The Heller School for Social Policy and Management
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Effect of Income and Wealth Inequality on Adult Blood Pressure: Cross-sectional Evidence from a native Amazonian society in Bolivia

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Abstract

Research, mostly in industrialized communities, has found a close positive association between community level income inequality, individual social rank and poor health status. Evidence from modern society suggests that with an increase in community level income inequality, individual health status deteriorated because of psychosocial stress and a negative environment; some effects of inequality are evident only in case of the poor earning less than community's average income while some suggest it affects an entire society by depleting social capital and disinvestment in the public sector. Very few literatures have shown that one step up in social ranking systems is correlated with an increase in individual health conditions. By using data from 366 adults (aged between 16-70 years) belonging to a farming- foraging indigenous Amazonian community in Bolivia and taking blood pressure as a proxy for stress related diseases, I analyze the association between village level income/wealth inequality, individual social rank in the village and individual blood pressure patterns. After conditioning for many covariates in linear regression analyses, I found negative and statistically significant results only for the association between traditional wealth inequality and diastolic blood pressure. Further, affects are evident only for people having less than average village traditional wealth and the direction of association varies according to the level of inequality. Focused policy interventions to enhance economic conditions of the poor through trade protection, job skill building and subsidies are essential to protect the poor from stress related diseases.

Key Words: Income/ wealth inequality, social rank, blood pressure, Amazonian community of Bolivia

Executive Summary

After the famous Whitehall study of 1985, effect of community level income inequality and social rank on individual health status has became a popular research subject. However, most of the studies done have focused only in industrialized communities and have used only cash income as a measurement of socio-economic status. Few literatures suggests community level income inequality affects health status by creating psychosocial stress through reducing social capital and creating a negative environment; however, very few research focused on stress related diseases such as blood pressure to test the effects of inequality. I tried to link these missing links in my study by using data from 366 adults (aged between 16-70 years) residing in an indigenous Amazonian community located in Bolivia.

I used traditional wealth and modern wealth, with the cash income, as a measurement for socio-economic status. I believe that the Tsimane', being a traditional community and a society recently introduced to market income, traditional wealth comprising of canoes and mortars, and modern wealth compromising of bikes and matches, have significant importance. The outcome variable blood pressure levels capture both diastolic and systolic blood pressure, and also include hypertension and pre-hypertension as proxies for high blood pressure.

However, psychosocial stress is not the sole contributor to blood pressure elevation; life style indexes depicting diet patterns, salt intake, and health compromising behaviors such as smoking, drinking, and a lack of physical activity also have a significant effect on blood pressure patterns. I used a multivariate linear regression analysis to test the association between inequality and blood pressure patterns; all regressions are controlled for age and sex.

Initial linear regression analyses have found a negative statistically significant association only for traditional wealth inequality and diastolic blood pressure. However, unreliable coefficients and the direction of association urge further sensitivity analyses. In addition, initial analyses did not suggest the importance of path variables such as individual wealth and social capital in controlling the effects of community level inequality and the differential effect of inequality according to gender. Sensitivity analyses done by controlling for individual wealth, social capital, gender and the Gini quadratic term have found:

1. The effect of traditional wealth inequality on diastolic blood pressure is evident only in the case of people having less than average village traditional wealth. For people having above average traditional wealth, inequality seems to have no effect in blood pressure levels.

2. Traditional wealth inequality does not have any differential effects by gender unlike statements made in various literatures. Blood pressure patterns of both males and females show similar symptoms under stressful conditions caused by wealth inequality.

3. Social capital is claimed as a path variable through which inequality affects individual health. However, controlling for social capital did not attenuate the correlation coefficient of traditional wealth inequality and diastolic blood pressure, denying social capital as a path variable.

4. The direction of association on traditional wealth inequality and individual diastolic blood pressure depends on the level of inequality; initially, with an increase in community level inequality diastolic blood pressure increases, while after an inflection point, with an increase in inequality diastolic blood pressure decreases. However, the inflection found to be is 1.05 which

implies traditional wealth inequality never bears a negative association with diastolic blood pressure levels for the Tsimane' community.

However, an unreliable correlation coefficient indicates result biasness; a limited number of observations of Gini might be the source of biasness. Hence, with recommending affirmative policy action to bridge the gap between the rich and the poor, this paper urges further exploration with a bigger sample size.

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Abbreviations

ACE-DD	Angiotensin- Converting Enzyme Genotype
BMI	Body Mass Index
BP	Blood Pressure
CI	Confidence Interval
CIA	Central Intelligence Agency
CV	Coefficient of Variance
DBP	Diastolic Blood Pressure
DR	Direct Reading
EH	Essential Hypertension
GDP	Gross Domestic Product
ILO	International Labor Organization
NWHRC	National Women Health Research Center
OR	Odds Ratio
SBP	Systolic Blood Pressure
SD	Standard Deviation
SES	Socio Economic Status
SESS	Socio- Economic Status Syndrome
SID	Sustainable International Development
SRHS	Self Reported Health Status
STATA	Data Analysis and Statistical Software
US	United States
UN	United Nation
UNDP	United Nation Development Program
UNICEF	The United Nations Children's Fund

Introduction

The debate of prioritizing equity or economic growth in development action has been increasing in past years. Economic growth and poverty alleviation has always been primary on the agenda for human development; however, in the last two decades human development has been redefined with an emphasis on individual freedom of choice and equal accessibility to socio-economic resources. The new definition of human development accepts economic growth as a mean for development rather than as an end and diverts the international aid concentrated on economic development towards ensuring equality and equity. The concept behind this redefinition is looking at the growing gap between the rich and poor, i.e. inequality of income/wealth and the social status that restricts the accessibility of the poor to public services such as health and education thereby creating a stressful negative environment for poor people. The availability of fewer resources to cope with a stressful environment enhances a community's vulnerability and leads to worsening health conditions.

Several studies have shown that community level income/wealth inequality and person's social status has a significant impact on individual health. This affect is found to be higher in highly unequal communities compared to egalitarian societies. However, most of these studies are based on reports from industrialized, modern countries with very sparse evidence from non-industrialized, foraging communities. Indigenous communities' dependant on farming, hunting and gathering for livelihoods are traditionally more egalitarian than industrialized and modern communities; market and modernization create competition and inequality in the community by exposing high valued consumer goods only accessible to few people (Pavan et al., 1999; Nguyen and Peschard, 2003). However, some traditional communities with market contact are experiencing a cultural transitional phase. In addition to this, most of the studies conducted use income inequality to test the effects of inequality on individual health; but according to Sapolsky (2004), the importance of the type of income, cash income or income earned from modern and traditional assets, vary from community to community. According to Vira et al. (2007), importance of traditional wealth, such as agricultural land and agricultural equipments, is higher relative to modern assets for farming communities. Further, the Tsimane' community has just started trading and interacting with the market; hence, they do not have significant cash income (Vira et al., 2007). Therefore, measures of income other than cash income such as traditional and modern wealth inequality are used to capture forms of inequality in the community.

This study intends to examine the affects of community level income/wealth inequality on individual health objectives, especially on stress related diseases, by taking blood pressure levels as a proxy in the farming and foraging community of the Tsimanes' in the Bolivian Amazon. Further, this study will explore the association between individual social rankings with individual health after controlling village level inequality and individual health.

I am using blood pressure as a health indicator to examine my hypothesis. To this date, most studies done on high blood pressure levels as an effect of westernization challenges the change in the lifestyle by paying little or no attention to psychosocial stress caused due to the loss of social capital, in turn, increasing income/wealth inequality. Lifestyle changes include eating habits, specifically eating habits that increase in salt and meat consumption, drinking and smoking habits, and reduce physical activity. However, these factors found only explain 5% of high blood pressure cases (NWHRC, 2009, p.1). Loss of social capital, social cohesion and living in a negative environment elevates blood pressure levels by creating psychosocial stress (Deaton, 2003; Li and Zhu, 2006). Few studies assert that income inequality

is caused by a stressful social environment and produces growing incidences of high blood pressure cases in developed countries. I am trying to relate these two missing research links in my paper by examining the affects of community level income/wealth inequality and social status on blood pressure patterns in a foraging community on the verge of industrialization.

Learning Objectives

Resolving any specific developmental concerns cannot be done in isolation as all aspects of human development are interrelated. Development programs and projects intended to bring desired change in people's socio-economic and environmental conditions necessitate looking into both micro and macro aspects of an issue. Hence, from the Sustainable International Development program (SID) at the Heller School for Social Policy and Management, I have aspired to build my policy and program assessment skills, both qualitative and quantitative, as well as redirect scarce human and non-human resources for desired change. Therefore, I have been taking courses such as:

- Monitoring and evaluation
- Policy and program evaluation
- Introduction to Statistics
- Applied Econometrics
- Advance Econometrics
- The Demographics of Development
- Communication for Impact

The above mentioned courses broaden my perspective by being exposed to both micro and macro dynamics associated with developmental issues. 'Monitoring and evaluation' provided me several techniques, both qualitative and quantitative, to assess program level impacts while 'Policy and program evaluation' introduced me to the broader picture. Quantitative research skills such as statistics and econometrics enabled my critical thinking process to assess the impacts and outcomes of any developmental policy and program considering all the aspects of human development process. 'Advanced Econometrics', and 'Policy and program evaluation' gave me the scope to exercise my quantitative and qualitative policy and program analysis skills. 'The Demographics for Development' helped me to understand the social aspects of development and thereby, helped build upon my qualitative research skills. The transfer of ideas from lab to land to facilitate necessary changes in a society requires better communication skills; 'Communications for Impact' offered me the technical expertise to disseminate ideas in more effective manner. In addition, direct reading (DR) and 'Master Paper Seminar Class' helped with quantitative and qualitative research required for my master's thesis.

In summary, the courses and the classes I took in the first year of my degree program helped me to develop an understanding of –

- The frameworks for development and effects of macro level policy changes in micro level household distribution and individual level human capital building.
- The interrelationship between various socio-economic, cultural and environmental factors associated with development and the significance of the acknowledgement of these associations in program and policy formulation, implementation and evaluation.

Further, these courses helped me to build-

- Conceptual knowledge of methods of developmental policy and program planning, implementation and evaluation
- Skill and expertise to collect, understand and analyze quantitative data beneficial for decision-making

Background and Development Context

Geographic Area Context

"Bolivia is one of the poorest countries in Latin America" (UNICEF, 2003; Godoy et al., 2008) and is ranked fifth in the western hemisphere. However, after 2005, Bolivia experienced an increase in GDP per capita income. According to Center for Economic and Political Research (CIA, US), during the period of Morales Government (2005-2009) Bolivia had an average 5.2% GDP growth rate, the highest in a thirty year span. Further, in the year 2009 Bolivia has registered highest GDP growth in the western hemisphere (CIA, US). Much of the economic growth can be attributed to the country's financial gain in the hydrocarbon sector; it has been presumed that the wealth acquired from this sector was equally distributed among people. However, the GINI index indicated otherwise. From the period of 1999 to 2006, the GINI increased from 44.7 to 59.2 (CIA, US). According to UNDP's Millennium Development Goal report (UNDP, 2009), Bolivia ranks 113 on the Human Development Index which includes 174 countries.

Poverty is not uniformly distributed in Bolivia and is highly concentrated in rural areas among indigenous people. Indigenous people comprise 62% of the 3.9 million population (The World Bank, 2002). According to the report, Bolivia's poverty rate is higher among its indigenous community than non-indigenous community; for example, the poverty rate among rural indigenous communities is 86% versus 74% among rural non-indigenous communities. The World Bank report suggests that the top 10% of the Bolivian population consume 22 times more than the bottom 10% and two-thirds of the bottom 10% of the population is indigenous. According to the report, indigenous people will need twice income per person than non-indigenous people to escape poverty if the country's entire income is redistributed. Poverty is not only the state in which one experiences the lack of economic resources, but also restricts access to social services and resources. An example of this can be found by looking at health services where 30% of indigenous women deliver children under the supervision of health care professionals compared to 55% of non- indigenous women; indigenous tradition could be the driving factor behind the lower number of children delivered under medical supervision within indigenous communities.

Amerindians are one of the largest indigenous populations in Bolivia. Tsimane' Amerindians, a dispersed population of 8000 people, live in 100 villages in lowland of Bolivia primarily along the Maniqui and Apere rivers (Garcia et al., 2004). Tsimanes' are a hunting-gathering and farming community dependant on slash-burn agriculture, fishing, hunting and the collection of forest products for their subsistence. My study is based on the Tsimane' people living in 13 villages along the river Maniqui in Beni district situated a mean distance 25.96km (min= 5.71 km, max= 47.74km) from San Borja. San Borja is an important market center and provides labor opportunities to the Tsimanes' community (Godoy et al. 2008).

The Tsimanes' interaction with the outside world is very limited (Zeynalova, 2008). Even marriages are held within the same community to tighten the social thread (Zeynalova, 2008); cross-cousin marriage is

part of Tsimanes' culture. However, due to the recent invasion of miners, Tsimanes' are gradually exposing themselves to outsiders. With exposure to the market, the livelihood patterns of Tsimanes' changed; they are entering into the market economy shifting from agriculture to trading. Through the change in livelihood patterns, the introduction to the marketplace has created hierarchies in the seemingly homogeneous community by shifting individual income and education levels.

Developmental Issue Context

Does inequality matter in development?

Addressing the Millennium World Summit in August 2000, Tenzin Gyatso, the 14th Dalai Lama mentioned, "There can be no peace as long as there is grinding poverty, social injustice, inequality, oppression, environmental degradation, and as long as the weak and small continue to be trodden by the mighty and powerful" (Global forum, d.k) . Nobel Laureate Amartya Sen (1999) mentions in his book "Development as Freedom" that inequality restrict human access to socio-economic resources and thereby impede the development of individual agency to build human capability; hence, development only can be possible by eluding all forms of inequality in society. Further, as mentioned in Deaton (2003, p.119), Wilkinson has shown that the mortality rate reduced when the gap between rich and poor narrowed, specifically during World War II.

Most studies suggesting an association between inequality and human development point out that inequality largely hampers individual health by creating a negative environment and reducing social capital. Loss of social capital erodes social networks and wanes social trust, decreasing investment in the public sector in establishments such as hospitals, health clubs, etc. Investment in the common public sector benefiting both the poor and rich is found less in places with a lower number of social institutions and social cohesion. In addition to this, loss of social cohesion promotes competition and anxiety, and fosters a negative social environment. Negative social environments compel people to adopt health compromising behaviors such as smoking and drinking in the absence of proper coping outlets in the form of health clubs, parks, etc. Social stress, caused by unequal access to resources, competition and in the absence of proper coping mechanisms, can lead to a decline in individual health. Inequality is a crucial issue in development as it discriminatorily affects more poor and underprivileged individuals, though some academicians assert that inequality affects both rich and poor individuals by reducing social trust, cohesion and investment in public sectors (Wilkinson, 1996).

However, this view is not universal and according to the other school of thought inequality is just a distraction rather than an impediment in poverty eradication (Wilkinson, 2009). Martin Luther also states, "an earthly kingdom cannot exist without inequality of persons. Some must be free, some serfs, some rules, some subjects" (Stuber, d.k). This school of thought accepts that inequality is innate to nature; some even went further to suggest inequality is essential for development as unequal access to resources promotes competition and enhances individual effectiveness and efficiency. According to this view, individual income is essential for individual growth rather than relative income; an individual's position in society as income increases, as well as his or her access to resources, essentially developing stronger coping mechanisms.

Developmental agencies, conversely, pursue their developmental goals based on these two opposite schools of thought. Big international agencies such as World Bank follow the second school of thought and promote economic growth rather than considering equality and equity. But in recent years,

specifically after the introduction of Human Development Index, agencies such as the United Nations emphasize restoring equality and equity in economic distribution to promote the overall wellbeing of a community. However, the crucial aspect of this developmental fix is most of the studies are based on industrialized countries, while the developmental policies are created for developing countries with developed countries in mind. Response to this developmental quandary is essential for planning effective utilization of resources, specifically in developing countries where available resources are restricted by poor economic growth. My study intends to explore the association between community level inequality and individual blood pressure, an indicator for human wellbeing, in a hunting and gathering indigenous community of Bolivia to seek out sustainable policy suggestions.

Why high blood pressure is important to development?

High blood pressure, known as hypertension, is the reason behind the suffering of approximately one billion people and causes 7.1 million deaths per year worldwide (Chobanian et al., 2003, p.1206). Further, hypertension has been claimed to be a contributing factor to other diseases such as cardiovascular heart stroke and diabetes, which is the world's leading cause of death. In the United States, 65 million people have been diagnosed with hypertension and nearly half are women; high blood pressure killed nearly 50,000 Americans in 2002 and was listed as a primary or contributing factor to 261,000 additional deaths (NWHRC, 2009, p.1). Hypertension cases are higher among men when compared with women, however after menopause; women are more vulnerable to hypertension. According to National Women Health Research Center (2009), relatively more women die from hypertension than men. The prevalence of hypertension, assumed to be restricted only to industrial countries, is now widespread in developing countries due to the adoption of modernization and the life style changes associated with it.

Lack of physical activity; a diet comprising of high amounts of sodium and potassium containing preserved food, carbohydrates and meat products; and smoking and drinking are usually the factors assumed to be the contributing to high blood pressure. But in approximately 95% of cases involving hypertensive patients the cause is unknown. In medical terms, the condition is known as "primary hypertension" and the remaining 5%, when the causal factor is known, is termed "secondary hypertension". Schwartz et al. (2003) mentioned that multiple environmental, psychosocial and genetic factors produce disease symptoms. The contribution of psychosocial factors to high blood pressure is controversial; American Heart Association didn't include the social factors in blood pressure measurement (Chobanian et al., 2003). However, differential pressure levels among different sex, race, and socioeconomic groups imply the significance of the psychosocial factor in determining high blood pressure. For example, 20 percent of white women are hypertensive compared to 30-40 percent of African-American women (NWHRC, 2009, p.1). Previous studies have also shown psychosocial factors including stressful tasks, psychological distress, occupational stressors, and social alienation to be associated with elevated blood pressure in both laboratory and cohort studies (Sapolsky, 2004; Fitton, 2005; Freites et al, 2007).

First, a study regarding blood pressure is essential to development because of its differential pattern by sex, race and socioeconomic status. Second, the pathways through which psychosocial stress affect blood pressure patterns, such as loss of social capital and negative environment, is related to the field of development (Lynch et al., 2004). A study of inequality and blood pressure, thus, is not a research inquiry to provide support evidence for the association between income inequality and diseases; rather it is a

developmental inquiry to understand the association between a national, state, and community level income/wealth inequality as well as individual health statuses in developing countries.

Development Questions:

My study aims to answer the developmental dilemma of emphasizing economic growth to elude inequality, thereby helping the developmental agency plan developmental strategies for optimum utilization of scarce socio-economic resources. I will analyze the association between income/wealth inequality and blood pressure. Income, traditional wealth and modern wealth will be examined differently to assess the differential impact of different income sources on blood pressure. In addition, the paper will also assess the relationship between rank of the individual measured on the basis of individual wealth and income, and blood pressure.

The main postulation of this study is that psychosocial stress created by inequality is a significant deciding factor of individual blood pressure levels. However, to test different aspects of this theory, I will use four different hypotheses.

Hypothesis 1: Village income/wealth inequality is positively associated with individual blood pressure patterns. This implies that with an increase in village level income/wealth inequality, individual blood pressure levels will increase.

Hypothesis 2: Village level income/wealth inequality will worsen the health statuses of poor people earning less than the village average income/wealth. People earning more than the average income/wealth will remain unaffected by village level inequality. Individual level income works as a buffer against the worse health status (Godoy, 2005) and for poor people, social capital works as a buffer that deteriorates with an increase in inequality.

Hypothesis 3: Wealth, income, and social interaction groups are differently defined for females and males in a society, implying differential impacts of all the above-mentioned hypotheses for different sexes. This premise leads to another hypothesis that the blood pressure levels of men are adversely affected by income/wealth inequality and income/wealth rank in comparison to women because of men's close interaction with the market and other higher social groups.

Hypothesis 4: Rather than absolute income, relative income of an individual is important for better health status which will be tested by assigning specific ranks to every individual on the basis of their individual income/wealth. The rank of an individual in a specific village is negatively correlated with high blood pressure levels; this signifies that a higher rank is associated with lower blood pressure levels and lower rank is associated with higher blood pressure levels.

Data and Method

A literature review was performed to select the suitable variables for designing regression models. Physiological, social science and previous studies on similar or related subjects suggest a significant contribution of genetic, psychosocial and environmental factors on blood pressure patterns. Panel dataset collected over 2002-2007 by a team consisting of a multi-disciplinary and international group of researchers is used to examine the hypotheses; however, I treated the dataset as cross-sectional data as most of the variables are measured in the year 2007 and main explanatory variables in the year 2006 . I used the statistical software package STATA 10 for generating statistical results. Simple linear regression

models clustered for household effect and robust error method was used to minimize standard errors. My paper deals with individual level income/wealth, and social position that may be influenced by household level income/wealth; hence, the probability of data clustering based on the household is higher. Thus regression analyses were clustered for the household level to mitigate the clustering effect. Multiple linear regression analyses were run to test the variability, strength and direction of the coefficient for each model.

Outcome Variables

Systolic blood pressure, diastolic blood pressure, hypertension and pre-hypertension are used as the proxies for blood pressure. Blood pressure measurements were repeated thrice for every individual to minimize the measurement error (Schwartz et al., 2003). One nurse accompanied the survey team in 2007 to measure blood pressure; the same nurse repeated the observation for an entire sample size to avoid any measurement biasness. The mean individual systolic blood pressure and mean individual diastolic blood pressure were measured by taking the mean of the three observations.

Individuals are identified with "hypertension" when the individual mean systolic blood pressure is greater than 140mmHg or mean individual diastolic blood pressure is greater than 90mmHg. An individual is categorized as "pre-hypertensive" when the mean individual systolic blood pressure is greater than equal to 120mmHg but smaller than equal to140mmHg or the mean individual diastolic blood pressure is greater than or equal to 80 but less than or equal to 90mmHg.

Main Explanatory Variables

Main explanatory variables include Gini income-village, Gini modern wealth-village, Gini traditional wealth-village, and rank representing the level of income/wealth inequality at the village level and the social position of individuals in a village on the basis of their income/wealth level respectively. The four main explanatory variables are measured during 2006 at the village level. I used Gini-coefficient as it measures the inequality at an average value for an entire community. "The Gini coefficient is defined as half of the arithmetic average of the absolute differences between all pairs of incomes in a population, the total then being normalized on mean income" (Subramaniam and Kawachi, 2006, p.78). The Gini-coefficient takes value between 0 and 1; 0 represents perfect equality with equal distribution of income among entire population while 1 represents perfect inequality. The Gini coefficient is usually measured by using a Lorenz curve; I used a STATA Gini generator to generate Gini coefficients.

Individual level income includes the total amount of cash earned by the individual from wage and sale. Traditional wealth includes nine kinds of assets including canoes, mortars, cooking pots and small livestock such as chickens; modern wealth includes 13 types of modern assets used by the Tsimanes' such as shotguns, bikes, and matchboxes(Godoy et al., d.k). Women and men possess different traditional wealth and modern wealth in a household; women usually own small livestock and pots, and use them to barter in the time of need. Rank, measured by individual income/wealth, depicts the social position of an individual in the village relative to others and takes values from 1 to 58.5; 1 being the lowest rank and 58.5 is the highest rank. Three types of economic inequality and two measurements for rank are included in the regression analysis as Sapolsky (2005) suggested human dominance is of a complex nature and the significance of contributing factors varies from community to community and species to species.

Other Explanatory Variables

Evidence shows that blood pressure increases with a decrease in physical activity and vegetable intake, and with increase in salt intake (Pavan et al, 1999). Other explanatory variables can be categorized into three categories- i. Path variables, ii. Life style changes comprised of dietary patterns and health compromising behaviors, and education levels representing human capital building, and iii. Physical health status includes Body Mass Index (BMI), physical activity and bed-days.

Path Variables: Variables through which community level inequality assume to affect the individual blood pressure, are called path variables; path variables are comprised of social capital and individual income/individual wealth.

Social Capital- Social capital, depicting an individual's social networking, is measured by the number of times a person has made a gift to others, the number of days person has helped others by giving her/his labor and the ability to borrow 100 Boliviano during emergency. Tsimanes' follow the cross-cousin marriage, is a reason as to why gifts to both kin and non-kin are included in the measurement of social capital. Further, in the rural farming community, labor sharing and on-time credit has significant importance. Factor analysis is used to check the compatibility between three variables before forming a social capital variable. Social networking works as a buffer against the psychosocial stress by providing better coping outlets.

Individual Income/Individual wealth- The association of income/wealth inequality and health depends upon the individual income/wealth level (Li and Zhu, 2006; Chung, 2004); some researchers claim inequality affects only poor people (Li and Zhu, 2006) and some state it affects the entire community (Wilkinson, 1996). The natural logarithm of income is used to avoid skewness of data collected as 190 individuals out of 370 have zero income while wealth is used in linear form as only three individuals do not possess any means of traditional wealth whereas everyone in the sample has some form of modern wealth.

Life Style Changes**:** "A traditional life style (no contact with civilization, diet based on complex carbohydrates and vegetables, high energy expenditure) may protect against the development of hypertension" (Pavan et al., 1999, p. 749).

Diet pattern- A diet containing high salt and fat content, and high amount of preserved food is found to be positively associated with high blood pressure (Pavan et al., 1999; Chobanian et al., 2003) while an indigenous community sustaining on a low-salt, high fish and vegetable diet is rarely affected by high blood pressure (Pavan et al., 1999; Silva et al., 2006). The measurement of total salt consumed by an adult per day in kilograms, and total meat consumed by an adult per day in kilograms is used to control the effect of diet on blood pressure. Meat consumed includes cow head, beef, pork, chicken, and duck but does not include fish, game and wild birds that have been part of the diet of this hunting-gathering community for years.

Health Compromising Behavior- Smoking and drinking alcohol are among the traditional factors that affect blood pressure levels (Carvalho and Silva, 2003); statistical analysis done with Amazonians in Brazil found that hypertension was doubled with the consumption of 40 ml of alcohol per day (Freites et al., 2007). Alcohol consumption measures amount of beer consumed by an adult in liters; it doesn't include the consumption of chicha, the local drink made from cassava or maize, as chicha does not have similar physiological effects like beer. Alcohol consumption is grouped into two categories - "Yes" if the

person drinks more than or equal to 3 liters of beer in last seven days before the day of interview and "No" if the person drinks less than 3 liters of beer in last seven days before the day of interview as 40ml alcohol is accepted as the threshold level after which alcohol consumption is found to have a positive association with high blood pressure (Chobanian et al., 2003). I dropped alcohol consumption variable after univariate analysis because of less variation. Cigarette consumption measures whether the person smoked during the last week or not. The number of cigarettes consumed may be a better representation of person's smoking addiction. In addition, coca consumption measuring whether individual consumed coca last week or not is used as control as coca consumption found to bear positive association with increase in blood pressure level.

Education- The maximum school grade attended by the individual during the year 2007 is used to measure individual education attainment. Education protects individual health from the effect of income inequality by increasing social networks, influencing life-style behaviors, problem solving skills and values (Winkleby, 1992); Winkleby found people with the lowest educational attainment exhibited the highest prevalence of risk factors.

***Physical Health Status*:** Physical health condition includes body mass index (BMI), the amount of physical activity done by individual and number of bed-days a person takes, signifying bedridden days due to sickness. Researchers suggest body mass index (BMI) measured by individual total body weight in kilograms divided by height in meter squares has a positive association with blood pressure patterns (Carvalho and Silva; 2003). The physical activity of an adult Tsimane' is measured by adding total forest area growth cleared and total planted area in the year 2007; Tsimane' follows the slash-burn agriculture and every year they clear forest growth for this purpose (Jha, 2007). High physical activity helps control the deposit of adiposity tissue and fat which reduces pressure on the arteries exerted by the movement of blood; sickness reduces body weight and thereby reduces the pressure level of the blood in the arteries essentially lowers blood pressure.

Control Variables

Age is used as a control variable as diastolic blood pressure is presumed to increase until the age of 50-55 years and systolic blood pressure increases after the age of 55 (Chobanian et al., 2003). However, according to Silva and Eckhart (1994), blood pressure increases with age is the effect of life-long food and environment patterns rather than the expected physiological process of a human being. Several studies conducted on indigenous communities in Brazil (Silva et al., 2006), the Amondava community (Pavan et al., 1999) and Yanomami Indians (Carvalho and Silva, 2003), have found that age is not positively associated with blood pressure for indigenous populations. The sample size included individuals from the age group of 16-70 years; children until 16 years age are not included as they don't enter into the wage market and older people aged above 70 years are excluded as blood pressure variation is high after age 70.

Both the male and female population is treated separately for every regression analysis as inequality and rank affects both sexes differently (Sapolsky, 2005; Silva et al., 1995). Using a pooled cross-sectional sample of the United States from 1979-1986, Winkleby (1992) has shown that men constantly demonstrated higher risk than women across all hypertension risk factors. Female sample size did not include pregnant women but did include lactating women; high blood pressure variation is normal during pregnancy whereas only in first week of lactation women are identified with a rise in blood pressure levels (Chobanian et al., 2003).

Path variables, life style changes in dietary pattern and human capital, and physical health conditions are controlled in the empirical analysis to produce unbiased results. However, statistical analyses are not controlled for genetic and emotional factors, which have been found to have an effect on blood pressure. Inequality increases competition and gives rise to negative emotions such as anxiety, anger and fear (Kawachi, 2000; Wilkinson, 2006). By using empirical analysis method, Freites et al. (2007) found that factors such as advanced age, smoking, alcohol consumption, and body size make a significant contribution to blood pressure patterns when they occur simultaneously with the ACE-DD genotype. However, the random sample selection method is expected to control the effect of randomly distributed genetic factors. Hence, by controlling all the possible and available variables, the statistical analyses are expected to produce unbiased estimates.

Literature Review

The increasing prevalence of stress related diseases such as cardiovascular heart disease, ischemic heart disease and hypertension (NWHRC, 2006) in last few years, both in industrialized, transitional and developing countries, has been driving research. Simultaneously during 1990-2000, most countries, with the exception if those in the Middle East and Sub Saharan Africa, experienced an increase in income inequality (ILO, 2008) compelling researchers to explore the association between stress caused by inequality and stress related diseases. Chung (2004) stated, " the relationship between income inequality and health has been analyzed extensively in the literature, largely because there is a clear policy implication that an income redistribution policy towards equal income distribution may help to enhance public health if an unequal income distribution is a real health risk factor" (p.1). In this section, I review the literature on following three topics-

A. Income, Income Inequality and Health : Theories and Hypotheses
B. Pathways through which inequality may affect health: stress and social capital
C. Stress and blood pressure

Income, Income Inequality and Health: Theories and Hypotheses

"Our evolutionary history predisposes us towards fairness, and sickens us when we live in unequal environments" (Deaton, 2003, p.114).

Inequality in socio-economic status creates social hierarchy and exposes individuals to a harmful environment containing a lack of access to health services, improper hygiene and sanitation, and risky health behaviors such as smoking, drinking, and societal seclusion by reducing social capital. Several studies in Westernized societies argue that stepwise descent in socioeconomic status is correlated with an increased risk of cardiovascular, respiratory, rheumatoid, and psychiatric diseases; low birth weight; infant mortality; and mortality from all causes. These studies deny the reverse causality from health to income and emphasize the lower health status of those who belong to the lowest step of the social ladder (Sapolsky, 2005). Studies done by Subramaniam and Kawachi (2003) suggest that racial differentials in mortality rated among white and black people in United States are a manifestation of the affect of inequality in socio-economic status. Socio-economic status is claimed as "one of the strongest and most consistent predictors of a person's morbidity and mortality" (Winkleby et al., 1992, p.819). Researchers and academics divided into groups when it came to decide whether the individual's absolute income or individual's relative income mattered most in contributing to an individual's health status. This section of

the literature review explores the various hypotheses deriving from the association between income, income inequality and individual health.

Absolute Income Hypothesis: Individual income is positively correlated with health (Grossman, 1972; Preston, 1975 as mentioned in (Li and Zhu, 2006). Higher income increases access to better health services and a good nutritious diet thereby, enhancing an individual's health status. This theory, known as "absolute income hypothesis", states that poverty restricts an individual's access to the health services, a nutritious diet, hygienic living conditions and can result in health risks. I will further explore the various aspects of "absolute income hypothesis" as follows.

Li and Zhu (2006). mentioned "the absolute income hypothesis argues that people with higher incomes have better health outcomes, but income inequality or relative income has no direct effect on health" (2006, p.3). This concept is also known as a poverty hypothesis (ibid.), which emphasizes the importance of individual income levels irrespective of the income of neighborhoods or the state in accessing a better health. This hypothesis supports that the rich have better health than the poor due to their ability to access social resources, and denies the negative health consequences associated with the poor for "being poor" or due to psychosocial stress. As mentioned in Deaton (2003), Rogot, Sorlie, and Johnson (1992) estimate that an individual from the United States having a family income greater than $50,000 in 1980 had about a 25 percent longer life expectancy than a person who had a family income less than $5,000. According to Karralson et al. (2008), this hypothesis has strong empirical support. Empirical analysis conducted in Indonesia with 14,014 adults aged 25-74 living in 13 provinces found that the mean income at the municipality level has a positive and statistically significant relationship with self-reported individual poor health statuses (Chung, 2004).

However, the association between absolute income and individual health status is not linear. According to Li and Zhu (2006) self reported health statuses have a non-linear relationship with per capita income; health statuses were found to increase with the per capita income, however, with a decreasing rate. This implies that the slope of the function does not remain constant throughout the period; gradually the effect of increasing per capita income in building good health diminishes over time (Karralson et al, 2008). Subramaniam and Kawachi (2004, p.79) describes the concave function of per capita income on health by mentioning that "each additional dollar of income raises individual health by a decreasing amount". Adler and Ostrove (1999) have suggested a similar model called "The Threshold Model" which states that increasing levels of income below the poverty line could contribute to improved health; however, increasing levels of income above the poverty line would have less influence in improving health condition.

In summation, ill health is a consequence of low income in the sense that more income improves health among those with high incomes. From a policy analysis point of view this theory lays stress on the economic growth of the poor to provide better health statuses rather than reducing inequality, but should acknowledge the non-linear association between absolute income and health status before adopting policies like wealth redistribution.

Income Inequality Hypothesis: The association between income and health claims to include other factors at the individual level rather than simply poverty (Lynch et al., 2004). Instead of measuring the

absolute income of an individual, income inequality is measured; the gap between the poor and the rich in the community affects individual health. This second theory is referred to as "income inequality hypothesis"; according to this hypothesis, income inequality plays an important role in determining individual health and is positively associated with health risks (Li and Zhu, 2006; Karlsson et al, 2008). However, two perspectives exist regarding the effect of income inequality on individual health statuses: the weak version of the income inequality hypothesis claims that income inequality only affects poor people and the stronger version of income inequality asserts the affects of inequality on an entire society irrespective of individual wealth levels. Therefore, through literature review, I will attempt to find evidence and theories supporting the stronger and weaker versions of the income inequality hypothesis.

Pickette and Wilkinson (2007) proposed that unequal societies face more health and social problems in relation to egalitarian society; infant mortality, the rates of lower birth weight and the rates of teenage pregnancy were higher in communities with high inequality. Adler and Ostrove (2001) have shown by qualitative analysis that the unequal distribution within state, country, and metropolitan areas is positively associated with the rate of mortality. They stated that higher life expectancy rates for people living in areas with less income inequality is independent of the average income of the area suggesting more than absolute income and meaning that income inequality matters. Multilevel analysis done by Subramaniam and Kawachi (2003) found that for every 0.05 increase in the Gini coefficient, the odds ratio (OR) of reporting poor health increased by 1.39 (95% CI: 1.26, 1.51). The effect of the Gini coefficient on health remained significant after conditioned for the proportion of the state's black population (OR= 1.30; 95%: 1.51, 1.45). Data explains that the racial differential in the health status in the United States is due to higher inequality rather than racial discrimination.

The weak version of the income inequality hypothesis claims that income inequality only affects the poor people who lack economic resources and are deprived from several health and education facilities provided in the community. As mentioned in Li and Zhu (2006), Wagstaff and Doorslaer (2000) stress that only the poor are affected by inequality, also known as 'deprivation hypotheses'. Li and Zhu (2006, p.1) mentioned, "Some (Wilkinson, 1996) even go further and argue that income inequality may affect the health of both the poor and the well-off in a society (referred to as the strong income inequality hypothesis), possibly through disinvestment in public health and human capital, the erosion of social capital, or stressful social comparisons (Kawachi and Kennedy, 1999)". This view is defined as the "stronger version of income inequality hypothesis". Chung's (2004) findings supported this version. Empirical analysis done in Indonesia suggest that communities with higher unequal income distribution available health provisions were less; the correlation coefficient of public health provisions and the Gini coefficient is -6.37 which implies an additional one unit increase in the Gini coefficient is associated with a 6.37% decrease in health provisions within the community (Chung, 2004).

Hence, the income inequality hypothesis presumes that income inequality per se is a threat to the health of individuals within a society, even holding their incomes constant. It focuses on the direct tie between health and income inequality, regardless of a person's particular income level.

Relative Income Hypothesis: The third theory is called "relative income hypothesis" and Karlsson et. al. (2008) affirms that "the main mechanism through which relative income assumed to matter to health is the stress which might be induced by belonging to the relatively deprived position in a particular society" (p.7). Relative income theory considers both inequality levels in community and individual income levels in explaining worsening health statuses.

Relative income hypothesis stresses the comparison between individual incomes with an average income in a reference group that differs from individual to individual (Karlsson et al, 2008). Studies suggest that an individual's health worsens if his/her income remained the same while the other had an increment in income. According to Li and Zhu (2006) a change in one unit in rank is associated with 0.508 percentage change in self-reported health statuses. "The correlation coefficient between the annual rate of change in life expectancy and in the proportion of income received by the least well off 60% of the population was 0-47 ($p<005$). The correlation coefficient between life expectancy and percentage of income received by least well off 70% families was 0 .73 ($p<0-01$), showing that among these countries a fall in the prevalence of relative poverty was significantly related to a more rapid improvement in life expectancy" (Wilkinson, 1992, p. 166) . The increases in income have greater affects on the health of the poor than on the health of the rich, although all have better health at higher income levels (Deaton, 2003).

The concept of the relative income hypothesis is comparable with the affects of a weak version of the income inequality hypothesis and deprivation hypothesis; however, the similarities are not consistent. "Deprivation hypothesis", "absolute income hypothesis" and "relative hypothesis" believe that only the poor's health status hampers because of low income, persisting inequality in the community or deviation of individual income from the mean community income. The hypothesis accepts that a lack of economic resources restricts the access of poor people to several social resources which results in poor health conditions, and the adoption of health comprising behaviors. However, absolute income hypothesis does not take into account state or community income inequality whereas "deprivation hypothesis" asserts that low income levels are affected only when community level inequality is high. The relative income theory is in accordance with the weak version of the income inequality hypothesis as with an increase in income inequality, the gap between the poor and the rich will increase and the conditions of the poor will worsen (Li and Zhu, 2006).

Hence, the relative income hypothesis emphasizes the significance of individual income levels in relation to community income levels taken both as absolute income hypothesis and income inequality hypothesis in deriving the worsening individual health statuses.

Rank Effect: Rank effect is in accordance with the "relative income hypothesis". Rank effect, also known as "social status syndrome" (Marmot et al, 2004) denotes social status significance in deciding one's health status. Rank effect varies from community to community, and from species to species; in addition, deciding factors assign rank in the society varies from society to society. The literature review will explore the variations in rank effect within different societies.

The rank effect direction of stress is different for different species and populations. Sapolsky (2005) classified society into two categories: a despotic or top-down society and egalitarian or bottom-up society, according to the nature of dominance. In a despotic society, dominance is achieved by aggression and intimidation whereas in an egalitarian society, dominance is attained by the support of subordinates. Evidence found from experiments with monkeys, mice, baboons, rhesus', and white-throated sparrows suggest that in a despotic society, a person belongs to a lower rank suffers from psychological stress whereas a person belonging to a higher rank suffers from physical stress, solidifying the importance in maintaining a certain rank. Further, he reclassified ranks according to stability. He specified that in some societies, such as feral male baboons and squirrels, rank is hereditary and stable. In such communities, lower ranked individuals experience physical and psychological stress because of their subordinate ranks, which come with a lack of social control, lack of resources, and lack of social outlets that can be used as coping mechanisms. However in some societies, one has to earn the rank; individuals in higher ranks have

to use their power to maintain their position (ibid.) and in such societies, as displayed in African wild dogs and female ring-tailed remurs, physical and psychological stress is mostly experienced by the dominant rank.

These classification systems considered the animal society as a platform where rank has been decided by only one aspect to devise a theory; however in human society, ranking systems are complex and are decided by several factors. Income, education, and position in the neighborhood are some of the significant deciding factors that contribute to the ranking system and the rank effect varies according to what matters most to the subject varying from individual to individual (Sapolsky, 2005). Evidence suggests that in human society low ranked individuals mostly suffer. According to Reyes- Garcia et al. (2008) higher ranking in the social ladder can be correlated with a greater BMI, larger mid-arm circumference and a greater sum of the four skin fold measurements.

The threshold model proposes (Adler and Ostrove, 1999) the affects of relative income positively associated with health statuses until the individual reaches average income; however after average income, additional increments in income are not associated with health conditions. The threshold model is challenged by the Whitehall study (Marmot, 2004) which emphasizes that life expectancy increases with each successive step of occupational grades up to the very top, not only until the mean. According to this research, the rank effect on individual health is on a ”gradient” pattern (Marmot, 1996) and the degree of affect depends on how many people are above you in the social ladder as each person with higher rank has the potential to produce threat, insult or violence that can generate stress (Deaton, 2003).

This gradient effect not only affects those who are lower, or poorer, in the social hierarchy but also on the impact of the health of individuals across all income levels (Kawachi, 2000; Godoy et al, d.k; Nguyen and Peschard, 2003; Sapolsky, 2004). The gradient relationship between health and mortality exists even in countries with a free public health care system and even in Scandinavian countries (Deaton, 2003; Marmot, 2004). Sapolsky affirms that stress can be experienced at each level of the gradient, even at the top, as a function of social organization. Research on Nigerian civil servants found a greater incidence of risk factors for cardiovascular disease such as obesity, high fat diet, and high blood pressure among high ranked individuals (Adler and Ostrove, 1999). This effect has had a differential impact in both the sexes. Individual wealth rank is found to be more significant for women than men at the village (Godoy et al., 2006). However, most of the studies focused on the comparison of high ranked and low-ranked women rather than between men and women, which is plausible on the ground that the rank effect varies according to the reference group. Considering restricted interaction with the market, women’s social interaction was mostly restricted; hence, the rank among closely associated groups matters more than with the entire community.

Some Other Aspects of Income, Income Inequality and Health Hypotheses*:* The impact of relative income and relative position on the health status of a person varies according to sex. According to Li and Zhu (2006) an inequality study in China reported that 76 percent men had good health whereas only 70 percent women had good health. Men were found to exhibit a higher risk of cardiovascular disease than women (Winkleby et al., 1992). Sapolsky (2005) asserts that the differential experiencing effect of inequality by different sexes is also evident in the case of primates and animals; as the result of male-male competition in Old World monkey species, low-rank males were found to have mean minimal reproductive access to females. However, females actually had the freedom to choose who they mate with. A study done by Strogatz et al. (1997) in United States found that black women are used to more

stress than black men: regression analysis between social support, stress and gender found the coefficient for women is 0.79 and 0.74 for men.

However, all the researchers do not accept the effect of income inequality as universal. According to Winkleby et al. (1992) income inequality has a much less effect on cardiovascular risk factors like cigarette smoking, systolic and diastolic blood pressure, and total and high density lipoprotein cholesterol. They proposed that instead of income, higher education has a higher negative correlation with cardiovascular risk factors. Even though Denmark has low levels of income inequality, the rate of smoking is high and life expectancy is low amongst Danish women. For other cultural reasons, an egalitarian social diffusion of smoking among women has helped generate both low socioeconomic inequality in smoking and the lowest female life expectancy in Western Europe (Lynch et al, 2004). Precedence of health comprising behavior and worsening health conditions in egalitarian societies indicate the presence of other deciding factors of worsening health conditions.

Pathways through which inequality damages health

"Equal societies have more social cohesion, more solidarity, and less stress; they offer their citizens more public goods, more social support, and more social capital; and they satisfy humans' evolved preference for fairness." - (Deaton, 2003, p.113). Income or income inequality causes stress, by exerting psychosocial pressure contributing to the worsening of health. According to the psychosocial environment theory (Lynch et al., 2004), income inequality is associated with health primarily through two main pathways: compromising health behaviors and social stress. However, "psychosocial stress" is common to both pathways; stress is found to be one of the reasons behind coronary heart diseases and blood pressure (Li and Zhu, 2006; Strogatz 1997; Nguyen and Peschard, 2003). This section of the paper will explore the pathways through which community level inequality affects individual health statuses.

First, income inequalities create a negative emotional environment which lead to stress and health compromising behaviors like smoking and drinking (Kawachi, 2000; Li and Zhu, 2006). Health compromising behavior is found to be one of the factors contributing to high rate of heart disease, blood pressure and headache (Strogatz et al., 1997; Li and Zhu, 2006). The comparison between the rich and the poor created by income inequalities causes negative emotions such as envy, shame, guilt, anger, depression, cynicism and hostility (Kawachi, 2000; Wilkinson, 2006). Moreover, inequality increases competition and fretfulness; one experiment conducted with 11 to 12 year old Indian children found that children's performance in solving mazes, specifically the performance of lower caste children, went down after they declared their respective castes in public. Similar findings were obtained in the United States with black and white children during the testing of their abilities (Pickette and Wilkinson, 2007).

Second, inequalities erode social cohesion and social capital leaving societies without social safety nets to buffer against adverse health outcomes (Godoy et al., 2005; Sapolsky, 2004). Social capital and inequality are contrary by definition; social capital is about respecting each other and a horizontal relationship, while inequality is about "hierarchy and asymmetry" (Wilkinson, 2000). Dressler (1991) proposed a 'stress-buffering' hypothesis of social support according to which people having social networks and supports would be less affected in stressful periods whereas people lacking strong social networks will be strongly affected by stress. Karralson et al. (2008) gave possible reasons for this phenomenon: low levels of social capital and cohesion which promote crime and that unequal society allocate fewer resources to public

services. Moreover, social networks are believed to promote better health education (Baum, 1999) and the lack of cohesion exposes individuals to higher crime or accident rates (ibid.).

Besides these two mechanisms, researchers suggested another possibility of course through which inequality affects the health of the individual. Income inequality reduces public disinvestment by reducing social cohesion and trust (Nguyen and Peschard, 2003); the number of health provisions and education centers is lower in higher unequal communities relative to egalitarian societies (Chung, 2004). Li and Zhu (2006) stated "low relative income may cause stress and depression leading to illness (Cohen *et al.*, 1997) or weaken one's power in the allocation of local health-related resources (Deaton, 2003; Kawachi and Subramaniam, 2003)" (p.1). Sapolsky (2004) claims lower Socio-Economic Status SES is associated with lower health clubs and parks, and provides less coping opportunities to an individual of lower rank. Further, low income neighborhoods have been found to have more liquor stores and less access to nutritious foods (Adler and Strove, 2001); this can explain high obesity rates among the black African women compared to white women. The unavailability of coping outlets to mitigate negative emotions can foster stress; chronic stress over time is a reason behind cardiovascular diseases and hypertension. Further, investment in public infrastructure protects the poorer more relative to rich (Nguyen and Peschard, 2003) as the accessibility to economic and social capital enables the rich to invest in private protection shields. A multilevel analysis done by Menec et al. (2010) found that neighborhoods matter; people living in the poorest areas had significantly higher odds of having arthritis, diabetes, hypertension, congestive heart failure, ischemic heart disease, chronic obstructive pulmonary disease, depression and stroke compared with those living in well off areas.

In addition to these, modernization leads to the disintegration of traditional values and goals; "breakdown in traditional values leads to chronic autonomic nervous system arousal that, overtime, elevates arterial pressures" (Fitton, 2005, p.159). As mentioned by Dressler (1982), modernization creates pressure on an individual through the display of consumer goods, and individuals who lack economic resources to support high materialistic lifestyles experience higher blood pressure rates (Fitton, 2005).

Several studies claim that the affects of income inequality is evident in adults who have suffered inequality during their childhood; hence, rather than the current effect, it is the lag effect which matters. According to Fitton (2005), a family's socio-economic status, which is predicted by the consumption pattern and income, is a greater determinant of child health. Families having higher socio-economic status are able to provide better healthcare services to their children. Meller and Miyo (2003) mentioned by Karralson et al. (2008) suggests that those in the 15-19 year old age group lagged in the affects of inequality the strongest. Lynch et al. (2004) emphasized that while studying the relation one needs to understand the impact of the relationship of income inequality and health in every stage of life including infancy, childhood, and adolescence as all these groups experience stress differently, and therefore have different health behaviors. The association between adult socioeconomic status and health behavior is dependent on the socioeconomic status of those individuals as children. People born into low, middle, or high-income families have different probabilities of receiving a good education, which then affects status, income, and a number of different behaviors. Therefore, it is important to know the impact of socio-economic status of parent on a child‘s health behavior, which determines his or her future health conditions. For instance, Nguyen and Peschard (2003) stated that stressed mothers gave birth to lower weight babies who are vulnerable to significant health problems in adulthood. Further, he emphasizes that chronic stress levels are correlated with higher cortisol levels and can increase the vulnerability to infectious diseases. A parent's income and child's health condition have been found to be positively

associated; however a relationship between a parent's relative position in society and a child's health is not widely researched.

In summary, the effect of income inequality on individual health is not consistent. However relative income hypothesis has been found to have an effect on individual health. The role of environmental factors such as pathogens and carcinogens on health is not deniable; however, social factors like the availability of social networks, institutional support, health services and coping outlets to deal with negative emotions in a healthy manner determines an individual's vulnerability to worsening health conditions. "Social capital and stress are the two pathways through which income inequality affects, if any, the individual health" (Lynch et al, 2004). Children's health is found to be positively associated with a parent's socio-economic status. However, sometimes it is hard to claim that the association between inequality and worsening health is purely because of inequality as it is difficult to isolate the effects of inequality from poverty.

Stress and Blood Pressure

Diet pattern, physical activity, smoking and age are the traditional factors associated with blood pressure elevation (Steffen et al., 2005). The increase of blood pressure with age and variation according to sex is perceived as a natural physiological process innate to the entire human kind; Systolic Blood Pressure (SBP) is assumed to increase while Diastolic Blood Pressure DBP decreases after age of 50 and women's blood pressure levels are supposed to be lower than men. However, according to the report by the National Women's Health Resource Center (NWHRC, 2009) all the above said factors are able to describe only 5-10% of all hypertension cases. Further, studies suggested that an increase in blood pressure with age is not observed within traditional communities that have low fat diets and stress free lives (Silva et al., 2006; Feio et al., 2003; Carvalho and Silva, 2003); similarly higher blood pressure levels of men is found only in industrialized and transitional communities, not in traditional and rural communities (Silva and Eckhart, 1994). Further, Steffen et al. (2006) suggests that suffering in any form has the potential to increase blood pressure. This section will explore how physical and psychosocial stress affects blood pressure patterns.

Using the linear and stepwise regression analyses of 46 indigenous people in rural Brazil, Silva et al (1995) found that more traditional communities have much lower BP levels (109/74) in men and (101/70) in women than more mechanized communities where BP levels were higher (120/76 for men and 118/70for women). According to Silva and Eckhart (1994), blood pressure increases with age due to the cumulative effect of lifelong diet and environmental factors. Various studies suggest that increments in blood pressure levels with individuals shifting from rural to urban environments (Pavan et al., 1999), or from modern to western cultures (Feio et al., 2003; Silva and Eckhart, 1994) imply that the environment plays a crucial role in hypertension and cardiovascular risk patterns. Blood pressure is the physiological outcome not only of biological changes such as physical activity, the deposit of adipose tissue, or dietary changes, but also of environmental factors such as sanitary changes and socio-ecological stress like cultural changes (Fitton, 2005). Freites et al. suggests that "essential hypertension (EH) is a multi-factorial disease triggered by several genetic and multiple environmental factors in conjunct" (2007, p.393).

Psychosocial stress plays an important role in blood pressure patterns. The National Institute of Health and the American Heart Association do not include stress as a risk factor for high BP. However, recent longitudinal studies have found that changes in stress predict changes in BP (Steffen et al., 2006). Steffen et al. (2006) accentuates this point by providing the precedence of Italian nuns who maintained a stress-

free life and had significantly lower BP in comparison to Italian laywomen of same demographic features and dietary patterns. The studies done with Samburu tribesmen in Kenya after controlling body mass index and cholesterol levels found that individuals having low blood pressure do not show a rise in blood pressure with age and showed a major increment in blood pressure within three years of joining the Kenyan Army (Steffen et al., 2006). "Blood pressure is highly sensitive to the symbolic communication and social interactions" (Dressler and Bindon, 2000, p.257). The association between social stress and blood pressure patterns is also explored in cases concerning animals and primates. As mentioned by Sapolsky et al (2004, p.400), "social stress can adversely affect cardiovascular function in rodents (Henry, 1997), non-human primates (Strawn et al, 1991, Manuck et al, 1995) and humans (Williams, 1989). Social sub-ordination has been associated with elevated resting blood pressure in laboratory rats, rabbits (Eisermann, 1992), baboons (Sherkovich and Tatoyan, 1973, Sapolsky and Share, 1994), and macaques (Kaplan and Manuck, 1989)". Several types of stress associated with blood pressure suggested by literature include (i) acculturation stress due to a change in culture generated because of movement from traditional and rural society to western and urban society, and (ii) stress due to socioeconomic status (SES) caused by lower income, education and occupational attainment. However, both types of stress are interrelated. Acculturation is the process of shifting from traditional culture to western or modern culture, which leads to economic competition (Fitton, 2005); the disruption of social networks (Steffen et al, 2005) gives rise to stress related to socioeconomic status.

Acculturation Stress: Acculturation which enhances individual stress levels by creating anxiety to accumulate modern wealth (Steffen et al., 2006), by decreasing social support (Silva et al., 2006) and by increasing job demand. This further emphasizes that extreme emotions such as rage, fear and anger associated with the acculturation process increase the levels of epinephrine and norepinephrine which are discernible by high pulse rates and blood pressure. Sapolsky (2005) suggests another mechanism by which stress affects the blood pressure; estrogen protects the blood vessels, stress reduces the secretion of estrogen levels and thereby increases blood pressure. In a meta analysis of 125 studies from MEDLINE and PsychINFO with 223,335 participants, Steffen et al. (2006) found that sudden acculturation is associated with +4mmHg increase in Diastolic Blood Pressure (DBP).

Socioeconomic Status Syndrome: The other type of stress which is found to influence blood pressure patterns is the socioeconomic status syndrome (SESS). SESS, associated with western societies (Steffen et al, 2006) and acculturation (Steffen et al., 2006; Silva and Eckhart, 1994), is related to higher blood pressure independent of health behaviors such as hygiene, smoking and access to health services (Steffen et al., 2005). Modernization creates economic competition between people by displaying consumer goods and economically disadvantaged groups fail to maintain lifestyles with high valued consumer goods, also known as lifestyle incongruity and identified with high blood pressure levels (Fitton, 2005). According to Strogatz et al. (1997), socioeconomic disadvantage, or discrimination, often is associated with racial differences and contributes to differential blood pressure patterns among black and white individuals. A cross-sectional study of 1750 adults in Pitt County, New York supports this argument as the weighted linear regression analysis found differential systolic blood pressure associated with low support or high stress ranging from 5.2 to 3.6 mmHg in women and 3.5 to 2.5 mmHg in men (Strogatz et al., 1997). According to Winkleby et al. (1992), blood pressure elevation is a reaction to stressful circumstances and restricted access to social resources; individuals belonging to a lower socio-economic status very often suppress individual emotional reactions, which could cause elevated blood pressure.

However, the effect of stress caused by acculturation and socioeconomic status is found to be differing for men and women. A plausible explanation for this blood pressure pattern differential according to sex is a socially constructed one rather than a biological one. The effect is stronger in men as they are usually in the work place, exposing them to stressful environmental conditions for a longer period of time. Further, men's constant interaction with the dominant culture (Steffen et al., 2006) and individuals belonging to the upper social economic status increases blood pressure levels by increasing work place stress; whereas women usually remain in the house and in remain in contact only with culturally (Steffen et al., 2006), if not socio-economically, similar women. An empirical analysis conducted by Fitton (2005) of two Amazonian populations found that the economic resource index is positively correlated with the Systolic Blood Pressure (SBP) of men for both of the populations, but not for the women; the acculturation index was also positively correlated with the SBP of men, but not with women. Very few empirical analyses focused on direct association between income inequality and blood pressure. One literature focused on the association between income inequality and objective health indicators such as blood pressure, cardiovascular function (which found a non-linear relationship between the Gini), the measurement of income inequality, and heart function, but found no correlation between Gini and blood pressure rates(Li and Zhu, 2006).

Though very little literature explores direct association between income inequality and blood pressure patterns, several works of literature suggested the effect of stress on blood pressure patterns. My paper will link these two missing links by finding the association between inequality and blood pressure patterns, empirically.

Results and Discussion

Regression Models

I tested both the income inequality and relative income hypotheses. To test the income inequality hypothesis, I use the following model:

$$BP_{jhvt2007} = \alpha_0 + \beta_0\, \sigma_{vt2006} + \beta_1\, X\sigma_{vt2006} * male + \beta_2\, male_{ihv} + \beta_3\, X_{ihv2006} + \beta_4 SK_{ihvp} + Z_{ihvt2007} + \theta_{ihvt2007} + \delta_0\, C_i \quad \text{---- (1)}$$

In this model *i* indexes individual, *h* indexes household and *v* indexes village and subscript *t2007* and *t2006* indexes year of survey. BP, the outcome variable, stands for a vector of blood pressure indicators - systolic blood pressure, diastolic blood pressure, hypertension and pre-hypertension. The subscript $_j$ stands for the differential measures of blood pressure. β indicates the parameters to estimate. σ_{vp} index Gini-coefficient, measured during 2006 at the village level; X indicates individual income, traditional wealth and modern wealth and *SK* index the individual social capital. Z is the vector of individual level variables denoting life style changes such as cigarette and coca consumption; θ is vector of household-level variables such as amount of meat consumption, salt uptake etc.

The regression model used to test the relative income hypothesis is as follows-

$$BP_{ihvt2007} = \alpha_0 + \beta_0\, Xrank_{ivt2006} + \beta_1\, Xrank_{ivt2006} * male + \beta_2\, male_{ihv} + \beta_3\, X_{ihv2006} + \beta_4 SK_{ihvp} + Z_{ihvt2007} + \theta_{ihvt2007} + \delta_0\, C_i \quad \text{------ (2)}$$

Rank indexes social position of an individual in the village measured in the year 2006 on the basis of income and total wealth represented by X.

Univariate Analysis

Table 1. Definition of dependent, explanatory and control variables used in the regressions					
for Tsimanes' 16-70 years of age (inclusive)					
Female* = 188; Male= 178					
Name of variable	Definition of variable	Year of obs	N	Mean	SD
A. *Dependent variables*					
I. a. Individual Systolic Blood Pressure	Measured from three repeated measurements of individual systolic blood pressure; natural logarithm of individual systolic blood pressure is used in regression	2007	366	115.37	14.70
b. Individual Diastolic Blood Pressure	Measured from three repeated measurements of individual diastolic blood pressure; natural logarithm of individual diastolic blood pressure is used in regression	2007	366	66.22	10.8
c. Hypertension	Hypertension, when individual diastolic blood pressure > 90 mmHg or individual systolic blood pressure >140 mmHg and is a dummy variable has 1 when the subject has hypertension and is 0 when the subject does not have hypertension	2007	366	0.06	0.23
	Yes		21	5.34%	NA
	No		345	94.26%	NA
d. Pre-hypertension	Pre-hypertension, when individual diastolic blood pressure is ≤ 80 mmHg or individual systolic pressure is ≥ 120 mmHg and ≤139 mmHg, is a dummy variable and is equal to 1 when the subject has pre-hypertension and is 0 when the subject does not have pre-hypertension.	2007	366	0.30	0.46
	Yes		109	29.78%	NA
	No		257	70.22%	NA
B .Explanatory variables					
I. Explanatory variables					
Gini income-village	Gini coefficient of individual income in a village; income includes cash earned from wages and sales only.	2006	13	0.52	0.08
Gini modern wealth village	Gini coefficient of individual modern wealth in a village; modern wealth includes 13 modern assets, e.g. - shotgun, bikes.	2006	13	0.30	0.04
Gini traditional wealth village	Gini coefficient of individual traditional wealth in a village; traditional wealth includes nine traditional assets e.g. - mortars, canoes.	2006	13	0.32	0.06

Person's wealth rank	Person's rank in village based on total wealth (1= person with least wealth, 58.5= Person with highest wealth); total wealth includes both modern and traditional wealth	2006	366	19.66	14.78
Person's income rank	Person's rank in village based on cash income from wage and sale (1= Person with least income, 62= Person with highest income)	2006	366	19.74	13.39
Individual Income	Cash income of a subject from wages and sales	2006	366	-1.34	5.83
Individual Traditional wealth	Individual traditional wealth is measured from household-level traditional wealth	2006	366	1156.6	852.4
Social Capital	Social capital is z score of three factors; number of times person made gifts to others during the seven days before the day of interview, the number of days person helped others by giving her/his labor, and ability to borrow 100 boliviano during emergency	2007	366	5.67	6.00
Meat consumed	Kg of pork, beef and chicken consumed by the person during the seven days before the day of interview; measured at the household level	2007	366	0.98	1.45
Alcohol consumed	Person drank more than 3 liters of beer in last seven days before the day of interview or not; 1= Yes, 0= No. Measured at individual level.	2007	366	0.03	0.18
	Yes		12	2.28%	NA
	No		354	97.72%	NA
Cigarette consumed	Person consumed cigar in last seven days before the day of interview; 1= Yes, 0= No. Measured at individual level.	2007	366	0.20	0.40
	Yes		74	20.22%	NA
	No		292	79.78%	NA
Coca Consumed	Person chewed *coca* in last seven days before the day of interview; 1= Yes, 0= No. Measured at individual level	2007	366	0.26	0.44
	Yes		95	25.96%	NA
	No		271	74.04%	NA
BMI	Body mass index; body weight in kg/ stature square. In regression natural logarithm of BMI is used	2007	366	23.87	2.89
Salt intake	Kg of salt consumed by the person during the seven days before the day of interview; measured in the household level	2007	366	0.17	1.03
Physical Activity	Total area of old -growth cut and total area planted last year by the household divided by the household adult equivalent	2007	366	0.67	0.50
Bed Days	Number of self-reported days in bed due to illness during last 14 days before the day of the interview	2007	366	2.13	3.47
III. Control Variables					
Age	Person's age in years measured in 2007 ; 16years <	2007	366	35.81	12.89

	age <70 years				
Male	Person's sex. Male= 1, female=0 (pregnant women are excluded)	2007	366	0.49	0.50
	Male		178	48.63%	NA
	Female		188	51.37%	NA

* Do not include pregnant women

Outcome Variables

The systolic blood pressure of the Tsimane' mostly range from 100 to 110 mmHg for both males and females and are higher than any other Amazonian population (Silva et al., 2006; Pavan et al., 2006, Silva and Eckhart, 1994). By doing a linear and stepwise regression analysis of survey data comprised of 46 indigenous people in rural Brazil, Silva and Eckhart (1994) showed that blood pressure levels of men (109/74) and women (101/70) in indigenous communities are lower relative to the blood pressure levels of men (120/76) and women (118/70) of industrialized communities. From a univariate analysis, I found the mean systolic blood pressure for the Tsimane' male to be 120.08 mmHg with a coefficient of variation of 8.58 (*CV*= Mean/SD), higher than normal and inclined towards a pre-hypertensive stage. A female's systolic blood pressure was 109.94 mmHg with a variance of 7.91; a female's systolic blood pressure is lower compared to a male's but higher when compared to the females of other Amazonian communities. Diastolic blood pressure is lower for both men and women with the mean average being 67.99 mmHg, 63.94 mmHg and variance of 6.07 and 6.40 respectively. A high systolic blood pressure with a normal diastolic blood pressure is common among older people (Chobanian et al., 2003); however, in my sample only 28 people are above the age of 55 while 338 people are younger than age 55. Therefore, it can be concluded that an average Tsimane' is more inclined towards the hypertensive group than normotensive (see appendix-1 and appendix-2).

Table 2. Blood Pressure Patterns by Sex in Tsimanes' Bolivian Amazon Population

Blood Pressure Measures	*Female*		*Male*	
	Mean	*SD*	*Mean*	*SD*
Mean Systemic Blood Pressure	*110.94*	*14.03*	*120.02*	*13.99*
Mean Diastolic Blood Pressure	*64.56*	*10.08*	*67.94*	*11.19*
** Hypertension*	*0.05*	*0.23*	*0.06*	*0.23*
***Pre-Hypertension*	*0.20*	*0.40*	*0.41*	*0.49*

** Hypertension defined as Mean Systolic Blood Pressure≥ 140 mmHg or Mean Diastolic Blood Pressure ≥ 90 mmHg*

*** Pre-Hypertension defined as Mean Systolic Blood Pressure ≥ 120 mmHg and ≤ 140 mmHg or Mean diastolic Blood Pressure is ≥ 80 mmHg and ≤ 90 mmHg*

The number of hypertensive males and females in the Tsimane' community is 11(6.04% of total male) and 10 (5.32% of total female) respectively whereas 74 pre-hypertensive males (40.66% of total male) and 38 pre-hypertensive females (total of 20.21%). In comparison to other indigenous groups studied

earlier (Pavan et al., 1999; Silva et al. 2005; Silva and Eckhart, 1994), the Tsimane' on an average have higher blood pressure levels.

Main Explanatory Variables

The Gini income-village has good variability; for 13 Tsimane' villages Gini income varies between 0.34 and 0.66 which implies that certain villages have relatively higher inequality than the other. Gini traditional wealth-village and Gini modern wealth-village varies for 13 villages between 0.17-0.40 and 0.16-0.35. This indicates that among the Tsimanes' there is a wide variability in income relative to traditional wealth and modern wealth.

The interaction with the market is presumed to be the cause of inequality in Tsimane' villages; the market creates differences by providing different opportunities to skilled and unskilled laborers. However, I found that a village situated geographically far from a market, for instance the village is situated 12 hours walking distance from San Borja has a relatively higher Gini-income with 0.61; a village situated 10 hours walking distance from San Borja has relatively higher Gini-traditional wealth of 0.40. In a linear regression analysis of Gini-income, Gini-traditional wealth and Gini-modern wealth with walking distance to market in hours I found a positive correlation between distance and Gini-income/wealth; with an increase in distance from the market, inequality increases among indigenous people. Therefore, it may be possible that other factors either than the market contribute toward the increasing income inequality in Tsimane' villages. Further, it may be possible that distance from the market and inequality has a concave relationship, which I do not explore in this paper.

Multivariate Analysis

Table 3:

To test hypothesis-1, I used all the forms of cash income, and modern and traditional wealth as outcome variable to understand the dissimilar effects of different forms of wealth and income on the individual blood pressure patterns of the Tsimane' people.

Gini-income: Table-3, row (1) shows that Gini-income has a negative association with systolic blood pressure, hypertension and pre-hypertension, but a positive association with diastolic blood pressure. This implies that with increase in income inequality systolic blood pressure, hypertension and pre-hypertension decreases while diastolic blood pressure increases. However, none of the results for association between blood pressure and income inequality are statistically significant at a 95% confidence interval. Gini income's statistically non-significant association with systolic blood pressure, diastolic blood pressure, hypertension and pre-hypertension denies part of my hypothesis-1, that income inequality affects the blood pressure patterns of the Tsimane'. Subramaniam and Kawachi (2003), by using a multilevel analysis, pooled the current population survey data of 50 US states comprising of 201,221 adults claim that every 0.05 increase in the Gini coefficient is associated with a 1.39 (95% CI: 1.26, 1.51) increase in the odds ratio (OR) of reporting poor health. But, my findings with the Tsimane' deny any association between income inequality and blood pressure.

Subramaniam and Kawachi further maintain that studies in egalitarian societies relative to the United States such as Sweden, Japan, and Canada only found a null or negative association between inequality and health, but countries such as Chile, who had a relatively higher Gini than the United States, found a positive association between income inequality and poor health. However, as mentioned by Sapolsky

(2005) the human structure of dominance is complex and significance of any contributing factor varies from community to community. Therefore, it may be possible that modern or traditional wealth distribution is important to the Tsimane' community than cash income.

Gini-traditional wealth: Table 3, row (2) representing Gini-traditional wealth bears a statistically significant association with diastolic blood pressure elevation at a 99% confidence interval (p=0.000, t= 3.75). For other forms of blood pressure patterns, such as systolic blood pressure, hypertension and pre-hypertension, the association with Gini-traditional wealth is not statistically significant. The direction and coefficient of association between Gini-traditional wealth and diastolic blood pressure implies that a unit increase in Gini-traditional wealth is correlated with a 60.4% decrease in diastolic blood pressure levels. As I discussed earlier, the average diastolic blood pressure of a Tsimane' man is 67.94 mmHg and is 64.56 mmHg for a Tsimane' woman. Hence, with a unit increase in Gini- traditional wealth (mean= 0.32, SD= 0.062), a man's diastolic blood pressure will be 26.91 mmHg, reduced by 41.03mmHg and a woman's diastolic pressure will be 25.57 mmHg, reduced by 38.99 mmHg. Though the statistical significance of the association states the direction of the association between Gini-traditional wealth and diastolic blood pressure, the coefficient of association seems to be unreliable. Very few numbers of observations (13) for Gini may be the reason behind unreliable coefficients of association.

The significance of traditional wealth in deciding adult diastolic blood pressure patterns may be because of the importance of traditional wealth within Tsimane' villages in assigning social status. A study done in rural India suggests that traditional wealth, such as land and farming related equipment, is significant deciding factor in determining social rank instead of modern wealth for farming communities (Deaton, 2003). But in this case, the measurement of traditional wealth does not include land as the Tsimane' do not own land. However, according to Vira et al. (2007), the Tsimane' considered agriculture as their main source of livelihood. Though traditional wealth does not include land, it does include equipment that is essential to both the plantation and cutting of forest growth. Hence, it may be possible that the inequality of traditional wealth distribution in a village is a significant contributing factor to creating stress and therefore, the raising of individual diastolic blood pressure.

Gini-modern wealth- The direction of association between Gini-modern wealth and blood pressure patterns are similar with the association between Gini-income and blood pressure levels, except for hypertension. Gini-modern wealth bears a non-significant association with systolic blood pressure, diastolic blood pressure, hypertension and pre-hypertension. Hence, village modern wealth inequality has been found to have no influence on individual blood pressure patterns.

Table.3

Regression results of systolic blood pressure and diastolic blood pressure against income and wealth inequality for the Tsimane' (n=366) in 2007 (> 16years and <70 years)

Main Explanatory Variables	Outcome Variables											
	Systolic blood pressure			Diastolic blood pressure			Hypertension			Pre-hypertension		
	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]
Gini-income	-0.001			0.272			-0.334			-0.0964		
	(0.110)			(0.144)			(0.183)			(0.454)		
Gini-traditional wealth		-0.215			-0.604**			-0.205			-0.371	
		(0.118)			(0.149)			(0.123)			(0.558)	
Gini-modern wealth			-0.0354			0.0602			0.228			-0.691
			(0.190)			(0.289)			(0.270)			(0.870)
Constant	4.429**	4.507**	4.440**	3.751**	4.099**	3.860**						
	(0.0754)	(0.0725)	(0.0794)	(0.0970)	(0.0875)	(0.111)						
R^2 □	0.226	0.233	0.226	0.148	0.173	0.136	0.131	0.110	0.106	0.104	0.107	0.104

Regression Types: Ordinary-Least Squares (OLS) regressions for systolic and diastolic blood pressure , probit for hypertension and pre-hypertension with robust standard errors and clustering by household identity. For definition of variables see Table 1. *, ** represents significance at the 95%, 99% level. All regressions include BMI, meat consumption, alcohol consumption, cigarette consumption, coca and salt consumption, physical activity, bedridden days, age and sex. □ R^2 represents Psedo-R2 value for probit regressions Pregnant women are excluded in the pooled sample. Only above 5% level is accepted as statistically significant in this paper.

Modern wealth, such as the possession of shotguns and mortars, is the result of interaction between farming-foraging communities with the market. Cash income also symbolizes the interaction of a community with the market and modern society. According to numerous studies done on acculturation, modernization is a significant factor contributing toward high blood pressure and several other stress-related diseases. As I mentioned earlier, Fitton (2005) mentions that by exposing the community to high valued consumer goods, modernization and the market create economic competition between community members as only few of them able to access it. However, I found that in the case of the Tsimane' community modernization (in terms of income/modern wealth inequality) does not have any significant correlation with blood pressure patterns after controlling for other factors related to modernization such as diet patterns, health compromising behaviors and physical activity.

In summary, I found that income and modern wealth inequality do not have any effect on the blood pressure elevation of adult Tsimane' community members unlike several other studies done in non-egalitarian societies. But the unequal distribution of traditional wealth has been found to have a statistically significant correlation with diastolic blood pressure patterns. In the further analyses I conducted only Gini-traditional wealth and diastolic blood pressure as the initial association is found to be statistically significant. However, the negative direction of association between Gini traditional wealth and diastolic blood pressure patterns is intriguing; hence, I will emphasize on the path variables and factors affecting the correlation between Gini traditional wealth and diastolic blood pressure in the next section.

Sensitivity Analyses

The association between income inequality and health has several aspects: who are affected most- male or female, rich or poor or both equally; and the direction of association depending upon the type of community. The deprivation hypothesis, or weaker version of the income inequality hypothesis, suggests that the effect of income inequality affects only the health of the poor. As I mentioned before, an experimental analysis done in Indonesia with 14,014 adults aged 25-74 living in 13 provinces found that after conditioning for individual income, community level inequality was found to have a statistically significant and positive association with self-reported individual poor health status (Chung, 2004); this implies that irrespective of individual income/wealth levels, income inequality deteriorates individual health status. But Godoy et al. (2005) suggests that in small societies such the Tsimane' community, income inequalities would allow for the richer to buffer their own as well as the poor villagers health by having the capital to do so indicating the importance of social capital as a buffer. According to Lynch et al. (2004), by reducing social capital and creating stress income inequality affects individual health; he further suggests that with the diminution of social cohesion, trust not only affects the poor, but also the rich thus supporting the stronger version of the income inequality hypothesis. The paper will analyze both the weak and strong versions of the income inequality hypothesis by conditioning path variables such as individual income and social capital.

Furthermore, a cross-sectional study done in New York with 1750 adult found that systolic blood pressure elevation is higher in women (5.2 to 3.6 mmHg) in relation to men (3.5 to 2.5 mmHg) (Strogatz et al., 1997). This section will also analyze the differential effects, if any, of traditional wealth inequality on diastolic blood pressure patterns by gender. In addition, the direction of the association between income inequality and traditional wealth depends upon the type of community being examined. However, according to Li and Zhu (2006), the effects of Gini on health can be contrasted in the same community at different levels of Gini; he found that the self-reported health statuses of an individual increase with

inequality (a small Gini below 0.42) and decreases with inequality (a large Gini above 0.42). As in the initial analysis, I found a negative association between Gini-traditional wealth and diastolic blood pressure patterns; this section will further explore the direction of that association depending upon the levels of Gini.

Table 4 Analysis: the first column repeats the naïve model I used in the previous section to test the initial correlation between Gini-traditional wealth and diastolic blood pressure. The second column represents the restricted model controlled for individual traditional wealth to test the stronger and weaker version of the inequality hypothesis while the third column's results denote the association between Gini-traditional wealth and diastolic blood pressure after controlling for social capital.

I. Can individual wealth and social capital buffer against worsening health conditions?

i. Individual Level Traditional Wealth

The stronger income inequality hypothesis claims that income inequality affects both the poor and the rich while a weaker version suggests the effects of inequality only on the poor (Li and Zhu, 2006; Wilkinson, 1996; Chung, 2004). In the case of the Tsimanes', after controlling for individual traditional wealth I found a statistically significant (p=0.001, t= -3.48) correlation between traditional wealth inequality and diastolic blood pressure. The attenuation of the coefficient of Gini-traditional wealth from column (1) to column (2) after controlling for traditional wealth is very negligible (0.074). Though the coefficient for household traditional wealth is statistically significant (p= 0.032, t= -2.16) in column 2, the coefficient is negligible (equivalent to zero); therefore this rejects the significance of individual wealth as a path variable and accepts the income inequality hypothesis which states that income inequality itself is a threat to the health of individuals even after holding income constant. After dividing the entire village into two groups based upon the average traditional wealth (1650 Boliviano) and running the regression controlling for people having a below average traditional wealth (column 3) and for people above the average traditional wealth level (column 4), I found that traditional wealth inequality has a statistically significant correlation with diastolic blood pressure levels for poor people but not for the rich.

Table.4

Regression results of diastolic blood pressure against Gini-traditional wealth for Tsimanes (n=366) in 2007 (>16 years and < 70 years);

Main Explanatory Variables	Outcome Variables: Diastolic Bloodpressure					
	[1]	[2]	[3]	[4]	[5]	[6]
Gini-traditional wealth	-0.598**	-0.524**	-0.562**	-0.548**	-0.579**	3.007**
	(0.148)	(0.151)	(0.196)	(0.295)	(0.153)	(0.811)
Gini-square	^^	^^	^^	^^	^^	-6.315**
						(1.455)
Individual traditional wealth	^^	-2.17e-05*	-3.97e-05	-3.33e-05	^^	^^
		(1.01e-05)	(3.49e-05)	(2.01e-05)		
Social Capital	^^	^^			0.006*	^^
					(0.002)	
Gini-traditional wealth* male	0.248	0.232	0.267	0.0619	0.237	0.229

	(0.222)	(0.222)	(0.270)	(0.480)	(0.222)	(0.208)
Male	-0.046	-0.039	-0.038	-0.004	-0.045	-0.038
	(0.073)	(0.073)	(0.086)	(0.162)	(0.073)	(0.068)
Constant	4.102**	4.099**	4.134**	4.070**	4.094**	3.598**
	(0.087)	(0.087)	(0.110)	(0.171)	(0.087)	(0.139)
R^2	366	366	236	130	366	366
	0.167	0.178	0.161	0.211	0.168	0.205

Regression types: ordinary-least squares (OLS) regressions with robust standard errors and clustering by household identity. For definition of variables see Table 1. *, * Significant at 95%, and 99% level. All regressions include BMI, meat consumption, cigarette consumption, coca consumption, salt consumption, physical activity, bedridden days, age and sex. ^^ variables are intentionally dropped from the regressions. Pregnant women are excluded from the pooled sample.

The results in table 4, columns (2) and (3), support the weaker version of income inequality hypothesis. As stated by Adler and Ostrove (1999), the threshold model proposes that the effects of relative income positively correlated with health status until an individual reaches average income, and after an individual reaches average income the additional increment is not correlated with health conditions. I found similar results for people of the Tsimane' community where the average traditional wealth one unit increase in Gini-traditional wealth is correlated with a 56.2 percent (0.562*100= 56.2) increase in the average diastolic blood pressure level, but there is no association found between Gini-traditional wealth and diastolic blood pressure for people having above average traditional wealth. As I already mentioned in the previous section, the coefficient of correlation is not realistic which may be because of the fewer number of observations.

I found evidence supporting the weaker version of income inequality and threshold model proposing that income inequality is significant only for poor people having fewer resources to buffer stress. However, Chung (2004) mentions that a stronger version of the income inequality hypothesis supports communities with larger inequalities; hence, it may be possible that the traditional wealth inequality amongst Tsimane' villages is not large enough to affect the entire village.

ii. Social Capital

According to Sapolsky (2004) socio-economic status and disease hazards are inversely (negatively) associated whereas social integration is directly (positively) associated with health risk. As I discussed earlier, the Tsimane' do not own land, but being farming community they value farm and farming equipment higher than modern wealth. Vira et al. (2007) mentions that inequality erodes social cohesion which poses major crisis before an individual/family when the adult working head of the family get sick or injures. Further, Vira elaborates that in a socially cohesive society during crisis periods neighbors and friends help each other by sharing labor; but a reduction in social capital erodes social trust and people do not help each other anymore. Hence, social capital diminution is the pathway through which traditional wealth inequality hampers individual health. However, after conditioning for social capital, which also includes labor sharing, I found a statistically significant (p=0.001, t=-3.45) association between Gini-traditional wealth and diastolic blood pressure (column 3); the direction of association is similar with the

naïve model only with a minute attenuation in the coefficient (0.019). Although social capital, itself is statistically significant (p= 0.001, t= 3.40). Dressler's (1991) "stress-buffering" hypothesis proposes the creation of a social network harboring support acts as a buffer during crisis periods and protects people against health risks. But the result I found denies the "stress-buffering" hypothesis and suggests that irrespective of levels of social cohesion, inequality in traditional wealth negatively affects diastolic blood pressure.

II. Is Gini-traditional Wealth Affects Blood Pressure of Women Differently from Men?

According to Li and Zhu (2006), 70 percent women in China were found to be in good health while 76 percent men were found to be in good health. Strogatz et al. (1997) found similar evidence in the United States; the correlation of the coefficient for social support and stress was found to be 0.79 for women while 0.74 for men. However, Steffen et al. (2006) suggests that blood pressure elevation is higher in men relative to women because of their close and constant interaction with individuals belonging to upper socio-economic statuses. I, for all the regression analyses, found a positive coefficient for the interaction term of Gini-traditional wealth and males (gender), representing men as more affected by traditional wealth inequality than women as proposed by Steffen et al. (2006). According to the naïve model (column 1), a one unit increase in traditional wealth inequality elevates the diastolic blood pressure of men by 20.2% [{0.248 (coefficient of interaction term for male and zero for female) - 0.0464 (coefficient of variable male which is zero for female)}*100 = 20.2%] higher than women. However, the coefficient is not statistically significant (p= 0.442, t=0.77); hence, the evidence denies any differential impact of traditional wealth inequality on diastolic blood pressure by gender.

III. Does Village level Traditional Wealth Inequality reduces individual diastolic blood pressure level

As found in all the regression models from [1] to [5], Gini-traditional wealth bears a negative correlation with diastolic blood pressure levels negating both the strong and weaker versions of the income inequality hypothesis. Hence, for further analysis, I used the quadratic term of Gini to explore any quadratic association between Gini-traditional wealth and diastolic blood pressure. A study done by Li and Zhu (2006) in China has proved that Gini bears a negative association on health status until it reaches 0.42; after it reaches 0.42, Gini has a positive correlation with health status. However, after controlling for the quadratic term of Gini, I found that Gini-traditional wealth bears a positive association with diastolic blood pressure levels. This implies that until the inflection point, a one unit increase in traditional wealth inequality is associated with an increase in blood pressure levels, but after the inflection point blood pressure levels decrease with an increase in Gini-traditional wealth. It may be possible that the immediate effect of increasing traditional wealth inequality on diastolic blood pressure is higher which gradually starts decreasing with time. The inflection point is 1.05 [6.315/ (2*3.007) = 6.315 / 6.014 = 1.05], which is unreliable as Gini ranges from 0 to 1. This implies traditional wealth inequality does not have a negative association with blood pressure levels throughout.

In summary, evidence supports a second hypothesis that traditional wealth inequality affects only poor people. Individual level wealth acts as a buffer to protect individual health against the deviation of diastolic blood pressure patterns; however, social capital is found not to be a path variable as after holding social capital constant, the effects of Gini-traditional wealth does not get attenuated from the naïve model. A regression analysis conducted with the Gini- quadratic term proves my hypothesis that Gini-traditional wealth bears a positive association with diastolic blood pressure levels; however, with time the

association between Gini and diastolic blood pressure turns to be negative. Hence, I partially accept the first and second hypotheses stating the effects of income/wealth on individual blood pressure patterns, especially for the poor earning less than average village traditional wealth negating the hypothesis for individual income and modern wealth. Though I accept that the hypotheses are holding true for traditional wealth, unreliable coefficients necessitate further exploration with bigger sample size.

Rank and Blood Pressure Pattern

The relative income hypothesis states the significance of the relative position of an individual based on her or his income/wealth on determining individual health status; a higher social position denotes better health status and vice-versa. Further, this hypothesis claims that irrespective of the level of inequality in a community, a relatively lower position of an individual in society hurts individual health status. According to Li and Zhu (2006), a change in one unit in rank is associated with a 0.508 percentage change in self-reported health. Reyes-Garcia et al. (2009) claim that a higher-ranking on the social ladder is associated with a greater BMI, a larger mid-arm circumference and a greater sum of the four-skin fold measurements. This section will explore the effect of rank (social position of an individual measured on the basis of individual income and total wealth, respectively) on blood pressure patterns after holding community level inequality and individual income/wealth constant.

Table.5
Regression results of Systolic and Diastolic Bloodpressure, Hypertension and Pre-hypertension against rank measured on the basis of individual income and total wealth for Tsimane' (n=366) in 2007 (> 16years and <70 years); see notes

Main Explanatory	Outcome Variables							
Variables	Systolic Bloodpressure		Diastolic Bloodpressure		Hypertension		Pre-hypertension	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Rank-income	-0.0003		-0.0013		-0.0016		-0.0015	
	-0.0008		-0.001		-0.0012		-0.0036	
Rank-total wealth	^^	0.0005	^^	-0.0003	^^	-0.0007	^^	-4.36e-05
		(0.0006)		(0.0008)		(0.0010)		(0.0028)
Rank* male	0.0002	-0.0011	0.0001	-0.0010	-0.0012	-0.0009	0.0031	-0.0003
	-0.0009	(0.0007)	-0.0012	(0.0009)	-0.0015	(0.0009)	-0.0041	(0.0032)
Male	0.0763**	0.100**	0.0269	0.0459	0.0307	0.0188	0.183	0.247**
	(0.0215)	(0.0216)	(0.0286)	(0.0257)	(0.0260)	(0.0239)	(0.0982)	(0.0876)
Constant	4.440**	4.482**	3.823**	3.979**				
	(0.0634)	(0.0634)	(0.0889)	(0.0834)				
R2	0.230	0.247	0.143	0.158	0.170	0.147	0.105	0.116

Notes: ordinary-least squares (OLS) regressions with robust standard errors and clustering by household identity (model 1, 2, 3, 4); d-probit regressions with robust standard errors and clustering by household identity (model 5, 6, 7, and 8). For definition of variables see Table 1. *, ** Significance at 95% and 99% level. All regressions include BMI, meat consumption, cigar consumption, coca consumption, salt consumption, physical activity, bedridden days, age and sex; regression for rank-income includes individual income, Gini-income and rank-total wealth includes individual total wealth and Gini-total wealth. ^^ variables are intentionally dropped from the regressions.* Pregnant women are not included.

Table 5 shows that neither rank-income nor rank-total wealth bears a statistically significant association with blood pressure patterns. Rank-income has a negative association with systolic blood pressure, diastolic blood pressure, hypertension and pre-hypertension; this implies that with an increase in rank,

blood pressure decreases reducing the probability of high blood pressure. This is in accordance with the third hypothesis, that individual rank in a society has a positive effect on individual health status. Column 1, representing association of rank-income with systolic blood pressure, states that a one rank increase in social status is associated with 0.0003 mmHG reduction in systolic blood pressure. However, none of the associations between rank-income and blood pressure patterns are statistically significant ($p > 0.005$, $-2<t<2$) which denies the fourth hypothesis. As I earlier pointed out, cross-cousin marriage transforms the entire Tsimane' village to an extended family; hence, it may be possible that family relationships mitigate the rank effect.

In summary, traditional wealth inequality has considerable influence on diastolic blood pressure patterns and the association does not have any differential effects according to gender for the Tsimane' community of the Bolivian Amazon. The results confirm that the weaker version of the income inequality hypothesis and threshold hypothesis suggests a significant effect of traditional wealth inequality on blood pressure patterns of poor people having less than village-level average wealth. Further, the result points out that inequality has an immediate consequence but gradually loses its effect and individual blood pressure patterns are not affected by the level of wealth. The social position/rank according to person's income/total wealth is seems to have no effect on the blood pressure patterns of the Tsimane' people. However, due to a limited number of observations of Gini, omitted variables such as genetics and negative emotions indicate further exploration of the subject. Several studies have shown that advanced age, drinking, smoking and body size cause hypertension only when they occur simultaneously with the ACE-DD genotype (Freites et al, 2007). Freites et al. (2007) asserts that individuals who carry D–alleles have an increase of 7.8 mmHg in systolic blood pressure as compared to those who have only I allele. Karralson et al. (2008) suggests that the effects of income inequality are prominent among those adults who have faced inequality during their childhood; hence, wealth/ income inequality has a lag effect rather than an immediate one. Further, the poor health statuses of a particular group (women) in a seemingly egalitarian society of Denmark suggest the effects of some other factors other than income/wealth inequality in deciding individual health statuses.

Conclusion and Recommendations

Limited socio-economic resources demand prioritizing developmental concerns for proper redistribution of resources to resolve problems. For the past few decades researchers, academics and social scientists have debated prioritizing poverty alleviation programs for economic growth or wealth redistribution policy for equity and equality. Researchers and academicians divided into two groups suggesting the significance of one issue over another. Prioritization of developmental concern is crucial for development as it drives both national and international policy changes and regulates fund allocation.

Literature suggests that income inequality not only hampers with social cohesion and increase crime rates, but also is closely associated with worsening health statuses. Drawing from data collected from 366 adults (aged between 16-70 years) from an indigenous Amazonian community in Bolivia, I found that income inequality, modern wealth inequality and rank did not have any effect on blood pressure patterns of the hunting-gathering community unlike findings from industrialized and transitional communities. However, traditional wealth inequality has significant negative association with diastolic blood pressure levels. Further, the affects of traditional wealth inequality on diastolic blood pressure is evident only in case of people having traditional wealth less than average village wealth which essentially is in accord with a 'threshold hypothesis' and 'weak version of income inequality hypotheses'. Furthermore, my result

analysis suggests the direction of association between inequality and diastolic blood pressure depends upon the level of inequality.

Inequality in socio-economic status does not only affect the individual's present health status, but also has a lag effect on the next generation. Karralson et al. (2008) in reference to Meller and Miyo (2003) suggests that the strongest effect of inequality is observed among those adults who have experienced inequality in their childhood.

> According to Vira et al (2007, p.22) "Income-inequality is a product of capitalism economics in which the wealth and cash income is distributed disproportionately due to various economics, social and political processes within a population. In the United States, we see that there is a disparity in access to jobs, education, and there are highly segregated divisions in living space based on race and class. People living in these resource-poor areas fall into a vicious, cyclical poverty trap…… these inequalities persist unless there is an intervention aimed to relax these disparities."

Hence, inequality has locked the poor in a vicious cycle, and without specific interventions it will not be possible for them to break the cycle for generations. Vira et al. (2007) further suggest that similar forces like the United States as mentioned above found to play a role in Tsimane' society creates disparity among the poor and the rich which necessitates affirmative action to overcome disparities.

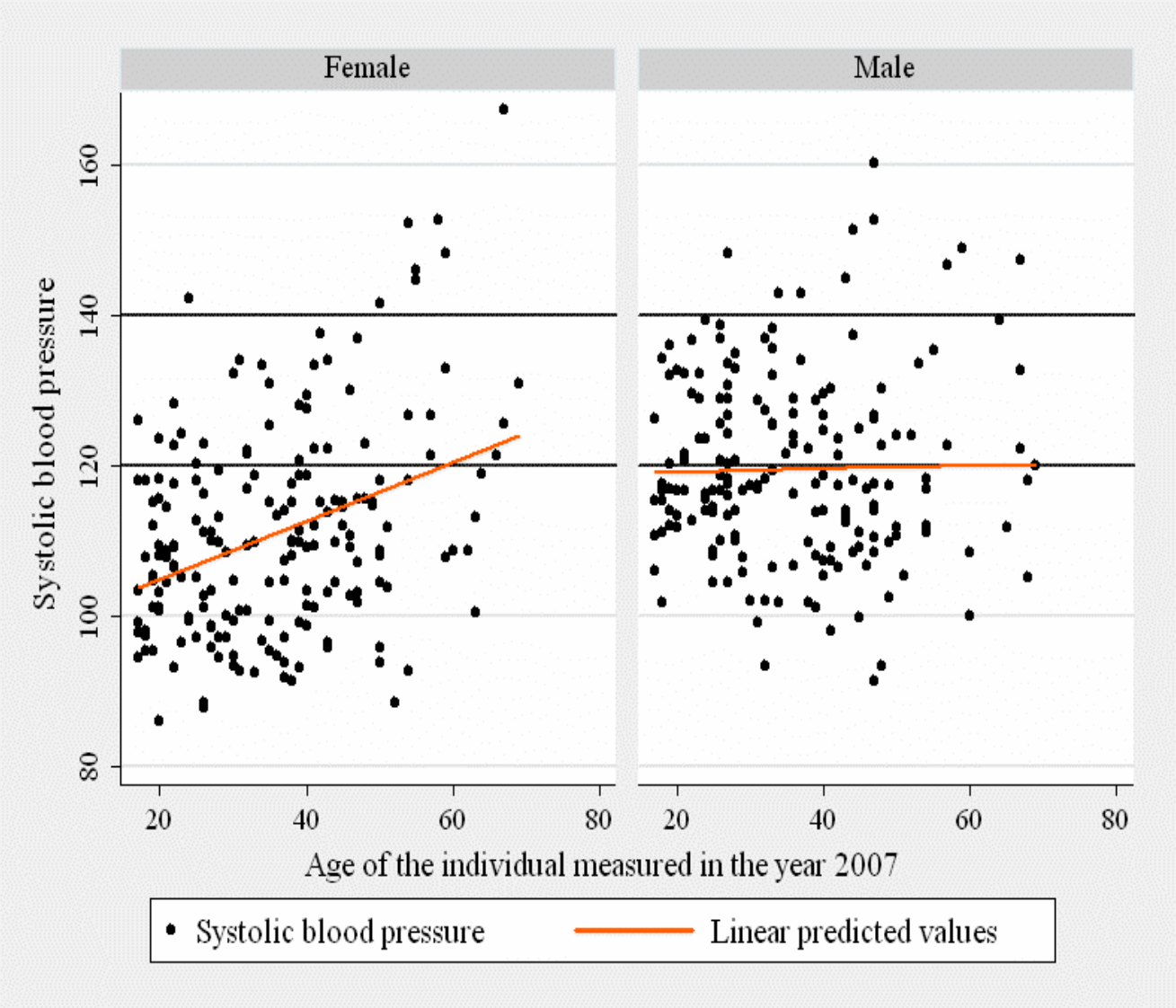
The outcome of the regression analysis suggests individual levels of traditional wealth acts as a buffer against the affects of wealth inequality and protects people from stress related diseases. Though social capital has a statistically significant association with diastolic blood pressure patterns, controlling social capital were not able to attenuate the affects of wealth inequality. Hence, specific policy actions and developmental programs should aim to elevate the status of the poor above the average wealth level. According to Sundstorm (1998), communal action can reduce inequality levels by sharing assets and forming institutions; however, government policies of taxation, transfers of funds, and the regulation of the market has made a significant contribution to reducing the gap. Though this farming community seems to be less perturbed by modern wealth inequality and income inequality, trade protection may be helpful in reducing the expansion of the gap.

However, Sundstorm (1998) suggests that protectionist trade policy could save the poor, but it has had a negative effect on economic growth. Further, he suggests policies that directly enhance the income of the poor such as job training, subsidies, or minimum wage that are more beneficial rather than trade protection policies. Skill enhancement/job training may enhance the probability of the poor to get jobs in market, but without the promotion of education for all job training programs will not be able to achieve the desired success. Some researchers assert that instead of income, higher education has a significant negative correlation with cardiovascular risk factors such as cigarette smoking, and high systolic and diastolic blood pressure levels (Winkleby et al., 1992); however, after controlling individual education levels I found significant positive association between community traditional wealth inequality and individual diastolic blood pressure patterns after including the inequality quadratic term. The results raise concern about the success of education in reducing the gap between the poor and the rich, however Sundstorm (1998) mentions that education has a long-term effect. Therefore to reduce the gap in the near future, redistribution policy should be adopted by the government. Subsidies for purchasing traditional equipment essential for agricultural purposes may help the poor to counteract the inferior feelings that

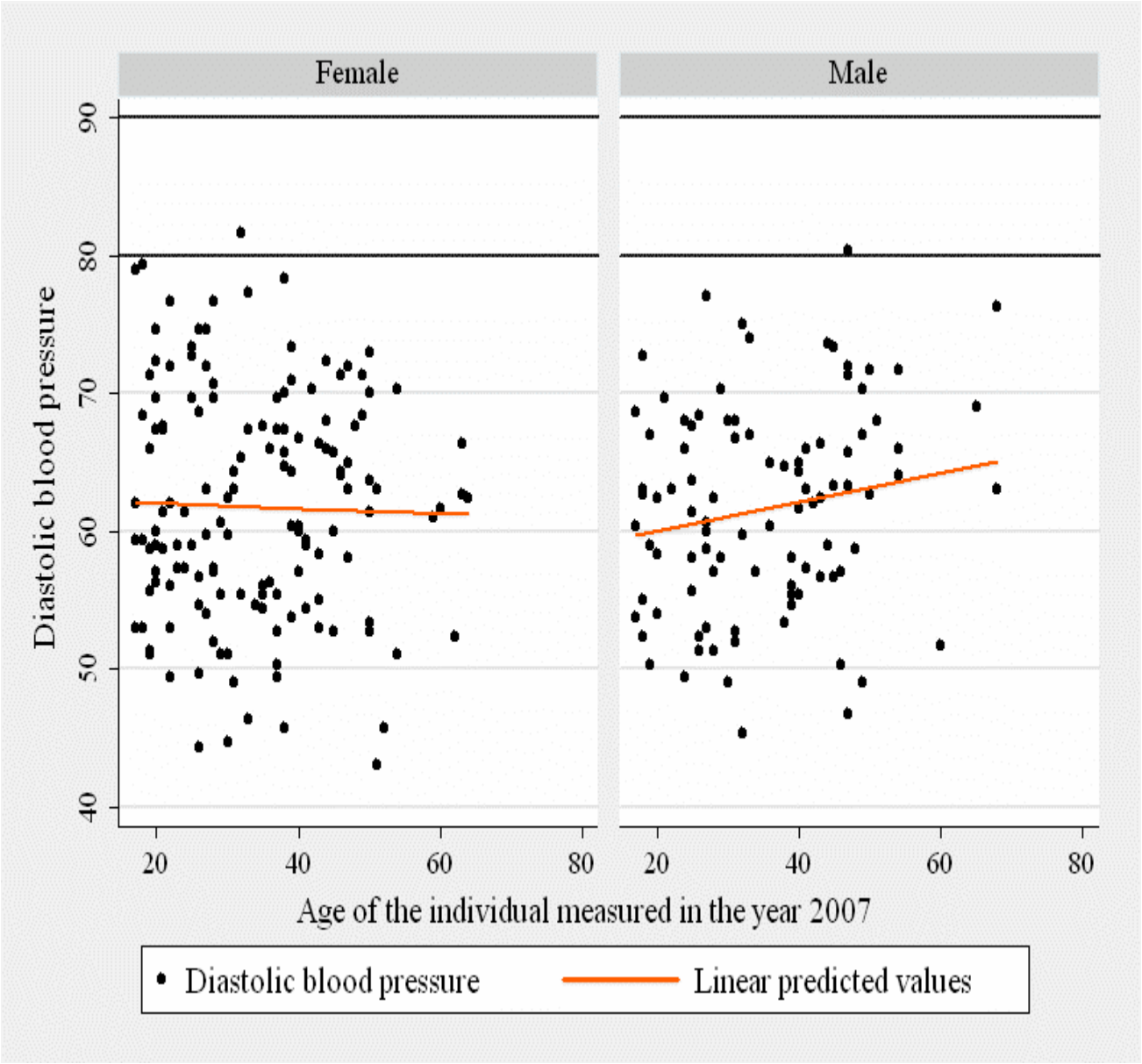
cause stress. Considering all the recommendations from the aforementioned literatures reviews and result analyses, the paper is suggesting a package of programs for unwinding the disparities in the Tsimane' community; package should include trade protection, skill enhancing programs, and subsidies to purchase agricultural and other essential equipments.

Besides the affirmative policy recommendations, it is essential to explore deeper into the subject. The overestimated coefficient of association suggests biasness in the results; a limited number of observations for the Gini may be a possible cause of biasness. Further, regression analyses did not take into consideration factors such as genetics, and negative emotions that have been found to have a close correlation with human blood pressure patterns. Hence, the paper urges further exploration of the association between income/wealth inequality and blood pressure patterns in indigenous, hunting-gathering communities crossing the cultural transitional phase with bigger sample size.

Appendix- 1


Female
Male
Systolic blood pressure
80
100
120
140
160
20
40
60
80
Age of the individual measured in the year 2007
Systolic blood pressure
Linear predicted values

Appendix-2


Female
Male
Diastolic blood pressure
40
50
60
70
80
90
20
40
60
80
Age of the individual measured in the year 2007
Diastolic blood pressure
Linear predicted values

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