Structural social determinants and catastrophic illnesses in municipalities in the Colombian department of Valle del Cauca

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ABSTRACT

Objective. T*o explore possible associations between self-reported prevalence of catastrophic illnesses such as chronic renal failure, HIV/AIDS and cancer and a set of structural social determinants.*

Methods. *Ecological study using data from the 2005 Population Census conducted by the National Administrative Department of Statistics (DANE), focusing on municipalities in the Colombian department of Valle del Cauca that experienced the highest prevalence rates for catastrophic illnesses during 2000–2005. Associations were measured with Pearson's chi-squared statistic and Fisher's Exact Test. Prevalence ratios were calculated, with 95% confidence intervals.*

Results. *Statistically significant associations were observed between catastrophic illnesses and social structural determinants in the form of illiteracy, deficient sanitary infrastructure, quality of housing units and access to health services.*

Conclusions. *A role was observed for social determination of catastrophic illnesses in this context. However, additional analyses are required that recognize the complexity of health-determining processes and that explore the interrelationships among social, structural, behavioral and psychosocial determinants in depth.*

Key words Catastrophic illness; socioeconomic factors; ecological studies; neoplasms; HIV; kidney failure, chronic; Colombia.

Catastrophic illnesses are characterized by high technical complexity and management, high costs, low incidence and low cost-effectiveness of treatment. Although many illnesses have characteristics that would allow them to be classified as catastrophic, Colombian health regulations (1, 2) recognize only a few, among which are cancers, chronic renal failure (CRF) and HIV/AIDS.

Global figures with respect to the incidence and prevalence of these illnesses are not encouraging. It is predicted that by 2020 the total incidence of cancer will have increased by 50% over current rates (3). From 2001 to 2010, the number of people infected worldwide with HIV increased by 17% (4). In 2011, over 346 million people worldwide had diabetes, one of the principal causes of CRF (5). The situation in Colombia is no better, with a prevalence of 0.7% for HIV and 0.87% for CRF (6-8). These illnesses represent a growing public health problem: they increasingly claim more lives, affect a larger fraction of the population, threaten the financial sustainability of health systems, and increase the risk of impoverishment at the household level.

Determinants of catastrophic illnesses include genetic load, lifestyle, quality of health care services, and socioeconomic conditions. Traditionally, public health studies have focused more on the first three factors than on socioeconomic circumstances. This tendency is even more pronounced in Colombia, where research on the social determinants of health (SDH) in general and on catastrophic illnesses in particular is scarce.

This study contributes evidence on determinants of catastrophic illness for a

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particular region, in a developing country where such studies are limited. It differs from other analyses of SDH in Colombia in that it is an ecological study with measures aggregated at the municipal level and in making use of a little-explored source of public information: the General Census conducted by the National Administrative Department of Statistics (9).

In this context, the objective of this study was to explore possible associations between the self-reported prevalence of catastrophic illnesses such as CRF, HIV/AIDS, and cancer and a set of potential structural social determinants (SSDs) in those Colombian municipalities of Valle del Cauca that experienced the highest prevalence rates for such events during 2000–2005. A priori, it was expected that higher prevalences of catastrophic illnesses would be found to be associated with inadequate municipal provision of health coverage and basic sanitation services, as well as with substandard quality of housing units and higher rates of illiteracy.

MATERIALS AND METHODS

An ecological study of 42 municipalities from the Colombian department of Valle del Cauca was conducted. The data were taken from the expanded questionnaire of the General Census conducted by DANE in 2005 (9), which comprised three modules: housing units, households and heads of household/respondents.

The census made use of a probability sample of households selected in real time (i.e., in the field, based on standard criteria), and stratified so as to provide estimates at the level of the commune (an administrative unit that groups sectors of neighborhoods [*barrios*]) in large cities and the Bogotá district, and at the level of the municipal seat and for urban and rural areas in other municipalities (10). The household was the unit of selection. To ensure quality of information, mobile computing devices with intelligent questionnaires were used.

To verify data quality, all tables consulted were checked through the public census information system—i.e., REDATAM+SP version 5 (CELADE-División de Población, CEPAL. Santiago de Chile)—that totals coincided with the sum of their components (by variable within municipalities and by municipality within states). Data fields with no response were excluded, which modified the marginal totals for each variable in its respective municipality. Any data that seemed unusual were verified through telephone consultation with DANE.

The data for this study came from a secondary source (i.e., the census), and were accessed through the REDATAM+SP system, which compresses and encrypts the original census data to guarantee confidentiality of information. To create the REDATAM database, three security controls are applied: 1) to avoid identification of individuals, identifiers on housing units, households and people are replaced with codes and geographic tags at the municipality level; 2) a system of "key words" limits access to certain users; and 3) the vector files of the database are transformed and encrypted to prevent their being accessed directly (11). The final dataset used in this study thus consisted of, for each municipality, the total numbers of individuals for each outcome and exposure pairing.

The study was approved by the Ethics Committee of the School of Health, Universidad del Valle, Cali, Colombia.

Study variables

Variable selection was conditioned by the availability of information and the processing alternatives offered by the REDATAM system. Questions and response codes from the expanded questionnaire that are relevant for this analysis are reproduced in the text here, as per the original coding.

Health variables related to catastrophic events were abstracted from question 38 of the heads of household/respondents module of the expanded questionnaire, with responses 7, 9, and 10 indicating illness:

Q38: *During the LAST FIVE YEARS, have you suffered OR DO YOU HAVE ANY ILLNESS that has required:*

7. *Dialysis because of chronic kidney failure?*
9. *Treatment for HIV-AIDS?*
10. *Chemotherapy and radiotherapy for cancer?*

Four variables representing SSDs were constructed on the basis of question 3 and question 5 of the housing unit module and question 36 and question 41 of the heads of household/respondents module. These reflect minimum assets required for a high quality of life with respect to physical conditions and health. More broadly, they indicate inequalities in the economic development of municipalities, which are generally associated closely with municipal differentials in health.

Questions from the housing unit module were used to construct one variable to capture housing unit quality and another related to municipal sanitary infrastructure. For the former, the housing unit was assumed to be of good quality if the respondent selected responses 1, 2 or 3 on Question 3, or of inadequate quality for responses 4 or 5:

Q3: *What is the PREDOMINANT flooring material?*

1. *Wall-to-wall wool or synthetic fiber carpeting, marble, polished or lacquered wood slats or parquet;*
2. *Colored ceramic tile, vinyl, or tiles made of synthetic materials that look like brick;*
3. *Cement mixed with fine gravel*
4. *Unfinished wood boards placed side by side; or plant materials such as woven reed mats or palm leaves;*
5. *Bare floors (Dirt, sand).*

The second variable was based whether the housing unit had aqueduct services, as evaluated in Question 5 (N.B., each option is an independent question with a yes/no response; "1" indicates "yes"):

Q5: *The housing unit HAS services of:*

1. *Electricity;*
1. *Sewage system;*
1. *Aqueduct;*
1. *Natural gas utility;*
1. *Telephone landline.*

A variable measuring level of illiteracy for the municipality was based on Question 41 of the head of households/respondents module:

Q41: *Do you know how to READ AND WRITE?*

1 *Yes;*
2. *No.*

From the same module, responses 1-5 for Question 36 were regrouped into two categories that represent affiliation with the general social security system in health (responses 1-4) or lack thereof (response 5). This variable aimed to identify real opportunities for access to health care services.

Q 36: For health care, are you the...CONTRIBUTOR, PERSON COVERED or BENEFICIARY of:

1. *The Social Security Institute (ISS);*
2. *Special regimes (Armed Forces, National Police Force, National University, ECOPETROL—the Colombian Petroleum Co., Educators);*
3. *Another EPS (Health Care Promoting Entity);*
4. *An ARS (Administrator of a Subsidized System) through the SISBEN (System for Selecting Beneficiaries for Social Programs);*
5. *None;*
6. *Does not know.*

Data analyses

A descriptive analysis was first undertaken to establish, for each of the 42 municipalities, the self-reported prevalence of the three catastrophic events, and their percentile rankings within the overall data set. The municipalities with the highest prevalence rates (85th percentile or higher) in urban and rural areas were separated out; all subsequent further analysis refers to these municipalities. To measure the association between the health outcome and the four SSD variables considered, contingency tables were constructed for each social determinant and Pearson's chi-squared statistic (χ^2) was calculated. When the expected counts in any of the cells of the table were less than 5, Fisher's exact test was used. The prevalence ratio was calculated, comparing prevalence among exposed and non-exposed individuals, along with its 95% confidence interval.

RESULTS

The municipalities with the highest prevalence of self-reported catastrophic illnesses, along with significant measures of association (contingency) with the SSDs (i.e., sanitary infrastructure, quality of housing unit, level of illiteracy, and access to health services) and prevalence ratios were reported. Table 1 highlights the concentration of cases of CRF, cancer, and HIV/AIDS in Vijes and Argelía (which occupy the top two positions for all three events) and in El Dovio and Buenaventura (in positions three and four).

An association was found between municipal prevalence of self-reported cancer and sanitary infrastructure and the quality of housing units in Vijes, El Dovio, Buenaventura, and Caicedonia. In the municipality of Jamundí, associations were observed with sanitary infrastructure, illiteracy rate and affiliation with the health care system, in Cartago with flooring materials and affiliation with the health care system, and in Argelia with sanitary infrastructure and the illiteracy rate (Table 2).

Statistically significant associations were found between CRF and quality of the housing unit (everywhere but Argelia), with sanitary infrastructure (Vijes, Argelia, Buenaventura, El Dovio, and Jamundí), with illiteracy (Argelía, Buenaventura, and Zarzal) and with access to medical services (Buenaventura, Calima, and Jamundí) (Table 3).

Table 4 illustrates statistically significant associations between the self-reported prevalence of HIV/AIDS and the four SSDs. In six of the seven municipalities considered, HIV/AIDS was associated with sanitary infrastructure. In addition, it was associated with the illiteracy rate in Argelia, Buenaventura and Trujillo; with the quality of housing units in Vijes, Buenaventura, and Dagua; and with access to health care services in El Dovio, Buenaventura, and Dagua. There was no evidence of an association with any of the SSDs in Cartago.

Based on the prevalence ratios in Table 2, Table 3, and Table 4, it can be stated in general terms that not having access to aqueduct service, not knowing how to read and write, not having good-quality flooring, and not being affiliated with the health care system at the municipal level constituted population-level determinants during the period 2000–2005 for the three catastrophic illnesses studied. Nevertheless, some unexpected associations in the reverse direction were observed: (i) cancer was associated with aqueduct service in Vijes and Caicedonia, literacy in Jamundí, good flooring materials in Caicedonia, and affiliation with the health care system in Cartago (Table 2); (ii) CRF was associated with aqueduct service in Vijes and good flooring materials in Zarzal (Table 3); and (iii) HIV was associated with aqueduct service in Vijes (Table 4).

TABLE 1 Highest prevalences (%) of self-reported cancer, chronic renal failure and HIV/AIDS in the municipalities of Valle del Cauca, Colombia, from 2000–2005[a]

Percentile ranking	CRF		HIV/AIDS		Cancer	
	Municipality	Prevalence	Municipality	Prevalence	Municipality	Prevalence
100	Vijes	0.95	Vijes	0.99	Vijes	1.55
97.6	Argelia	0.63	Argelia	0.46	Argelia	0.65
95.1	Buenaventura	0.35	El Dovio	0.34	El Dovio	0.58
92.7	El Dovio	0.34	Buenaventura	0.32	Buenaventura	0.53
90.2	Calima	0.23	Trujillo	0.12	Caicedonia	0.50
87.8	Jamundí	0.19	Dagua	0.08	Jamundí	0.38
85.4	Zarzal	0.18	Cartago	0.07	Cartago	0.37

[a] Data source: prepared by the authors based on the Colombian General Census (7).

DISCUSSION

The findings of this study reveal that the highest levels of prevalence of catastrophic illnesses (CRF, HIV/AIDS, and cancer) were concentrated in four municipalities of the department of Valle del Cauca (Vijes, Argelia, El Dovio, and Buenaventura) that have below-average levels of development.

This study provides statistically significant evidence for the hypothesis that unfavorable socioeconomic conditions in the municipalities—in particular, deficient coverage of basic sanitation services, low quality of housing units, higher rates of illiteracy and lack of affiliation with the health care system—are associated with higher prevalence of catastrophic illnesses.

The disparities in development in Colombian municipalities are expressed in differences in living conditions and social infrastructural elements which include sanitary infrastructure, quality of housing units and health care services. In general, these inequalities translate into disparities in population health. In a majority of cases, inequities thus arise not from choices made by people but rather from discrepancies in the opportunities that different groups have to access the benefits offered by development (12–14).

In this way, low or inadequate investment in public infrastructure that affects

TABLE 2 Significant associations between structural social determinants and the prevalence of self-reported cancer in municipalities of Valle del Cauca (Colombia) with the highest prevalences from 2000–2005[a]

	Inadequate sanitary infrastructure (Aqueduct service)			Illiteracy rate			Deficient quality of the housing unit (Flooring material)			No access to health services (Affiliation with health care system)		
Municipality	*P*	PR	CI 95%	*P*	PR	CI 95%	*P*	PR	CI 95%	*P*	PR	CI 95%
Vijes	0.000	0.37	0.22–0.60				0.000	4.60	2.59–8.07			
Argelia	0.000	3.35	1.76–6.33	0.000	6.15	3.21–11.7						
El Dovio	0.000	5.24	3.04–8.97				0.017	2.29	1.18–4.44			
Buenaventura	0.000	1.60	1.43–1.77				0.000	1.79	1.59–2.00			
Caicedonia	0.004	0.09	0.01–0.62				0.039	0.70	0.50–0.97			
Jamundí	0.000	2.31	1.67–3.19	0.000	0.24	0.11–0.50				0.000	3.92	3.14–4.87
Cartago							0.000	2.99	2.48–3.59	0.000	0.51	0.35–0.74

PR: prevalence ratio (exposed versus unexposed).
[a] Data source: authors' calculations based on the Colombian General Census (7).

TABLE 3 Significant associations between structural social determinants and the prevalence of self-reported chronic renal failure in municipalities of Valle del Cauca (Colombia) with the highest prevalences from 2000–2005[a]

	Inadequate sanitary infrastructure (Aqueduct service)			Illiteracy rate			Deficient quality of the housing unit (Flooring material)			No access to health services (Affiliation with health care system)		
Municipality	*P*	PR	CI 95%	*P*	PR	CI 95%	*P*	PR	CI 95%	*P*	PR	CI 95%
Vijes	0.031	0.53	0.30–0.92				0.000	12.98	4.11–40.95			
Argelia	0.014	2.31	1.21–4.37	0.000	3.96	2.03–7.64						
Buenaventura	0.000	3.31	2.94–3.71	0.000	2.16	1.86–2.49	0.000	4.26	3.52–5.15	0.000	1.83	1.61–2.06
El Dovio	0.000	5.21	2.58–10.49				0.007	4.16	1.45–11.86			
Calima							0.046	2.20	1.06–4.58	0.006	2.82	1.39–5.70
Jamundí	0.000	5.63	3.98–7.94				0.000	5.16	3.66–7.26	0.000	2.43	1.72–3.42
Zarzal				0.000	5.67	3.52–9.13	0.000	0.25	0.12–0.55			

PR: prevalence ratio (exposed versus unexposed).
[a] Data source: authors' calculations based on the Colombian Comprehensive Population Census (7).

TABLE 4 Significant associations between structural social determinants and the prevalence of self-reported HIV/AIDS in municipalities of Valle del Cauca (Colombia) with the highest prevalences from 2000–2005[a]

	Inadequate sanitary infrastructure (Aqueduct service)			Illiteracy rate			Deficient quality of the housing unit (Flooring material)			No access to health services (Affiliation with health care system)		
Municipality	*P*	PR	CI 95%	*P*	PR	CI 95%	*P*	PR	CI 95%	*P*	PR	CI 95%
Vijes	0.002	0.39	0.21–0.71				0.000	13.53	4.28–42.65			
Argelia	0.000	4.14	1.89–9.00	0.000[b]	6.41	2.95–13.87						
El Dovio	0.000	7.71	3.74–15.82							0.000	1.93	0.82–4.48
Buenaventura	0.000	2.77	2.45–3.12	0.000	1.52	1.28–1.79	0.000	3.58	2.98–4.29	0.000	1.61	1.42–1.83
Trujillo	0.000[b]	9.03	3.68–22.12	0.022[b]	3.14	1.22–8.09						
Dagua	0.000[b]	27.02	10.96–66.57				0.035	2.97	1.03–8.54	0.044	2.23	1.00–4.96
Cartago												

PR: prevalence ratio (exposed versus unexposed).
[a] Data source: authors' calculations based on the Colombian Comprehensive Population Census (7).
[b] *P*-value from Fisher's exact test of two-sided hypotheses.

the SSDs generates a lower capacity in some population sectors for preventing illness and its consequences. This affects the ways in which people relate to HIV/AIDS, cancer and CRF in terms of prevention, detection and treatment, as well as the incidence and prevalence of these catastrophic events.

Several international studies associate deficiencies in socioeconomic conditions with CRF, HIV/AIDS, and cancer in various forms. In Peru, a direct correlation was found between the level of poverty and the diagnosis of advanced-stage cervical and breast cancers (15). In the United States, a higher prevalence of cases of gynecological cancer was observed among women residing in poor zones than among those from higher income areas (16). In Ireland, the incidence of some types of cancer (head, neck, lung and cervix) was higher in poor populations (17). In the states of Northeast Brazil, a positive association

was found between rates of mortality due to cervical and uterine cancer and socioeconomic indicators describing the worst living conditions (18). In Malaysia, patients with hematological tumors that reported lower household incomes had poorer physical functioning and suffered more pain (19). In Europe, a negative association was found between indicators of socioeconomic status and the risk of developing lung cancer (20). Similar results were found in a socioeconomically deprived region of Germany (21). In England, socioeconomic inequalities were found in the survival rates for different types of cancer (22). Similar results were found for the incidence of different types of cancer in the United States (23).

Similarly, a greater risk of developing CRF was associated with low incomes and unemployment in the United States (24). In Australia, an ecological study found a strong association between certain indicators of social disadvantage and terminal renal illness when standardized for gender, age and place of residence (25). In some rural regions of El Salvador and Nicaragua, an association was found between rural labor and a decrease in renal functioning (26, 27).

With respect to HIV/AIDS, it was found that South African educators who had higher incomes and educational levels had a lower prevalence than educators with low incomes and lower educational levels (28) and that people who attended clinics to receive treatment for HIV had a higher socioeconomic profile, on average, than the people from the community (29). In Botswana, it was found that younger, more educated and better paid people were more likely to get tested for HIV (30). In Tanzania, stigma toward people with HIV/AIDS was higher among the poorer, less-educated people who live in rural areas (31). In the United States, socioeconomic status, together with other measures of socioeconomic disadvantage and race, has been associated with higher rates of mortality due to HIV/AIDS (32) and higher rates of HIV diagnosis (33).

In Colombia, research that relates social determinants to catastrophic illnesses is scarce (14), focusing primarily on the role of inequalities and social inequities as determinants of diagnosis and access to treatment for illnesses such as breast cancer (34–36).

With respect to HIV/AIDS, Arrivillaga et al. (37) found that the probability of women adhering to HIV treatment decreased for those who had low social status and were members of the subsidized health regime or did not have health insurance. No national studies were found on CRF and its association with SDH. Some explanations of how social inequalities are related to HIV/AIDS, cancer, and CRF are as follows:

1. The social conditions of disadvantaged populations—e.g. having a lower level of education, lower income or not being affiliated with the health care system—decrease the likelihood that these groups receive timely diagnosis and adequate treatment in all clinical stages of illness (34–36, 38, 39).
2. The poorest populations, especially those that live in rural zones, face considerable limitations in accessing medical services because of their geographic location and transportation costs. This can also affect their adherence to required treatments (35, 37).
3. Differences in the socioeconomic context of populations can act as potentiators of risk factors related to lifestyle, behavior and psychosocial stress, which can contribute to cancer (39) as well as trigger chronic illnesses such as hypertension and diabetes, which can further develop into catastrophic illnesses (40).
4. Populations that are highly disadvantaged with respect to socioeconomic factors are generally engaged in labor that implies greater risks for health, which may increase their likelihood of developing, for example, some types of cancer or CRF (41, 42).
5. Employment opportunities and productive activities in some regions can increase the risk of exposure to environmental factors that increase the risk of contracting cancer, CRF, or HIV/AIDS (42–44).

Potential sources of bias in this research include the following: (i) given that data collected though household surveys was self-reported, individuals may have omitted information for fear of being stigmatized. This bias factor is particularly important in people with HIV/AIDS; (ii) since the REDATAM consultation system permits us to access the frequency of each catastrophic event at the municipal level but not at the individual level, it was assumed that the health events are independent of each other although in reality this might not be true. This is a frequent limitation in ecological studies where the unit of analysis is the group (in this case, the municipality) and not the individual. This complicates the extrapolation of results from the group to the individual level and vice versa. For this reason, such studies are generally considered exploratory. Despite this limitation, the ecological approach is appropriate when health is studied in an environmental context (45), as is the case here. The object of study, for this aggregate data, is the geopolitical unit (i.e. the municipality), and the purpose is to explore possible associations between SSDs and the prevalence of self-reported catastrophic illnesses at the municipal level. (iii) Based on the data collected, it is not possible to distinguish among different types of cancer. The results might have differed if it had been possible to differentiate based on tumor site; i.e., some determinants such as occupation or behavioral factors have differential impact on the various types of cancer (46).

Despite all these possible sources of bias, this research constitutes a first approximation, for Colombia, of the association between catastrophic illnesses and SSDs from an ecological perspective. Future research should consider multivariate analyses that stratify by characteristics of the respondents such as sex and age, while including variables that allow for identification of more detailed socioeconomic conditions at the municipal level.

The focus on SDH represents a contextual approximation to the causes of health and illness. Analysis of the determinants of ill health and implementation of the actions necessary to modify them requires a recognition of the complexity of health-determining processes, in particular that health is the outcome of multiple causes that could in fact act differently in specific contexts. Consequently, the structural determination of catastrophic illnesses merits further analyses to explore the interrelationships they may have with behavioral and psychosocial determinants.

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Determinantes sociales estructurales y enfermedades catastróficas en los municipios del departamento colombiano del Valle del Cauca

RESUMEN

Objetivo. Explorar las posibles asociaciones entre la prevalencia autonotificada de enfermedades catastróficas, tales como la insuficiencia renal crónica, la infección por el VIH/sida y el cáncer, y un conjunto de determinantes sociales estructurales.

Métodos. Se llevó a cabo un estudio ecológico mediante el empleo de datos del Censo de Población del 2005, realizado por el Departamento Administrativo Nacional de Estadística (DANE) y centrado en los municipios del departamento colombiano del Valle del Cauca que experimentaron las tasas más altas de prevalencia de enfermedades catastróficas durante el período del 2000 al 2005. Se midieron las asociaciones mediante la prueba estadística de ji al cuadrado de Pearson y la prueba exacta de Fisher. Se calcularon las razones de prevalencia con intervalos de confianza de 95%.

Resultados. Se observaron asociaciones estadísticamente significativas entre las enfermedades catastróficas y los determinantes sociales estructurales en forma de analfabetismo, infraestructura sanitaria deficiente, calidad de las viviendas y acceso a los servicios de salud.

Conclusiones. En este contexto, se observó una función de determinación social de las enfermedades catastróficas. Sin embargo, se requieren nuevos estudios que comprueben la complejidad de los procesos determinantes de la salud y exploren a fondo las interrelaciones entre los determinantes sociales, estructurales, conductuales y psicosociales.

Palabras clave Enfermedad catastrófica; factores socioeconómicos; estudios ecológicos; neoplasias; VIH; fallo renal crónico; Colombia.