Med UNAB

Artículo Original

Measuring health inequalities over time

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Summary

Background: several methodologies have been used to measure health inequalities. Most of them do so in a cross-sectional fashion, causing significant loss of information. None of them measure health inequalities in social territories over time. **Methods:** this article presents two approaches to measure health inequalities: one approach consists of a refinement of cross-sectional study, by using the analysis of variance (ANOVA) procedure to explore whether the gap between social territories is real or due to chance. Several adjustments were made to limit errors inevitably found in multiple comparisons. Polynomial procedures were then applied to identify and evaluate any trends. The second approach measures the health gap between social territories or strata (as defined in this study) over time using the Poisson regression. These approaches were applied using life expectancy and maternal mortality data from Venezuela. **Results:** a positive relationship between social territories and life expectancy was found, with a significant linear trend. The relation between maternal mortality and social territories was quadratic. The measurement of the gap between least developed social territory and the most developed territory showed a gap reduction from the first to the second decade, mainly because of an increase of maternal mortality in the more developed area, rather than a real improvement in the least developed. **Conclusions:** this study helps to clarify the impact that public policies and interventions have in reducing the health gap. Knowledge that a health gap between social territories can decrease without showing improvement in the least developed sector , is an important finding for monitoring and evaluating health interventions for improving living and health conditions in the population. [*Bergonzoli G, Bergonzoli V. Measuring health inequalities over time. MedUNAB 2007; 10:173-181*].

Key words: Health gap over time, Social territories, Health determinants, Evaluating public policies and social programs, Poisson regression.

Resumen

Antecedentes: muchas metodologías han sido utilizadas para medir las brechas en salud, la mayoría de ellas lo hacen en forma transversal, por lo que pierden la riqueza de la información aportada por series de tiempo. Ninguna lo ha hecho entre territorios sociales en series cronológicas. **Métodos:** para la medición transversal, se empleó el ANOVA para explorar si las brechas entre los territorios sociales son reales o explicables por el azar; se aplicó el ajuste debido al error de múltiples comparaciones y los polinomios para evaluar la tendencia y su tipo. Para la medición de la brecha en series de tiempo entre territorios sociales se utilizó la regresión de Poisson, debido a que toma en cuenta todos los puntos de la serie. Para la demostración de estos métodos se utilizó la esperanza de vida al nacer y la mortalidad materna en Venezuela. **Resultados:** se encontró una relación directa entre los territorios sociales y la esperanza de vida, con una tendencia lineal significativa. La relación entre la mortalidad materna y territorios sociales fue cuadrática. La medición de la brecha, entre los territorios sociales #1 y #5, mostró que la brecha se redujo entre la primera y segunda década, a expensas de un aumento de la mortalidad materna en el territorio social más desarrollado y no por la disminución en el menos desarrollado. **Conclusiones:** el conocimiento derivado del estudio del comportamiento de la tendencia de la brecha en salud es básico como evidencia empírica del impacto de las políticas públicas y las intervenciones aplicadas para la reducción de las mismas. El saber que las brechas pueden presentar disminución sin que ello signifique una mejoría en los territorios sociales menos desarrollados es un hallazgo importante para el monitoreo y evaluación de los programas establecidos para el mejoramiento de las condiciones de salud de la población. [*Bergonzoli G, Bergonzoli V. Medición de las inequidades en salud a lo largo del tiempo. MedUNAB 2007; 10:173-181*].

Palabras clave: Brechas en salud a través del tiempo, Territorios sociales, Determinantes de la salud, Evaluación de políticas públicas y programas sociales, Regresión de Poisson.

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Paper received: Octuber 21th 2006; accepted: June 11th 2007.

Introduction

The measurement of health inequalities over time continues to challenge researchers and health officials. Most methodologies measure health inequalities in a cross-sectional fashion.[1-6] Few methods measure the evolution of the gaps over time. Several studies have begun taking into account variations within and between groups, as well as trends in health inequalities, but as they take into account only two points of the time series, information is lost.[7-12] While these methodologies are important, they are insufficient to form a complete picture of the behavior of health inequalities over time. In addition, there is no measurement of the evolution of the health gap between social territories or stratified population groups over time, based on health determinants.

Many countries in the developed world have reported health inequality studies; some has become universal landmarks, such as the Black Report[13] and the Acheson[14] report. An increased interest in health inequality determinants, mostly outside the traditional health sector, has been shaped by the recent launching of the World Health Organization Commission on Social Health Determinants.[15] The establishment of this Commission, led to the development of new practical terminologies for the health inequality concept.[16-18] This study proposes a methodology for estimating, monitoring, and evaluating the evolution of health gaps among social territories over time, taking into consideration all points of the time series.

Materials and methods

The methodology used in this work has already been published elsewhere,[19] and was developed using life expectancy and maternal mortality data taken from secondary sources routinely produced by the Ministry of Health Statistics Offices in Costa Rica, Guatemala and Venezuela. Even in countries with diverse degrees of development in healthcare and information systems, it is possible to apply the analytical procedures proposed here, in order to obtain empirical evidence on health inequalities.

Definition of social territories. In our study, the geographical unit of analysis was the first sub-national level, or state, in Venezuela. Other geographical units of analysis could be used depending on available data with comparable level of desegregation. The states were then stratified into social territories. Social territories are units of analyses generally defined as populations that share socioeconomic and other characteristics, but that do not necessarily share geographic borders.[20-26] Statistical procedures were performed using SPSS®.[27] The economic criterion, gross national product per capita (GNP) adjusted for purchasing power parity (PPP$),[27,28] was used to build the social territories or strata. Then, the k-means cluster procedure was used to build 5 social territories.

Cross-sectional measure of health inequalities. Once the social territories were constructed, life expectancy and maternal mortality data were evaluated applying cross-sectional analysis. Maternal mortality was used because it has been prioritized in the declaration of the Millennium Development Objectives.[29] The one-way variance analysis (ANOVA) was used to estimate the effects of the intra- and inter-group variability (horizontal and vertical gap). To estimate the health event trend among the five social territories, the polynomials procedure was applied and the homogeneity of variances and normality were evaluated. In order to control the effect of multiple comparisons error, the Bonferroni procedure was applied when the variances were homogenous; if they were not, the Tamhane's T2 test was used. The alfa level used is 0.10.

Health inequality measure over time. On the second approach, an evaluation of the whole time series at national level was made by dividing the chronological series into decades to evaluate the impact, if any, of the applied interventions on the registered trend. A simple regression model was applied to each decade. To measure the health gap between social territories over time, a regression coefficient was estimated for each social territory, and a parallelism test[30] was used to evaluate whether or not the two regression coefficients differed. This can also be done using a single straight-line equation. The Poisson regression was used to estimate the magnitude of the gap between two social territories. This procedure takes into account all points of the time series. A 90% confidence interval was calculated. Data on life expectancy at birth and maternal mortality rate per 100,000 live births in Venezuela were used in order to demonstrate these methodological procedures.[31-33]

Results

As stated, the social territories were defined using GNP adjust for PPP$. Social territory #1 has the lowest GNP adjusted for PPP$, indicating lower social development. Social territory #5, has the highest GNP adjusted for PPP$, indicating higher social development. The remaining territories demonstrated a range of intermediate development. Once the social territories were defined, the event of interest was modeled on them.

Cross-sectional measurement of the gap in health. The next step of the methodology was to model life expectancy at birth, as well as maternal mortality in the social territories. Life expectancy is the average expected number of years to be lived.

Table 1. Social territories in Venezuela, from lowest to highest GNP adjusted for PPP$. Venezuela, 2002.

ST #1 (Lower)	ST #2	ST #3	ST #4	ST #5 (Higher)
Amazonas	Yaracuy	Lara	Nueva Esparta	Distrito Capital
Delta Amacuro	Sucre	Falcón	Aragua	Miranda
	Trujillo	Monagas	Anzoátegui	
	Portuguesa	Mérida	Bolívar	
	Barinas	Táchira	Carabobo	
	Guárico	Cojedes	Zulia	
	Apure			

ST: Social territory.

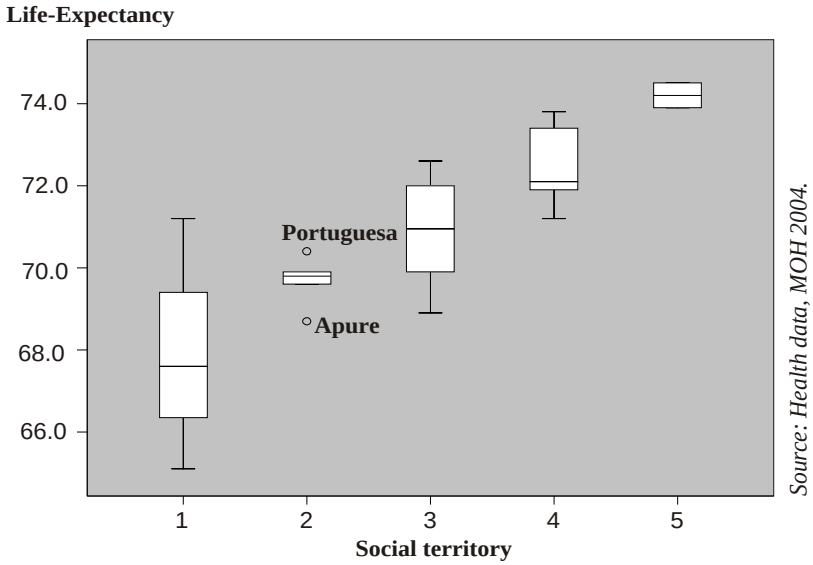


Figure 1. Life expectancy according to social territory. Venezuela, 2002.

Table 2. Life expectancy, according to social territory. Venezuela, 2002.

Social territory	1	2	3	4	5
$\overline{X}$	68.0	69.7	70.9	72.4	74.2
SD	3.1	0.6	1.4	1.0	0.4

Abbreviations: SD=Standard deviation, $\overline{X}$ = Mean.

The analysis of variance (ANOVA) for life expectancy yielded an F equal to 9.1 with 4 and 22 degrees of freedom, and an associated probability of 0.000; indicating that at least one of the comparisons among the 5 social territories was statistically significant. Since the variances were not homogenous, a test based on a Tamhane's T2 test was used (Leven Test 3.7, p=0.02). The result showed that the differences between social territory 2 and social territories 4 and 5, and between social territories 3 and 5 were statistically significant. Curiously the test did not yield a statistically significant difference between social territories 1 and 5, even though visually the variability seems not to overlap. By using a polynomial procedure, a statistically significant linear trend among the strata was found, with an F equal to 32.5 and $p < 0.0001$ with 1 and 22 degrees of freedom (figure 1).

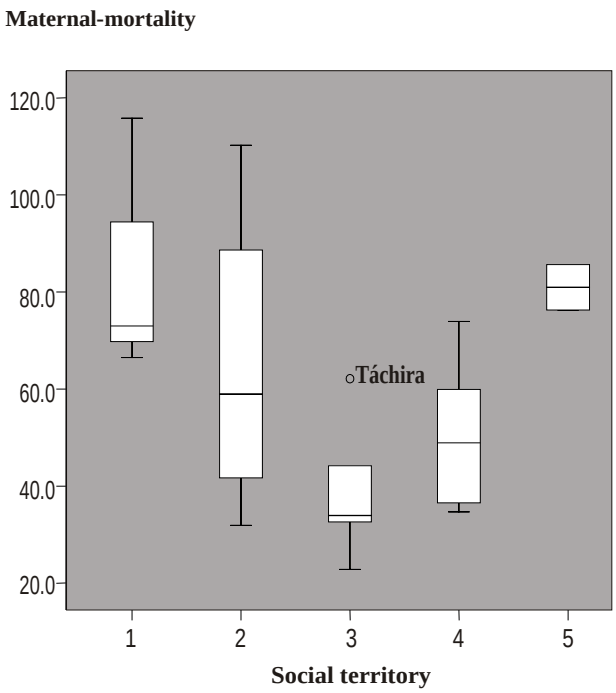
Table 3. Maternal mortality, according to social territories.

Social territory	1	2	3	4	5
$\overline{X}$	85.1	65.1	38.3	50.5	81.0
SD	26.8	30.1	13.5	11.6	6.6

Mortality average per 100,000 newborn.

Regarding the maternal mortality analysis, the ANOVA yielded an F of 3.4 with 4 and 22 degrees of freedom, and an associated probability of 0.03, which indicates that at least one of the comparisons among the 5 strata is statistically significant. Since the variance were not homogenous the Tamhane's test was used (Levene test 2.8, p=0.06).

The result shows that the difference between territories 3 and 5 was statistically significant. A quadratic trend was found among the five strata using the polynomials test, F of 9.9 with 1, 22 df to 9.9 with a probability = 0.006 (figure 2).

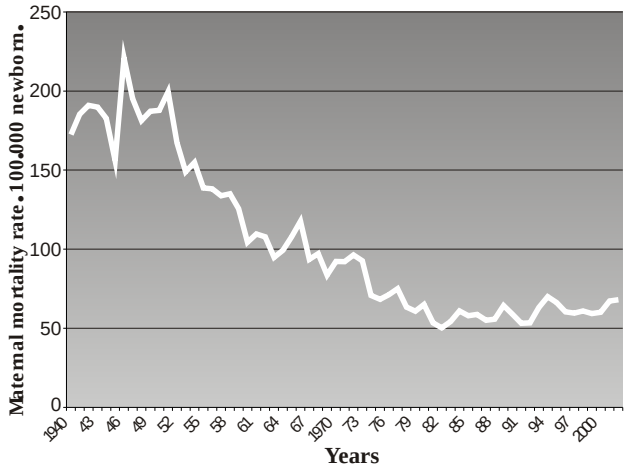


Source: Health data, MOH 2004.

Figure 2. Maternal mortality according to social territories. Venezuela, 2003.

Measuring health inequalities over time at national level. To evaluate the maternal mortality trend at the national level, data from 1940 through 2003 were used.

At first glance, the yearly data seems to indicate that the maternal mortality trend has been decreasing as a consequence of the applied public health interventions until 1980, and that it has flattened since 1980 (figure 3).



Source: Epidemiology Dept. MOH.

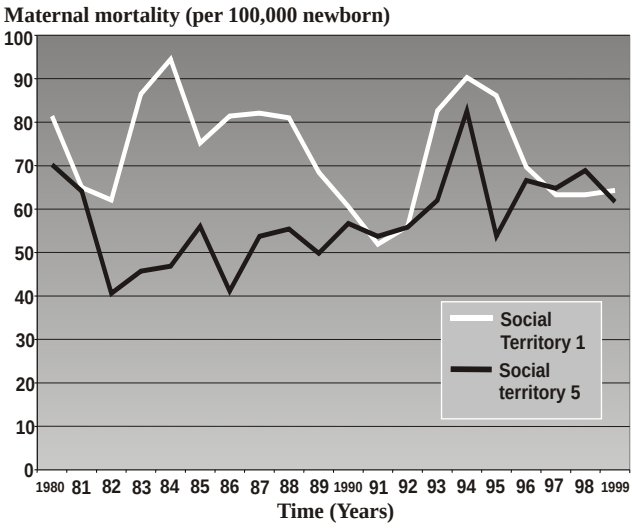
Figure 3. Maternal mortality trend. Venezuela, 1940-2002.

However, when data were divided into decades, and a simple linear regression method was applied, it became clear that the magnitude and quality of beta coefficient (speed and direction measured by the slope) had not been homogenous in all decades indicating differential impact over time. Furthermore, there were decades in which the trend has shown significant increase, as in the eighties (table 4).

To further explore the evolution of the health gap between social territories over time, we analyzed the maternal mortality trend of social territories 1 (least developed) and 5 (most developed)

Table 4. Maternal mortality trend analysis, according to time series (Decades). Venezuela, 1940-1999.

Decade	Intercept	Beta coefficient	t Student	P-value	Judgment-value
1940-49	179.7	+ 1.17	0.62	0.51	Non-significant
1950-59	187.4	- 7.77	- 6.51	0.00	Significant
1960-69	111.1	- 1.95	- 2.02	0.08	Significant
1970-79	94.4	- 3.24	- 3.44	0.01	Significant
1980-89	52.3	+ 0.84	2.29	0.05	Significant
1990-99	58.9	+ 0.29	0.48	0.64	Non-significant



Source: Epidemiology Dept. MOH.

Figure 4. Maternal mortality trend. Social territories #1 and #5. Venezuela, 1980-1999.

Figure 4 shows that the maternal mortality gap during the first decade (1980-89) is greater than in the following decade. The maternal mortality trend in social territories 1 and 5 was erratic in 1980-89 and 1990-99, as shown by the national registered trend analysis from 1980 onward (figure 3). The next step was to evaluate whether the regression coefficients differed between social territories during these decades. Two procedures were applied: first, a single straight-line equation and second, two straight-line equations, equivalent to a parallelism test. The procedure to evaluate whether the magnitude in coefficients differs by using two straight line equations is as follows:

$$T\,df = \frac{[\hat{\beta}_{e1} - \hat{\beta}_{e5}]}{[S\hat{\beta}_{e1} - \hat{\beta}_{e5}]^{½}} \qquad df = n_1 + n_2 - 4 \qquad (1).$$

Where $\hat{\beta}_{e1}$ and $\hat{\beta}_{e5}$ are the slopes (regression coefficient) from social territory 1 and 5, based on their own data.

$[S\hat{\beta}_{e1} - \hat{\beta}_{e5}]^{½}$ is the standard error of the coefficients' difference. The sum of the estimated variances from the regression equations for each coefficient was required to calculate the standard coefficient error. The standard error is equal to the square root of the following variance:

$$\sqrt{S^2}\,\hat{\beta}_{e1} - \hat{\beta}_{e5} = \sqrt{S^2}p,y/x * \left[\frac{1}{(n_1-1)S^2x_1} + \frac{1}{(n_2-1)S^2x_2}\right] (2),$$

where:

$$S^2p,y/x = \frac{(n_1-2)S^2y/x_1 + (n_2-2)S^2y/x_2}{n_1 + n_2 - 4} \qquad (3).$$

Hence S^2y/x_1 and S^2y/x_2 are obtained from the square sums (SS) of the residuals, respectively. And, S^2x_1 y S^2x_2 are the data variances from each social territory. Once the straight-line procedure was applied to both social territories, we obtained the following results, which we put into formula 3:

$$p,\,y/x = \frac{[10-2] * 112.7 + [10-2] * 90.5}{10 + 10 - 4} = \frac{1625.6}{16} = 101.6$$

This result goes into formula 2:

$$S^2\hat{\beta}_{e1} - \hat{\beta}_{e5} = 101.6 * \left[\frac{1}{[10-1] * 101.4} + \frac{1}{[10-1] * 91.8}\right] = 101.6 * 0.0023 = 0.243$$

Finally, this result goes into formula 1:

$$t\,df = 16,\ \alpha = 0.10 = \frac{[0.372 - 1.113]}{[0.2343]^{½}} = 1.53$$

The theoretic value from the t Student distribution, with 16 degrees of freedom and an alfa level of 10%, is 1.34. In conclusion, these two regression coefficients are different in their magnitude (table 5).

Table 5. Maternal mortality, according to decades, in social territories #1 and #5. Venezuela, 1980-1999.

Decade	Social Territory	Beta coefficient	Standard error	T Student	P (Alfa level)
1980-89	1	+ 0.372	1.17	0.32	0.76
	5	- 1.113	1.05	1.06	0.32
1990-99	1	+ 0.309	1.60	0.19	0.85
	5	+ 1.099	0.95	1.15	0.28

There is another approach for comparing regression equations through a single multiple-regression model that contains one or more dummy variables to distinguish the social territories which are being compared. First of all, it is necessary to define an indicator variable or dummy variable:

Full model: $Y = \hat{ß}_0 + \hat{ß}_{1x} + \hat{ß}_{2z} + \hat{ß}_{3xz+e}$

This produces two models:

Social territory #1, if z = 0 then $Y_1 = \hat{ß}_0 + \hat{ß}_{1x+e}$
Social territory #5, if z = 1 then $Y_5 = (\hat{\beta}_0 + \hat{\beta}_2) + (\hat{\beta}_1 + \hat{\beta}_3)\, x + e$

If $\hat{ß}_3 = 0$, then $\hat{ß}_{1\text{-}5} = \hat{ß}_1$. This brings us to $\hat{ß}_{1\text{-}5} = \hat{ß}_{1\text{-}1} = \hat{ß}_1$ or *parallelism.*

The formula to estimate this statistic is:

$$F\,(xz / x,z) = \frac{Regression\ SS\ (X, Z, XZ) - Regression\ SS\ (X, Z)}{MS\ residual\ (X, Z, XZ)}$$

Where regression SS means the square sum of the regressors (independent or explanatory variables) for the full and reduced model; and MS residual represents the mean square of the residual for the full model. With this statistic, the null hypothesis where both trend lines are parallel can be evaluated; that is, if the $\hat{ß}_3$ coefficient is equal to zero, and the gap between social territories remains without change over time. The XZ term represents the interaction term between maternal mortality rate and social territory.

The result, based on the available data, is:

$$F\,[xz / x,z] = \frac{4063.12 - 3253.6}{10 + 10 - 4} = \frac{809.5}{56.7} = 14.3$$

with 1, 61 degrees of freedom. The theoretic value of F=3.1 (Snedecor statistic), with 1, 61 df and an alfa level of 10%.

In conclusion, the two regression coefficients are different in their direction; that is, they are not parallel. In other words, the term that represents the interaction term (effect modification) makes a significant contribution. Therefore, we rejected the null hypothesis for the $\hat{ß}_3$ as being equal to zero, which shows a real synergic effect between maternal mortality and the extent of social development in both social territories. This result was the same regardless of the method used.

The last step of the methodology consisted in estimating the health gap between the two social territories using a Poisson regression. The result represented the health gap (inequality) between the trend in social territory #1 compared to the trend in social territory #5, taking the latter as the baseline from 1980-89.

The same procedures were applied for data from the decade, 1990-99 (table 6).

Table 6. Health gap (distance) between trends in social territories # 1 vs. # 5. Venezuela, 1980-1999.

Decades	Ψ	90% confidence interval
1980-89	1.48	1.34 – 1.64
1990-99	1.10	0.96 – 1.22

Ψ *is the odds ratio.*

As a final conclusion, in 1980-89 the maternal mortality gap was 48% higher in social territory #1 compared to #5, with a range between 34% and 64%. Note that during the following decade, the gap decreased to 10% (a 79% reduction), albeit the low limit contains the unity (null hypothesis).

Discussion

This study proposed a method to measure health inequalities between social territories over time. Increased political interest in examining the link between health and human rights[34-37] has made the measurement of health inequalities a subject of great importance for many countries[38-40] and for the health sector.[41-43] Most currently-published studies employ cross-sectional analysis, which is valuable but insufficient to build a complete picture of the health gap's behavior. Since the health inequality definition[44, 45] refers to comparisons among population groups rather than among individuals, recent efforts have begun to analyze smaller geographic units, i.e. at a local level.[46] There is growing consensus that social forces or determinants outside the health sector contribute to health gaps or inequalities. Furthermore, the mechanisms by which these forces produce inequalities are not well understood.[47-51] How to quantify the effects of these forces on health inequalities over time is still a question that has to be explored.

In our study, health inequalities have been measured using two procedures. First, cross-sectional analysis was modified by creating and using social territories and applying a proxy-variable that represents health and social determinants. The social territories were based on an economic criterion, the gross national product per capita (GNP) adjusted for purchasing power parity (PPP$), and then was used as a determining factor for social and health inequalities.

Table 1 shows the stratification of the Venezuelan states, which were chosen as the geographical unit of analysis. The states of Amazonas and Delta Amacuro belong to the least developed social territory (#1) and Miranda and Distrito Capital belong to the most developed social territory (#5). Life expectancy and maternal mortality rate data were then modeled. Because of the great variability found among social territories, the ANOVA procedure was applied to evaluate the

vertical gap within territories (intra group) and the horizontal gap among territories (inter group) that could be attributed to the difference in PPP$ or simply explained by chance (Graph #1 and #2). The results indicate that, for life expectancy, at least one of the comparisons between the five social territories is statistical significant (F= 9.1, df= 4.22 and a= 0.10 with an associated probability of p< 0.0001).

Results of multiple comparisons between social territories by means of the Tamhane's test, due to a lack of homocedasticity of variances (Levene test = 3.7; p=0.02), revealed that in comparing social territory #5 against #2 and #4, chance alone is not an explanation. The same result was obtained by comparing social territories #4 and #2. Although the conglomerates procedure classifies the units of analyses in homogenous groups, where life expectancy and maternal mortality events were modeled, a great vertical variability was found. This means that the poorest territories are not homogenous for these two events; that is, there is a vertical (intra territory) inequality. The use of the polynomials procedure yielded a significant linear trend, F=32.5, df=1, 22 and a= 0.10 with a probability of p< 0.0001.

This result allows us to state that in the case of Venezuela, a greater degree of development, as a whole, promotes greater life expectancy. The analysis of maternal mortality yields an F=3.4, df= 4.22 and a= 0.10 with an associated probability of 0.03; indicates that at least one of the comparisons between social territories is significant (theoretical value 2.25 with equal df number and alfa level). Multiple comparisons were evaluated using the Tamhane's test, due to a lack of homocedasticity in variances (Levene test= 2.8, p=0.06), which yielded a statistically-significant difference between territories #5 and #3. When examining the trend by polynomial procedure, it yielded F= 9.9, df=1.22 and a= 0.006, indicating a quadratic trend, which suggests the presence of different factors acting on these two social territories. Trend and multiple comparison tests represent an added value compared to what has been done in health gap estimation in cross-sectional analysis.

The evolution of variability in each territory, after a public health intervention, will serve as an indicator for monitoring and evaluating the intervention's impact on the health event in question. The second method involved measurement of health inequalities over time, which yields a more comprehensive understanding of the trend's behavior. Working at sub-national level is highly recommended to ensure that intra-national differences being unmasked; it is also true that analyses done until now for national levels are extremely limited and lose valuable information. For this reason, we propose that the first analysis of a time series be done only when a sufficient amount of observations become available, and then, dividing the time series into equal units of time. For this study, we have chosen the decade as the unit of comparison.

Figure 3 contains the registered maternal mortality trend between 1940 and 2003. An observer could assume that health interventions have been successful because the trend seems to be indicating a reduction during the specified time period. Nevertheless, an examination of each decade as a unit of time shows that the rate of decrease has been different and the trend has actually increased during the last two decades (although not significantly in the last decade; table 4). It is clear that the applied interventions did not have the expected impact in all decades.

Figure 4 shows a comparison between the least and most developed territories, #1 and #5, respectively. Note that the health gap between them is greater in 1980-89 than 1990-1999. This phenomenon can have several interpretations: 1. the trend in social territory #1 decreased more quickly than in social territory #5, causing the overall gap reduction, or 2. the trend in territory #5 increased considerably, while the trend in social territory #1 decreased only slightly. Several other scenarios are possible.

Table 5 contains the following results: the coefficients' magnitudes, in both territories and for both decades, have remained relatively equal. The regression coefficient's direction in territory #1 has been positive, or increasing in both decades, and territory #5 showed a negative regression coefficient, or decreasing trend, in 1980-1989 and a positive, or increasing, trend in 1990-1999. However, these results are statistically non-significant in both decades. This result confirms the trend observed at national level in both decades, and suggests the public health interventions were not entirely successful during that period.

In order to evaluate whether a difference exists in the regression coefficients' magnitude between social territories, two procedures were used: first, by means of using two straight line equations, one for each territory, and second by means of a single straight line equation. The result was a t Student = 1.53 df = 16 and an alfa level = 0.10; being the theoretical value 1.34 with equal degrees of freedom number and significance level. The result yielded evidence that the magnitude of the regression coefficients from both social territories differ statistically in the first decade. This suggested a real synergic effect exists between maternal mortality and the extent of social development in both social territories over time, although the key factors might be different.

Once the magnitude and direction of the regression coefficients in the social territories was determined, the next step was to estimate the gap between social territories being compared using a Poisson regression. This procedure's strength lies in that it takes into account all the data points of the time series. Table #6, contains the results of the measurement of health gaps between social territories #1 and #5 in 1980-1989 and 1990-1999. During 1980-89, the maternal mortality gap in territory #1 was 48% above the baseline measurement in social territory #5. As seen in Table #5, the slope, or regression coefficient, in territory #1

decreased 17% (from +0.372 to +0.309), while the regression coefficient of territory #5 changed only slightly (1.3%). Notice also that territory #5's regression coefficient moves from decreasing trend during the first decade towards increasing trend in the second. This reduction cannot necessarily be interpreted as an improvement on the population's health conditions, since the gap reduction did not occur because territory #1 improved, but because territory #5 worsened.

Through this study's improved methodologies for the measurement of the health gap, we hope to increase analytical competencies of the health ministry's technical teams, improving their knowledge of health disparities as well as to provide a set of methods that allow health officials to monitor and evaluate public health policies and social interventions aimed to diminishing health inequalities. The criterion selected to construct the social territories has several strengths in addition to grouping similar units together. This stratification facilitates the task of selecting a social territory as a baseline against which to compare the other territories. In cross-sectional studies, this stratification allows for the possibility of examining, with greater detail, the differences in a social territory's behavior (its vertical and horizontal gaps), of evaluating whether or not this difference is real, and of establishing the presence and the type of the trend among social territories.

Finally, this study's most significant contribution is the measurement of the health gap among social territories over time. The gap or distance between the trend in two social territories was measured using the Poisson regression[52,53] because it takes into account all the points or observations available in the chronological series. It is precisely here, where we would like to emphasize the analysis of time series, at national level, by dividing the time series into equal sections, that is, decades. Another unit of analysis may be selected depending on the number of available observations. It is acknowledged that the greater number of units of time available, the better the results.

Among the limitations that we can point out is the difficulty in certain countries to access enough data at sub-national levels for long periods of time. In order to do this Health Ministries will need to work harder to strengthen their information systems.[54] The technology and qualified human resources required to apply these procedures are scarce in most developing countries. Since a single study will not be able to describe all aspects of the determinant factors accountable for health inequalities, we hope this work inspires further research of health inequalities measurements over time among social territories. The evaluation of the changes in health inequalities over time is, without doubt, crucial to uncover whether pubic policies and social interventions at sub-national level, are feasible and effective, both technically and economically, in countries with limited technological development.

Acknowledgments

We would like to thank: Dr. Edgar Rivera, Former Epidemiology Dept. Director of the MOH, Venezuela, for his wise advice. Mr. Edgar Medina, statistician, an assistant of the MOH Epidemiology Dept. Director, Venezuela, for his technical contributions Dr. Beatriz Sánchez, MOH epidemiologist, for her invaluable data contributions. Mrs. Minerva D'elia, Coordinator of Venezuela PAHO's Information Center, for her bibliographic support. Mr. Lenin Saaman, Venezuela PAHO's Informatics Center, for his technological support. Mrs. Olga Lopez, my assistant at Venezuela PAHO's Office, for her technical support. Dr. Marcelo Korc and Marcello Bergonzoli, for their editorial support, and for all those who made this publication possible.

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