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Abstract

This paper investigates the differences in the links between the socio-economic conditions and child health of ethnic groups in rural Guatemala. Variations in the links are observed within indigenous populations as well as between ethnic groups. To observe the differences within indigenous populations, groups are classified according to the language spoken in the home and the area of residence. Indigenous people who speak Spanish in the home, that is, those who share relatively more ladino features, have similar tendencies as ladinos regarding the correlation between socio-economic conditions and child health in some areas. Improvements in economic status are likely to contribute to improvements in ladino children's health status. The effect is relatively low or non-existent for indigenous people, particularly for those who share more indigenous features. The likely explanation is that indigenous people who share relatively more indigenous features use household resources inefficiently for child health compared to the ladino population and indigenous people who share relatively more ladino features. Because ethnic groups tend not to reside in the same area, one aspect of the variations in the links between socio-economic conditions and child health among ethnic groups is reflected by the different regional areas of residence.

Keywords: malnutrition, HAZ, WAZ, ladino, indigenous people, K'iche', Kaqchikel

1. Introduction

Inequality in levels of child health has been observed between ethnic groups in Guatemala (Marini & Gragnolati 2003), a problem that has persisted for decades and is showing an increasing trend. In 1995, 67.2% of indigenous children were stunted while the percentage of the non-indigenous stunted children was 36.7% (ENSMI 1995). In 2009, the share of stunted children among indigenous people was 69.5% while 36.2% of non-indigenous children were found to be stunted (ENSMI 2008/9).

One of the major causes of the health gap between ethnic groups is socio-economic variation such as different income levels. Studies on the economics of health determinants and demography show that socio-economic disparity is a common cause of diverse conditions related to child health in Latin American countries (Behrman & Skoufias 2004).

In addition, socio-cultural differences between ethnic groups indicate that although

socio-economic variation is a major cause of the health gap, differences in the impact of socio-economic conditions on health outcomes could be another concern. For example, studies in anthropology imply that indigenous people use resources inefficiently because of socio-cultural features (see Burleigh et al. (1990), for example), which results in poor health outcomes regardless of the amount of resources available to the household.

Examining the variation between ethnic groups, the linkage between socio-economic conditions and child health, and identifying the reason for the disparity is crucial to understanding the persistent severe child malnutrition in Guatemala. However, although empirical studies in determinants of child health in Guatemala imply heterogeneity in the determinants of health between ethnic groups (see Gragnolati 1999, for example), the studies have not examined the possible causes in detail.

One of the difficulties in conducting an empirical analysis is that an ethnic group identified by household survey data contains various sub-groups within an ethnic group with respect to socio-cultural and physical features. In Guatemala, household surveys typically identify ethnic groups by self-identity. Because of historical and other reasons, some indigenous people claim to be of ladino ethnicity. Also, grouping indigenous sub-groups into one ethnic group may not be appropriate. There are 22 official indigenous languages spoken in Guatemala and, in many cases, individuals do not understand multiple indigenous languages. Therefore, the socio-cultural features of an ethnic group reported by small sample research, such as anthropological studies, may not be the features shared by the ethnic groups classified by large sample survey data.

The other difficulty is that Guatemalan ethnic groups reside geographically separately in many cases. Because of the disparity between the areas in the factors affecting child health conditions, existing surveys in Guatemala are insufficient for a quasi-experimental comparable analysis using samples that share similar features.

Focusing on indigenous populations, Nakagami (2010) examined the differences in the effect of socio-economic conditions on child nutrition among indigenous people with different socio-cultural features. The study first noted some ways that socio-cultural differences within indigenous people cause affect variation. Second, although the study did not classify the groups of indigenous people by resident area, which could be the major cause of the socio-cultural variation within indigenous group, the study classified the indigenous people by their language usage[i] and language ability as indicators of to represent socio-cultural features within indigenous people. Then, using height-for-age as measures for child health, the study analyzed data from two indigenous ethnic groups (K'iche' and Kaqchikel) to estimate the determinants of child health.

The estimates indicated that the linkage between socio-economic conditions and child health differed between the two indigenous ethnic groups. Within an indigenous ethnic group, the study implied that any link between child health and socio-economic conditions will be less strong for

those who speak an indigenous language compared to the Spanish-speaking people. Also, the study indicated that variations in the link between child health and socio-economic conditions are caused by differences in health production efficiency caused by socio-cultural differences among the indigenous people.

Building on Nakagami (2010), and by considering geographical factors, this current paper examines the differences in the links between socio-economic conditions and child health of ethnic groups in rural Guatemala. This study uses a weight-for-age measure for child health in addition to a height-for-age measure used in the analysis by Nakagami (2010). Applying the argument by Nakagami (2010), this study categorizes the possible reasons for variation in the linkage between socio-economic conditions and child health among ethnic groups based on a theoretical foundation and an empirical study of health determinants. Detailed classification of socio-cultural groups within the indigenous population provides a basis for a comparison of the differences in the linkage of ethnic groups within indigenous populations and other ethnic groups such as the ladino population, which was the object of Nakagami's (2009) study on the relationship between socio-economic and child health.

The remainder of this paper is organized as follows. Section 2 describes the empirical framework. Section 3 clarifies the possible causes of variation in the health determinants between ethnic groups. Section 4 describes the data and variables used in the study. The empirical results are presented in Section 5, and Section 6 concludes the paper.

2. Analytical Framework and Hypothesis Identification

2.1 Analytical Framework for Child Health Determinants

The theoretical framework for the empirical analysis of child health determinants is based on family economics (Schultz, 1984). Empirical analysis is typically conducted by estimating a reduced-form child health (nutrition) demand function derived from a household utility maximization framework, which implies that child health status H is influenced by child characteristics z_i, household characteristics z_h, and community characteristics z_c. Household characteristics z_h include the measure for household socio-economic status, such as the level of parental education and the household economic condition.

$$H = f(z_i, z_h, z_c)$$

In principle, the variables used to represent household economic status require estimations of wage and non-labor income (see Barrera, 1990, for example). Instrumental variable estimation is conducted for the analysis using household consumption expenditure if valid instrumental variables

are available (see Thomas, Lavy, & Strauss, 1996, for example). Alternatively, a reduced-form health demand function could be estimated using a wealth (asset) index (see Linnemayr, Alderman, & Ka, 2008, for example).

2.2 Hypothesis for the Causes of Linkage Variation

Socio-cultural features and socio-economic variation are the main likely factors differentiating the impact of child health determinants among ethnic groups. Table 1 summarizes the beneficiaries of socio-economic household improvements on child health by ethnic group and the associated hypotheses. The table relies on two assumptions widely observed in Guatemala. First, indigenous people share traditional Guatemalan indigenous socio-cultural features to a greater extent than non-indigenous people. In Table 1, indigenous people are assumed to base household health production decisions on non-biomedical health beliefs and to have a lower level of Spanish language ability. Second, the socio-economic status of indigenous people is lower than that of non-indigenous people.

2.2.1 Socio-cultural Differences

Schultz (1984) indicated that an analytical framework implies that the reduced-form socio-economic variables, such as income or education, are affected by efficiency in health production, preferences, and social norms. These elements may vary among ethnic groups with different socio-cultural features. Additionally, the socio-cultural features of an ethnic group could affect economic return on education, which is likely to be captured by the level of education of fathers.

Efficiency in health production is reflected in this study as calorie-expenditure elasticity and/or calorie-income elasticity that causes variation in the impact of socio-economic improvements on child health. Indigenous people in Guatemala may use resources inefficiently for child health production for the following reasons (Nakagami 2010)[ii]. First, indigenous people in Guatemala tend to rely on indigenous (non-biomedical) health beliefs with respect to their health production decisions in comparison to non-indigenous people (Goldman et al. 2001). If biomedical health beliefs and knowledge lead to efficient health production decisions, household decisions based on indigenous health beliefs are likely to result in poor health outcomes although the same amount of resources is available to households. Second, indigenous people are likely to have limited access to biomedicine information; indigenous people who are not Spanish speakers are particularly disadvantaged when accessing biomedical information. The language barrier could act as an additional obstacle to securing health-related resources such as medical services, which might be provided only by Spanish-speaking staff.

Ethnic differences in preferences and social norms cause variation in the values of child

Table 1 Beneficiaries of Household Socio-Economic Improvements on Child Health by Associated Hypotheses

	Household Socio-Economic Improvements		
	Economic Condition	Parental Education	
Hypotheses		Mother	Father
Socio-Cultural Differences			
1-1. Efficiency in Health Production Technology	non-indigenous	non-indigenous	(non-indigenous)
1-2. Preferences and Social Norms	unknown	unknown	unknown
1-3. Labor Income	—	—	non-indigenous
Socio-Economic Differences			
2-1. Income Level	indigenous	—	—
2-2. Mother's Educational Level	—	non-indigenous	—

health, calorie-expenditure elasticity, and calorie-income elasticity. Socio-cultural features may be reflected in child health value preferences and consumer preferences in food and other goods and services. Social norms or other socio-cultural features of ethnic groups could affect consumption patterns. Therefore, as discussed in Jensen and Miller (2010), improvements in socio-economic conditions could have a negative impact on health. However, previous studies on Guatemala have not investigated the differences in the effect of variation in preferences and social norms on consumption patterns among ethnic groups.

The education of fathers may have a different impact on child health according to the ethnic group (Nakagami 2010)[iii]. If variables related to fathers' education capture information on labor income, the impact of education on child health could differ among ethnic groups. According to Patrinos (1997), the economic return of male education varies according to the ethnic group. Education for ladino males creates greater opportunity for higher income. The Kaqchikel indigenous people receives a low economic return, but it is superior to the economic return of the K'iche' indigenous people.

2.2.2 Socio-economic Differences

Socio-economic disparity between ethnic groups could be another factor contributing to the ethnic differences in the linkage between socio-economic conditions and child health. The impact of socio-economic conditions on child health might be non-linear. In Guatemala, the poverty rate of non-indigenous people was 40.6 while that of indigenous people was 73.4 in 2011 (ENCOVI 2011). The average level of education among non-indigenous people is 5.9 years for males and 5.3 years for females. On average, indigenous males completed 4.2 years of education, and indigenous female received three years of education (ENCOVI 2011).

The household economic status could affect the impact of the household resource variables because the calorie-expenditure elasticity decreases with household expenditure level in low-income countries (Alderman 1993). If calorie-expenditure elasticity is the major cause of the impact variation between households at different economic levels, the effect of the household resources on child health is more significant in low-income households. Moreover, in cases where fathers' education captures information on labor income, the correlation between father education levels and child health is considered more significant in low-income households. This implies that if indigenous people have a low socio-economic status the impact of household economic conditions and fathers' education levels is greater for indigenous people.

Regarding mother's education levels, Svedberg (1997) noted that improvements in health production technology as a result of maternal education contribute to child health only when the mother achieves a certain level of education. This suggests that the effect of a mother's education is greater when mothers reach a higher level of education.

2.2.3 Geographic Factors

Regional variation in ethnic groups could be another cause of ethnic differences. If there is significant bias in the composition of ethnic groups by region, this may be a reflection of regional factors other than those of ethnic origin. In Latin American countries, the impact of socio-economic variation on health varies by region (Behrman & Skoufias 2004). In Guatemala, the huge variation in altitude within the country affects child growth significantly (Gragnolati 1999)[iv].

Regional differences also affect the socio-cultural features of ethnic groups; an example is the oppression of indigenous people. Indigenous people have been treated as insignificant people and have experienced substantial social disadvantage. Particularly during the civil war, partly caused by oppression, some indigenous people began to claim ladino ethnicity (see Melville & Lykes (1993) for example). Because the oppression took different forms across regions, socio-culturally similar groups in different regions claim themselves as separate ethnic groups. Also, regional socio-economic conditions have affected socio-cultural features of residents such as the local common language, which could be another major cause.

3. Data

3.1 Data Description

Following Nakagami (2009, 2010), this study analyzes the 1995 Guatemalan Survey of Family Health (Encuesta Guatemalteca de Salade Familiar: EGSF)[v]. The data were collected from rural communities each with between 100 and 1,800 households. Women aged from 18 to 35 were surveyed between May and October 1995. Household-level, individual-level, and anthropometric information were collected. Details of the survey were described in Pebley and Goldman (1999).

The survey was conducted in four departments (Chimaltenango, Suchitepéquez, Totonicapán, and Jalapa). The survey does not represent all the rural regions of Guatemala, but only four departments were chosen on the basis of the population's ethnic composition. Most of the residents in Jalapa are ladino and are typically Spanish-speaking only. The residents of Totonicapán are mainly indigenous people whose indigenous language is K'iche'. Both indigenous people and ladino people reside in Suchitepéquez and Chimaltenango. The major indigenous language spoken in Chimaltenango is Kaqchikel. In Suchitepéquez, both K'iche' and Kaqchikel are the major indigenous languages.

3.2 Ethnic Groups and Socio-cultural Features

In Guatemala, the household survey classifies ethnic groups by self-identification. EGSF mainly contains data of ethnic groups on ladino, K'iche', and Kaqchikel. However, in this survey, ethnic identity is basically chosen from ladino[vi], indigenous, or others. Language and clothes are

other conventional measures used in Latin American countries (Gonzalez 1994) to identify ethnic groups that share socio-cultural features. Following Nakagami (2000), the language spoken by the mother in the home is used to identify the samples that share the same socio-cultural features within an indigenous ethnic group. The residential region (department) is used to distinguish the regional effect on ethnic and socio-cultural features.

Table 2 illustrates the mean and standard deviations of the variables used in the analysis. Excluding samples with missing data, the study analyzed 2,926 samples[vii]. The samples were stratified by department (Chimaltenango, Suchitepéquez, Totonicapán, and Jalapa), ethnic group (ladino, Indigenous people), and the mother's language spoken in the home (Spanish, K'iche', and Kaqchikel). In the remainder of the paper, indigenous people who speak Spanish in home are also referred to as Spanish-speaking indigenous people. Also, indigenous people who speak an indigenous language in the home, K'iche' or Kaqchikel, are referred to as indigenous language-speaking indigenous people, K'iche'-speaking indigenous people, and Kaqchikel-speaking indigenous people. Also, if a respondent claimed both ladino and indigenous ethnic identity, the children was classified as indigenous people. If a respondent speaks both Spanish and an indigenous language in the home, the children were classified indigenous language-speaking indigenous people. And, if a respondent speaks multiple indigenous languages in the home, the children were classified as members of the main indigenous group residing in the department.

Descriptive statistics in Table 2 are presented by department in order according to the share of ladino socio-cultural features in the population. The first column shows the data for ladino children in Jalapa[viii]. The second to sixth columns show the data for ladino and indigenous children in Suchitepéquez, respectively. In Suchitepéquez, the majority of households speak Spanish in the home, although the native language of the indigenous people is K'iche' or Kaqchikel. The data for Chimaltenango, where the main indigenous language is Kaqchikel, are shown from the seventh to tenth column for the ladino and indigenous populations also. The eleventh and thirteenth columns show the data for the indigenous children of Totonicapán where the native language of the indigenous people is K'iche'.

3.3 Variable Definitions

Child health status is measured by weight-for-age and height-for-age expressed by the z-score of the NCHS standards. Both indexes capture the long-term health status. However, weight-for-age is affected more by recent phenomena compared to height-for-age (Alderman 2000). Children whose weight-for-age is below the –2 standard deviation cut-off point are classified as "wasting," while height-for-age below the –2 standard deviation cut-off point are classified as "stunting."

Variables for household economic condition and parental education provide information on

Tab1e 2 Descriptive Statistics (Mean and Standard Deviation)

Department	Jalapa	Suchitepéquez					Chimaltenango				Totonicapán		
	All	All					All				All		
Ethnic Identity	(Ladino)		Ladino	Indigenous				Ladino	Indigenous		(Indigenous)	Indigenous	
Language Spoken in Home	(Spanish)		Spanish		K'iche'	Kaqchikel		Spanish		Kaqchikel		Spanish	K'iche'
Height -for-Age	-2.201	-1.899	-1.309	-2.076	-2.179	-2.517	-2.431	-1.525	-2.227	-2.752	-2.983	-2.714	-3.049
	(1.315)	(1.231)	(1.230)	(1.174)	(1.088)	(1.074)	(1.232)	(1.381)	(1.182)	(1.143)	(1.178)	(1.029)	(1.204)
Weight-for-Age	-1.378	-1.344	-0.959	-1.476	-1.487	-1.523	-1.381	-0.755	-1.266	-1.579	-1.749	-1.629	-1.778
	(1.098)	(1.073)	(1.168)	(1.028)	(0.828)	(0.957)	(1.025)	(1.108)	(0.995)	(0.986)	(1.055)	(0.981)	(1.071)
Asset Index	-0.781	0.359	1.366	0.088	-0.344	-0.706	0.951	3.028	0.979	0.604	-0.516	0.555	-0.777
	(1.974)	(1.885)	(2.339)	(1.596)	(1.308)	(0.749)	(1.628)	(2.109)	(1.515)	(1.385)	(1.401)	(1.624)	(1.205)
Log Per Capita	3.898	3.841	4.120	3.751	3.748	3.569	4.005	4.476	4.081	3.865	3.901	4.183	3.832
Household Expenditure	(0.796)	(0.662)	(0.768)	(0.597)	(0.581)	(0.483)	(0.626)	(0.583)	(0.587)	(0.620)	(0.590)	(0.719)	(0.533)
Father's Education													
School Experience	0.645	0.694	0.769	0.684	0.591	0.556	0.854	0.849	0.836	0.872	0.663	0.843	0.619
(yes=1)	(0.479)	(0.461)	(0.422)	(0.465)	(0.495)	(0.506)	(0.353)	(0.361)	(0.371)	(0.335)	(0.473)	(0.365)	(0.486)
Years	2.413	2.747	3.639	2.557	2.061	1.037	3.899	4.623	3.888	3.796	2.207	3.380	1.921
	(2.328)	(2.477)	(2.749)	(2.336)	(2.097)	(1.224)	(2.393)	(2.536)	(2.462)	(2.295)	(2.141)	(2.237)	(2.018)
Mother's Education													
School Experience	0.623	0.581	0.817	0.547	0.242	0.222	0.800	0.887	0.763	0.819	0.494	0.752	0.431
(yes=1)	(0.485)	(0.494)	(0.387)	(0.498)	(0.432)	(0.424)	(0.400)	(0.320)	(0.426)	(0.385)	(0.500)	(0.434)	(0.496)
Years	2.182	2.137	3.827	1.726	0.652	0.296	2.831	4.509	2.563	2.810	1.329	2.446	1.056
	(2.289)	(2.434)	(2.626)	(2.125)	(1.364)	(0.823)	(2.329)	(2.391)	(2.313)	(2.230)	(1.772)	(2.277)	(1.507)
Mother`s Height (z-score)	0.059	0.016	0.116	-0.003	-0.104	-0.112	-0.017	0.132	-0.002	-0.053	-0.080	-0.065	-0.084
	(0.192)	(0.185)	(0.188)	(0.166)	(0.151)	(0.216)	(0.161)	(0.155)	(0.157)	(0.150)	(0.160)	(0.154)	(0.161)
Mother's Age	26.756	26.746	26.933	26.459	27.106	29.704	27.064	27.925	26.681	27.271	26.465	26.835	26.375
	(4.624)	(4.825)	(4.766)	(4.897)	(4.243)	(4.357)	(4.518)	(4.763)	(4.310)	(4.640)	(4.549)	(3.927)	(4.687)

Parents Houshold Head	0.855	0.813	0.769	0.831	0.788	0.889	0.853	0.906	0.888	0.813	0.784	0.760	0.790
(yes=1)	(0.353)	(0.390)	(0.422)	(0.375)	(0.412)	(0.320)	(0.355)	(0.295)	(0.316)	(0.390)	(0.412)	(0.429)	(0.407)
Gender Houshold Head	0.905	0.927	0.846	0.950	1.000	0.963	0.943	0.925	0.928	0.959	0.862	0.810	0.875
(male=1)	(0.293)	(0.260)	(0.362)	(0.219)	(0.000)	(0.192)	(0.232)	(0.267)	(0.260)	(0.198)	(0.345)	(0.394)	(0.331)
Houshold Size	6.328	6.639	6.755	6.571	6.318	7.778	6.507	5.736	6.474	6.656	6.747	7.041	6.675
	(2.071)	(2.245)	(2.088)	(2.368)	(1.882)	(1.450)	(2.004)	(2.077)	(2.163)	(1.814)	(2.485)	(3.277)	(2.248)
Child Birth Order	3.469	3.437	3.476	3.372	3.303	4.667	3.560	2.887	3.408	3.799	3.418	3.331	3.440
	(1.968)	(2.005)	(2.162)	(1.946)	(1.881)	(1.776)	(2.071)	(1.750)	(1.917)	(2.213)	(1.942)	(1.917)	(1.949)
Child Gender	0.508	0.509	0.524	0.497	0.561	0.481	0.454	0.453	0.493	0.420	0.475	0.512	0.466
(male=1)	(0.500)	(0.500)	(0.501)	(0.500)	(0.500)	(0.509)	(0.498)	(0.503)	(0.501)	(0.494)	(0.500)	(0.502)	(0.499)
No. of Observations	811	798	208	497	66	27	700	53	304	343	617	121	496

socio-economic household status. The study used the asset index proposed by Filmer and Pritchett (2001) to capture household economic conditions. The asset index is created using the samples from the four departments. Table A1 in the Appendix shows a description of the variables used to create the asset index and the result of principal component analysis[ix]. In addition, household size is included in the estimation to control for family size. Also, for reference, Table 2 shows per capita household expenditure[x].

Parental education captures information concerning household ability to raise a child and labor income (Barrera 1988). Family gender roles imply that the education of the mother is likely to contain more information concerning health production technology compared to the education of the father. Information on labor income, however, is captured more by the father's education than that of the mother.

The other variables controlled for the estimation followed the variables of past studies on child health determinants. Height[xi] and age are included as maternal characteristics. Mother's height may reflect generic information and information on her unobservable ability to manage household resources for health production, which is not captured by other variables such as education (Strauss & Thomas, 2008). Mother's age might affect child health because younger mothers, particularly teenagers, tend to have poor pregnancy outcomes (Rees, Lederman, & Kiely, 1996).

Other household characteristics include explanatory variables that capture the features of the head of household. To control the effect, dummy variables that identify the head of household and the gender are also included. The children of the household head enjoy better health from preferable resource distribution. A female head of household is likely to allocate more resources to child health compared to a male head of household (Smith et al. 2003).

Child characteristics include gender, age, and birth order for explanatory variables. If households have gender (male) preference for children, the gender of the child affects the child health status. The birth order of children is included because child health conditions tend to be worse for younger children in low income countries (Horton 1985). The effect of child age differences is controlled by dummy variables to capture the age-specific pattern of child growth reported in Shrimpton et al. (2001)[xii].

3.4 Socio-economic and Child Health Conditions by Ethnic Group

Table 2 shows the descriptive statistics for all groups. The table indicates that child health (height-for-age and weight-for-age) for the group that shares more indigenous features tends to be worse. The tendency is observed within departments but is not clear between departments. Within all departments, the health of children with a Spanish-speaking indigenous mother is better than the health of children of indigenous language-speaking indigenous mothers but worse compared to the health of children of ladino mothers. Among the indigenous people residing in Suchitepéquez, the

nutritional condition of Kiche-speaking indigenous children is better than Kaqchikel-speaking indigenous children.

Table 2 also implies that groups that share more features of indigenous people tend to face inferior socio-economic situations (parental education, asset index, and household expenditure per capita) within departments. On the other hand, similar to the child health condition, the tendency is not clear between departments.

4. Estimation Results

Tables 4 and 5 show the estimation results of the community fixed-effects models. Table 4 shows the estimated determinants for height-for-age while Table 5 shows the results of the estimated determinants for weight-for-age[xiii].

Tables 4 and 5 show that among the variables related to socio-economic conditions, the household economic situation (asset index) is statistically significantly correlated with height-for-age for some groups. Child health status is less correlated with the household economic situation for the group that shares more indigenous features. The tendency is observed between the departments in general, but is not so clear within departments.

In the department of Jalapa, where the majority of residents are ladino, household economic improvements affect child health more compared to other departments. On the other hand, in general, no linkage is observed in indigenous language-speaking indigenous people in any of the other departments (Chimaltenango, Suchitepéquez, and Totonicapán).

In Suchitepéquez, although some estimates are marginally statistically significant, the coefficients of the asset index of ladino and Spanish-speaking indigenous people are similar but the coefficient of the ladino people is slightly larger. However, the correlation between economic status and child health of ladino and Spanish-speaking indigenous people in Suchitepéquez is not as significant as it is among the ladino in Jalapa. Additionally, no correlation is observed in the child health and economic status of indigenous language-speaking indigenous people (K'iche' and Kaqchikel).

In Totonicapán and Chimaltenango, where the majority of residents are indigenous people, the estimator of the asset index of Spanish-speaking indigenous people tends to be marginally statistically significant, whereas the estimator of the asset index of indigenous language-speaking indigenous people is likely to be insignificant statistically. Also, the coefficient of the estimates of Spanish-speaking indigenous people are smaller than the coefficient of the estimates of the ladino in Jalapa and Suchitepéquez.

For the ladino residing in Chimaltenango, although the estimator of the asset index of the ladino is not statistically significant, probably because of sample size, the coefficients are larger than the coefficients of the ladino who reside in Jalapa. This also implies that the estimators of the ladino

Table 3 Determinants of Height-for-Age (Classified Samples)

Department	Jalapa	Suchitepéquez			Chimaltenango			Totonicapán	
Ethnic Identity	Ladino	Ladino	Indigenous		Ladino	Indigenous		Indigenous	
Language Spoken in Home	Spanish	Spanish		Indigenous	Spanish		Kaqchikel	Spanish	K'iche'
	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Asset Index	0.134***	0.098*	0.095**	-0.080	0.170	0.074	-0.024	0.136	-0.042
	(0.031)	(0.058)	(0.037)	(0.149)	(0.137)	(0.056)	(0.049)	(0.094)	(0.054)
Father's Education									
School Experience	-0.188	-0.863***	0.051	0.403	-0.555	0.263	-0.345	0.470	-0.171
(yes=1)	(0.123)	(0.277)	(0.153)	(0.363)	(0.889)	(0.249)	(0.241)	(0.452)	(0.164)
Years	0.043	0.221***	0.028	-0.003	0.277**	-0.020	0.068*	-0.167*	-0.012
	(0.027)	(0.048)	(0.033)	(0.101)	(0.127)	(0.044)	(0.040)	(0.086)	(0.040)
Mother's Education									
School Experience	0.005	-0.080	0.205	0.576	-0.441	-0.285	0.018	-0.083	0.031
(yes=1)	(0.120)	(0.298)	(0.135)	(0.416)	(1.027)	(0.207)	(0.197)	(0.349)	(0.176)
Years	0.029	0.021	-0.033	-0.106	0.080	0.055	0.031	0.138**	0.006
	(0.028)	(0.052)	(0.035)	(0.151)	(0.153)	(0.044)	(0.037)	(0.067)	(0.058)
Mother`s Height (z-score)	1.787***	1.58***	1.597***	1.611**	-0.621	2.019***	1.397***	0.577	1.84***
	(0.234)	(0.441)	(0.283)	(0.779)	(2.038)	(0.411)	(0.378)	(0.831)	(0.317)
Mother's Age	0.03**	0.031	0.035**	0.051	0.003	0.076***	0.037*	-0.017	0.011
	(0.012)	(0.024)	(0.015)	(0.033)	(0.079)	(0.023)	(0.020)	(0.041)	(0.016)
Parents Houshold Head	-0.124	-0.053	-0.203	0.297	-1.902	0.175	-0.237	0.120	-0.139
(yes=1)	(0.158)	(0.275)	(0.181)	(0.397)	(1.600)	(0.306)	(0.219)	(0.375)	(0.176)
Gender Houshold Head	0.168	0.247	-0.090	1.343	-1.002	0.005	0.339	0.163	0.086
(male=1)	(0.141)	(0.246)	(0.208)	(1.088)	(1.102)	(0.287)	(0.300)	(0.327)	(0.155)

Houshold Size	0.024	-0.047	-0.013	-0.103	-0.067	-0.016	-0.058	-0.029	-0.038
	(0.030)	(0.053)	(0.029)	(0.067)	(0.235)	(0.047)	(0.052)	(0.046)	(0.030)
Child Birth Order	-0.105***	-0.111	-0.108**	-0.038	0.089	-0.177**	-0.064	-0.068	-0.050
	(0.039)	(0.073)	(0.044)	(0.092)	(0.280)	(0.069)	(0.054)	(0.092)	(0.043)
Child Gender	-0.002	-0.207	-0.015	0.266	0.052	-0.054	0.098	-0.089	0.108
(male=1)	(0.073)	(0.148)	(0.090)	(0.211)	(0.448)	(0.125)	(0.115)	(0.233)	(0.099)
Constant	-1.555***	-0.764	-0.843	-1.207	0.327	-2.726***	-0.756	-0.194	-0.695
	(0.415)	(0.776)	(0.538)	(1.605)	(2.338)	(0.675)	(1.208)	(1.360)	(0.558)
Adjusted R-squared	0.395	0.346	0.350	0.428	0.301	0.250	0.258	0.058	0.250
F-statistic	14.919	4.036	8.035	3.218	1.895	3.735	4.208	1.216	5.331
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.054	0.000	0.000	0.232	0.000
No. of Observations	811	208	497	93	53	304	343	121	496

Notes: * indicates significance at 10% level, ** at 5% level and *** significant at 1% level of confidence.

Table 4 Determinants of Weight-for-Age (Classified Samples)

Department	Jalapa	Suchitepéquez			Chimaltenango			Totonicapán	
Ethnic Identity	Ladino	Ladino	Indigenous		Ladino	Indigenous		Indigenous	
Language Spoken in Home	Spanish	Spanish		Indigenous	Spanish		Kaqchikel	Spanish	K'iche'
	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Asset Index	0.07***	0.086	0.034	-0.237*	0.125	0.042	0.011	0.089	0.061
	(0.027)	(0.053)	(0.034)	(0.140)	(0.130)	(0.045)	(0.039)	(0.082)	(0.042)
Father's Education									
School Experience	-0.098	-0.6*	-0.034	0.076	-0.269	0.165	-0.228	0.128	0.075
(yes=1)	(0.106)	(0.255)	(0.138)	(0.340)	(0.845)	(0.200)	(0.190)	(0.399)	(0.128)
Years	0.028	0.159***	0.034	0.116	0.103	0.031	0.009	-0.107	-0.039
	(0.023)	(0.045)	(0.030)	(0.095)	(0.121)	(0.035)	(0.031)	(0.075)	(0.031)
Mother's Education									
School Experience	-0.089	-0.364	0.153	0.576	-0.380	-0.266	-0.043	0.185	0.041
(yes=1)	(0.103)	(0.274)	(0.122)	(0.390)	(0.976)	(0.165)	(0.156)	(0.308)	(0.137)
Years	0.044*	0.063	-0.038	-0.117	-0.010	0.047	0.019	0.077	-0.011
	(0.024)	(0.047)	(0.031)	(0.142)	(0.145)	(0.035)	(0.029)	(0.059)	(0.045)
Mother`s Height (z-score)	1.275***	0.762*	1.29***	-0.019	-0.790	1.111***	0.87***	0.926	1.19***
	(0.202)	(0.406)	(0.256)	(0.730)	(1.937)	(0.329)	(0.299)	(0.733)	(0.247)
Mother's Age	0.019*	-0.013	0.017	-0.007	0.054	0.045**	0.012	-0.020	0.003
	(0.011)	(0.022)	(0.013)	(0.031)	(0.075)	(0.018)	(0.016)	(0.037)	(0.013)
Parents Houshold Head	0.034	0.154	-0.236	0.198	-0.453	0.172	0.048	-0.111	0.036
(yes=1)	(0.137)	(0.253)	(0.164)	(0.372)	(1.521)	(0.245)	(0.174)	(0.330)	(0.137)
Gender Houshold Head	0.128	0.382*	-0.043	1.691	-0.827	-0.081	-0.088	-0.116	0.144
(male=1)	(0.122)	(0.226)	(0.189)	(1.019)	(1.048)	(0.230)	(0.237)	(0.288)	(0.120)

Houshold Size	0.033	-0.011	-0.034	-0.019	-0.008	0.017	-0.055	-0.057	-0.036
	(0.026)	(0.049)	(0.026)	(0.063)	(0.224)	(0.038)	(0.041)	(0.041)	(0.023)
Child Birth Order	-0.098***	-0.080	-0.015	0.047	-0.184	-0.098*	-0.033	0.034	-0.020
	(0.034)	(0.067)	(0.039)	(0.086)	(0.266)	(0.055)	(0.043)	(0.081)	(0.033)
Child Gender	-0.034	-0.195	-0.040	-0.039	0.027	-0.024	-0.040	-0.369*	0.066
(male=1)	(0.063)	(0.137)	(0.082)	(0.198)	(0.426)	(0.100)	(0.091)	(0.205)	(0.077)
Constant	-0.679*	0.753	-0.214	-2.000	1.054	-1.195**	0.717	1.895	0.879**
	(0.359)	(0.715)	(0.486)	(1.504)	(2.222)	(0.541)	(0.956)	(1.199)	(0.434)
Adjusted R-squared	0.353	0.384	0.307	0.198	0.019	0.323	0.375	0.196	0.425
F-statistic	12.627	4.587	6.783	1.732	1.041	4.906	6.541	1.858	10.642
Prob(F-statistic)	0.000	0.000	0.000	0.034	0.458	0.000	0.000	0.011	0.000
No. of Observations	811	208	497	93	53	304	343	121	496

Notes: * indicates significance at 10% level, ** at 5% level and *** significant at 1% level of confidence.

population are larger compared to the estimators of the Spanish-speaking indigenous people in Chimaltenango.

For parents' education, in general, no systematic pattern is observed between the groups regarding the correlation between child health and education in both mother's education and father's education, although some groups do show a correlation, such as mother's education of ladino in Jalapa, with the determinants for weight-for-height. Mother's height is a positively significant determinant in the estimates of the most of the groups, and no pattern is observed between the groups. Birth order, on the other hand, is negatively correlated with child health. No specific estimate pattern is discernible among the groups.

Tables 5 and 6 show the estimators of the determinants for the aggregated samples for each department. In addition to the variables used in the previous estimation, dummy variables for ethnic groups and the mother's language spoken in the home is used for the estimation. The patterns of the coefficient regarding the variables related to household economic condition imply that child health status is more correlated with the household economic situation for the departments with high group population ratio that shares more ladino features. With respect to parental education, correlation is observed in mother's education in Jalapa with weight-for-age determinants, and father's education in Suchitepéquez with the determinants for both height-for-age and weight-for-age. Mother's height and birth order are correlated for all the groups, but no systematic pattern was observed between the departments.

In summary, the following tendencies are observed. First, the difference in the linkage within indigenous people is significant. Spanish-speaking indigenous people tend to be similar to ladino people, while indigenous people who speak an indigenous language are dissimilar to ladino. The tendency is observed between the departments but is not significant within the departments. Within departments, differences within indigenous people vary significantly by department. Second, in general, child health status is more correlated with the household socio-economic situation for the groups that share more ladino features. Third, a portion of the differences between ethnic groups or groups that share different socio-cultural features is reflected in regional variation.

Table 2 shows that there are differences in the mean values for the variables related to household socio-economic conditions between the ethnic and socio-culturally different groups. This implies that the possible causes of the variation in the determinants between groups are socio-economic differences as well as socio-cultural variations.

First, we examine the validity of the hypothesis on socio-economic differences, that is, non-linearity impact. This hypothesis predicts that child health of the low socio-economic groups is affected to a greater extent by the variables related to household resources (asset index and fathers' education). Comparing the differences between the departments, some groups that share more ladino features tend to have a high correlation between child health status and household socio-economic

Table 5 Determinants of Height-for-Age (Aggregated Samples)

	Jalapa	Suchitepéquez	Chimaltenango	Totonicapán
	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Asset Index	0.134***	0.084***	0.06*	-0.015
	(0.031)	(0.030)	(0.033)	(0.043)
Father's Education				
School Experience	-0.188	-0.056	-0.037	-0.057
(yes=1)	(0.123)	(0.121)	(0.158)	(0.145)
Years	0.043	0.079***	0.035	-0.043
	(0.027)	(0.026)	(0.027)	(0.034)
Mother's Education				
School Experience	0.005	0.124	-0.200	-0.117
(yes=1)	(0.120)	(0.114)	(0.132)	(0.137)
Years	0.029	-0.011	0.05*	0.060
	(0.028)	(0.027)	(0.026)	(0.040)
Mother`s Height (z-score)	1.787***	1.628***	1.677***	1.786***
	(0.234)	(0.221)	(0.266)	(0.285)
Mother's Age	0.03**	0.041***	0.049***	0.011
	(0.012)	(0.011)	(0.014)	(0.015)
Parents Houshold Head	-0.124	-0.136	-0.111	-0.100
(yes=1)	(0.158)	(0.135)	(0.168)	(0.153)
Gender Houshold Head	0.168	0.055	0.147	0.174
(male=1)	(0.141)	(0.150)	(0.183)	(0.134)
Houshold Size	0.024	-0.026	-0.040	-0.046*
	(0.030)	(0.023)	(0.032)	(0.024)
Child Birth Order	-0.105***	-0.112***	-0.095**	-0.048
	(0.039)	(0.033)	(0.040)	(0.037)
Child Gender	-0.002	-0.051	0.058	0.073
(male=1)	(0.073)	(0.072)	(0.080)	(0.088)
Ethnic Identity		-0.257**	-0.360	
(indigenous=1)		(0.103)	(0.245)	
Language Spoken in Home		0.048		
(indigenous=1)		(0.189)		
Language Spoken in Home		-0.010		-0.27**
(K'iche'=1)		(0.221)		(0.134)
Language Spoken in Home			-0.313***	
(Kaqchikel=1)			(0.111)	
Constant	-1.555***	-0.886**	-1.761***	-0.476
	(0.415)	(0.396)	(0.519)	(0.513)
Adjusted R-squared	0.395	0.360	0.312	0.228
F-statistic	14.919	11.922	8.920	5.655
Prob(F-statistic)	0.000	0.000	0.000	0.000
No. of Observations	811	798	700	617

Notes: * indicates significance at 10% level, ** at 5% level and *** significant at 1% level of confidenc

Table 6 Determinants of Weight-for-Age (Aggregated Samples)

	Jalapa	Suchitepéquez	Chimaltenango	Totonicapán
	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Asset Index	0.07***	0.046*	0.049*	0.037
	(0.027)	(0.027)	(0.026)	(0.034)
Father's Education				
School Experience	-0.098	-0.092	-0.012	0.138
(yes=1)	(0.106)	(0.110)	(0.126)	(0.116)
Years	0.028	0.072***	0.022	-0.055**
	(0.023)	(0.023)	(0.022)	(0.027)
Mother's Education				
School Experience	-0.089	0.033	-0.188*	-0.023
(yes=1)	(0.103)	(0.103)	(0.105)	(0.109)
Years	0.044*	-0.004	0.036*	0.021
	(0.024)	(0.025)	(0.021)	(0.032)
Mother`s Height (z-score)	1.275***	1.076***	0.991***	1.198***
	(0.202)	(0.200)	(0.212)	(0.227)
Mother's Age	0.019*	0.017	0.029***	0.003
	(0.011)	(0.010)	(0.011)	(0.012)
Parents Houshold Head	0.034	-0.040	0.169	-0.029
(yes=1)	(0.137)	(0.123)	(0.134)	(0.122)
Gender Houshold Head	0.128	0.137	-0.110	0.141
(male=1)	(0.122)	(0.136)	(0.146)	(0.107)
Houshold Size	0.033	-0.016	-0.010	-0.044**
	(0.026)	(0.021)	(0.026)	(0.019)
Child Birth Order	-0.098***	-0.057*	-0.072**	-0.007
	(0.034)	(0.030)	(0.032)	(0.029)
Child Gender	-0.034	-0.086	-0.011	-0.008
(male=1)	(0.063)	(0.065)	(0.064)	(0.070)
Ethnic Identity		-0.2**	-0.156	
(indigenous=1)		(0.093)	(0.195)	
Language Spoken in Home		0.163		
(indigenous=1)		(0.171)		
Language Spoken in Home		-0.185		-0.157
(K'iche'=1)		(0.200)		(0.107)
Language Spoken in Home			-0.171*	
(Kaqchikel=1)			(0.089)	
Constant	-0.679	-0.168	-0.215	1.136***
	(0.359)	(0.358)	(0.414)	(0.408)
Adjusted R-squared	0.353	0.309	0.368	0.389
F-statistic	12.627	9.709	11.194	11.076
Prob(F-statistic)	0.000	0.000	0.000	0.000
No. of Observations	811	798	700	617

Notes: * indicates significance at 10% level, ** at 5% level and *** significant at 1% level of confidence.

situation with a better socio-economic situation. In some departments where multiple ethnic and socio-cultural groups reside, the same tendency is observed.

The hypothesis also predicts that a correlation between mother's education and child health is observed only if mother's education is above a certain level. However, the estimates do not show the pattern in general. For example, the estimator for indigenous people in Totonicapán, who enjoy the highest average level of mother's education, is smaller than some other groups. Therefore, the hypothesis for socio-economic differences is not valid.

Among the hypothesis for socio-cultural differences, that is, differences in production efficiency and differences in labor income, the hypothesis for differences in labor income is not accepted because fathers' education does not correlate with child health in general.

The hypothesis for efficiency in health production technology implies that the variables related to household socio-economic condition (asset index and parental education) have a greater impact on health for ladino or indigenous people who share more ladino features. Additionally, if mother's education captures information on household health production technology, maternal education has a greater impact for the ladino or indigenous people who share more ladino features. In general, the pattern of the coefficient is consistent with the hypothesis for groups between departments while limited tendency was observed for groups within departments with multiple ethnic and socio-culturally different resident groups. In contrast to the variables for household socio-economic conditions, mother's height, which captures information concerning mothers' ability to manage household resources for health production, did not show a specific pattern between the groups.

To summarize, if ethnic differences in preferences and social norms do not affect the differences in the linkage between the groups, the results indicate that the variation of the determinants between ethnic groups and socio-cultural groups is likely to be caused by differences in health production efficiency.

5. Conclusion

This paper examined the existence and the cause of the differences in the linkage between socio-economic conditions and child health between ethnic groups in rural Guatemala. Huge disparity is observed within indigenous people according to indigenous language (K'iche' and Kaqchikel), the language spoken in home (K'iche', Kaqchikel and Spanish), and the area of residence (Chimaltenango, Suchitepéquez, Totonicapán, and Jalapa). In some departments, Spanish-speaking indigenous people have similar tendencies as the ladino people. Improvement in socio-economic status is likely to contribute to improvements in ladino children's health status. As indicated in Nakagami (2010), the effect is relatively low or non-existent for indigenous people, particularly for those who share more indigenous features even after considering geographic effects.

The reason is likely to be that indigenous people use household resources inefficiently for child health production compared to ladino people. Because ethnic groups tend not to reside in the same areas, some of the differences among ethnic groups are reflected by differences in regional residence.

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[ii] Gragnolati (2001) indicated that language usage (mother's spoken language in the home) may cause the differences.

[ii] Nakagami (2010) mentioned the reason as possible socio-cultural differences within indigenous people, which might cause variations in the determinants among indigenous people.

[iii] See (ii).

[iv] The altitudes at the capitals of Jalapa, Chimaltenango, Suchitepéquez, and Totonicapán are 1,183 meters, 2593 meters, 410 meters, and 2,097 meters, respectively (Gragnolati 1999).

[v] Pebley, A., and N. Goldman. Guatemalan Survey of Family Health (EGSF), 1995 [computer file] 2nd ICPSR version. Santa Monica, CA. : Rand [producer], 1995 Ann Arbor MI : Interuniversity Consortium of Political and Science Research [distributor] 1999.

[vi] Because the survey is conducted among females, ladina (feminine) not ladino (masculine) is used in the Spanish questionnaire.

[vii] The following samples were excluded from the analysis because the number of sample was fewer than 10: ladino residing in Totonicapán (6 samples), ladino residing in Jalapa (10 samples), K'iche' speaking residing in Chimaltenango (two samples), and indigenous people residing in Suchitepéquez but not Kaqchikel nor K'iche' (eight samples).

[viii] Nakagami (2010) estimated the child health determinants using ladino residents' samples in Jalapa of EGSF. The descriptive statistics presented in Nakagami (2010), Table 1, column 1 and the values in Table 2, column 1 in this study have no critical differences. The differences in the values are because of the following. First, the number of samples is slightly different because there is a slight differences in the variables used in Nakagami (2010) and this study. This caused the exclusion of some samples because of missing data. Second, Nakagami (2010) used an asset index constructed from data only from ladino residents in Jalapa, whereas this paper used an asset index constructed from all the samples used in this study. Second, the z-score of mother's height was calculated using data from ladino residents in Jalapa only in Nakagami(2010) while this study's calculations used all the samples in this study.

[ix] The variables used for creating the asset index are as follows. Ownership of oxcart, bicycle and motorcycle. Having electricity and working television and owning a telephone, radio, and refrigerator as well as dummy variables to identify the households who use gas for cooking and households who cook and sleep in different rooms. For drinking water sources, dummy variables are used to identify households with access to clean drinking water, which is households that obtain drinking water from an in house tap, tap on the house patio, or a well on the patio. For toilets, two types of dummy variables are used. One is an in-house toilet, the other is an outside toilet or latrine. To capture the quality of the residence, four variables are used. For materials for walls and roofs, high quality wall materials (concrete or blocks) and high quality roof materials (corrugated metal or plastic) are used. For floor quality, high quality floor materials (tile) and low quality floor materials (earth) are added.

[x] EGSF collected household consumption data and constructed several household consumption

measures (see Pebley & Goldman, 1999). The data presented in Table 2 are calculated from the value of the ETR_F (total household expenditure excluding firewood after trimming) in the HHEXPEND file.

[xixi] The study created the z-score using all the samples. The values differ from Nakagami (2009, 2010), which calculated the z-score from the specific samples used in the analysis.

[xii] Descriptive statistics and estimators are omitted in the tables.

[xiii] Nakagami (2010) estimated the child health determinants using ladino residents' samples from Jalapa of EGSF. The estimator presented in Nakagami (2010) Table 2 (column 1) and 3 (column 1), the estimated values of Table 4 (column 1) and 5 (column 1), and those in Table 6 (column 1) and 7 (column 1) in this study have no critical differences. See viii for the cause of the differences in the estimates.

Table A1 Scoring Factors and Summary Statistics of the Variables Entering the Calculation of the First Principal Component

	Scoring Factors	Mean	Standard Deviation
Own Telephone	0.084	0.004	0.061
Own Refrigerator	0.192	0.065	0.246
Own Television	0.282	0.323	0.468
Own Radio	0.100	0.749	0.433
Own Bicycle	0.157	0.355	0.479
Own Motorcycle.	0.084	0.022	0.146
Own Oxcart	0.024	0.009	0.096
Drinking Water from In House Tap/Tap on House Patio/Well on Patio	0.340	0.661	0.473
In House Toilet	0.218	0.085	0.279
Outside Toilet/Latrine	0.065	0.614	0.487
Main Source of Lighting Electric	0.240	0.485	0.500
Cook and Sleep Separate Room	0.101	0.883	0.321
Main Cooking Fuel Gas	0.221	0.110	0.313
Wall High-Quality Materials (Concrete or Brocks)	0.234	0.226	0.418
Roof High-Quality Materials (Corrugated Metal or Plastic)	0.186	0.597	0.491
Floor High-Quality Materials (Tile)	0.174	0.052	0.223
Floor Low-Quality Materials (Earth)	-0.302	0.641	0.480