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Complex Social Gradient in Life Expectancy in Costa Rica: an Ecological Study with 24-Million Person-Years Follow-Up

Complejo gradiente socioeconómico en esperanza de vida en Costa Rica: un estudio ecológico con seguimiento de 24 millones de personas-año

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ABSTRACT: The knowledge of Costa Rica's situation regarding the social gradient in mortality is still incomplete. National Electoral Rolls, which included all adult Costa Rican citizens were used. The event was death between 2010 and 2018. The exhaustive final sample included 2,747,616 people for 23,985,602 person-years of follow-up. An ecological study at the electoral district level was performed. A negative social gradient was observed in men and in women, in particular in urban area. A protective effect of rural areas compared to urban areas was revealed in men, but not in women. As a result, in men, the poorest districts of mixed/rural areas had similar life expectancy than the richest districts in urban areas. These results partially contradicted the international literature on socioeconomic inequalities. It demonstrates the importance of studying contexts other than high-income countries to better understand the social inequalities in health worldwide.

KEYWORDS: Mortality; Health inequalities; Middle-income country; Costa Rica.

RESUMEN: El conocimiento sobre la distribución del gradiente social de la mortalidad en Costa Rica aún no ha sido totalmente comprendido y nuevos estudios pueden confirmar o refutar lo que anteriormente se ha observado. Se utilizaron las listas electorales nacionales, que incluían a todos los ciudadanos costarricenses adultos. El evento fue la muerte entre 2010 y 2018. Siendo la muestra exhaustiva final de 2.747.616 personas para 23.985.602 personas-año de seguimiento. Se realizó un estudio ecológico a nivel de distrito electoral, para caracterizar la situación socioeconómica de cada uno. Se observó un gradiente social negativo en hombres y mujeres, en particular en el área urbana. Se observó un efecto protector de las áreas rurales en comparación con las áreas urbanas en los hombres, pero no en las mujeres. Como resultado, en los hombres, los distritos más pobres de las áreas mixtas/rurales tenían una esperanza de vida similar a la de los distritos más ricos de las áreas urbanas. Estos resultados contradicen parcialmente la literatura internacional sobre las inequidades socioeconómicas en mortalidad. Demuestra la importancia de estudiar contextos distintos a los de los países de ingresos altos para comprender mejor las desigualdades sociales en salud en todo el mundo.

PALABRAS CLAVE: Mortalidad; Inequidades sociales en salud; Desigualdades sociales en mortalidad; Inequidades sociales en mortalidad; País de ingresos medios; Costa Rica.

INTRODUCTION

Socioeconomic inequalities in life expectancy have been previously shown in several countries across the world, such as, European countries, United States, Australia, China, Brazil or India (1-7). A recent study carried out in Europe showed a consistent negative social gradient, where people with higher educational level have higher life expectancies (8). In the United States of America, socioeconomic and ethnic related factors accounted for 60% of the large differences (up to 20.1 years) of life expectancy between the counties with the lowest and highest life expectancy. However, the vast majority of evidence regarding this topic comes from industrialized and high income countries. And yet, health inequalities are one of the greatest concerns in low and middle income countries (LMIC's) (9,10).

In Latin America, a recent study using an ecological approach showed that higher area-level socioeconomic position was associated with higher life expectancy, especially in Santiago (Chile) and Panama City (Panama) (11). In San Jose (Costa Rica), the authors found geographical disparities but did not demonstrate a relation between ecological socioeconomic position and life expectancy. This study only contemplated the capital region and 27 counties, which does not allow a precise measure of the characteristics of the place of residence. However, the results were consistent with previous studies in Costa Rica, which revealed no negative social gradient in mortality in elder people (12,13). Nevertheless, a recent work showed differences in life expectancy between people born in the province of Limon, one of the poorest of the country, compared to people born in the other provinces (14). Finally, the knowledge of Costa Rica's situation regarding the social gradient in mortality is still incomplete. Previous studies at the individual level were only carried out on elderly people, which might hide inequalities, as relative socioeconomic inequalities in mortality generally decreased with age (15,16). Moreover, previous international studies showed that health inequalities might have different scales and mechanisms in rural and urban area (17-20)

This hypothesis has not been tested in Costa Rica yet and might contribute to a better understanding of the social inequalities in Costa Rica.

Costa Rica it is a middle-income Latin American country with 5-million inhabitants characterized by a strong socioeconomic inequality. Its Gini Index is 51.0, and recently the country has been classified as one the most unequal country in the World (21). Despite this, Costa Ricans have a high life expectancy (80.0 years in 2016), statistics that are comparable to those of high income countries. Costa Rica appears to be characterized by an absence of negative social gradient in mortality. This absence may be viewed as surprising, regarding the situation of other middle and high income countries and deserves to be studied and deserves to be further studied. One of the particularities of the country is the access to reliable and meaningful data from national registries, that have achieved national completeness, (22) allowing for analyses of health inequalities from an ecological perspective (23). Ecological studies permit to use the socioeconomic territorial characteristics, such as, urbanity and socioeconomic position or development (24) to measure inequalities in health (23).

The aim of this study was to analyze the association between the socioeconomic characteristics of the place of residence and life expectancy in Costa Rica. The hypothesis tested in this work was that the richer a district is, the higher the life expectancy is, a link which can be different in urban and rural conditions. The analysis were split by age and sex to highlight possible differences.

MATERIALS AND METHODS

SAMPLE

The sample was based on the National Electoral Rolls used for presidential elections of 2010. National Electoral Rolls included all adult Costa Rican citizens who have a valid cédula, a unique identification number, on January 1, 2010. The cédula is essential for everyday life when living in Costa Rica, so the vast majority of the citizens older than 18 years old are included in the National Electoral Rolls. People dead before January 1, 2010 were excluded using the National Death Index. National electoral rolls, National Birth Index, and National Death Index were merged using the cédula. People born after December 31, 1990 were excluded because the National Electoral Rolls are not fully complete for people of 18 years old or younger. People who did not appear in the National Death Index nor in the National Electoral Rolls in 2016 or 2018 are considered lost and excluded from the sample (13). People who did appear in 2006, and 2016 or 2018 were included, using their electoral district in 2006.

The final sample included 2,747,616 people for 23,985,602 person-years of follow-up. Figure 1 presents the flow-chart presenting the sample and exclusions.

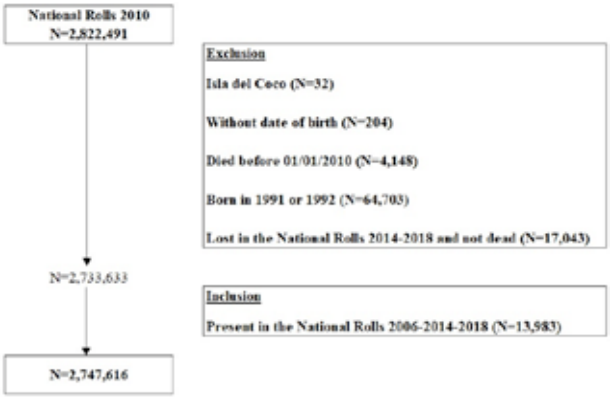

Figure 1. Flow-chart (N=2,747,616).

SOCIOECONOMIC DATA

An ecological study at the level of the electoral district was conducted, performing a methodology previously used in a Costa Rican cancer mortality

study recently published (25). Costa Rica, with 5 million inhabitants, is administratively divided into 481 districts (in 2018). Each district was described using the 2011 Census. The 2011 Census includes anonymized individual information on more than 4.3 million people (94% of the population in 2011). Districts were divided by area (urban, mixed, and rural) and wealth.

A district was considered as urban using the 2011 Census if more than 80% of its inhabitants lived in an urban area (26). Symmetrically, a district was considered as rural if more than 80% of its inhabitants lived in a rural area. The districts where more than 20% and less than 80% of its inhabitants were living in a urban area were classified as mixed.

Wealth was described using the percentage of people having a Basic Unmet Needs (BUN), a proxy used to characterize poverty in the 2011 Census. BUN indicator comprises four dimensions: access to a decent shelter, access to a healthy life, access to knowledge and access to other goods and services. We previously used BUN indicator to measure health inequalities in Costa Rica (25,27). For further information on BUN indicator, please see (28). Districts were divided by BUN into quartiles of population based on the 2011 Census population composition in each district.

GROUPS OF DISTRICTS

Districts were divided in eight groups by crossing their classification by urbanity (rural and mixed; urban) and wealth (BUN). The poorest districts (Q3 and Q4) of urban area and the richest (Q1 and Q2) of mixed and rural area were grouped to have a satisfactory number of districts in each group. Finally, six groups were studied. Table 1 presents the characteristics of the six groups.

ANALYSIS

The outcome of interest was the time-to-event. The event was the death. For each subject, the date of entry was the age of the subject on January, 1st, 2010. The date of the last follow-up was either the age of death, or the age of the subject on December, 31, 2018. Survival function according to age from 20 years old was described by sex using a parametric survival model based on a Gompertz distribution. Cluster-robust standard errors were estimated at the district level.

In a first analysis, Model 1 was adjusted for district's wealth (BUN) and Model 2A for urbanization and district's wealth, both at age 20 years. Models 2B and 2C were adjusted for urbanity and district's wealth at ages 40 and 60 years respectively. In a second analysis, we calculated life expectancy at 20, 40 and 60 years of age, using a parametric survival model based on a Gompertz distribution (14,29) for each group of districts and each sex. Life expectancy was estimated using the calculation proposed by Missov and Lenard (30) and expressed as the average expected number of years of life remaining from a given age (20, 40, 60 years old). Confidence intervals were estimated using bootstrap sampling.

SENSITIVITY ANALYSIS

We ran the same analysis replacing the BUN measure of district wealth with two different indicators: the percentage of adults having a university education level (UEL); and the percentage of people of the poorest quartile (PQ) according to the house characteristics and state of the house, measuring material deprivation.

To create this last variable, we generated an additive score summing the following variables:

having telephone, radio, television, satellite cable, computer, internet, car or moto, running water, hot water, electricity, bathroom, sanitary service, garbage collection, ceiling, states of the house/roof/ground/walls, overcrowding (31). This standard of living score ranged from 0 to 16. Then, we divided the population in quartile and calculated the percentage of people of the poorest quartile in each district.

Table 1. Descriptive statistics of the sample (Total), and by group of districts (N=2,747,616).

		Urban districts			Mixed-rural districts		
	Total	**Group 1 (Richest)**	**Group 2 (Intermediate)**	**Group 3 (Poorest)**	**Group 4 (Richest)**	**Group 5 (Intermediate)**	**Group 6 (Poorest)**
Districts (N)[1]	481	73	51	42	61	88	166
Sample							
N	2747616	724505	512113	429589	275948	314442	491019
%[2]	100.0%	26.4%	18.6%	15.6%	10.0%	11.4%	17.9%
Sex							
Men	49.9%	48.0%	49.3%	49.7%	49.7%	51.2%	52.7%
Women[3]	50.1%	52.0%	50.7%	50.3%	50.3%	48.8%	47.3%
Age (01/01/2010)							
<40[3]	51.0%	47.7%	51.4%	52.9%	50.0%	50.8%	54.3%
40-59	34.1%	35.0%	34.6%	33.5%	34.9%	34.1%	32.4%
>=60	14.9%	17.3%	14.0%	13.6%	15.1%	15.1%	13.3%
Death							
N	161698	45186	29111	26043	15694	18806	26858
%[3]	5.9%	6.2%	5.7%	6.1%	5.7%	6.0%	5.5%
Wealth							
BUN	27.4%	13.3%	21.2%	31.3%	20.9%	29.8%	45.9%
UEL	19.4%	35.1%	21.6%	15.3%	20.1%	12.6%	7.8%
PQ	24.8%	6.7%	13.6%	26.5%	16.1%	31.5%	52.3%
Urbanity	72.8%	99.1%	96.2%	95.1%	58.1%	40.9%	32.3%

Legend: 1Number of districts. BUN (Percentage of people with at least one Basic Unmet Need). UEL (Percentage of adults having a university education level); PQ (Percentage of people of the poorest quartile). Lecture: 2 26.4% of the sample lived in district of Group 1. 3 52.0% of people who lived in Group 1 were women, 47.7 were younger than 40 years old, and 6.2% died.

RESULTS

Table 2 showed the results of the survival model at age 20 years. The results were different according to sex. There was no clear social gradient in mortality in men (Model 1). There was a clear negative social gradient in women, where the more deprived a district was, the higher the mortality (HRQ2=1.11 [1.08-1.15], HRQ3=1.17 [1.13-1.21], HRQ4=1.22 [1.17-1.27]). Nevertheless, when adjusting for urbanity, a clear negative social gradient was observed for both men and women (Model 2A). Moreover, there was no difference according to urbanity in women, whereas the protective effect of rural area was important in men.

Table 3 presents the results of the survival model (Models 2A, 2B, 2C) at 20, 40 and 60 years of age, for men and women. At the age of 40 and 60, the negative social gradient decreased, especially in men. Nevertheless, it remained significant. The important protective effect of rural area in men was similar at ages 20, 40 and 60 years. There was no difference according to urbanity in women at ages 20, 40 and 60 years.

Table 2. Survival model at 20 years of age adjusted for wealth (Model 1), and wealth and urbanity (Model 2A) in men (N=1,370,684) and in women (N=1,376,932).

	Men HR [95%CI]	**Women HR [95%CI]**
	Model 1	
Wealth		
Q1 (richer)	1	1
Q2	1.04 [1.00-1.08]	1.11 [1.08-1.15]
Q3	1.08 [1.02-1.14]	1.17 [1.13-1.21]
Q4	1.02 [0.98-1.06]	1.22 [1.17-1.27]
	Model 2A	
Wealth		
Q1 (richer)	1	1
Q2	1.07 [1.03-1.11]	1.12 [1.08-1.15]
Q3	1.15 [1.09-1.21]	1.18 [1.13-1.23]
Q4	1.17 [1.12-1.22]	1.24 [1.17-1.31]
Urbanity		
Rural	0.78 [0.75-0.82]	0.96 [0.91-1.01]
Mixed	0.88 [0.84-0.91]	0.99 [0.95-1.03]
Urban	1	1

Table 3. Survival model at ages 20, 40 and 60 years adjusted for wealth and urbanity in men (N20=1,370,684, N40=913,539, N60=359,007) and in women (N20=1,376,932, N40=937,847, N60=387,725).

	Model2A: 20 years HR [95%CI]	**Model 2B: 40 years HR [95%CI]**	**Model 2C: 60 years HR [95%CI]**
		Men	
Wealth			
Q1 (richer)	1	1	1
Q2	1.07 [1.03-1.11]	1.06 [1.02-1.10]	1.06 [1.03-1.10]
Q3	1.15 [1.09-1.21]	1.12 [1.07-1.17]	1.08 [1.03-1.13]
Q4	1.17 [1.12-1.22]	1.12 [1.07-1.17]	1.07 [1.02-1.12]
Urbanity			
Rural	0.78 [0.75-0.82]	0.78 [0.75-0.82]	0.82 [0.78-0.86]
Mixed	0.88 [0.84-0.91]	0.87 [0.84-0.90]	0.88 [0.85-0.92]
Urban	1	1	1
		Women	
Wealth			
Q1 (richer)	1	1	1
Q2	1.12 [1.08-1.15]	1.12 [1.08-1.16]	1.13 [1.09-1.17]
Q3	1.18 [1.13-1.23]	1.18 [1.13-1.23]	1.15 [1.10-1.21]
Q4	1.24 [1.17-1.31]	1.23 [1.16-1.31]	1.19 [1.13-1.27]
Urbanity			
Rural	0.96 [0.91-1.01]	0.96 [0.91-1.01]	0.98 [0.93-1.04]
Mixed	0.99 [0.95-1.03]	0.99 [0.95-1.03]	1.00 [0.96-1.05]
Urban	1	1	1

Table 4 presents the life expectancy at ages 20, 40 and 60 years in the different groups of districts, by sex. Life expectancy was higher in women compared to men, at ages 20, 40 and 60. Nevertheless, the absolute gap between men and women was larger at age 20 (4.5 years) compared to age 60 (3.0 years). In men, life expectancy was higher in mixed and rural areas (59.8 at 20 years) compared to urban areas (58.7 at 20 years), whereas in women, life expectancy was higher in urban areas (63.9 at 20 years) compared to rural area (63.2 at 20 years). In men and in women, the absolute gap between mixed and rural, and urban area was stable over the life time.

At the age of 20, a strong negative social gradient was observed in men and in women in urban areas, where the poorest districts had a life expectancy 2.1 [1.4-2.9] years inferior in men and 2.2 [1.6-2.7] years in women compared to the richest districts (Table 4). In mixed and rural areas, at the age of 20, the negative social gradient was significant but less important. Life expectancy was only 0.5 years lower in men, and 0.8 in women in the poorest districts in mixed and rural area compared to the richest districts in mixed and rural area. Table 4 also confirmed the protective effect of mixed and rural areas in men. At the age of 20, life expectancy in the poorest

districts of mixed and rural areas was similar to the life expectancy in the richest districts of urban area (59.6 years). In women, there was no such protective effect. As a result, life expectancy was 2.7 [2.0-3.5] years lower in the poorest districts of urban areas compared to the richest districts of mixed and rural areas in men whereas in women, the life expectancy was the highest in the richest districts of urban areas.

The negative social gradient in life expectancy in urban areas diminished at ages 40 and 60 years but remained important in men (1.6 [1.0-2.2] at 40 years of age, 1.0 [0.6-1.5] year at age 60 years) and in women (2.1 [1.5-2.6] years at 40 years, 1.6 [1.1-2.1] year at age 60 years). In mixed and rural area, at the age of 40, there was no longer a negative social gradient in men, and the negative social gradient remained small in women (0.7 [0.2-1.1] year). At 60 years of age, the life expectancy was higher in the poorest districts of mixed and rural areas in men, and the negative social gradient was no longer significant in women.

The sensitivity analysis showed similar results when using the UEL and the PQ indicators. According to the log-pseudolikelihood, Model 2 using the UEL indicator was the best to describe mortality in women, and the worst in men. Inversely, the PQ indicator was the best to describe men mortality and the worst in women. In men and in women, the model using the BUN indicators gave the intermediate results compared to the two others.

Table 4. Life expectancy at ages 20, 40, 60 years, in men and in women, for each group of districts (N=2,747,616).

	Expected number of years of life remaining [95%CI]		
	20 years	**40 years**	**60 years**
Men	59.2 [58.9-59.4]	40.4 [40.2-40.6]	22.8 [22.7-23.0]
Urban	58.7 [58.4-59.0]	39.9 [39.6-40.1]	22.4 [22.2-22.6]
Richest (Group 1)	59.6 [59.3-59.8]	40.5 [40.2-40.7]	22.8 [22.6-23.0]
Intermediate (Group2)	58.6 [58.2-59.0]	39.8 [39.5-40.1]	22.3 [22.0-22.5]
Poorer (Group 3)	57.4 [56.7-58.1]	38.9 [38.4-39.4]	21.8 [21.4-22.2]
Mixed and rural	59.8 [59.6-60.0]	41.1 [40.9-41.3]	23.4 [23.2-23.6]
Richest (Group 4)	60.2 [59.9-60.5]	41.2 [40.9-41.4]	23.2 [22.9-23.4]
Intermediate (Group 5)	59.8 [59.3-60.2]	41.0 [40.7-41.4]	23.4 [23.1-23.7]
Poorer (Group 6)	59.6 [59.3-60.0]	41.1 [40.8-41.4]	23.5 [23.3-23.8]
Women	63.7 [63.5-63.8]	44.2 [44.0-44.4]	25.8 [25.6-25.9]
Urban	63.9 [63.7-64.2]	44.4 [44.2-44.7]	26.0 [25.8-26.2]
Richest (Group 1)	64.8 [64.5-65.1]	45.2 [45.0-45.5]	26.6 [26.4-26.9]
Intermediate (Group2)	63.6 [63.3-63.8]	44.1 [43.9-44.3]	25.6 [25.4-25.8]
Poorer (Group 3)	62.6 [62.1-63.1]	43.2 [42.7-43.7]	25.0 [24.6-25.4]
Mixed and rural	63.2 [63.0-63.4]	43.8 [43.6-44.0]	25.3 [25.2-25.5]
Richest (Group 4)	63.7 [63.3-64.0]	44.1 [43.8-44.5]	25.5 [25.2-25.8]
Intermediate (Group 5)	63.3 [63.0-63.6]	43.9 [43.6-44.1]	25.4 [25.2-25.8]
Poorer (Group 6)	62.8 [62.6-63.1]	43.5 [43.2-43.8]	25.2 [24.9-25.4]

Legend: At 20 years old, a man can expect living 59.2 years in average: a man who lives in an urban area can expect living 58.7 years and a man who lives in a mixed or rural area can expect living 59.8 years.

DISCUSSION

Mortality and life expectancy differed according to the characteristics of the district of residence in Costa Rica between 2011 and 2018. A strong negative social gradient was observed in urban area, in men and in women, where people from the most advantaged urban areas had on average a lower mortality and a higher life expectancy. In mixed and rural areas, the negative social gradient was less marked. A protective effect of rural areas compared to urban areas was observed in men, but not in women. As a result, in men, the poorest districts of mixed and rural areas had similar life expectancy than the richest districts in urban areas, and life expectancy at age 20 years was 2.7 years higher in the richest districts of mixed and rural areas compared to the poorest districts of urban area. In women, the poorest districts of urban areas had a life expectancy 2.2 years inferior compared to the richest district of urban areas.

This study showed the existence of complex interactions between age, sex, urbanity, wealth and life expectancy which may enlighten researchers understanding namely to comprehend why previous studies in Costa Rica have not demonstrated a negative social gradient in health (12,13). In women, we found a clear negative social gradient. Nevertheless, it was bigger in urban areas compared to mixed and rural areas. In men, the negative social gradient only appeared after adjusting for urbanity, due to the protective effect of mixed and rural areas, whereas mixed and rural areas are less developed than urban area. The protective effect of mixed and rural areas in men might be explained by health risky behaviors. For example, in a recent study regarding the social determinants of tobacco consumption in Costa Rica, we showed the presence of a strong protective effect of rural area in tobacco consumption, after adjustment for socioeconomic factors (32). Since tobacco consumption is far more prevalent in men compared to women, this might explained why mixed and rural areas have a protective effect in men. Moreover, various studies in Costa Rica on social inequalities in health focused on the study of elderly people. In our study, the negative social gradient observed in mixed and rural and urban areas decreased between the age of 20, 40 and 60 in men and in women. This is consistent with international literature, which demonstrated that relative socioeconomic inequalities in mortality generally decreased with age (15,16). The impact of violent deaths, such as, traffic accidents and homicides (particularly associated to drug traffic and poverty in Latin American countries), which are more frequent in young adulthood, needs to be studied. It might also be due to a selection effect. Further studies on the causes of death are necessary to better understand this result.

These results were partially consistent with international literature. A negative social gradient in life expectancy has been observed in the majority of countries (1-6). In most cases, the gap in life expectancy between the most and the least socially deprived was more important in men compared to women (4,7,33,34). In women, we also found a negative social gradient in mortality, in accordance with the international literature. In men, we did not observe the same pattern, but we observed its existence, within both urban and mixed-rural areas in men. This was due to the apparent protective effect of mixed and rural areas, which mitigated the negative social gradient, in men. As a result, in men, the poorest districts, which are in mixed and rural areas, had a higher life expectancy compared to the richest districts, which are in urban area. This strong protective effect of mixed and rural area in men is surprising and have not been previously reported in the international literature. At the international level, there are contradictory results, depending on the characteristics of rural and urban areas. In United States, in France, in China, mortality is higher in rural area compared to urban area, (35-37) but the reverse was found

in United Kingdom (38). The positive or negative effect of urban area was similar in men and in women, (35-37) in contradiction with our results. Moreover, in the majority of these studies, the protective effect of urban or rural areas can be explained by socio-demographics characteristics, such as, deprivation. As a result, some studies showed a direct protective effect of urban area, (35) but very few showed a direct protective effect of rural areas (39).

The estimations we presented of life expectancy at ages 20, 40, 60 years were similar to the estimations made by the National Institute of Statistics of Costa Rica (INEC), for both men and women (40). In men, we respectively calculated 59.2, 40.4, 22.8 and INEC estimated 59.2, 40.5, 23.0 in the same period. In women, we respectively calculated 63.7, 44.2, 25.8 and INEC estimated 63.8, 44.4, 25.9.

Our study had some weaknesses. First, the results of an ecological study are not necessarily transferable to the individual level. Moreover, information at the district level is less precise compared to individual information, in particular in urban districts, which are more populated compared to rural districts. We would probably have found stronger relationships according to socioeconomic position using individual variables. Similarly, using a smaller geographical unit to approximate the location of residence would probably allow us to observe larger differences. These issues complicated the comparison between our results and the results of similar studies in other countries. These comparisons would have allowed us to measure if the inequalities observed are larger, comparable or smaller than the inequalities in other countries. Second, the electoral district might not be the last place of residence, and we could not take into account the house movings. Nevertheless, in Costa Rica, 80% of the adult population live in the same province they born, (41) so migration in a district sociologically different is not common. Third, we used the National Electoral Rolls as a criteria of inclusion, which excluded foreign people and people younger than 20 years old. Focusing on adults might introduce a selection bias, but in Costa Rica, infant mortality rate is low (42). Fourth, stronger differences might have been showed using other indicators of wealth. For example, in our study, even if we obtained similar results, UEL indicator seemed to be the best to describe mortality in women, and PQ indicator to describe men mortality. Further investigation at the individual level are necessary to confirm and better understand these differences according to sex.

Despite these limitations, this study had a number of strengths. The main one was the quality of the databases, which are exceptional in a middle-income country. The National Rolls, the National Death Index and the National Birth Index achieved completeness (22,43), which allowed us to study all the Costa Ricans born before 1990 during nine years. We were able to reply upon 24 million years of follow-up. We used census data based on more than 4.3 million people to describe districts (94% of the population in 2011). This allowed us to describe with the necessary precision urbanity and wealth in each district. There are few studies in Latin America on socioeconomic inequalities in life expectancy or mortality. Finally, the statistical model we used, where the date of entry was the age of the subject at the beginning of the study, allowed us to estimate the survival function between 20 and 120 years old by taking into account the segment of life of each observation.

This study showed a negative social gradient in men and in women in urban area, and in rural areas. The negative social gradient was more marked in urban areas compared to rural areas. In men, there was a protective effect of rural areas, but not in women. As a result, in men, the poorest districts of the country, which are rural districts, had a similar life expectancy compared to the richest districts, which are urban districts.

These results were surprising because they partially contradicted the international literature on socioeconomic inequalities. Nevertheless, few studies come from Latin America. Our analyses demonstrate the importance of studying contexts other than high-income countries to better understand the social inequalities in health worldwide. To understand these results further, more studies on the relation between social characteristics and risk behaviors, environmental and occupational factors, or stress have to be implemented in middle and low-income settings. Describing the social distribution of life expectancy in Costa Rica, can be an effective method to guide preventive policies and to promote a constant surveillance system examining the evolution of health inequalities in the country.

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