Research Paper

Social determinants of health in Colombia: Regional analysis and challenges*

DOI: http://doi.org/10.15446/av.enferm.v43n1.121318

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Abstract

Objective: To characterize the social determinants of health across geographic regions in Colombia.

Materials and methods: A descriptive correlational study was conducted between 2023 and 2024 using the DESOSA81 instrument with a sample of 2,725 participants from five Colombian regions. Univariate and bivariate analyses were performed. Pearson's Chi-square test was applied to examine associations between variables, and Kendall's Tau-b and Tau-c coefficients were used to assess the strength of association.

Results: Women predominated in the sample, with a mean age of 36.5 years. Significant regional differences were observed in social and economic conditions, revealing inequities in access to employment, education, and health services. Gender, educational attainment, and employment status were found to influence health-related behaviors, stress levels, and overall well-being, reflecting structural and intermediate inequalities that vary across territories.

Conclusions: This study highlights rural–urban disparities and confirms that social and economic inequities, compounded by factors such as gender and geographic location, are key determinants of health and well-being in Colombia.

Descriptors: Social Determinants of Health; Equity; Socioeconomic Factors; Health Status Disparities; Colombia (source: DeCS, BIREME).

* The article is derived from a macro research project at the University of Caldas entitled "Psychometric Properties of the Instrument for Measuring the Social Determinants of Health DESOSA81" (*Propiedades psicométricas del instrumento para la medición de los Determinantes Sociales de la Salud* DESOSA 81). This research also led to the publication of the article "Exploring the invisible threads: Social determinants of health and emotional self-perception in Colombia" in the International Journal of Social Psychiatry in 2024.

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Citation: Betancurth Loaiza DP; Vélez Álvarez C; Patiño-Fernández L. Social determinants of health in Colombia: Regional analysis and challenges. Av. enferm. 2025;43(1):121318

Received: 01/07/2025
Accepted: 27/10/2025

ISSN (impreso): 0121-4500
ISSN (en línea): 2346-0261

Determinantes sociales de la salud en Colombia: análisis regional y desafíos

Resumen

Objetivo: caracterizar los determinantes sociales de la salud por regiones geográficas en Colombia.

Materiales y métodos: entre 2023 y 2024, se realizó un estudio descriptivo correlacional con 2.725 participantes de cinco regiones del país, utilizando el instrumento DESOSA81. Se efectuaron análisis univariados y bivariados, aplicando la prueba de Chi-cuadrado de Pearson para identificar asociaciones y los coeficientes Tau-b y Tau-c de Kendall para determinar la fuerza de las relaciones.

Resultados: predominaron las mujeres con una edad promedio de 36,5 años. Se evidenciaron diferencias regionales en las condiciones sociales y económicas, con inequidades en el acceso a servicios básicos como el empleo, la educación y la salud. Factores como el género, el nivel educativo y la situación laboral influyeron en los hábitos de vida, el estrés y el bienestar, evidenciando desigualdades estructurales e intermedias entre regiones.

Conclusiones: este estudio resalta las disparidades rural-urbanas y confirma que las inequidades sociales y económicas, agravadas por el género y la ubicación geográfica, constituyen determinantes clave de la salud y el bienestar en Colombia.

Descriptores: Determinantes Sociales de la Salud; Equidad; Factores Socioeconómicos; Disparidades en el Estado de Salud; Colombia (fuente: DeCS, BIREME).

Determinantes sociais da saúde na Colômbia: análise regional e desafios

Resumo

Objetivo: caracterizar os determinantes sociais da saúde por regiões geográficas na Colômbia.

Materiais e métodos: Entre 2023 e 2024, realizou-se um estudo descritivo correlacional com 2.725 participantes de cinco regiões do país, utilizando o instrumento DESOSA81. Foram feitas análises univariadas e bivariadas, aplicando-se o teste qui-quadrado de Pearson para identificar associações e os coeficientes tau-b e tau-c de Kendall para determinar a força das relações.

Resultados: as mulheres predominaram na amostra, com idade média de 36,5 anos. Observaram-se diferenças regionais nas condições sociais e econômicas, revelando iniquidades no acesso ao emprego, à educação e aos serviços de saúde. Fatores como gênero, nível educacional e situação laboral influenciaram os hábitos de vida, o estresse e o bem-estar, evidenciando desigualdades estruturais e intermediárias entre as regiões.

Conclusões: O estudo evidencia disparidades rural-urbanas e confirma que as iniquidades sociais e econômicas, agravadas pelo gênero e pela localização geográfica, continuam sendo determinantes-chave da saúde e do bem-estar na Colômbia, reforçando a necessidade de políticas públicas adaptadas aos contextos regionais.

Descritores: Determinantes Sociais da Saúde; Equidade; Fatores Socioeconômicos; Disparidades nos Níveis de Saúde; Colômbia (fonte: DeCS, BIREME).

Introduction

The social determinants of health (SDH) refer to the social, economic, cultural, and environmental conditions that shape individuals' living circumstances and, consequently, their opportunities for health and well-being (1). It is increasingly recognized that the SDH must be reexamined in light of contemporary challenges and the emerging dynamics of social exclusion. Although the World Health Organization's (WHO) conceptual framework remains a valid foundation, Frank *et al*. argue that it should be expanded to encompass political, environmental, and structural factors that influence health opportunities and outcomes throughout the life course (2).

This broader perspective emphasizes that inequality extends beyond economic dimensions to include various health-related domains, such as health status across the life span, the incidence and mortality of noncommunicable diseases, lifestyle behaviors, exposure to violence, mental health, access to essential services, social cohesion, and civic participation (3). In response, several Latin American countries—including Argentina, Bolivia, Chile, and Mexico—have developed policies focused on addressing SDH and promoting community participation, with initiatives aimed at enhancing equity and interculturality in health (4).

Colombia has long been characterized by persistently high levels of inequality and poverty. According to the National Administrative Department of Statistics (DANE), the Gini coefficient for 2022 was 0.556 (5), indicating substantial income inequality, and in 2024, unemployment remained high at 11.7% (6). Unmet basic needs vary widely among departments, ranging from 6.18% to 68.89%. Afro-descendant communities and Indigenous people face greater barriers to access health services and experience higher risks of poverty—a situation rooted in the enduring legacy of colonialism that continues to perpetuate structural inequality in the country (7).

In this context, Franco-Giraldo emphasizes the need for further research and information to understand, address, and raise awareness about the inequities affecting the population (8). This entails a social commitment to generating and disseminating knowledge that supports deeper analysis and understanding of how the SDH impacts population health. Therefore, it is essential to promote and manage health knowledge to guide initiatives aimed at reducing social and health inequities among Colombians across different regions. Such efforts must foster inclusive and differentiated policies that consider social, ethnic, class, and gender dimensions, thereby advancing equity and social justice.

Materials and methods[1]

A descriptive correlational study was conducted between July 2023 and June 2024 to characterize the SDH in five regions of Colombia: Caribbean, Pacific, Andean, Orinoco, and Amazon. The sample size was calculated using data from the 2018 national census provided by the DANE. The formula for a finite population was applied with a 95% confidence level ($\alpha = 0.05$) and a p-value of 0.5, which maximizes the sample size in the absence of known variance. The standard error (d) was set at 0.05, and a 10% nonresponse rate was considered.

$$n = N*Z1\text{-}\alpha/22*p*q\ /d2*(N\text{-}1) + Z1\text{-}\alpha/22*p*q$$

Based on this calculation, the minimum required sample per region was 422 surveys, yielding a total minimum of 2,110. The final sample obtained comprised 2,725 participants nationwide. Participants were residents of 32 departments, ensuring broad territorial representation across the country. The departments with the highest participation were Caldas, Meta, Antioquia, Caquetá, Bolívar, Nariño, Bogotá, and Valle del Cauca. Smaller samples were obtained from Vaupés, Quindío, Casanare, Boyacá, and Vichada, among others. Regarding area of residence, 91.6% of participants lived in urban areas, while 8.4% resided in rural zones. Rural participation varied by region, ranging from 7% in the Orinoco region to 17% in the Pacific region.

Inclusion criteria required participants to be aged 18 years or older, reside in one of the five study regions, and have sufficient time to complete the questionnaire. Individuals unable to understand or voluntarily consent to participation were excluded.

A nonprobability sampling strategy was employed using the snowball technique, through which participants referred additional volunteers within their social networks (9). Data collection was conducted using DESOSA81, a validated instrument designed to assess SDH. The tool comprises 81 items organized into seven general dimensions and thirty specific subdimensions, encompassing 19 structural and 62 intermediate social determinants of health. The validation process included face and content validity testing via the Delphi technique, with participation from 14 national and international experts in public health and social sciences. The instrument demonstrated strong internal consistency (Cronbach's alpha = 0.952) and high content validity (Lawshe's index = 0.909) (10).

The survey was administered online with the support of researchers and academic collaborators from various Colombian cities. Recruitment and data collection were conducted through both digital and in-person channels to ensure wide dissemination and participation.

Data analysis was performed in three stages. First, a univariate analysis described the structural and intermediate determinants for each region. Second, a bivariate analysis identified statistically significant associations ($p < 0.05$) between structural and intermediate determinants. Pearson's Chi-square tests were used to assess associations, complemented by the contingency coefficient and Kendall's Tau-b and Tau-c, depending on the variable type. Finally, results were compared across regions.

1 Any reference to terms such as "region" or "population" in this study pertains exclusively to the sample group of participants and does not represent or infer characteristics of the entire national or regional populations of colombia.

This study adhered to the ethical principles outlined in the Declaration of Helsinki of the World Medical Association and followed the regulations for health research established in Resolution 8430 of 1993 by the Colombian Ministry of Health. Ethical approval was granted by the Ethics Committee of the Faculty of Health Sciences at Universidad de Caldas (Manizales, Colombia), as documented in Act No. 011 of 2023. Informed consent was obtained from all participants prior to completing the questionnaire.

Results

The final sample comprised 2,725 participants, distributed heterogeneously across the five regions of the country: 34.7% from the Andean region, 18.2% from the Amazon region, 16% from the Caribbean region, 15.7% from the Orinoco region, and 15.5% from the Pacific region. The average age of participants was 33 years (range: 18-88 years). Overall, the sample was predominantly young, urban, and female, with a considerable proportion engaged in formal employment. Most respondents resided in urban areas, had completed secondary education, and reported belonging to middle-income households. These characteristics reflect the structural composition of the study sample and provide a general overview of the sociodemographic and economic conditions represented across the five regions.

Table 1 presents the regional distribution of the structural determinants of health included in the study. Significant regional differences were identified in educational attainment, employment status, income level, ethnic identification, and marital status. The Andean and Caribbean regions exhibited the highest levels of education and formal employment, whereas the Caribbean and Amazon regions had the largest proportion of participants with low income. These contrasts highlight the pronounced socioeconomic and demographic heterogeneity that characterizes Colombia's territorial landscape.

Table 1. Structural determinants of health by geographic regions

Structural determinants	Andean	Amazon	Caribbean	Orinoco	Pacific
Predominant sex	Women (66.7%)	Women (69.1%)	Women (72.2%)	Women (62.3%)	Women (69.9%)
Most frequent educational level	Postgraduate (33.2%)	Secondary education (31.3%)	Secondary education (32.9%)	Secondary education (36.5%)	Secondary education (35.3%)
Dominant employment status	Formal employment (62%)	Formal employment (57%)	Formal employment (61%)	Formal employment (43%)	Formal employment (49%)
Proportion with income < 1 SMLMV*	34%	32.9%	4.6 %	54.3%	45.5 %
Ethnic-group participation	4%	5%	9%	5%	13%
Predominant marital status	Single (49.7%)	Married (31.1%)	Married (34%)	Single (59.5%)	Single (50.9%)

*SMLMV: *salario mínimo legal mensual vigente* (current legal monthly minimum wage in Colombia).
Source: authors.

Across the Andean, Amazon, Caribbean, and Pacific regions of Colombia, women and individuals aged 35 to 37 years constituted the majority of participants. In the Andean region, 66.7% of participants were women, and ethnic minorities represented 4% of the sample. Regarding education, 33.2% had completed postgraduate studies, while 35.9% reported financial constraints that limited their ability to continue their education. In terms of income, 44% earned more than three SMLMV (current legal monthly minimum wage), whereas 34% earned less than one SMLMV; 62% of participants reported being formally employed or self-employed.

In the Amazon region, 69.1% of participants were women. Ethnic representation accounted for 5%, including 2.6% Indigenous respondents. Secondary education was the most frequently reported level (31.3%), and economic barriers to continuing education affected more than one-third of respondents.

In the Caribbean region, women made up 72.2% of the participants. Secondary education was the most common educational level achieved (32.9%), and 32% of respondents reported income below one SMLMV. Most participants were either formally employed or self-employed (61%).

The Pacific region exhibited the greatest ethnic diversity (13%), including 7.6% Indigenous and 4.7% Afro-descendant participants. Women represented 69.9% of respondents. Secondary education was the most frequent educational level (35.3%), while 39.8% reported financial barriers to pursuing further education. Formal employment accounted for 49%, though 45.5% of participants reported earning less than one SMLMV.

In the Orinoco region, 62.3% of participants were women, and ethnic representation reached 5%. The most common educational level was secondary education (36.5%). Regarding income, 54.3% of respondents reported earning less than one SMLMV, and 43% were formally employed.

Overall, the findings indicate that the Andean region concentrates the highest levels of education and formal employment, whereas the Orinoco and Pacific regions exhibited the largest proportions of low-income households and greater ethnic diversity. These regional variations reveal a segmented social structure, in which education and formal employment remain the primary axes of social and health differentiation across Colombian regions.

Intermediate determinants by region

To analyze the intermediate SDH, several dimensions were examined, including physical environment and infrastructure (housing, security, public services), transportation, health systems, emotional health, life habits (stress, diet, and use of legal and illegal substances), and interpersonal relationships. These indicators provide a multidimensional understanding of living conditions and daily practices across the five regions, enabling the identification of territorial contrasts in access to services and health-related behaviors.

As shown in Table 2, health coverage remains high at the national level, with the highest rates observed in the Orinoco region and the lowest in the Pacific. Access to drinking water exceeds 90% in all regions; however, sewerage systems and internet connectivity exhibit pronounced regional disparities, with markedly lower figures in the Caribbean and Pacific regions.

Alcohol consumption within the past three months varied by region, being highest in the Andean region and lowest in the Amazon region. Analysis of food security indicators revealed a clear gradient of food insecurity across territories: in the Andean region, only 10.1% of participants

reported skipping meals, whereas this proportion increased to 32.3% in the Orinoco and 27.5% in the Pacific region. These findings underscore the persistence of territorial inequities linking economic conditions, access to services, and nutritional well-being across Colombia's regions.

Table 2. Intermediate determinants of health by geographic regions

Intermediate determinants	Andean	Amazon	Caribbean	Orinoco	Pacific
Health coverage	90.6%	89.3%	89.2%	92.7%	79.9%
Predominant socioeconomic stratum	Medium (3-4) 59.9%	Low (1-2) 47.1%	Low (1-2) 54.5%	Low (1-2) 59.3%	Low (1-2) 55.7%
Access to drinking water	99.5%	98.2%	98.2%	97.0%	97.4%
Sewerage service	95.8%	81.2%	79.7%	88.1%	71.3%
Internet connection	91.2%	74.3%	71.0%	76.6%	57.3%
Vigorous physical activity	53.2%	27.9%	20.2%	39.8%	39.3%
Alcohol consumption in the last 3 months	54.1%	33.1%	33.9%	39.1%	37.4%

Source: authors.

Andean Region

The most common types of housing were houses (53.5%) and apartments (40.2%). Among participants, 43% paid rent and 37.7% owned their homes. Nearly all respondents had a designated cooking area (98.7%), and 95.5% had a toilet connected to the public sewerage system, although coverage was lower in rural areas. Natural gas (88.5%) was the main source of energy for cooking, and 90% reported access to drinking water. The most frequently used means of transportation were public transport (35.4%) and private cars (30.5%), while 13.6% reported transportation difficulties when attending appointments or activities. Health coverage reached 90.6%, with 43.6% reporting a trusted health professional, and 48.4% rating their health as good or excellent. Regarding life habits, 58.3% engaged in physical activity, 54.1% consumed alcohol, 97.8% purchased their food, and 10.5% skipped meals due to lack of money. Economic stress affected 41.3% of participants, and 86.8% reported receiving support from family or friends, although participation in religious (28%) or social (26%) activities remained limited.

Amazon Region

Most participants lived in apartments (54.3%) or houses (41.8%), of which 40.2% were owned, 30.9% rented, and 28.5% still being paid off. Access to basic services was high—99% had a cooking area and 89.5% had a sewage connection—though drinking water and waste disposal coverage were lower. The most frequent means of transport were public transportation (37.4%), private cars (30.1%), and motorcycles (20.2%); 14.5% reported transportation barriers, and 18.2% cited administrative or geographical difficulties accessing health services. Most participants were affiliated with the contributory health regime (70.5%), and 41% rated their health as good. Physical inactivity was prevalent (69.7%), and 21.8% reported skipping meals due to insufficient resources. Stress

was reported by 65.1%, and 37.8% lacked support from family or friends, with limited participation in religious (33%) or social (29%) activities.

Caribbean Region

Most participants lived in apartments (53.3%) or houses (42.8%), and 72.2% owned their homes. Nearly all respondents had a designated cooking area (98.4%), and 91.3% had toilets connected to a sewerage system. Public transportation (43.7%), motorcycles (23%), and private cars (22.3%) were the most common modes of transport, though 14.9% experienced mobility difficulties. Health coverage reached 89.2%, but 18.2% faced barriers to healthcare access, and 39.1% perceived their health as good or excellent. Food insecurity affected 23.9%, who reported skipping meals due to economic hardship. Family or friend support was reported by 55.2%, while participation in religious (30%) and social (25.7%) activities remained low.

Orinoco Region

Most participants lived in houses (69.6%) or apartments (23.4%), with 48.9% renting their homes. Toilets connected to the public sewerage system were available to 90.4%, though rural areas had more limited access. Drinking water and electricity coverage exceeded 90%, and 93% of participants lived in urban areas, primarily within low (59.3%) and middle (37%) socioeconomic strata.

The most frequent transportation modes were public transport (32.3%) and motorcycles (30%), while 17.3% reported mobility difficulties. Health coverage reached 92.7%, though 19% reported barriers to accessing healthcare, and 34% rated their health as excellent or very good. Regarding health behaviors, 64.2% did not engage in regular physical activity, 60.9% abstained from alcohol, and 89% did not smoke. Economic limitations affected dietary diversity for 32.3%, and 78% reported having family or friend support, though participation in religious (28.8%) and social (41.9%) organizations remained low.

Pacific Region

The most common housing types were houses (51.9%) and apartments (40.3%). A designated cooking space was available to 96.2%, and 80% had toilets connected to the public sewerage system, with lower availability in rural areas. Drinking water coverage reached 97.4%, though disparities persisted in other public services between urban and rural settings. The most used means of transport were public transportation (34.6%) and private cars (23.5%), while 19.7% experienced transportation difficulties preventing them from attending appointments or work. Although 42.7% perceived their health as excellent or very good, 20.1% lacked health insurance, and 29.9% reported barriers to healthcare access.

Most participants did not engage in physical activity (67%), 62.5% abstained from alcohol, and 92.2% did not smoke. Economic hardship led 27.5% to skip meals, while stress was common (76.8%), mainly associated with financial strain (52.4%) and work-related demands (41.9%). Social support was reported by 69.9%, though participation in religious (30.3%) and community organizations (38.6%) was low.

Correlation between structural and intermediate social determinants

Table 3 summarizes the correlations identified. Overall, the observed associations were weak to moderate in magnitude, reflecting the multifactorial and interdependent nature of the variables analyzed. Significant relationships were identified particularly between age, sex, educational level, employment status, and several intermediate determinants such as self-perceived health, physical activity, stress, and substance use.

Table 3. Correlation between structural and intermediate social determinants

Intermediate determinant	Structural determinant	Test used	Geographic region				
			Andean	Amazon	Caribbean	Orinoco	Pacific
			χ^2 = Chi squared; Ctg Tc = Kendall's Tau-c; Tb = Kendall's Tau-b *Statistical significance: $p < 0.05$				
Socioeconomic stratum	Age	χ^2	54.869 (< 0.001)*	24.674 (< 0.001)*	29.293 (< 0.001)*	9.157 (0.165)	50.795 (< 0.001)*
		Tb	0.036	0.062	0.156	-----	0.023
	Highest educational level achieved	χ^2	215.499 (0.000)*	193.824 (0.000)*	136.182 (0.000)*	70.824 (0.000)*	123.069 (0.000)*
		Tc	0.04	0.072	0.154	0.031	0.058
	Current employment situation	χ^2	66.927 (< 0.001)*	63.962 (< 0.001)*	53.746 (< 0.001)*	19.036 (0.008)*	69.667 (< 0.001)*
		Ctg	0.257	0.338	0.332	0.207	0.376
	Economic income in the last month	χ^2	206.761 (< 0.001)*	161.471 (< 0.001)*	110.596 (< 0.001)*	63.490 (< 0.001)*	130 (< 0.001)*
		Tb	0.086	0.086	0.216	0.15	0.251
	Marital status	χ^2	56.164 (< 0.001)*	19.811 (0.019)*	30.449 (< 0.001)*	34.257 (< 0.001)*	28.703 (< 0.001)*
		Ctg	0.237	0.243	0.256	0.273	0.254
Days per week of vigorous exercise practice	Biological sex	χ^2	19.643 (< 0.001)*	7.664 (0.022)*	4.090 (0.129)	12.089 (0.002)*	25.532 (< 0.001)*
		Ctg	0.137	0.108	-----	0.166	0.139
	Highest educational level achieved	χ^2	38.588 (0.000)*	78.269 (0.000)*	53.705 (0.000)*	15.550 (0.113)	37.187 (0.000)*
		Tc	-0.43	-0.206	-0.113	0.012 (0.765)	-0.136
	Current employment situation	χ^2	17.064 (0.009)*	16.865 (0.010)*	18.018 (0.006)*	6.817 (0.338)	2.048 (0.915)
		Ctg	0.133	0.182	0.199	----	----
	Economic income in the last month	χ^2	13.767 (0.032)*	56.849 (0.000)*	40.987 (0.000)*	2.332 (0.887)	33.539 (0.000)*
		Tc	0.069	0.092	0.077	----	0.164

Intermediate determinant	Structural determinant	Test used	Geographic region				
			Andean	Amazon	Caribbean	Orinoco	Pacific
			χ^2 = Chi squared; Ctg Tc = Kendall's Tau-c; Tb = Kendall's Tau-b				
			*Statistical significance: $p < 0.05$				
Little variety in food due to lack of money or other resources in the last month	Age	χ^2	32.505 (< 0.001)*	7.587 (0.023)*	9.751 (0.008)*	20.256 (< 0.001)*	11.253 (0.004)*
		Ctg	0.182	0.123	0.148	0.213	0.161
	Identification with ethnic groups	χ^2	1.001 (0.317)	4.555 (0.033)*	6.176 (0.013)*	0.004 (0.952)	5.841 (0.016)*
		Ctg	----	0.096	0.119	----	0.12
	Highest educational level achieved	χ^2	59.069 (< 0.001)*	19.514 (0.002)*	1.879 (0.866)	25.075 (< 0.001)*	13.597 (0.018)*
		Ctg	0.242	0.195	----	0.236	0.177
	Economic income in the last month	χ^2	52.123] (< 0.001)*	35.750 (< 0.001)*	20.850 (< 0.001)*	39.121 (< 0.001)*	32.042 (< 0.001)*
		Ctg	0.231	0.262	0.215	0.294	0.271
	Marital status	χ^2	12.729 (0.005)*	9.511 (0.023)*	8.275 (0.041)*	27.702 (< 0.001)*	1.413 (0.702)
		Ctg	0.115	0.137	0.137	0.247	----
Alcohol consumption in the last 3 months	Age	χ^2	70.217 (< 0.001)*	4.669 (0.097)	6.510 (0.039)*	23.316 (< 0.001)*	1.120 (0.571)
		Tb	0.155	----	0.121	0.228	----
	Biological sex	χ^2	19.036 (< 0.001)*	10.007 (0.002)*	6.384 (0.012)*	22.212 (< 0.001)*	7.454 (0.006)*
		Ctg	0.14	0.141	0.12	0.142	0.132
	Highest educational level achieved	χ^2	22.860 (< 0.001)*	44.096 (< 0.001)*	36.449 (< 0.001)*	13.567 (0.019)	15.250 (0.009)*
		Ctg	0.154	0.286	0.278	----	0.187
	Economic income in the last month	χ^2	17.148 (0.001)*	19.334 (< 0.001)*	15.430 (0.001)*	2.589 (0.459)	27.249 (< 0.001)*
		Ctg	0.135	0.195	0.186	----	0.251
	Marital status	χ^2	20.406 (< 0.001)*	11.237 (0.011)*	11.606 (0.009)*	23.775 (< 0.001)*	2.447 (0.485)
		Ctg	0.145	0.149	0.161	0.23	----
Frequency of stress in the last month	Age	χ^2	70.217 (< 0.001)*	18.488 (0.001)*	18.407 (0.001)*	29.474 (< 0.001)*	4.647 (0.325)
		Tb	-0.021	0.067	0.034	-0.079	----
	Biological sex	χ^2	13.679 (0.001)*	7.624 (0.022)*	1.852 (0.396)	5.210 (0.074)	9.884 (0.007)*
		Ctg	0.119	0.123	----	----	0.151
	Gender identity	χ^2	10.133 (0.006)*	7.018 (0.030)*	1.813 (0.404)	13.731 (0.001)*	9.508 (0.009)*
		Ctg	0.113	0.118	----	0.177	0.148

Intermediate determinant	Structural determinant	Test used	Geographic region				
			Andean	Amazon	Caribbean	Orinoco	Pacific
			χ^2 = Chi squared; Ctg Tc = Kendall's Tau-c; Tb = Kendall's Tau-b *Statistical significance: $p < 0.05$				
	Highest educational level achieved	χ^2	31.133 (0.001)*	49.777 (0.000)*	33.560 (0.000)*	28.369 (0.002)*	17.655 (0.061)
		Tc	0.026	0.096	0.068	0.024	----
	Current employment situation	χ^2	23.950 (0.001)*	31.431 (< 0.001)*	29.777 (0.00)*	34.927 (< 0.001)*	19.880 (0.003)*
		Ctg	0.157	0.244	0.253	0.275	0.212
	Economic income in the last month	χ^2	12.218 (0.057)	68.925 (< 0.001)*	62.823 (< 0.001)*	15.109 (0.019)*	18.228 (0.006)*
		Tc	----	-0.075	-0.042	0.026	-0.092
	Marital status	χ^2	48.879 (< 0.001)*	17.234 (0.008)*	28.231 (< 0.001)*	20.907 (0.002)*	12.684 (0.048)*
		Ctg	0.222	0.183	0.247	0.216	0.171

Source: authors.

Age-related correlations

Age demonstrated predominantly weak positive correlations with variables such as socioeconomic stratum and housing type, indicating that older adults (> 60 years) were slightly more likely to live in traditional houses and belong to higher socioeconomic strata—a relationship most pronounced in the Orinoco region.

The association between age and self-perceived health was moderate across most regions, with perceived health declining with age, particularly in the Caribbean region, where 37.5% of older adults rated their health as fair or poor. Vigorous physical activity tended to decrease with age (weak negative correlation), whereas walking habits showed a weak positive association with younger age groups, especially in the Andean, Pacific, and Orinoco regions.

Correlations between age and the use of psychoactive substances or alcohol were weak and negative, concentrated mainly among younger participants in the Amazon and Caribbean regions.

Sex-related correlations

Correlations between biological sex and intermediate determinants were generally weak but consistent across regions. Men reported slightly better self-perceived health and greater engagement in vigorous physical activity, while stress exhibited a moderate positive correlation among women, particularly in the Andean, Amazon, and Pacific regions.

Alcohol and psychoactive substance use also showed moderate positive correlations with male participants, especially in the Andean and Orinoco regions.

Educational level correlations

Educational attainment showed moderate correlations with socioeconomic stratum and home ownership, indicating a direct gradient between education and material living conditions. Conversely, vigorous physical activity displayed a weak negative association with education in most regions, except in the Andean region, where postgraduate participants were more active.

The use of psychoactive substances was higher among individuals with lower educational levels, whereas alcohol consumption was higher among those with higher education, particularly among postgraduate participants. Stress was reported more frequently among individuals with secondary education.

Employment status correlations

Employment status showed statistically significant associations with several structural and intermediate determinants across all regions. Among structural variables, the strongest correlations were observed for socioeconomic stratum and housing type, reflecting consistent links between employment stability and material living conditions.

Stress frequency demonstrated weak to moderate but significant associations with employment across regions, with the highest coefficients found in the Orinoco and Caribbean regions. Unemployed and informal workers faced greater socioeconomic and psychosocial difficulties, particularly in the Caribbean, Orinoco, and Pacific regions, whereas the Andean region was comparatively less affected.

Overall correlation trends

Across all regions, the analysis revealed a consistent social gradient in health. Educational attainment, employment, and marital status were significantly associated with housing conditions and socioeconomic stratum. Variables such as limited diet, psychoactive substance use, and alcohol consumption exhibited weak to moderate correlations, while tobacco use showed no significant association.

The Amazon region presented a greater number of statistically significant relationships, whereas the Pacific region showed fewer. Married individuals predominated in higher socioeconomic strata, while single participants were concentrated in lower strata. Individuals who were single or living in free union experienced greater food insecurity and reported higher rates of psychoactive substance and alcohol use.

Discussion

This study contributes to the regional understanding of how the SDH interact within multi-layered systems of inequality in Colombia. Although the non-probabilistic design precludes generalization to the national population, the patterns identified offer valuable insights into the relational dynamics among structural and intermediate determinants. The findings align with global evidence demonstrating that gender, education, employment, and income remain decisive dimensions in shaping health opportunities and outcomes (11,12). Moreover, results from the SALURBAL Project confirm that gender and socioeconomic context jointly determine exposure to health risks and access to services across urban settings in Latin America (12).

Regional differences in informal employment and unemployment, as well as correlations between employment and intermediate determinants, illustrate how labor dynamics influence health outcomes. Individuals with formal employment or business ownership reported a more favorable perception of their health. This finding supports the conclusions of López-Ruíz *et al.*, who identified informal employment as a key structural determinant limiting healthcare access and reinforcing social exclusion in Central America, particularly within marginalized urban areas (13).

Education continues to represent one of the most powerful yet unevenly distributed social resources in Latin America. The educational gradient observed in this study is consistent with global monitoring by the WHO's World Health Statistics (11) and with the cross-country analysis by Roberti *et al.*, who found that lower educational attainment correlates with poorer service quality and reduced institutional trust (14). These convergent findings highlight that education should be viewed as a collective investment in equity rather than merely an individual achievement.

In Colombia, the apparent universality of health coverage masks persistent inequities in both access and outcomes. Although national surveys report affiliation rates exceeding 90% (15), a population-based study in Manizales found coverage levels between 81.7% and 88.8%, depending on socioeconomic group (16). Similar evidence across Latin America suggests that expanding coverage alone does not eliminate structural and territorial barriers to equitable care (14-16).

Gendered health behaviors further exemplify the interplay between social norms and structural inequality. Regional analyses demonstrate shifting patterns in tobacco and alcohol consumption across gender and income strata (17-20). Alcaraz and Pichon-Riviere noted a diversification of tobacco consumption across Latin America (17), while Hernández-Vásquez *et al.* (19) and Xu *et al.* (20) identified combined effects of sex, age, and socioeconomic status on alcohol use (19, 20).

Food insecurity in this study reflected the convergence of structural and intermediate determinants, particularly age, income instability, biological sex, and ethnic identification. The associations observed indicate that access to adequate food remains highly sensitive to fluctuations in employment and household composition, especially among women and younger participants. In contrast, Prada-López, in a national study, found no significant association between food insecurity and either women's educational level or the gender of the household head (21).

Patterns of physical activity revealed in this study suggest that engagement in exercise remains unevenly distributed across social groups. Although correlations were weak, they consistently pointed to gendered and socioeconomic gradients—participation decreases with age and educational attainment, while men tend to report higher activity levels. The SAPASEN study similarly identified gender and education as significant predictors of physical activity across South American countries (22). Similarly, Alettaz *et al.* found that women, older adults, individuals with incomplete secondary education, and low-income groups were less likely to meet WHO physical activity guidelines (23).

The pattern of stress observed supports the interpretation that economic instability and labor precarity act as psychosocial mediators linking material deprivation to perceived ill health. This interpretation aligns with Thomson *et al.*, who demonstrated that fluctuations in income and job security undermine mental well-being through cumulative social strain, particularly among individuals in lower socioeconomic strata (24). Patiño-Fernández *et al.* expanded this understanding in the Colombian context, showing that emotional self-perception mirrors structural asymmetries in education, occupation, and income (25).

Although the bivariate associations identified were weak in magnitude, their consistent direction suggests an underlying relational dynamic among determinants. Previous studies have shown that when analyzed jointly, social determinants tend to amplify each other's effects, revealing stronger and more complex associations than those observed individually. Schiltz *et al.* described this as the clustering of social determinants of health, wherein multiple forms of disadvantage co-occur and exert cumulative effects on social health inequalities (26). Recognizing these intersections underscores the importance of employing multivariate analytical approaches to better capture the social architecture of inequality that sustains health disparities across territories.

Conclusions

This study advances understanding of how the SDH operate across Colombian regions, demonstrating persistent asymmetries in education, employment, living conditions, and psychosocial well-being. These disparities reveal that health inequities are not isolated outcomes but rather expressions of structural and territorial inequalities embedded within the country's social fabric.

From a theoretical perspective, the findings reinforce the need to move beyond linear or single-factor explanations and adopt multilevel frameworks that reflect the interdependence between structural and intermediate determinants. This approach contributes to bridging the gap between the WHO conceptual framework and the contextual realities of middle-income countries such as Colombia.

At the practical level, the results call for region-specific policy actions. In the Andean region, efforts should focus on strengthening social protection and educational and occupational support; in the Amazon and Pacific regions, on improving infrastructure and access to health and education; and in the Caribbean and Orinoco regions, on promoting food security and stress reduction strategies. Integrating these differentiated priorities into national initiatives such as PAIS[2] and MAITE[3] would foster territorial equity and operationalize the principle of "health in all policies." Ultimately, addressing Colombia's health inequities requires confronting the social architecture of inequality through intersectoral, participatory, and territorially grounded approaches. However, future longitudinal and parametric studies are necessary to elucidate how these determinants interact and evolve over time.

Limitations

While this study provides a broad regional overview of the SDH in Colombia, several methodological constraints should be acknowledged. First, the use of a non-probability snowball sampling method introduces potential selection bias, as participation depended on voluntary networks rather than random selection, limiting representativeness and external validity. Second, the underrepresentation of rural residents and minority groups—including Indigenous, Afro-descendant, LGBTIQ+, migrant, and other vulnerable populations—may have restricted the diversity of perspectives captured. Finally, although the DESOSA81 instrument exhibited strong internal consistency and content validity, the absence of construct validation and reliance on self-reported data may have introduced

2 *Política de atención integral en salud* (PAIS): national colombian framework that articulates actions across the health system to ensure integrated, equitable, and person-centered care, with a strong emphasis on territorial and intersectoral implementation.

3 *Modelo de Acción Integral Territorial* (MAITE): A health management model implemented in Colombia that is designed to coordinate actions across the national health system with the aim of effectively addressing the needs of the population.

measurement bias. Therefore, while this research constitutes an important empirical contribution to the characterization of SDH in Colombia, the results should be interpreted with caution and not generalized to the national population.

Conflict of interest

The authors declare no conflict of interest.

Funding

This study received financial support from the Universidad de Caldas for its development.

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