifically looking for the rate, pressure, and any unique quality or irregularity of the pulse. Also for confirming a diagnosis of xowanik, as well as other parallel illnesses, the healers use the carotid artery in the neck, the armpits, heart, and inside the mouth and throat. The healers first make a diagnosis in the right radial pulse located on the wrist. Here, they detect if the patient, “is going to live more time,” or if, “they are not going to live more time.” If the pulse is rapid and strong then the patient can live. If the pulse is slow, heavy, and/or irregular then the patient is going to die. Both are considered xowanik. However, if either pulse type changes within two days then it is not xowanik and is something else. The types of irregular pulse rates associated with xowanik are constant over time and may worsen if no treatment is given.

These two types of pulse correspond with the two types of xowanik. The two types are shown below Table 8.1 as I interpret them to be distinguishable across different experiential domains. The first, *ransil* (his/her force), is detected by a fast pulse rate and is curable. The second, *ranxel* (his/her energy), detected by a slow and heavy pulse rate, and with few exceptions, is not curable. Ransil is considered to be a normal physical disability. It is defined by weakness inherent to the patient’s body, imbalance in the force within the patient, or both. Ransil is considered to be an abnormal spiritual disorder. It is defined by absence of force brought on by the translocation of the patient’s essential energy and is inherent to the unknown nature of energy.

Ransil: Xowanik Type I

For diagnosing ransil, the healers will look for other signs of illness in addition to the pulse. The appearance of the patient is elementary as stated by one healer, “the heart detected in the pulse goes fast but the body goes slow.” The healers look into the eyes of the patient and note that, “people can see but they are not watching.” For the Poqomchi’ the sensation of hunger is a fundamental sign of health and identity. A patient who suffers from ransil does not want to eat, or only wants to eat “strange” things. The physical representation of ransil, weak force, is *maxta rikikel* (to have no blood). The lack of blood in their bodies produces another sign of ransil, “our clothes get wet in the rain, the young and old especially, and we cannot dry them [clothes] with our own bodies.” The cloud forest climate in which the Poqomchi’ live is naturally cool and continually very damp. The only way clothes stay dry is by being hung near a fire or from one’s own body heat. The inability to dry one’s own clothes is a sign of decreasing body heat and clammy skin associated with vasoconstriction. This is interpreted as the body no longer being capable of generating the warmth required to dry one’s clothing, rather than as the clothing cooling the body causing the dampness to be suspended as “vapor” or stagnant air.

Detecting a *fiebre* (‘fever’) is also important, but can be considered independent from xowanik. However, the sort of fever that the healers are concerned with is not like that known in Western biomedicine. It is not an increase in body temperature. The healers insisted that they did not detect an increase in temperature on the body or skin as part of a fever diagnosis. When the healers described an increased body temperature it was only in association with specific infections such as the flu, phenomena, or malaria. They did not use a specific term such as fever, only the expression that “the body heats up,” with a particular infection. The sort of fever the healers detect is, “born in the stomach,” and there are two types. The healer first detects if the air that comes out of your mouth is hot because “when someone has a hot stomach then the mouth is

hot.” They look for an inflamed tongue and throat and possibly sores. In young children the same may be detected around the anus. They then examine the radial pulse, feeling with both hands for irregularities under the armpits, and finally clasping the neck with both hands. A fever that exists inside the body is diagnosed by a rapid radial pulse. A fever that exists inside the stomach is diagnosed by a radial pulse that is slower and thuds, a pattern that must also be detected in the carotid arteries of the neck.

Ransil: Treatment

The healers insist that when ransil is detected it is important to act quickly. There are several medicinal plants that can be given to the patient to treat ransil. The primary goal of treatment is to stimulate a sense of hunger and encourage appetite. The healers prefer to visit the patient’s house because the most important part of the treatment is to coach the family in urging the patient to take the medicine and most importantly to eat. Normally, sick individuals in a household are isolated and left alone. In the case of ransil the healer has to direct the family to actively engage their sick family member. Visiting the family regularly to check that the patient is eating and that the family is encouraging them to eat is the most important part of the treatment. Patients are told to eat a variety of fruits and vegetables. The treatment is working if after a week the family or the patient says he or she is eating and if the family says the patient is asking for food and water. This indicates that the sense of hunger has returned. The return of hunger is an indication that the patient is recovering. This reflects the purpose of the medicinal plants and the social interaction with the family. The healer attempts to restore hunger as a symptom of ransil, not to cure ransil directly.

The roots and leaves of the plant *quiche* (epiphytic bromeliads) have many broad medicinal properties helpful to anemic individuals. The roots and leaves are boiled and are said to look like blood. A glass of this is drunk twice daily for one week, morning and night. Pregnant

women can only take a small dose because it may cause miscarriage, but a full dose can be taken 6 months after giving birth. It is an antioxidant, antibacterial, and antifungal (Coelho et al., 2010), containing nutritional properties that are good for blood (Pio-Leon et al., 2009), and has beneficial effects on the calcium-phosphorous balance and metabolism in blood, thereby aiding O₂ delivery and kidney function (Winkler & Zotz, 2009; Zarzecki et al., 2004). Another common medicinal plant is called *chispa* (*Pteridium aquilinum* or a species of fern). Chispa stimulates appetite, reduces internal bleeding, diarrhea, parasites, stomach cramps, and nausea (Cáceres et al., 1993; Maass, 2005). Parts of the plant are crushed and boiled then taken three times a day for approximately one week. Finally, for fever there are several different poultices, rubs, or soaks that use a combination of plants, liquids and warmth from the concoction itself or from time spent in the sun (García et al., 1999, p. 232). These mixtures are typically rubbed on the abdomen, legs, and arms.

Table 8.1.
Two levels of xowanik and corresponding experiential domains

Experiential Domain		Xowanik (Sp. Susto, Eng. 'Fright' or 'Shock')	
Type (severity)	Level 1	Level 2	
Affliction	Ransil	Ranxel	
Definition	Weak force, energy still present	Lost force, energy has left.	
Route Word	<i>Ansil</i> (Sp. Fuerza, Eng. 'Force')	<i>Anxel</i> (Sp. Energía, Eng. 'Energy')	
Verb Fright	<i>Yo'rik</i> (intransitive)	<i>Yo'sik</i> (transitive)	
Verb Fright Definition	To cause fright (normal)	To cause fright (abnormal)	
Verb Fright Source	Comes from animals, family members, events	Comes from extreme fear including people, strangers, sex outside of marriage, witchcraft, HIV, cancer, diabetes, internal pain of unknown origin, chronic conditions, and other disease and illness that commonly afflict adults.	
Verb Fright Origin	Physical, the body, originates from this world	Originates from the other side and the destiny of this sickness is determined by the other side.	
Proximal Cause of Affliction	Poor nutrition, breaking behavioral taboos or sin, imbalance of hot-cold, inherent physiological weakness	No sense of hunger, energy is called to remain on the other side, witchcraft	
Who is Affected by Affliction	Children under 3, also children 3-5, and women. It may affect pregnant women, but because ransil is locally considered more 'normal' while 'sick' with pregnancy the pregnancy itself is the actual affliction. Men are not affected.	All ages and genders. If this occurs in children it is very unnatural. If it occurs in men death is certain.	
Normal/ Abnormal Classification of Affliction	Normal, debility	Abnormal	
Principal Domain of Affliction	Physical, the body	Spiritual, the other side	
Outcome of Affliction	Life, curable	Death, expected to die within 6 months, not curable. (It can be cured with fast action and if a cure is granted from the energies and ancestors on the other side.)	

Ranxel: Xowanik Type 2

In the first stages, diagnosing ranxel is a similar process to diagnosing ransil. There are all the visual signs in the eyes, the movement of the person, the appearance of their body, and any specific symptoms known to arise from a lack of force or not having blood. Then, the radial pulse is checked but most likely the healer will find nothing because the ransil, the force of the person, is gone. The healers attempt to get the ransil to reappear in the pulse by blowing on both the left and right radial pulse of the patient. Some healers will blow two times while others will blow three times. Blowing into the vein is essential because wind represents differentiation within the indifferent space of air. Wind channels stimuli, giving direction to something that is perceivable. Wind establishes the chance to create a signal, a symbolic representation, and establish meaning in the space of nothing. The air blown by the healers is heaved from deep inside their bodies, not simply from the mouth. Blowing two or three times is also essential to this process. The number 2 (*ki'ib*) represents an understanding of choices derived from duality and balance. The number 3 (*ixib'*) represents movement or action that brings integration. The healers are acknowledging the uncertainty of the illness and attempting to correct an imbalance. They are also attempting to interject flow and meaning into the stagnant empty space of the body. Once the channel is established through blowing in the veins, the healer calls the patient's name into the radial pulse. The name is carried by the wind, passing effortlessly into the vein and directly into the blood. Through the blood, the patient's *anxel* (identity, personhood, and essential energy, possibly a Mayanization of "angel") is called back from the other side. A connection is established and a variable quantity of their *ansil* (force) may, but most likely will not, return to the body's blood. If the pulse does not return, or if it is only a slow heavy pulse, the patient has no more time here on earth. An estimation or expectation that the Poqomchi' healers

frequently gave was that the person's physical body would die within 6 months. Of course, there is the possibility of recovery.

Ranxel: Stories of Diagnosis and Treatment

The quotes below were gathered from healers' stories about different patients that they treated. These were chosen because they reflect particular aspects of the Poqomchi' experience with anemia in the context of navigating the brink of death. Some of the passages offer a chance to parallel Western biological understandings of anemia with Poqomchi' treatment processes.

“Fire, lightning, susto.”:

I detected susto in an older woman, her lips were very dry and she was drinking lots and lots of water over and over again. She could not stop drinking water. I was called there to visit her. She did not respond or acknowledge me. I asked her where she had been frightened. She did not respond. She would not answer. But, this is how the sickness is. Then, in a moment she was able to recall that this sickness had started near the fire. I asked if the fire had frightened her. She then remembered, “Ahhh yes, it was by the fire. A bolt of lightning struck nearby and then I fell to the ground. That's where I was frightened. I was left on the ground in darkness by the fire. When I woke I had a headache. That's when the susto started.” The woman was able to remember what had frightened her when I discovered where she had been frightened. (Healer, 2011)

The healer works with the asustados to identify a retrospective provocation. He wants to find out exactly what caused the patient's current severe condition. The healer begins by immediately recognizing the symptoms and abnormal behaviors that are common with *susto*. For this patient, excessive thirst and consumption of water was a sure sign to the healer. In some cases of severe anemia the body struggles to maintain cellular fluid balance, which leads to the excessive consumption of water. Once the cause is known in objective terms the healing can begin.

“I worked quickly. . . I called upon the 13 names.”:

Because of her grave condition, she was close to death. She had to be treated for ranxel. I worked quickly to save against unnecessary suffering. I called upon the 13 names, women and men, 13 names: San Juan, San Bartólome, San Pablo, Concepcion, Santa Maria, Santa Barbara, Santa Catalina, Catalino, Rosario, Santa Lucia, Maria Ochente, Santa Machaul, San Gabriel, Santa Domingo, San Juan Bautista, Angel Gabriel. . . I ask

for the apostles, the ancestors, to support the cure for the patient, that these 13 come help heal the sick. (Healer, 2011)

A top priority for the healer is to establish a link to the other side, into the heavens and underworlds. This is where the fuerza and energía of the afflicted has gone and is now cared for and held. The afflicted's personhood and time on earth is being determined by unknown games of chance. The players of this game are the 13 energies, the Poqomchi' ancestors, and as one healer stated, "of course God, the Virgin, and the Holy Ghost too." To navigate this dimension of the unknown the healer takes agency over the known. He calls out to the 13 energies and addresses each by name. Today, these names take the form of Catholic and Christian religious figures. It is important to note that the concept of knowing and opening a channel of communication to the other side is what matters. The names called by the healers are never consistent, nor do they use precisely 13. This confirms that this healing method is meant to recognize, acknowledge, and then ascertain the seriousness of the condition—that this is a discourse with death requiring petitions and specific symbolic gestures. Finally, the healers always emphasize the need for urgent action. *Susto* and related illnesses such as anemia, forms of malnutrition, metabolic acidosis, and shock advance slowly. Neither the afflicted nor their family notice the slow accumulation of symptoms until something about their behavior makes it undeniable. By then, it may be too late. The healer is always working against the clock in order to save the personhood, not the body.

"It seemed she had a doll inside of her trembling.":

A man came to me and asked if I could help his wife who appeared as though she had a little animal inside of her. She was dying of pain and her husband had no medicine to give her. She had been in bed for 3 years with ranxel, but the husband's call was about the pain. When I got there her stomach was trembling. She had a doll inside of her stomach put there by witchcraft... what seemed to be a doll. When something like this is inside the stomach it is witchcraft. When something happens with bloating and major pain in the stomach it is important to move fast and we can save them, although it is only with plants we can cure them. (Healer, 2011)

For the Poqomchi' and the ancient Maya dolls and mannequins serve as a metaphor for something meaningless and chaotic. The state of chaos is emphasized because the doll is shaking. The illness is vibrating out of step with the body and therefore abnormal and objectively separate from the body. Dolls can be used to fool people who are not paying enough attention, lacking the knowledge, and do not recognize the illness could be tricking the healer and preventing him from identifying the correct provocation. For the Poqomchi', dolls have some essence but lack the essence of being human, which is the ability to produce meaningful symbols, sacrifice, and give thanks. Dolls are often implicated in witchcraft, especially highly taboo dark magic where people try to trick and manipulate ambiguity for material gain. It is important to note that the healer qualified his observation by saying, "what seemed to be a doll." This suggests that the healer's emphasis is not witchcraft itself, but the nature of the condition as tricky, unexplainable, objective, and potentially fatal. Finally, the husband's initiative to call the healer only when sickness becomes hopelessly unbearable speaks to how the Poqomchi' experience the threshold between normal and abnormal in the context of illness.

"It may be hard to cure.":

I told the husband to go and buy some *copal pom* [pine resin incense] and a candle so we can see our work. We burned a pound of *copal pom* through midnight. I also prepared medicine. For her, drinking *copal pom* boiled in a cup of water. A healer will prepare the copal pom like a small doll. He puts it in the water. If it sinks to the bottom it will be easy to cure the person. If it floats up to the top this is the signal that it will be very difficult to cure. (Healer, 2011)

Copal pom (in Poqomchi' the term is *sib'ineel*) is the same tree resin described in the Maya creation story that kept the head of One Hunter conscious, tricked the Death Lords into thinking Blood Woman had been sacrificed, the primary object of sacrifice the Death Lords would be allowed to receive, and used by grandmother to acknowledge her corn and connect with her grandsons. In the creation story copal was fashioned into the shape of a human heart to aid the

ruse. Above, the healer is making the allure of the copal irresistible by giving it anthropomorphic form. The Lords on the other side are just as susceptible to the ruse of a doll, mistaking the doll for the human being. If the doll sinks when placed in the element of water then it is being readily accepted by the energies on the other side. If not, the offering is less effective and without a strong connection healing will be difficult. The Maya practice of using copal is commonly described as warding off evil spirits or inviting good spirits by taking the place of blood sacrifice. However, for the healers copal serves to open a dialogue with the “spirits” by establishing a deep connection between the two worlds through a channel of symbolic blood. This type of healing work with the thresholds of death is best done in the deepest part of the night. Ancient Maya and Poqomchi’ today perceive this time of the night to be the optimal vantage point from which to scan the complexity of the unknown and the dimensions of 13 energies. This time of night in Onquilha’ is ritually active for healing and even for more formal religious gatherings. Initially, it may sound absurdly unhealthy to consume pine resin. However, there is sound biological reason why this practice is actually curative for people with severe anemia, sepsis, and iron deficiency. This will be further discussed below in the subsection titled, “Eating Ash: Pica in the Context of Chronic Anemia.”

“Two sicknesses, one I can cure and the other returns, it is not from here.”:

You see it in their face, they don’t eat, very pale, very dry, there is no more muscle, there’s no more body, and you see in the abdomen that is inflamed and moves, it moves, something inside gives the sickness, if you touch it they have pain. This sort of stomach pain comes from witchcraft, so there are really two sicknesses. The stomach pain you can alleviate normally but it returns again. There is a thread that stays in the throat and goes down to the stomach; a bad spirit stays in the mouth, throat, and neck. This patient has ranxel, a slow pulse that goes thud—thud—thud and jumps. This is nothing normal. This is not normal susto. It is susto from there [he pointed up to the sky without looking]. (Healer, 2011)

The healer is exposing an awareness of chronicity and recurrent severity of symptoms. He is identifying the severe physical symptoms of malnutrition: an exterior body that is wasting away

and an internal body that has already become irrevocably damaged. With severe anemia and illness, damage to the body's organs caused by hypoxia is not curable. This emphasis on chronicity gets at the literal and metaphorical depth of the condition. The cosmic complexity and corporal internality of the condition leaves only the possibility of managing the symptoms until death. The thread symbolizes a permanent link to the cause of sickness and the return of more severe symptoms.

“We say the names so we know we know.”:

For very strong susto I call to the vein on 8 different days to 13 names . . . San Pablo, San Lucas, San Pedro as I had said before. I blow twice in each wrist. First, call the name of the person. This ranxel is for calling to God, for calling those that are named by God. First we call the patients name, then we call to everybody asking where the patient is. “Is she there, are you keeping her there? We think maybe it might be good if you all return her to us, perhaps, instead of her staying there.” We call most to the Father in Heaven so that we know. This is to confirm we know. They say that he is our Father, the Father for the whole world. This is why we mention the name Jesus, the Father, the Son, and the Holy Spirit. We mention all the 13 names. One of these nights she got up to go to the bathroom and then came back and the intensity of her pain had gone away. The next day she awoke, lying in bed, with no pain. It's a lot of work. You will do this over 8 days, every night burning the copal pom and preparing it in a drink. (Healer, 2011)

The healer's comments reiterate the importance of knowing the names of those on the other side. More importantly, the healer confirms that the Poqomchi' “know they know” by speaking the names out loud. By knowing the names the energies are “invited” to be a part of life on earth. Energies are to be appeased indirectly and without confrontation, which forces the petitioning healer to control his emotion and behavior in the face of divine chance. The healer speaks into the blood stream. He merges his words into the blood through the convergence of blown air against the wrist. A healer's request is never direct because a direct request can be denied. The healer is asking the energies for the possibility that the energy of the afflicted person might return. Thus, the healing process is resigned to the subjunctive mood of hope and desire. For the Poqomchi' and in scientific terms energy is only indirectly observable. The healer's belief that

energy can be called back into the system is supported by the law of conservation of energy, whereby energy is neither created nor destroyed, but is transformed between spaces. The Poqomchi' perform the calling of names on 8 different days. For the Poqomchi', the number 8 represents a point at which the direction turns towards harmony. It is the symbolic equivalent of beginning an easygoing ascension to recovering. If the healing process were going to be effective it would be known on the 8th day.

“I’m not going to hide what I know.”:

I can say that I can or say that I cannot cure something. With all the 13 names we are successful. I am successful and that is why I do this work, with *susto* I succeed. A patient gets better. I am successful and that is why I call upon all the names, however many apostles there are. I am explaining to you what I know. I am not going to say that I will hide what I can do. I can cure. I can cure all these sicknesses. I have it here [gesturing with a flat hand over his chest]. I have it guarded and stored. I’m not going to hide what I know. This is the message I have. (Healer, 2011)

These comments were an extremely bold affirmation spontaneously given by a healer at the end of an interview. He testified to his knowledge and a lifetime of successful healing. However, his sort of knowledge is not contained as thought in the head. The healer is guided by his own soul, spirit, or energy. In turn he is directing his own energy to interpret the sickness and find a cure. The comments also suggest that the healers' credibility is currently being questioned by both Maya and non-Maya. As the community opens its arms with suspicion to Western biomedical clinicians and nutrition projects, the people of Onquilha' are faced with what appears to be two competing systems. A tension is rising between local healers and medical doctors who are competing for the same altruistic cause—that is, to heal the sick and cure anemia.

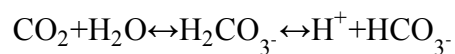
Part II: Contradictions Revealed from Understanding Anemia in Context

The Poqomchi' and other Maya communities are frequently criticized by outsiders for beliefs and behaviors believed to contribute to the perpetuation of anemia, which results in a perception by outsiders that attempts to improve Poqomchi' health are futile. However, these

perceptions originate from a Western biomedical understanding of anemia as a mere symptom that is acute and/or chronic, mostly non-recurring, and caused by a single etiology, and/or in a clinical and static context. A key component to understanding and resolving contradictions between Poqomchi' and Western medical understanding of anemia is consideration of the context in which mild, moderate, and even severe anemias are normal. In Part II of this chapter I explore five themes that Western standards consider harmful to anemic individuals. These themes include the following: 1) diet, 2) indoor cooking fires, 3) consumption of non-nutritive substances (pica), 4) the use of the *temazcal* (dry sauna), and 5) the hot-cold duality. In the early stages of drafting this dissertation these themes were framed as contributing factors to anemia. However, upon deeper examination and given a new understanding of the fragile physiology of anemic individuals, these themes demonstrate resilient strategies for accommodating chronic anemia, illness, and the risks of homeostatic imbalance.

In Chapter 7 the physiology of anemia was framed in the context of a diminished O₂ delivery platform and fragile homeostatic thresholds. These conditions subsequently demonstrated the progression of chronicity through conditions such as hypoxia, acidosis, and shock. These explicit conditions were examined in the context of parallel behavioral and cultural accommodations by the Poqomchi': 1) holding one's breath, which increases oxygenation and acidity and 2) avoiding sweat, which signals that the body has become too acidic and crossing thresholds of homeostatic balance to the point where body temperature could become dangerously high. In order to manage the risk of hypoxia, reduce acidosis, and prevent shock the Poqomchi' must have accommodative strategies that balance pH. This has to be a metabolic response that raises pH throughout the body following activity under conditions of anemia that has increased pH. The chemical equation below (Equation 8.1) shows the different forms that

CO₂ in the blood might take. Carbonic acid (H₂CO₃⁻) is represented in the middle, and is a mild acid. On the right is bicarbonate (HCO₃⁻), which is the body's primary form for transporting CO₂ to the lungs. HCO₃⁻ also neutralizes the H⁺ (free hydrogen ions) that is highly acidic. HCO₃⁻ can protect the body from acidosis. HCO₃⁻ is normally secreted from the kidneys but may be insufficient, and therefore oral consumption can compensate. The concentration of H⁺ ions is the primary determinant of pH. Acid accumulates in the blood via either route that transports CO₂ (H₂CO₃ or H⁺ + HCO₃⁻). This equation reflects the biological accommodation of anemia in chemical form. This fragile balance at times may extend beyond the realm of known control by the Poqomchi'. But, they have adapted several strategies outlined below that do allow them to manage and navigate this precarious balance through a buffer system.



Scholars have written about cultural themes in other Maya populations that are similar to those discussed in Part I and that will be discussed here in Part II (García et al., 1999; Authur J Rubel, 1964; R. Wilson, 1995). However, most of the research related to Maya nosological concepts focuses on descriptive data as psychosomatic or phenomenological—not in the context of specific pathology endemic to a community and ecology. Similarly, there is a wealth of scientific research on the biology of anemia, but mostly correlation studies. Such research is helpful for answering limited research questions, but because it is bound by a narrow framework the findings are often not broadly applicable to real world contexts. The rigor of the scientific method safeguards against mere perception of speculation or essentialism, but shrouds the complexity of anemia under the safe cover of a limited scope, variables that are only theoretically and/or statistically isolated and controlled, and the removal of experiential and ecological contexts such as place, time, personhood, and movement. Here I avoid these pitfalls

by focusing on the experience of anemia in context, wherever it may be found. In order to temper speculation, I identified empirical evidence across disciplines and subjected it to rigorous comparative analysis. The five themes discussed below demonstrate a salient synergy between culture, biology, and biocultural accommodation of anemia.

Tortilla and Diet: Essential Threshold Regulator

One clue as to how the Poqomchi' experience anemia can be found by examining their diet and how it contributes to optimal equilibria. Poqomchi' women frequently asked me, "¿Come tortilla?" ("Do you eat tortillas?"), to which I answered yes. The question was posed similarly to how people in Western societies might ask, "Are you drinking water?" or "Do you exercise?" The purpose of these questions is to get an idea of the respondent's physical health. The Poqomchi' follow with another question: "How many tortillas do you eat?" To which I would reply by saying that I ate 6-8 tortillas at a meal, which is a lot, and my questioner was always satisfied with that response. The women would quickly point out that they only ate 2-3 tortillas. Then, in casual conversation the women would account for how many tortillas were eaten by every family member. A strict rule of thumb among the Poqomchi' is 3 tortillas for women, 5 for men, 2-3 for children, and ½-2 for young children. This is not about diet as nutritional components, instead: this is about diet as a foundation of health. This section discusses the cosmological significance of corn for Poqomchi' identity, time, and order. It also covers the process of removing acidity from corn and their broader diet.

A Poqomchi' woman stated with defiant frustration, "People today are wild children because they do not know who they are, they don't follow the ancestors." She was referring to the belief that children should be raised according to their unique cosmic identity, a practice still followed today but not as extensively as in the past. The Poqomchi' use the 260-day *Tzolk'in* calendar for religious and symbolic purposes. It is for all cycles of time related to being human.

The *Tzolk'in* calendar moves in two synchronous cycles of 20 and 13. There are 20 days (known as *nawaal*, an elemental unseen internal spirit of the individual) and there are 13 numbers (known as energies, also referred to as intentions or vibrations). Any of 260 combinations of these two cycles, i.e., any given day in this calendar year, represents a unique permutation of time and space. The day a human being is born is a particular combination of individuality and universality, which determines the personhood of the each human being. For the Poqomchi', time and personhood are synonymous because one's day of birth is also one's footing in the current of life. Because 13 marks the end of a cycle and leads to 1, the conceptualization of 13 and 0 are often the same. This concept can be visualized in the sequence of ...13-0-1..., zero is the transition between the end and beginning.

Zero is of cosmological significance because it is one of the first four human beings created in the Maya origin story of the Popol Vuh (Tedlock, 1985, 1996). Zero is a placeholder in the Maya numerical system and it is represented as a shell. The shell symbolizes the opening and transition to the otherworld and the ancestors, and the soul of the living if it begins to drift into death. The shell is the center among a multitude of directions and a doorway that is responsive to the actions of the living. It is through this channel that the names of those who reside on the other side came to be known. Zero, seed, and shell are synonymous and interchangeable symbols. A seed is conceptualized as yet nothing, but the origin of everything. A seed can also be visually depicted as empty space—as a hole in the earth representing the space where life and everything begins. The seed is nothing but unknown. This is another reason the healers must complete the naming of 13 names in addition to “knowing” the names. This ritual process opens the doorway to infinity, nothing, universal energies, a renewed cycle to begin the stages of healing, and the other side to begin a discourse with the unseen arbiters of chaos and

disorder. This is where the ancestors and supernatural beings play in a whimsical way with the outcomes of human life on this side. The Poqomchi' believe they are created from corn dough, not corn seed. The seed, which is simultaneously nothing and the possibility of everything, is made into dough from work. The first successful attempt by the Gods to create human beings would thrive from blood (Tedlock, 1985, p. 83). Corn is the bridge between ancestors and energies and the living through the blood. Corn, blood, the other side, ancestors, and the energies are all connected.

Corn is the most significant part of the Poqomchi' diet in the form of tortilla. However, corn is acidifying, until *Cal* (calcium hydroxide, a highly alkaline earth metal) is added in the process of preparing the dough known as *nixtamalization* (Gutiérrez-Dorado et al., 2008; Katz, Hediger, & Valleroy, 1974). *Cal* is in great supply from local quarries. Its addition to corn contributes to raising the pH of tortillas and subsequently the body. They soak the corn in lime water to detach the undigestible skin from the kernels. The Poqomchi' follow a strict diet of eating 9-15 tortillas each day, 3-5 during three daily meals. *Cal* may even be consumed raw as is needed or craved, most commonly by women and children. This base, when ingested into the body, would increase blood pH by increasing the bicarbonate buffer (Table 8.2). This is likely the reason why the Poqomchi' think of corn more as the body's structure. It is not necessarily considered *aliment* (Mayanization of the Spanish word "alimento", nutritious, good things in food). The Poqomchi' commonly explained that the reason they became ill was because, "all we have to eat is tortilla, so there is no food." The seeds of maize, consumed as tortilla, are who they are in terms of physical existence. Tortilla feeds the body, but more importantly the spirit, directly through the maize in the blood and a connection across time to their ancestors. Therefore, maize reflects the idea of continuity, stability, and sustenance.

Table 8.2.
Nixtamalization makes bicarbonate available to blood after three stages

Stage	Process Description	Chemical Notation
1	<i>Cal</i> (Calcium Hydroxide) is added to corn soaking in water.	$\text{Ca (OH)}_2 + \text{CO}_2 + \text{H}_2\text{O}$
2	The calcium ions draw in carbon dioxide from the air and form calcium carbonate.	CaCO_3
3	Calcium carbonate in the stomach combines with the protons from hydrochloric acid to form bicarbonate.	HCO_3^-

The ancient Maya and their descendants follow a diet that is basic (high to neutral pH). Western diets tend to be more acidic. The importance of an alkaline diet, especially for those who are anemic, is generally overlooked and focus is placed on nutritional content. All foods are either acidic or alkaline outside the body, but what is most important is what occurs inside the body in a pH relative context. Acidic or alkaline foods outside can have the opposite effects inside, acidic=alkalizing and alkaline=acidifying. This is because vegetables contain acidic moieties (parts of molecules) that are converted to their conjugate bases in the body.

The Maya's basic diet consists primarily of corn and beans, which are both made alkaline and alkalizing through preparation and simultaneous consumption. They prefer fruits such as lime, avocado, and pineapple, which are three of the highest alkalizing fruits. They avoid acidifying fruits such as plums, berries, and bananas. If they do eat fruits that are considered acidifying, they eat them unripe, which gives them a much higher pH than ripe fruits. This also means that the fruit will be free from worms, bacteria, and fungus. Their preferred vegetables are also some of the most alkalizing such as greens, broccoli, and cabbage. The Poqomchi' consume no dairy, which is one of the most acidifying categories of food. They prefer their own creole breeds of turkey and chicken. The meat composition of both fowl is more similar to game birds and they are raised free range. This gives the meat a substantially higher pH. For additional

protein they prefer highly alkalizing eggs over other rarely eaten and relatively expensive meats such as beef, fish, or pork. The Poqomchi' also insist on only using unprocessed sugar and sea salt, which are locally produced. Both are alkalizing, unlike processed sugar and table salt. Chili is commonly used in all meals, which has a strong alkalizing effect in the body, but otherwise is acidic. Coffee is another common food that is generally thought to be acidic; however, the way the Poqomchi' prepare it with the grounds neutralizes the pH. I did not identify any acidifying foods consumed regularly by the Poqomchi' of Onquilha'.

This basic diet has an alkalizing effect upon the body. Release of O₂ by Hgb is a pH-dependent process. As pH decreases due to CO₂ buildup and the proton donating ability of carbonic acid formed as a result, along with protons present due to diet, O₂ is released by Hgb. An acidic diet would further lower pH and increase O₂ release by Hgb. The Poqomchi' basic or neutralizing diet continues to raise pH in the blood even in the presence of increased blood CO₂ levels. A higher pH value results in less O₂ release to the tissues, but this happens while at rest, sitting during a meal. No physical work is being done that would require greater oxygenation. In the context of chronic anemia, the effect is greater and the experience would be more pronounced because less Hgb is available for O₂ uptake and release. In total, the combination of a basic diet with anemia has a more profound effect on increasing pH and reducing acidity in the blood while at rest, then allowing time for blood pH to neutralize just before work.

Eating Ash: Pica in the Context of Chronic Anemia

In my fieldwork I identified three distinct nonfood substances that the Poqomchi' consume on a fairly regular basis. These include ash from around the cooking fire, spent coffee grounds, and *copal pom* or pine resin. The exact cause or purpose of pica (eating nonfood substances) is unknown (Sera L. Young, 2010, pp. 404-406). Most research frames pica as a pathological disorder (Decker, 2013; Parry-Jones & Parry-Jones, 1992, p. 351). The general

consensus is that pica is evidence of underlying deficiencies in specific nutrients (Sera L. Young, 2010, pp. 407-408). Almost all research on pica finds an association or correlation between pica and poor health conditions such as anemia or parasitic infection. Studies showing correlations between pica and poor health consistently make the error of assuming causation (Kawai, Saathoff, Antelman, Msamanga, & Fawzi, 2009, p. 36; S. L. Young et al., 2007, p. 771). Thus, pica is frequently portrayed as a probable cause of many different illnesses.

Pica takes on a very different interpretation in the context of chronic anemia and the continual threat of acidosis. Research has shown that most pica substances throughout the world are alkaline (M. Wilson, 2003, p. 1525). Johns and Duquette (1991) demonstrated how clays prepared with acorns are detoxifying similar to clay consumption alongside potato based diets (Johns, 1986, p. 635). Several studies have shown convincing evidence that pica functions as a sort of antacid for dyspepsia (Frankel, 1977, p. 124). The most promising area of research has demonstrated a very broad increase in function and protection of the gut from pica (Sera L. Young, 2010, pp. 411-412). Protecting the gut is crucial in the context of chronic anemia, especially from pH imbalances and sepsis. However, because these nonfood substances are ultimately absorbed into the body and carried in the bloodstream there is a high possibility that pica serves a deeper metabolic function for those with anemia.

The first form of pica commonly reported by the Poqomchi' was that children and sometimes women eat earth from around the fire. This was frequently mentioned in the focus groups as a symptom of lacking fuerza. Among the Poqomchi' and with local medical practitioners the substance is referred to as earth or dirt. However, they are actually eating the accumulated wood ash from the fire ring. Wood ash is highly alkaline. It also contains a significant amount of carbonates, or metal salts, including: sodium, potassium, and calcium, as

well as trace minerals including: iron, magnesium, and manganese (Misra, Ragland, & Baker, 1993, pp. 103-104). The alkalizing effect of ash would be sufficiently beneficial to someone with anemia, but the range of salts and minerals would also help the body and blood in numerous ways. Because these salts and minerals are organic they are more easily absorbed and do not interfere with absorption of minerals such as iron when ingested as an organic complex (Conceição, Machado, Izumi, & Freitas, 2008, p. 2). In context, try to imagine a small child with mild anemia inside a smoke filled home causing the environmental CO₂ pressure to be high. The same child has also likely accumulated significant amounts of COHgb. The CO₂ pressure is causing O₂ to associate strongly with Hgb, which makes oxygenation difficult. The COHgb is reducing the overall O₂ carrying capacity. The child feels discomfort as oxygenation of the body becomes more difficult. Pica, the consumption of a bit of ash, is a ready source of carbonates, phosphates, and other essential salts and minerals that can be easily absorbed into the blood and facilitate oxygenation.

The second form of pica is somewhat discouraged. During extremely difficult births, women are encouraged to consume only used coffee grounds. Women do this for as long as two weeks before or after the birth. Also, midwives or family members may pack the inside of a woman's vagina with used coffee grounds. In laboratory studies, used coffee grounds are known to have a high capacity for buffering acid, neutralizing pH, and chelation or removal of toxic elements (Macch, Marani, & Tiravanti, 1986, p. 431). The grounds contain significant amounts of nitrogen, phosphorus, potassium, calcium, and magnesium. Nitrogen may be effective in preventing preeclampsia and difficulties in childbirth by decreasing oxidative stress (Myatt, 2010, pp. S66-S67). In 1966, Benesch & Benesch discovered that organic phosphates (2,3-DPG) have a profound effect on the affinity between O₂ and Hgb (1979, p. 115). Inorganic phosphates

are plentiful, especially in soils, clays, and ash. In the body, organic phosphates form as an ester of inorganic phosphates and inside red blood cells this would facilitate the functioning of Hgb.

The third form of pica is the consumption of *copal* or pine resin. The resin is boiled with water and drunk warm. It is given by the healers to people who are suffering from *xowanik*. The Poqomchi' word for copal is "sib'ineel", which shares the same root "sib'-' as two other illnesses. These illnesses are frequently diagnosed as secondary to *xowanik*. The first of these two illnesses is *sibjeel*, which is known in other areas of Guatemala as *hijillio*. The symptoms are very similar to kwashiorkor (inflammation in the legs, cheeks, and belly button). The second illness is *siponal* or *sipón*, which is known in other areas of Guatemala as *uxeel*. The symptoms are very similar to marasmus (described as wasting and hair that pokes up). Tree sap and its solidified form resin contains significant amounts of magnesium, calcium, manganese, phosphorous, and potassium (Dambrine et al., 1995, p. 233; Glavac, Koenies, & Ebben, 1990, p. 47).

Hgb in animals has a similar function and structure as chlorophyll in plants. The major difference between the two is that Hgb is structured around iron and chlorophyll is structured around magnesium (Lewis, 1996, pp. 4-5). Due to these similarities, magnesium has many beneficial effects on blood and metabolic pathways that are similar to iron and can in fact substitute for iron (Robscheit-Robbins & Whipple, 1930, p. 400). The benefits of magnesium would be especially noticeable in people who were suffering from iron deficiency and anemia. One study found that an increase in magnesium intake reduced the risk of anemia twice as much as an equivalent increase in iron intake (Shi, Hu, He, Yuan, & Garg, 2008). The same study also found that preexisting levels of iron in the body inversely moderated iron intake but not magnesium. This suggests that magnesium may be able to override iron absorption limiting

conditions such as inflammation or disease. There is a small but growing body of research that suggests magnesium has a crucial partnership in most areas where iron and Hgb is a primary moderating factor such as in ischemia (Barbagallo, Dominguez, & Resnick, 1999), gas balance and transport (De Rosa, Carelli Alinovi, Galtieri, Russo, & Giardina, 2008), mitochondria function (Willcocks et al., 2002), and numerous other domains that manifest symptoms of severe anemia.

Indoor Cooking Fires: Healing the Body during Sleep

The Poqomchi' consistently cook with indoor cooking fires, which are constantly burning in the homes to various degrees. The idea that indoor cooking fires could be beneficial seems absurd. Many organizations throughout Guatemala are dedicated to eliminating these fires due to perceived health risks. This perception stems from our understanding of carbon monoxide (CO) in smokers and carbon monoxide poisoning. However, studies have not shown any significant detrimental impact.

Research has only demonstrated mild asthma and respiratory problems to be associated with indoor cooking fires (Boy, Bruce, & Delgado, 2002, p. 109; Engle et al., 1997, p. 416; Neufeld et al., 2004, p. 116; Schei et al., 2004, p. 110; Smith-Sivertsen et al., 2009, p. 211). A review of studies on the effects of mild exposure to CO in human beings found that COHgb levels below 18% did not result in signs or symptoms of intoxication (Stewart, 1975, p. 409). The Poqomchi' are exposed to most smoke at night, after dinner and before bed, during digestion and rest. Most research and understanding of CO's detrimental impact to health is while awake when energy demands high. For the Poqomchi', environmental exposure peaks just before bed shortly followed by COHgb peaking as well, just when metabolic function alters for sleep. Through the night the intensity of smoke tapers off and the COHgb would slowly disassociate, keeping the pH in the blood low allowing for oxygenation throughout the body. This is not the

only benefit. Recent research suggests that CO interacts with nitric oxide (NO) and hydrogen sulphide (H₂S) in wood smoke with many healthy effects while sleeping for a person with anemia. Within the cardiovascular system, for example, all three gases together are vasodilators, promote angiogenesis and vascular remodeling and are protective towards tissue damage in, for example, ischemia-reperfusion injury in the heart. Similarly, all exhibit complex effects in inflammation with both pro- and anti-inflammatory effects recognized. It seems likely that cell function is controlled not by the activity of single gases working in isolation but by the concerted activity of all three of these gases working together (Li, Hsu, & Moore, 2009, p. 386).

Smoke also creates an ambient atmosphere that has a high partial pressure of CO₂ (PCO₂), which is also good for loading O₂ into the body. It seems antithetical to suggest that increasing oxygenation of body tissue by manipulating pH balance occurs in sleep in a similar way as it does during work. However, an increase in CO₂ stimulates chemosensitive areas, which in turn alter many biological processes such as respiration for regulating gases supplied for metabolic function (Guyton & Hall, 2006, p. 516). There is a natural increase in CO₂ at night in a flora filled environment as plants switch to giving off CO₂ and taking in O₂. Early hominids enhanced this CO₂ rich environment by evolving nightly nest-building with fresh leaves that give off CO₂, evolving to benefit from sleep in a rich CO₂ environment (Coolidge & Wynn, 2006; Koops, McGrew, Matsuzawa, & Knapp, 2012). Sleep is an active process, but especially under conditions of chronic anemia. While the mind is at rest the body can utilize the extra energy to actively repair cells in the body, especially those cells damaged through acidosis and hypoxia. Carboxyhemoglobin and a high PCO₂ are beneficial sleeping environments for human beings with large brains. All of these actions are thought to cool the blood, when it is increasing pH

and/or neutralizing—being made more alkaline—but it is okay, the body is not in motion and not requiring as much energy.

Temazcal: Healthy Healing Sweat

A temazcal is a sauna-like sweat lodge with extensive history and current usage among Maya as a therapeutic treatment for a vast but specific array of illness and disease (Groark, 1997, pp. 3-6). The temazcal exposes a person to a smoky vapor combined with heat from outside the body that produces a more homeostatic controlled sweat. The Poqomchi' avoid sweat when working because it pulls the oxyhemoglobin dissociation curve back to the left and decreases oxygenation, but at rest after work while healing they need to shift the curve back to a healthy balance. This would be a huge benefit in context of chronic anemia, hypoxia, and acidosis, especially when compounded by other illness and disease (Gayda et al., 2012; Hannuksela & Ellahham, 2001; Radoff, Thompson, Bly, & Romero, 2013; Sobajima et al., 2012; Zinchuk & Zhad'ko, 2012). There are many plasters and poultices commonly used in Maya medicine that when applied to the skin function similarly to the Temazcal (can be hot or cold and applied to sicknesses that are hot or cold) (García et al., 1999, p. 166)

The Hot-Cold “Duality” and Other CO₂ Enhancing Behaviors

The representation of the concept of hot-cold is primarily discussed in research as an objective duality of artifacts, not as a balance of subjective individual physiological experiences. Research has focused on the idea that temperature is the first variable in classifying objects under this hot-cold system. However, by modeling the fragile physiology of anemia, where a very small change in pH has dramatic effects on homeostasis, it is apparent that pH balance is the essential variable. Almost all foods, emotions, environments, activities, as well as illnesses and diseases, are classified by the Poqomchi' as either hot or cold. The vast majority of these correspond with a pH increasing (alkalizing) or pH decreasing (acidifying) effect on blood.

However, there are two types of increase, one is a normal amount and another is an excessive amount that can lead to sickness and imbalance (Table 8.3). The discourse and cultural practices that balance these four areas correspond to four pH polarities: hot, very hot, cold, very cold. In the body these polarities can be felt directionally criss-crossing, linear or in any other sequence depending on the circumstances. It is possible that the hot-cold duality has been misinterpreted in research because the two degrees of each ‘hot’ and ‘cold’ and their contextual relevance has not yet been identified (Bourget, 2005; Currier, 1966; Messer, 1987).

Table 8.3.
Two types of hot and two types of cold in normal and excessive pH shifts.

Type 1: Hot-Cold Duality			Type 2: Very Hot-Very Cold Duality		
Polarity	pH effect	Result	Polarity	pH effect	Result
Hot	pH increasing (alkalizing)	Balance and comfort	Very hot	pH increasing (alkalizing) in excess	Imbalance and illness, alkalosis
Cold	pH decreasing (acidifying)	Balance and comfort	Very cold	pH decreasing (acidifying) in excess	Imbalance and illness, acidosis

There are many other examples of behaviors that would increase oxygenation and bodily comfort, whether formally ritualized or habitually customary. The Poqomchi’ generally try to avoid open space which is full of airs and winds. Swaddling of newborns up to two years of age maintains a high PCO₂ and likely has beneficial effects on fetal Hgb (Bard, Côté, Praud, Infante-Rivard, & Gagnon, 2003, p. e285). Similarly and to avoid air and winds, women and children frequently use a small blanket or their hands to cover and cup the mouth and nose, which increases moist CO₂ vapor. During special gatherings, ceremonies, and while a women is giving birth, the Poqomchi’ cover the ground or floor of a building with several inches of pine needles, which create comfort in a high PCO₂.

Discussion

Xowanik, susto, soul loss, fright, and shock are not arbitrary terms that accidentally describe experientially identical human illnesses. It is not a mere coincidence that the meaning behind these terms shares so many commonalities, starting at the broadest level with energy balance, blood, and O₂—essential elements of life. These terms and the body of knowledge behind them are based in known truths about what it is like to live inside the human body. This knowledge was discovered by finding homeostatic balance in a multitude of environments, proven through thousands of years of perpetual testing, and recorded in symbolic meaning codified within Poqomchi' culture. Analysis of xowanik and symbolic representations of illness alongside an understanding of the physiology of chronic and endemic anemia demonstrates the cultural experience of accommodating anemia.

There are illnesses that are thought to be culture-bound syndromes, which are psychosomatic and arise from particular conditions within a population. Anemia is real, it is an illness, or more objectively, it is a physiological state of being. Anemia is as bound in culture as it may be bound by culture. It both shapes and is shaped by culture. Xowanik and chronic moderate to severe anemia present nearly identical abnormalities. More importantly, in the early stages, both xowanik and anemia persist for some time because they are disguised as normal. If biomedicine and indigenous Poqomchi' medicine are really saying the same thing, how do we bridge these different symbol systems? The analysis in this chapter followed the thread that weaves through the common thresholds. These are the liminal areas of disorder where symbolic meaning is deep and rich. Biomedical and Poqomchi' knowledge were paired along parallel objective effects and viewed by a third criterion, i.e., movement through thresholds of experience, diagnosis, cause, and cure. Xowanik is a highly flexible framework for disease. The

biophysical experience of anemia varies for each individual, but along similar trajectories. The division of xowanik into ransil and ranxel reflects clear channels for navigating precarious health conditions. Anemia is not generally chaotic; life is chaotic and then anemia becomes unmanageable as fuerza is lost—when the person is lost, anemia requires another dimension of navigation though a perpetual liminality ending in death.

Cultural practices are not static units or objects to be defined. Culture is the population-specific and shared processes of interpreting the world. It is not sufficient to simply define anemia or describe and classify xowanik. In order to understand the experience of illness and disease it is necessary to analyze the process and movement that is afforded by culture.

Understanding that an entire cultural complex lives in a state of normalcy with a biomedically defined abnormality turns our perception of human behavior, physiology, and symbolic culture on its head. Together, they have a physiologically and culturally different experience with the most basic elements on earth. Their preferred homeostatic balance and sense of comfort are grounded in different areas of experience. What might be considered healthy for a population with higher average Hgb, may be unhealthy for a population with lower average Hgb.

With a more comprehensive understanding of the physiology of chronic anemia it is now possible to understand xowanik or susto in a way that is logical in Western biomedical terms. Xowanik reflects a sense of order established from local cultural knowledge of imbalances, abnormality, and disorder. This occurs within their cultural and environmental contexts, as well as within individual bodies and continual variation in metabolic response to energy requirements. All of the symbolic discourse on managing imbalance can be coordinated with the fragile physiology and regulating pH balance to adequately oxygenate the body and maintain homeostasis. Xowanik is typically associated with a particularly frightening event that is often

identified many months later. Thus, xowanik is one potential retrospective identification of an objective threshold at which the symptoms of anemia have accumulated beyond a normally accommodative level that is locally recognized by the Poqomchi'. In this way, the Poqomchi' accommodate the ambiguous symptoms of anemia into an objective and manageable form.

Conclusion

The Poqomchi' believe that children simply should not die from xowanik, because children do not just die. In discourse, healers suggest that if a child dies it is due to witchcraft, but not because the healer believes in a dark magic or is going to try and reverse a spell or curse. The healer references witchcraft as a discursive tactic or metaphor for the absurd and unworldly injustice of child death. The Lords of Death made a promise to their ancestors to take no more human beings before their time. The healers and the community are well aware that the origin of unjust death stems from their environment and the structural violence they endure on a daily basis. Xowanik and the prescribed cultural behaviors of the Poqomchi' are folded into the rituals of daily life and they objectify this in a Christianization of an ideology derived from the Lords of Xib'alb'ah. A function of ritual and rites is, "putting at the service of the social order the very forces of disorder that inhere in man's mammalian constitution. Biology and structure are put in right relation by the activation of an ordered succession of symbols, which have the twin functions of communication and efficacy"(V. W. Turner, 1969, p. 93). The ambiguity of poor health, but more importantly the ambiguity of declining health experienced by a community member gives that person a liminal status. Illness is expected to be named, treated, and eliminated (Gardner, 1998; Wittgenstein, Pears, & McGuinness, 2001). Any affliction, like anemia that does not follow this tripartite process becomes problematic.

The evasive and complex nature of its symptoms and how it advances synergistically with other illness can cloud identification of the cause. Turner brings up the notion of liminality as a time of existential and ontological questioning. It is a chance to 'juggle the factors of existence' and solidify the meaning of one's place in the cosmos. In this section he considers liminality to be a sort of healthy therapeutic situation, but only when coupled with an end or final state following the liminal period. However, chronically afflicted or constantly fearful situations do not allow for an exit strategy from ontological chaos (V. W. Turner, 1969, pp. 105-106). One potential exodus from liminal status is the healers' and the family members' contribution to the anemic individual's awareness and knowledge of the coming order (Janzen & Arkininstall, 1978). The healer rallies the family, pushes with urgency, and identifies the expectations of normal behavior that should come. Without this education, ambivalence becomes chronic as does liminality.

The nosologies presented in Part I and the behaviors presented in Part II are part of the individual physical, or lived, experience of anemia (Scheper-Hughes & Lock, 1987). As social symbols they become part of a codified text which informs the appropriateness of behaviors and physiologic status of the biological organism. These are signs used to navigate through tensions of states of being. It is part of a codified text by which individuals interpret their well-being, framing the very identity of the Poqomchi' as well as their image of themselves. Observations of everyday objects, conditions, behaviors, and of their representation in discourse that may alleviate the symptoms of anemia illuminate the experience of anemia as a social process of navigating and accommodating the ambiguous space of an always changing illness.

Chapter 9. Navigating Biocultural Thresholds through Processes of Accommodation

The experience of anemia among the Poqomchi' is portrayed in this work as the navigation of a biological matrix in the context of structural violence. The Poqomchi' are guided through thresholds by processes of accommodation that span physiological and cosmological domains—between cell and symbol. There is a causal and symbiotic relationship of structural violence to the prevalence, chronicity, and endemicity of anemia among the Poqomchi'. Long stretches of history and human organization have erased awareness of the contextual complexities involving an environment which does not provide adequate resources for the Poqomchi'. Anemia is biologically, culturally, politically, and historically complex; and, Western biomedicine overly simplifies a pervasive human biology that leads to poor health for billions of impoverished people worldwide.

An inevitable result of studying anemia in social vivo, unlike in a lab or clinical setting, is that the subject is always in motion. For the person afflicted with anemia, moving through a biological matrix is a process of managing entropy. This process is observable when people come together through culture and confront the abnormality of illness and disease in discourse. I have referred to this process as a sort of navigation of thresholds. Thresholds are all a manner of equilibria or balance where outcomes change physically, mentally, and by symbolic designation. Anemia is conceptualized by Poqomchi' as a chronic and endemic tenuous hold on 'force' manifested in daily activities. In essence, anemia is about the human body's relationship with life in motion. It is about air, energy, and homeostasis. It is about comfort in physiological equilibria, awareness of the responses in behavior, and cultural prescriptions for accommodating the body in space across subjectivity in time. It is about constantly shifting biological baselines in the context of the body and its environment. It is about work and rest, within which a "current"

physiological status is desirable. Analysis of these spaces interpreted the experiential ranges of biological and cultural movement, as the continuity of anemia's thread through and across life.

I had no intention of focusing on the experience in any specific spatial domain, but rather to identify fluidity through interrelated phenomena pertinent to the experience of anemia. Steering through thresholds in this navigable space is a biologically and culturally liminal experience that requires fluidity. Moments where symptom and situation intersect are perceived in both the indicative "As-is" and the subjunctive "As-if" and reversals of reality play out between the two (V. W. Turner, 1986b, p. 33). With awareness that their affliction is a result of who the Poqomchi' are, their symptoms of anemia are woven in words through realms of both reality and play. Individually, they manage with mild-to-moderate anemia. However, the experience moves from normal to abnormal as moderate becomes severe and/or compounds with other illness. But even the abnormal is normalized as severe anemia loops into social scripts of loss and death and a shared narrative of suffering. Normal and abnormal are useful concepts, but only relative to the relationship between objects in a particular space, otherwise they are also shifting baselines. The Poqomchi' are thriving in the face of a fragile physiology and difficult environment through the continual process of normalizing—accommodating the abnormality, chaos, and disorder in search of balance. If balance cannot be achieved by the individual then the process is carried on by the community.

Under colonial and post-colonial structural violence the indigenous people of Guatemala lost a great deal of their own cultural know-how. Agency of the communities was seemingly stripped and placed into the postcolonial agricultural economy. Looking inward for solutions leaves both the individual and the community at a loss for meaning. Reaching out to the Spanish postcolonial society, the Maya encounter symbols with no meaning relevant to them or reference

to positive Maya self identification. Rather the symbols reify what a Maya woman will experience in a biomedical health clinic; she will be chastised for being dirty and not taking care of her kids and in light of having no money to purchase medicine or treatment will be given no solution to her problems. She will be identified by the proverbial and archetypical construct of the sick, dirty, poor, and lazy Indian, which paradoxically is symptomatically related to anemia.

Summary of Results

My analysis of ethnographic data was largely shaped by three questions that arose by chance during fieldwork: 1) Are nearly all of the Poqomchi' anemic?, 2) Why do they hold their breath when they walk? 3) Why do they avoid sweating? These questions served as clues to understanding the physical nature of anemia and how behavior and discourse would be related. The core chapters examined the prevalence, discourse, physiology, and broader narrative and nosologies of anemia (Chapters 5, 6, 7, and 8). The results of these four chapters demonstrated the thresholds of anemia through a conscious recognition of dualities such as acute-chronic, normal-abnormal, mild-severe, and living-dying. Themes were shared across chapters as they are across spatial domains such as movement, work, breathing, sweating, domestic life, and diet.

All school-age children were diagnosed with anemia, meaning they were below 11.5 g/dl in Hgb. The mean adjusted Hgb was 9.74 (N=87), which indicates a severe public health problem. Adjustments to Hgb data based on indoor cooking fires and altitude were made and demonstrate the impact of environment on O₂ carrying capacity and the biochemical nature of blood and gas. Even if adjustments were not made, 84% of school-age children would be classified as anemic and this would still constitute a severe public health problem. This study of the prevalence in Onquilha' is unique in research as a study of anemia in a single community. It

demonstrates that anemia is ubiquitous, endemic and chronic, in Onquilha' and in all likelihood occurs this way in certain pockets throughout the world.

The narrative data suggested that the Poqomchi' interpret anemia in a broad range of categories. Reflecting the difficulty mentioned above with objectifying invisible and/or changing symptoms, illnesses and diseases tend to blend together and culminate in descriptions of advancing systemic biological failure and death. In discourse, this blending advance and its avoidance revolves around their construction of the concept of fuerza, which is perceived as tenuous. This concept is subjectified in discourse about their routine movements and activities such as walking, eating, and socializing. It is delicately objectified at certain culturally known thresholds in additional discourse about the blood and body. In search of cause for symptoms that have suddenly become recognizably abnormal, the loved ones of the afflicted identify a provocation, a forerunning insult causing imbalance. Whether real or magic, their concern is the cascading effects on the body and balance of a fragile physiology. The Poqomchi' apply this discourse selectively and differently to children, women, men, and the elderly. The exchange of this information allows for a more urgent level of discourse concerning the treatability and survivability of individuals—is the time of death here? They are aware that maladies resulting from anemia could happen to any of them and as a result are not generally accusatory or blameful toward individuals and households that succumb to illness and disease. Together, they share an overarching and summative notion of suffering collectively for who they are as Poqomchi'.

This dissertation achieved a better understanding of how chronic anemia affects the body in motion, working, sleeping, in certain environmental or emotional contexts, and the in presence of other illness and disease. This analysis was spurred by the idea that contradictions in our

understanding of anemia arise from a Western biomedical model of anemia as individual, demographically isolated, acute, clinical, and a secondary condition that is easily treatable. At first, certain statements and behaviors of the Poqomchi' did not make sense—holding your breath while walking seemed counterintuitive for a person with deficient O₂ supply. This framework of anemia resolved such contradictions by demonstrating how the Poqomchi' manipulate CO₂ levels, pH balance, Hgb function, and homeostatic setpoints and thresholds in order to improve oxygenation. However such achievements come at the cost of accumulated acid in the body. If this acid is not remediated and regulated, then the condition of anemia can give way to more serious illness; both acute and chronic hypoxia and acidosis will contribute to death. The greatest threat is to children and women who could slowly succumb to shock, which can advance to an irreversible spiral. For this pathology, overheating from work can be dangerous, and sweating is a sign that homeostatic balance is upset. The oxyhemoglobin dissociation curve provided a visual model for understanding how circulation and energy balance is a fundamentally different experience for the Poqomchi' and their unique O₂ delivery platform based on lower Hgb levels. These biological setpoints and thresholds are consciously experienced in an extensive range of dualities that drive a host of accommodating behaviors, emotions, activities, ambient space, and the broadest spectrum of rules to live by.

Understanding the experience of anemia and where it becomes recognized by the Poqomchi' as abnormal, grave, and extraordinary required a deeper analysis and linkage of their broadest metacognitive causal theories. At this stage of advanced anemia and compounding illness and disease the Poqomchi' are directly facing death and engaging in a discourse that brings rational order to untimely chaos. The person is lost or nearly lost through the displacement of energy and loss of their temporal essence. The carbon structure of the body, composed

primarily of corn delivered to the gut by a regiment of tortilla still stands, but the personhood has slipped over to the spiritual world. This world is governed by different rules and procedures, which demand the assistance of a healer to navigate this space by communicating with the spiritual world through interpretations of the blood, pulse, and body. Xowanik, (susto, fright, or soul loss) for the Poqomchi' is not a unitary object or complete diagnosis. It is a discursive relationship between Ransil (level 1) and Ranxel (level 2), a distinction which represents such dualities of life-death, treatable-untreatable, survivable-un survivable, normal-abnormal, and here-there (this world with the spiritual world). Here, for the healers, certain Poqomchi' behaviors appear to be more deeply rooted in ritual practices through identification with cosmological beliefs. The collective accommodative behaviors can be found in larger cultural complexes such as diet, home, consumption of non-food medicinal substances, heat and gas therapy of the temazcal, and a hot-cold duality that encompasses almost all substances, food, emotions, conditions, and disease. The Poqomchi' must pay very close and ritualistic attention to such domains to ensure the continual balance of life. The experience of anemia becomes part of the corporate body, which includes the transcendence of time and space to their ancestors through blood.

Broader Impacts

This research, through an understanding of the Poqomchi' experience, significantly contributes to the field of anthropology and a global health problem. The most notable contribution is the identification of the liminal thresholds within a local biological matrix and the interpretation of how this space is navigated by continual processes of biological and cultural accommodation, analyzed through discourse (Frisancho, 1993; Janzen, 2002; Lock & Nguyen, 2011; McElroy & Townsend, 2009; V. W. Turner, 1968). A complementary contribution to

anthropology is the evidence that the biomedical construction of anemia is overly simplistic and prevents a better understanding of why anemia persists, becoming endemic and chronic (Lock & Nguyen, 2011; Ramakrishnan, 2001; Stuart-Macadam, 2006; Stuart-Macadam & Kent, 1992). By focusing on the physiology of anemia across broad contexts, this research raises awareness of how the Poqomchi' move through their environment with anemia. Analyzing discourse related to movement across the thresholds of anemia brings a dynamic approach to a dynamic problem. This reveals how the Poqomchi' manage the tensions and contractions that stem from the ambiguity of illness and the chaos it presents (Navarro, 1985; Scheper-Hughes & Lock, 1987; Singer, 1995)

An interdisciplinary framework was used in response to a call for integrative solutions juxtaposing divergent fields of research in order to upend our current biomedical understanding of anemia (Stuart-Macadam, 2006). A parallel call and warning was made to study disease and illness from vantage points that are as geographically broad and historically deep as possible, or risk missing distant signals on the horizon (Farmer et al., 2004, p. 309). Both Stuart-Macadam (2006) and Farmer et al. (2004) urge researchers to contextualize and demonstrate the complexity of anemia and disease in order to challenge old ideas and raise new questions. The community of Onquilha' provided such an opportunity to examine the deep history of anemia and its ubiquity across broad cultural and biological domains. In this approach, anemia and structural violence are not the primary object of study; rather, they are reference points from which the Poqomchi' construct the subjective experience of chronic and endemic anemia.

The modeling of a fragile physiology suggests a human metabolism that has been forgotten by modernity, where biomedical paradigms outline a normative idea of anemia that is not comparable to the Maya context. This model contributes to the medical anthropology of

Guatemala (Barrett, 1997) and the study of Maya nosologies (García et al., 1999; Arthur J Rubel et al., 1985; R. Wilson, 1995), shedding light on the mistaken assumption that ignorance on the part of the Maya prevents better health. Their behaviors may appear idiosyncratic, abstract, of even imaginary; however, this research shows they have a reservoir of rich information and their narrative is meaningful. This was the testimony of the Poqomchi' healers who spoke from generations of Maya memory balancing physiology in diverse environments and according to diverse metabolic energy needs. Recalling these memories corrects the erasure of history through the course of structural violence.

Throughout this dissertation, underlying the analysis and interpretation of experience, is a sense that the very way individuals and social groups consciously experience and cognitively construct subjectivity is fundamentally shaped by a lifetime of growth and development with anemia (Collins, 1997, p. 146; Geertz, 2010, p. 304). In his explorations of liminality, Victor Turner was interested in how symbolic meaning and ritual is shaped in the brain, how people orient themselves in the universe, postulate first causes, hypothesize and theorize about unknowns (1986b, pp. 26-34). Turner framed this as a mental jostling of objects in the material world processed in and between the indicative and the subjunctive moods. In this process, objects become symbolically meaningful and subjective. Turner hypothesized that this is driven by the human brain's perpetual cause-seeking activity, which is coupled with limited ability to perceive the impermanence of objects, e.g. fluidity, movement, change, the invisible and the unknown. My focus on symptoms through movement, in a retrospectively diagnosed illness presents such a challenge where the experience is commonly imperceptible. This research shows how the Poqomchi' accommodate the difficulty in objectifying fluid symptoms as the

community constructs symbolic frameworks that interpret the motion of symptoms that are as yet unseen.

Conclusion

For all its mundaneness, anemia is a surprisingly controversial subject. The calls to study anemia came with a warning that such research would risk committing scientific fallacy and upsetting the reader (Stuart-Macadam & Kent, 1992, p. 267). This dissertation answered a purposefully broad research question: What is the biological and cultural experience of anemia when it is chronic and endemic in a Poqomchi' Maya community? As intuitive as this question may seem, its formulation required a lengthy iterative process. The early chapters reflect my evolving research framework and conceptualization of anemia. As a medical interpreter, through mimicry and aggregation, I experienced a sense of the truncated experience as explained by thousands of Poqomchi'. The symptoms they reported might have appeared anecdotal, and in fact they were reported almost as a side note to other illness. However, when the same messages are repeated it becomes a pattern and thus a significant indicator of a local biology. My experience with the Poqomchi' and awareness to this pattern is what brought me to medical anthropology and the research problem of anemia.

If biomedical and Poqomchi' nosologies are really saying the same thing, both dealing with hypoxia and energy imbalance as a fundamental origin of disease and abnormality, how do we bridge this jargon? In the physiology of illness and disease, there are variables that cannot be measured and/or controlled. Discourse analysis contributes to our understanding of anemia and raises new questions about this divergently experienced illness. So, how do we eradicate anemia when anemia is part and parcel of who they are as people; when there is symbolic meaning behind anemia that is analogous to where they stand in Guatemala's social order as Poqomchi'?

Once we understand that it is part of their identity then we can reveal how culturally broad and biologically deep processes accommodate pathology. This is reflected in the symbols they use to communicate their experience. Once we understand that, we can work within their framework of symbols for collaborative biomedical intervention. This in turn may become positively imbedded in cultural identity and incorporated in the same way as public hygiene was shown to be negatively imbedded in women's discourse on fuerza. More importantly, our ignorance to the physiological differences attributed to environment and culture are likely to have negatively affected our perceptions of the Poqomchi'. Our awareness of the relativity and variability they experience means biomedicine's practitioners can reevaluate the efficacy of their approach to treatment and intervention. Finally, how does intervention become part and parcel of the experience such that the Poqomchi' expectation is no longer that anemia is normal, but that they can fix it and minimize the impacts? Along with local healthcare workers, we can speak their language by understanding their symbols related to the experience of chronic and endemic anemia.

Appendix A: Semistructured Interview Questionnaire (Page 1 of 2)

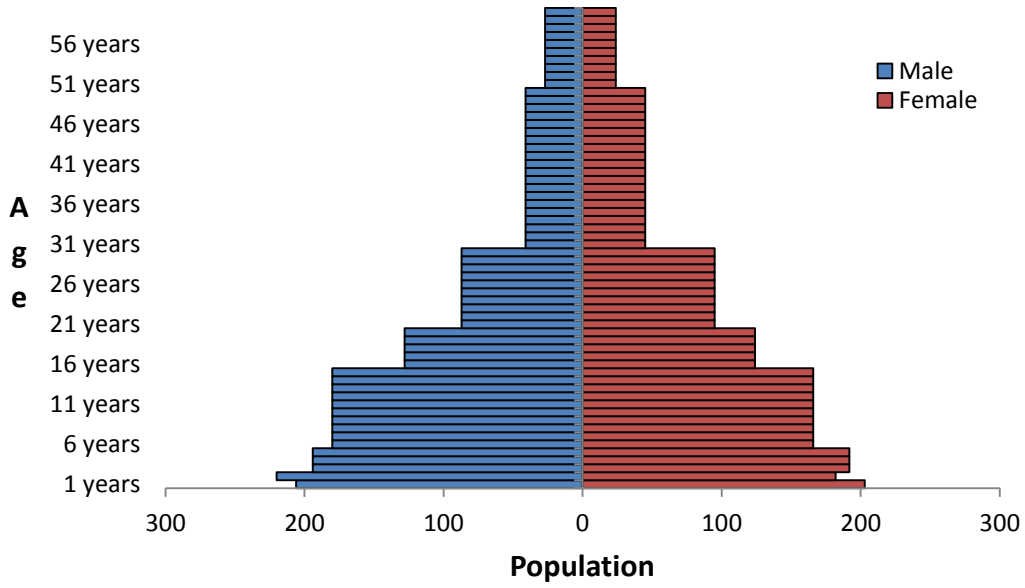
Poqomchi' Questionnaire to Female Midwives and Lay Persons

1. What is anemia? [¿Que es la anemia?]
2. Do you confuse bad blood with other illnesses at times? [¿Se confunde mala sangre con otras enfermedades a veces?]
3. Does bad blood have some relation with other illnesses such as malaria, malaria, asusto, dolor, diarrhea, or worms? [¿Mala sangre tiene algún relación con otras enfermedades como malaria, paludismo, asusto, dolor, diarrhea, o lombrices?]
4. Do you know someone that has had anemia? [¿Conocen a alguien que ha tenido anemia?]
5. How do the women behave physically? [¿Como se comportan las mujeres físicamente?]
6. What are other affects of anemia? [¿Cuales son otros afectos de anemia?].
7. If a woman gives birth while she suffers from anemia what affects will it have on her? [¿Si una mujer da luz mientras sufre de anemia que afectos tiene para ella?]
8. If a woman gives birth while she suffers from anemia what affects does it have on the baby? [¿Si una mujer da luz mientras sufre de anemia que afectos tiene para el bebe?]
9. Have you all seen women pass out often or not very often? [¿Habían visto mujeres que se desmayan mucho o poco?]
10. What causes week blood? [¿Que es la causa del mala sangre?]
11. What do the healers say about the cause of anemia. [¿Que dice los curanderos sobre la mala sangre?]
12. What do the women eat at home? [¿Que comen las mujeres en casa?]
13. What do women do to cure themselves? [¿Que hacen las mujeres para curarse?]
14. Do husbands worry about the health of their wives? Why? [¿Los esposos se preocupen por la salud de sus esposas? Porque?]
15. Do you all recommend that women take pills for anemia? [¿Recomienden que las mujeres tomen pastillas para la mala sangre?]
16. After recommending or living pills do the women take the medication or not? [¿Después de recomendar o dar pastillas, las mujeres toman o no toman?]
17. What color were the pills? [¿De que color eran las pastillas?]
18. With whom do you speak with about help with anemia? [¿A quién van a hablar sobre anemia para buscar ayuda?]
19. Do the healers know about the illness? [¿Los curanderos saben de la enfermedad?]
20. Does the health clinic know about the illness? [¿La clínica de salud sabe de la enfermedad?]
21. How much do women know about the illness? [¿Cuanto saben las mujeres sobre la enfermedad?]
22. What do you recommend the women do to heal themselves? [¿Que les recomiendan para curarse y recuperarse?]
23. What do you recommend for the women to avoid or prevent anemia? [¿Que recomiendan a las mujeres para evitar o prevenir la anemia?]
24. --Here I inserted the question: Do you all see stars or have cloudy vision? [¿Ustedes se ve chispas o nublado?]
25. What do you all eat at home? [¿Que comen ustedes en casa?]
26. --At this point I added the question: How often is there meat, chicken or beef? [¿Cada cuanto hay carne, carne de rez o carne de pollo?]

27. If one member of the family has anemia is it common that others in the family also have anemia? [¿Si un miembro de la familia tiene anemia es común que otros van a tener anemia en la familia?]
28. Why do some families suffer more than others from anemia? [¿Porque unas familias sufren mas del anemia que otras?]
29. How often do women die from anemia? [¿Cada cuanto muere alguien de mala sangre?]
30. Are there men with anemia? [¿Hay hombres con anemia?]
31. What should the government, mayor, or health clinic do to decrease anemia? [¿Que debe hacer el gobierno, alcalde, o la clínica de salud para bajar la mala sangre?]

Appendix B:

Population Pyramid of Tamahú, Guatemala 2006



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