

Barriers to Access in the Provision of Health Services in Colombia: Characteristics of the Affected Population

Fabio Andrés Hincapié Mesa^{1*} , Juan Carlos Londoño Roldán² 

¹ Universidad de Caldas, Manizales-Caldas, COLOMBIA

² Tecnológico de Monterrey, Business School, juan.londono@tec.mx

*Corresponding Author: fabio.hincapie@ucaldas.edu.co

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ABSTRACT

The study analyzes the barriers to access to public health services and their impact on the Colombian population 2020-2021. The literature recognizes that limited access to health services is a recurrent problem in lower-middle income countries. Information from the National Data Archive is used, developing robust probit and multinomial logit models to evaluate the impact of people's access to hospital services, as well as a cluster model to characterize the target population. The results show that the variables total household income, sex, age, social security regime and quality of service are statistically significant, with the ethnicity variable being insignificant. As a novelty, the inclusion of variables such as social security regime, ethnicity and household income as determinant and significant variables allows us to identify the characteristics of the patients and the barriers to access to health services in Colombia, making it possible to propose public policy guidelines.

Keywords: Access Barriers, Probit, Logit and Cluster Models, Health Services, Household Income, Ethnicity.

JEL: C01, C25, C38, I18, I19

INTRODUCTION

In low- and middle-income countries, government policies prioritize improving access to health services (Sara, 2019). As part of their effort, countries have integrated the Sustainable Development Goals (SDGs) and their targets into national development plans, aiming to enhance levels of comprehensive health well-being and overall quality of life (Jaimurzina *et al.*, 2015).

However, factors such as limited equipment, technology, coverage and universal access to health services, as well as inadequate social assistance, basic sanitation, prevention and health promotion actions, along with poverty conditions, contribute to exacerbating this problem (Sobral and Freitas, 2010).

According to Chernichovsky and Prada (2015), current health systems must ensure the implementation of public policies that elevate healthcare standards, social welfare, public sanitation, access to healthcare and fiscal discipline. It is essential to identify the primary barriers in the region, particularly financial, structural and cognitive barriers, as these facilitate root cause analysis and the design of interventions (Carrillo *et al.*, 2011).

Broadly speaking, barriers to access in healthcare encompass any conditions or situations that limit individuals from seeking, receiving or benefiting from the services offered by the health system (Mogollón-Pérez and Vázquez, 2008). This circumstances result in underutilization of available services (Campo-Arias *et al.*, 2020).

Numerous studies have identified various barriers affecting the provision of health services including technological limitations, information systems, economic constraints, ineffective promotion and prevention

policies, as well as structural and integration barriers, including the recent COVID pandemic (Sarikhani *et al.*, 2021; Elkhayat *et al.*, 2022).

Furthermore, Sana *et al.* (2020) emphasize that healthcare costs and poverty serve as significant barriers to universal access to healthcare, particularly for the self-employed (Richardson *et al.*, 2012).

While numerous studies have been conducted on barriers to accessing health services (Ali *et al.*, 2021), there is a lack of research in Colombia that accurately reflects the reality regarding access barriers to healthcare (Campo-Arias *et al.*, 2020). A bibliometric search of the Web of Science (WOS) and Scopus databases reveals that only eight studies have been published in the last decade for Colombia.

These studies primarily focus on barriers to accessing mental health services (Ali *et al.*, 2017; Campo-Arias *et al.*, 2014), administrative access barriers (Hernández *et al.*, 2015), socio-economic inequalities (Houghton *et al.*, 2020), geographical barriers to accessing health services in Nariño, Colombia (Caicedo-Rosero and Estrada-Montoya, 2016), a comparative study between 2 municipalities in Colombia and Brazil (Garcia-Subirats *et al.*, 2014), and finally, barriers and strategies in the case of Medellín, Colombia (Restrepo-Zea *et al.*, 2014).

This study aims to address the gap in evidence by utilizing updated databases to analyze the root of the problem and determine public policy guidelines for intervention in the regions.

Based on the above, the main objective of this study aims to explore the impact of access barriers to public health services on the Colombian population during the period of 2020-2021. Additionally, the study will examine the characteristics of the population affected by these barriers, including their age, gender, socioeconomic status, household income and health status (Gagné *et al.*, 2014).

Access Barriers to Health Services

Access barriers to health services are diverse and vary depending on the context, existing regulations, and the specific healthcare system. According to Douthit *et al.* (2015), disparities between rural and urban areas can be attributed to factors such as lack of relevant educational processes, social and cultural differences, absence of clear policies and regulations, and the isolation of living in remote areas.

From the perspective of health service users, one common barrier to accessing healthcare is transportation. Difficulties in transportation can lead to rescheduled or missed appointments, delayed care, and difficulties obtaining prescribed medications (Syed *et al.*, 2013). Furthermore, barriers to access often arise from the demand side, with underutilization of healthcare services being highly correlated with income and disparities, especially among vulnerable population (O'Donnell, 2007; Devoe *et al.*, 2007; Lazar and Davenport, 2018).

Poor or low-income populations, along with other vulnerable groups, often face barriers that prevent them from benefiting from public services and public spending. These barriers include lack of information, high access costs and social, cultural and ethnic differences (Sobral and Freitas, 2010; Sana *et al.*, 2020; Richardson *et al.*, 2012 and Ensor and Cooper, 2004),

In Latin America, similar findings have been observed, with household income, quality of care, delays at health centers, waiting times for appointments, lack of time, shortages of health workers and medicines, and financial and cultural constraints being identified as significant (Houghton *et al.*, 2020).

A comparative study between two municipalities in Colombia and eastern Brazil revealed distinct barriers to care-seeking behavior. In Colombia, barriers were mainly associated with health insurance, while in Brazil, long waiting times, lack of doctors and low levels of responsiveness were identified as key obstacles (Garcia-Subirats *et al.*, 2014).

In Colombia, studies on healthcare barriers have highlighted attitudinal barriers, stigma and discrimination, instrumental barriers, supply and demand barriers, and lack of treatment continuity (Campo-Arias *et al.*, 2020).

Geographical perspective have also been explored, with quantitative studies focusing on travel time and transportation as barriers, and qualitative studies emphasizing the means of transport required to reach hospital facilities (Caicedo-Rosero and Estrada-Montoya, 2016; Elkhayat *et al.* Restrepo-Zea *et al.*, 2014).

Supply and demand barriers can significantly impact the availability and quality of health services in Colombia. Insufficient medical staff and infrastructure in certain areas can limit the supply of healthcare services (Salazar *et al.*, 2016). Additionally, limited economic resources, lack of healthcare services in rural areas, and inadequate infrastructure pose significant barriers, particularly for low-income families (Lazar and Davenport, 2018). Discrimination and stigma towards vulnerable groups, such as LGBTIQ community, can also impede access to healthcare (Romani *et al.*, 2021).

In summary, research suggests that there are multiple barriers to accessing healthcare in Colombia, including economic, geographic, administrative, legal, attitudinal and treatment continuity barriers. Addressing these barriers is crucial to ensure that everyone has access to the healthcare they need for maintaining good health and quality of life.

METHOD

Probit and logit regression models are used to analyze the probability of individuals accessing hospital services based on their individual characteristics. Furthermore, a clustering algorithm is utilized to identify distinct groups of people who share similar characteristics and to simplify the analysis of complex data.

Chart 1 summarizes the findings from the literature review, specifically focusing on studies that have employed multivariate probit and logit regression models. The most commonly used variables and the main findings on barriers to accessing healthcare will also be considered for the current research.

Data Source

The data used in this study is obtained from the National Data Archive (ANDA) Citizen Service and the Quality of Life Survey (QoL) conducted by DANE (Departamento Administrativo Nacional de Estadística) in Colombia within departments of Colombia between 2012 and 2019.

In this study, robust multivariate Probit and Logit regression models were employed to address heteroscedasticity issues and obtain unbiased, consistent and efficient estimators both globally and individually. These models were based on the work of various authors found in the WOS and Scopus databases, including Carrillo et al. (2011), Ali et al. (2021), Gelberg et al. (1997), Devillanova and Frattini (2016), Atafu and Kwon (2018), Garcia-Ramirez et al. (2020), and Decker et al. (2021).

Chart 1: Synthetic Analysis Methodology and Variables.

Author(s)	Methodology	Variables	Top results
Gelberg L. et al. 1997	Unadjusted probability models.	VD: Four self-reported measures by health services use by physical illness or injury. VI: Data on demographic characteristics (gender, age, race, education, veteran status) and characteristics of the new social structure in Los Angeles.	Conflicting priorities (finding housing or employment, maintain wellness appointments and find childcare) were barriers to maintaining referral appointments in a sample of homeless women. Locating outpatient clinics where homeless people can congregate for subsistence and health services would help reduce the role of time and programming restrictions as barriers.
Carrillo J. et al. 2011.	The Health Care Access Barriers Model Healthcare (HCAB). Logistic and Factorial Regression Analysis.	VD: Access Barriers to Health Care. VI: The three intermediate variables (prevention, timely care, treatment), variables of sociodemographic characteristics, lack of care.	The Health Care Access Barriers Model provides a unique and effective taxonomy and framework for the classification, analysis and reporting of modifiable health problems. The specific focus on modifiable barriers facilitates the design of interventions that can lead to the reduction of disparities.
Richardson E. et al. 2012°	Multivariate regression analysis.	RV: Probability of not having health insurance VI: Gender, age, marital status, employment status, level of income, residential area (Urban, Rural)	Men were twice as likely to be uninsured than women. Participants aged 25 to 34 were most likely to be uninsured across different age categories. The poor were also more likely to lack coverage
Rocha-Buelvas A. et al., (2014)	Analyses, Multivariate	RV: Medical appointment in the last 12 months. VI: physical discomfort, functional limitations, physical pain, physical deterioration, psychological deterioration, social deterioration and disability. The second group included gender, age, ethnicity, academic program and semester, marital status and employment status. Finally, in the third: health status, oral-dental health status, dental problems,	Students who said they have poor health used more health services in the past year. Students who do not have their quality of life affected by physical disability and physical pain use health services less.

		mental health, satisfaction with the appearance of teeth, socioeconomic stratum, social support.	
Sánchez G. et al. (2015)	Multivariate analysis, logistic regression.	VD: Timely Treatment VI: Sociodemographic variables, times related with the clinical course of the disease, the denial of services and the submission of a "tutela".	23% submitted a "tutela" to access health services. There are significant associations between timely treatment, belonging to socioeconomic strata IV and V, and higher secondary schooling.
Devillanova & Frattini (2016)	Adjusted logit probability models.	VD: Access to medical service. VI: Socioeconomic characteristics (marital status, educational level, economic status, employment) and demographic characteristics (age ranges, sex), territorial variable, self-assessed health.	Immigrants get less access to all health services. The same pattern is observed for hospital visits. Immigrants are characterized by a better self-reported health condition.
Asmamaw Atafu & Soonman Kwon (2018)	Multivariate logistic regression used with the survey participants linked to the survey of health and qualitative establishments (approach group discussion and in-depth interview).	VD: Households with Health Insurance VI: The predictor variables social capital and related services, arrival time to health center, age, sex education, occupation, self-reported health, quality of health, chronic disease, household size, wealth index.	The study identified important characteristics of households, social capital and health facilities as a barrier to health insurance enrollment. Education status, age, knowledge and information about health insurance, self-assessment, providers, and availability of evidence all affect insurance enrollment.
Adelekan et al., (2019)	Bivariate and multivariate analysis to determine the predictors of difficulty in accessing HIV clinics.	VD: Access to Facilities Sex, Marital Status, Religion, Ethnicity, Educational Level, Age, Type of lack of support, Financial, Stigma on the part of who, Health of the worker, factors of inaccessibility, availability of medicines.	Access to health facilities was difficult, while about a quarter of them reported experiencing or suspecting stigmatizing behavior. This research showed that bad/dangerous roads, transportation cost, distance away from the facility also strongly represented association with difficulty in accessing health.
Akhtar S. et al., (2020)	Multiple regression analysis, Pearson correlation and t-test determine the relationships between the different variables that affect DAP.	VD: The Willingness to Pay (WTP) VI: were sex, education and monthly income of the respondents and occupation.	64% of respondents were willing to pay for CBHIS. Among the remaining 36% of those who do not want to pay the income and education level were significant predictors of WTP.
García-Ramírez et al. 2020	Multivariate logistic regressions.	VD: The use of outpatient, hospital and preventive health services. VI: Age, gender, marital status, education, ethnicity, disability, socioeconomic factors, region in Colombia, type of insurance, self-assessed health, multimorbidity need factors.	There are inequalities driven by individual characteristics such as wealth, urban residence, type of health insurance and multimorbidity.
Afshar Ali et al. 2021	Multivariate Logistic Regression Models to Predict the Relationship between Health Use and Health Various characteristics of	VI: Socio-economic status and level of education, access to information and communication technologies (ICT),	The results show that a number of factors are associated with an increased likelihood of using Health Services, including higher education, employment, higher household income, and access to ICT. The likelihood of health use is lower for older people

respondents.

Decker M. et al., (2021)	Logistic Regression Analysis	VD : Perceived Barriers. VI: Race/ethnicity, age, gender, sexual orientation, housing status and sexual experience.	Half of the young people reported concerns about the results of the tests (52.7%), the cost of the services (52.0%) and confidentiality of services (49.8%).
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Source: compiled by the authors WOS - Scopus.

The dependent variable used in the models was whether or not the patient attended hospital, while the independent variables included socioeconomic factors such as gender, age and total household income. Additionally, the models incorporated variables related to the quality of service, the healthcare payment system and ethnicity.

Furthermore, the literature suggests that, in order to improve the healthcare situation in Colombia, it is crucial to increase the coverage of health services for the entire population, regardless of age, and reduce the inequality gap. This includes focusing on preventing and outpatient care, considering factors such as income level, place of residence (urban-rural), and type of healthcare payment system (Garcia-Ramirez *et al.*, 2020).

From the literature review and based on the different models and variables used by the studies already mentioned in chart 1, Gelberg *et al.* (1997), Richardson *et al.* (2012), Adelekan *et al.* (2019), Garcia-Ramirez *et al.* (2020), use regressions and probabilistic models to determine access or not to health services. These models incorporate variables that encompass sociodemographic and social factors, in addition to the characteristics of the population under study. Consequently, Hypotheses 1 (H1), H2 and H3 are derived.

H1: Gender has a positive and significant effect as an access barrier to health services.

H2: Age has a positive and significant effect an access barrier to health services.

H3: Ethnicity has a positive and significant effect as an access barrier to health services.

For H4, the studies by Richardson *et al.* (2012), Devillanova & Frattini, (2016), y Sana *et al.* (2020) employ cross-sectional methods and multiple regressions to analyze barriers to accessing health services. These models incorporate socioeconomic variables such as income level, education level and willingness to pay, which, according to the authors are linked to the characteristics of the population studied.

H4: Household income has a positive and significant effect as an access barrier to health services.

In a much more differentiated context, the type of affiliation influences the probability that a person will or will not attend health services, so H5 allows us to verify whether it is significant and explanatory of the model designed.

H5: The type of health system affiliation has a positive and significant effect as a barrier to access to health services.

In relation to the quality of hospital services the studies by Garcia-Subirats *et al.* (2014) y Adelekan *et al.* (2019) emphasize how waiting lists, the affiliation system, the availability of care centers, as well as the characteristics of the population, affect the perception of quality. H6 aims to verify the quality of service.

H6: Healthcare service quality has a positive and significant effect as an access barrier to health services.

RESULTS

The models to be developed will examine the relationship between the dependent variable of whether a person attended hospital services and several independent variables such as sex, age, ethnicity, household income, healthcare payment system, and quality of service provision.

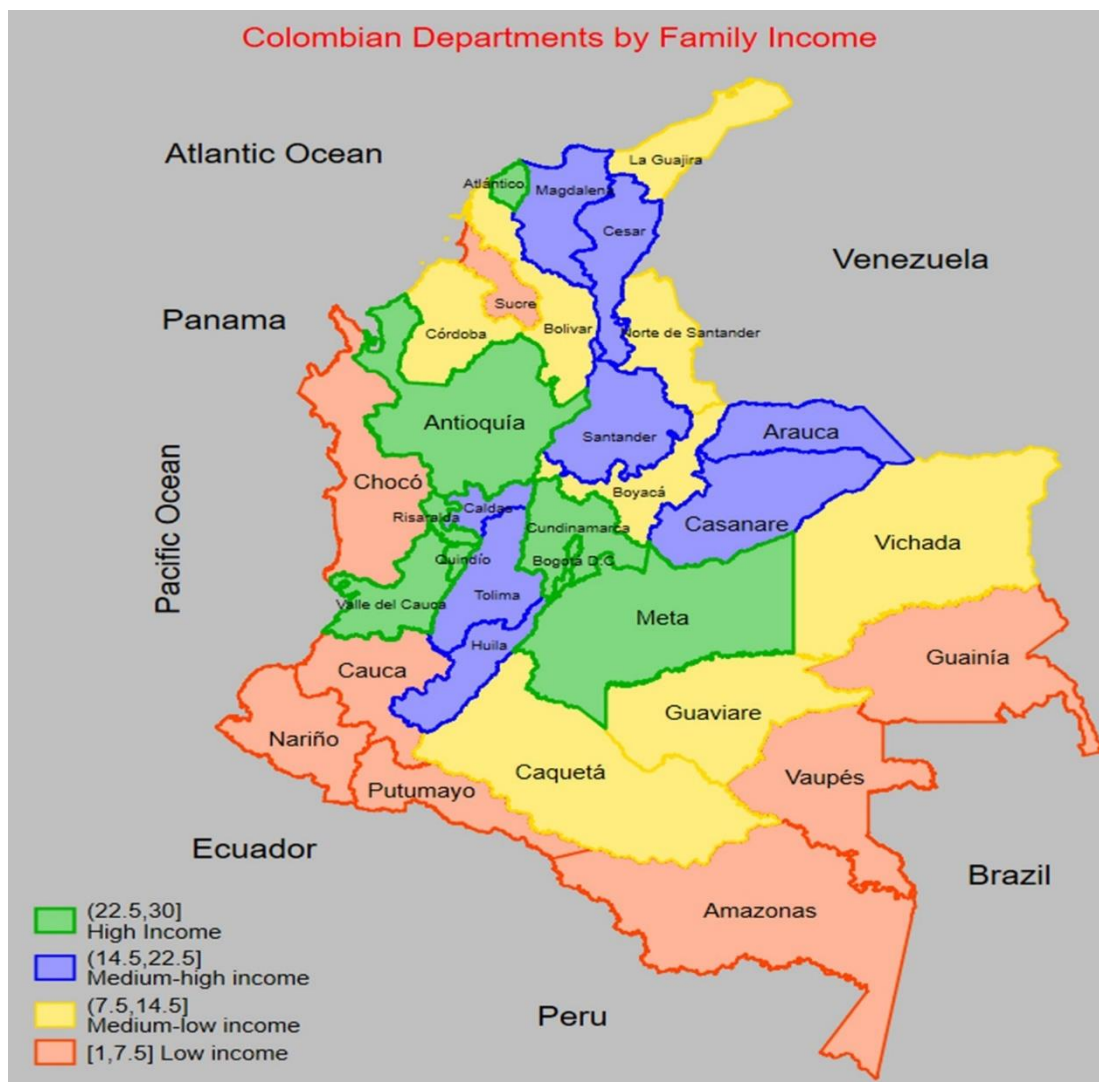


Figure 1: Colombian Departments by Family Income.
 Source: compiled by the authors.

Figure 1 illustrates the distribution of total household income in Colombia, which is a highly significant variable in the models developed to understand the reasons why people do not seek health services. The data is derived from the Quality of Life Survey (QoL) 2020-2021, specifically focusing on the departments of Antioquia, Atlántico, Bogotá D.C., Cundinamarca, Meta, Quindío, Risaralda and Valle del Cauca. These departments have the highest total income per household, with an average of \$1,999,869.5, which accounts for 25% of the total (green). These departments are considered less vulnerable in terms of access to health services.

The next group represents 25% of the total and consists of departments with medium-high incomes, including Arauca, Caldas, Casanare, Cesar, Huila, Magdalena, Santander, and Tolima (blue). The average total income per family in these departments is \$1,469,625.00.

The third group, representing 25% of the total, comprises departments with medium-low incomes, including Bolívar, Boyacá, Caquetá, Córdoba, La Guajira, Guaviare, Norte de Santander, and Vichada (yellow). The average household income in these departments is \$1,218,875.00.

Lastly, the most vulnerable or low-income departments, accounting for 25% of the total (orange), consist of Amazonas, Cauca, Chocó, Guainía, Nariño, Putumayo, Sucre, and Vaupés. The average household income in these departments is \$1,014,125.00.

Studies by Sana et al. (2020) and Richardson et al. (2012) have found that income level significantly influences the likelihood of accessing social insurance and the availability of resources to pay for health services in hospital institutions.

Once the variables are known, the Probit and Logit models are designed under the following structure: Equations (1 and 2) represent the different models (Gujarati, 2019).

$$Y_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \mu_i \quad (1)$$

Where: β_0 is the intercept.

Y is the dependent variable.

$\beta_0, \beta_1, \beta_2$ measure the change from X_1, X_2, X_k keeping the other factors constant.

μ_i is the error term.

$$Y^* = \beta_0 + X\beta + \epsilon_i \tag{2}$$

Where $Y = 1[Y^* > 0]$

Enter the notation $1[\cdot]$ to define a binary result. Function $1[\cdot]$ is called the flag function, which takes the value of 1 if the event inside the square brackets is true and zero if it is not.

Therefore, $Y=1$ if $Y^* > 0$ and $Y=0$ if $Y^* \leq 0$

The term ϵ is independent of X and has standard logistic distribution or standard normal distribution.

$X\beta$ are the response probabilities where: $X\beta = \beta_1X_1 + \beta_2X_2 + \dots + \beta_kX_k$

Chart 2 presents the results of the probit model, which is considered more robust than the logit model (appendix 1). The overall and individual significance of the variables included in the models are also reported. To interpret the results, marginal effects or partial derivatives are used, which measure the expected change in the probability that the dependent variable (attending hospital services) takes the value of "1" when one of the independent variables changes, while holding all other predictor variables constant.

The results of the partial derivatives or marginal effects are consistent with the robust Probit and Logit models, which have been corrected for heteroscedasticity problems. The $p > z$ values indicate that the variables are still significant and explanatory power for the dependent variable.

Both models suggest that gender is a relevant variable, since its marginal effect is significant testing H1. It indicates that women are 9.69% more likely than men to attend health services, that is, this population uses health services much more than men. Regarding age, which is categorized according to the National Administrative Department of Statistics (DANE, 2023), the marginal effect suggests that for each additional year of life, the probability of seeking health services increases by 6.9% for young adults, 15.13% for adults and 14.28% for older adults respectively, proving H2.

Chart 2: Multinomial Probit Model

Multinomial Probit regression			Number of Observations	=	3 433	
			Wald chi2(15)	=	93.81	
	Log likelihood = -2267.4764		Prob > chi2	=	0.0000	
Attended_alservicioHospitalario	Coefficient	Robust Standard Errors	z	P>z	95% Confidence Interval	
Sex	.360651	.0625825	5.76	0.000*	.2379917	.4833104
Age						
Young Adult	.271533	.1348538	2.01	0,044*	.0072244	.5358417
Adult	.5755661	.1330856	4.32	0.000*	.3147231	.8364091
Senior Citizen	.5449841	.1456816	3.74	0.000*	.2594535	.8305148
Ethnicity						
Black, mulatto (Afro-descendant), Afro-Colombian	-.1194926	.1656774	-0.72	0.471	-.4442143	.2052292
None of the above	-.1156262	.1353242	-0.85	0.393	-.3808567	.1496043
Income i_home						
Between 1 and 2 SMLMV	-.1533029	.0781998	-1.96	0.049*	-.3065717	-.0,000034
Between 2 and 3 SMLMV	-.0773385	.1174406	-0,66	0.510	-.3075178	.1528408
Greater than 4 SMLMV	.2894538	.114405	2.53	0.011*	.0652242	.5136834
Type of health insurance affiliation						
Special (FF.MM, Ecopetrol)	-.0871237	.1778816	-0.49	0.624	-.4357654	.2615179
Subsidized	-.2343627	.0746347	-3.14	0.002*	-.3806441	-.0880813
Quality of the service						
Good	-.0542858	.1083095	-0.50	0.616	-.2665686	.1579969
Poor	-.0554592	.1235248	-0.45	0.653	-.2975635	.186645
Very Poor	-.4409185	.1858668	2-37	0.018*	-.8052107	-.0766263
Doesn't know	.3558296	.3516632	1.01	(0.312)	-.3334176	1.045.077
Constant	-.9820132	.2297656	4-27	0.000	-.1432346	-.5316809

Source: compiled by the authors.

The ethnicity variable was included in the study based on its importance in analyzing access barriers to health services, as supported by the studies such as Gelberg *et al.* (1997), Adelekan *et al.* (2019), and Garcia-Ramirez *et al.* (2020). However, in the context of access barriers to hospital services in Colombia, ethnicity was not found to be relevant or significant, so H3 is not tested.

On the other hand, the total variable income by households was found to be highly significant and explanatory of the dependent variable, confirming the findings of H4. It was observed that families with an income below 2 Current Minimum Monthly Legal Wages (SMMLV) have, on average, a decreased probability of attending hospital services by 4.09%. The coefficient indicates that an increase in the dependent variable (income) leads to a decrease in the probability of seeking health services. This suggests that families with lower income lack resources to cover emergencies, medications, disabilities, and other healthcare-related expenses, which becomes a significant barrier to accessing hospital services.

Furthermore, the income category of households with income greater than 4 minimum wages found to have a positive and highly significant effect on the dependent variable. This means that for every unit increase in the dependent variable (income), the probability of attending hospital services increases by 7.86%. This is likely because households with higher income have greater financial capacity to afford healthcare services.

The subsidized category of health system affiliation type was also found to be highly significant and explanatory. However, it has a negative effect, suggesting that individuals belonging to the subsidized health affiliation system have a lower probability of attending hospital services by 6.31%, thus testing hypothesis H5 but with a negative effect on health service attendance.

Finally, H6 is confirmed as robust and highly significant, as it is supported by 11.41% as a poor quality service, indicating that households and individuals perceive deficiencies in the quality of services in the subsidized category. This perception becomes a barrier to access, reducing the willingness of individuals to use health services in this category.

Characterization of Individuals and Families

The agglomerative cluster model was employed to identify the characteristics of each individual in the study and group them into sets of similar objects. In this model, initially, each object is considered as a separate cluster (López-Roldán and Fachelli, 2015). Then, the algorithm calculates the distance between each pair of clusters and merges the two closest clusters into one. This process is repeated until all objects are grouped into a single cluster. To perform the clustering analysis, the Redmond or Ward binding method (Redmond *et al.*, 1963), also called minimum loss of inertia, was utilized.

Once the cluster number is chosen, the partition and the cluster homogeneity indicators are obtained. In this study, the clustering analysis resulted in the partitioning of the tree into 3 clusters (appendix 2). The clusters were composed of 2852, 515 and 117 individuals, respectively. The chart below presents the inertias of each cluster and their distances to the center of gravity of the sample.

Decomposition of Inertia.

Chart 3 provides information on the inertias of each cluster, the number of observations, the weights and the distances within and between the clusters. It also includes the total inertia and the relationship between inertias.

Chart 3: Decomposition of Inertia.

INERTIAS	INERTIAS		COUNTS		WEIGHTS		DISTANCES	
	BEFOR E	AFTER	BEFOR E	AFTE R	BEFOR E	AFTE R	BEFOR E	AFTE R
BETWEEN CLUSTERS	0.2674	0.2801						
WITHIN CLUSTER								
CLUSTER	0.6363	0.6064	2852	2798	2852.00	2758.00	0.0289	0.0347
CLUS*TER	0.2058	0.2230	515	569	515.00	569.00	0.6763	0.6638
CLUSTER	0.0335	0.0335	117	117	117.00	117.00	4.281	4.281
TOTAL INERTIA	1.143	1.143						
RATIO INTER INERTIA/TOTAL INERTIA:		BEFOR E	0.2339					
		AFTER	0.2450					

Source: elaborated by authors with SPAD software

The most homogeneous and smallest cluster is cluster 3 (inertia 0.0335). This suggest that individuals within this cluster vary significantly in terms of their characteristics or attributes. Cluster 1 is the most heterogeneous

(0.6363) and the largest of the 3 clusters. This implies that the individuals within this cluster vary significantly in terms of their characteristics or attributes.

Inertia measures the total variance within clusters and serves as an indicator of how well the data points are clustered (Fernández Santana, 1991). A lower inertia value indicates a better cluster solution, as it suggests that the data points are closer to their respective cluster centroids and, therefore, more homogeneously clustered. Therefore, the most homogeneous cluster that has the lowest inertia is cluster 3, which can be verified by the very low value of inertia and because the distance between individuals is equal.

Description of the Clusters.

Figure 2 illustrates the distribution of the clusters in the factorial plane. According to the figure, it can be inferred that cluster 1 (green) is larger than cluster 3 (blue), but less dispersed overall. Cluster 3 is smaller and more dispersed compared to the other two clusters.

Cluster 1. It represents the largest group, consisting of 82% of the individuals in the study, it consists mostly of people with a per capita income falling below a minimum wage threshold and affiliated to the subsidized healthcare payment system, whose family income does not exceed one minimum wage (SMMLV). In addition, their educational level is high school or below, their health condition is poor or bad, but they have attended hospital services, and fall into the category of elderly people.

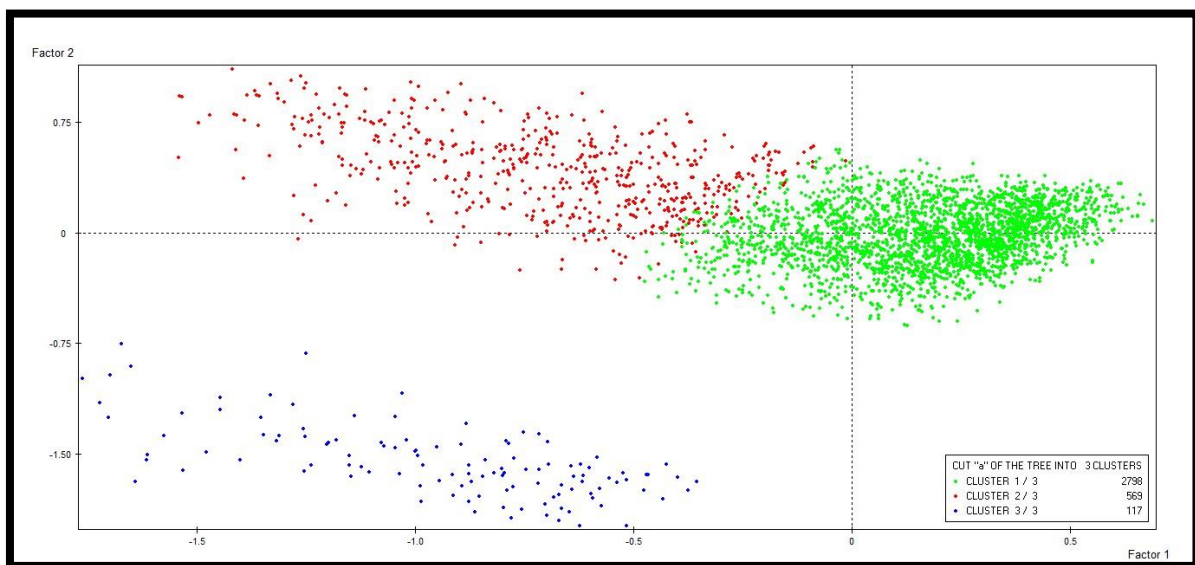


Figure 2: Factorial Plan Characterization of Access Barriers.

Source: elaborated by authors with SPAD software

Cluster 2. This cluster represents 15% of the individuals and is mainly composed of people whose per capita income is between 1 and 2 SMMLV, and whose household income exceeds 3 SMMLV. Most of them are affiliated to the contributory and special healthcare payment system, they have a graduate educational level and are currently studying. In addition, they have a good or very good health condition, and are mostly mature men who live in cities such as Bogotá and the Santanderes.

Cluster 3. This group of individuals represents 3% of the sample and is characterized by an educational level in the training process, mainly young people and adults. They are affiliated to the contributory healthcare payment system and both their per capita and household income range from 2 to 3 SMMLV. Most of them are women and have a good health condition.

In summary, clusters 1, 2 and 3 corroborate the findings and results of the robust probit model. This model shows that the main variables that cluster individuals' characteristics are household income, gender, educational level and type of affiliation. These variables explain why individuals use health services. Thus, the characteristics of individuals as a whole make it possible to identify and verify the main variables that influence the decision to access health services.

DISCUSSION

Based on the analysis conducted and the results obtained from the Probit and Logit models, several important findings can be concluded. These models proved that except for the ethnicity variable, all other variables used

showed high statistical significance, which suggests that they are important factors to explain why people did not seek hospital services.

It is important to point out that the signs of the coefficients obtained in the models were consistent with previous studies, further supporting the validity of the findings. In summary, these findings provide us with valuable information to better understand the factors that influence people's decision not to seek medical care and, consequently, may be useful to improve the provision of health services and promote the well-being of the population.

It is essential to highlight that one of the most important discoveries has been the great influence that household income has on the choice of whether or not seek hospital services. People perceive inadequacy or lack of resources as a significant obstacle to accessing health services. In addition, they consider that higher income is required to cover the costs of medications that are not covered by the system, co-payments and hospitalizations if they are beneficiaries and non-contributors.

Likewise, individuals with higher income, mostly affiliated to the contributory and special healthcare payment system, have easier access to health services, since they have greater economic resources to cover these additional expenses. In addition, they tend to have a better health condition in general and, therefore, less need to use hospital services frequently.

In conclusion, the findings highlight the importance of household income in determining access to hospital services. Efforts should be made in public health policy to ensure equitable access to healthcare and reduce economic barriers that hinder certain population groups from accessing necessary healthcare. Additionally, variables such as gender, age, healthcare payment system and quality of service should be considered when designing interventions and policies aimed at improving healthcare provision and promoting the well-being of the population.

The verification of hypotheses H1 and H2, which show a positive and statistically significant effect confirms that these hypotheses effectively explain the reasons behind the increased likelihood and need to seek hospital services. H3 hypothesis, which focuses on ethnicity, was found to be insignificant in the model, indicating that ethnicity is not a relevant characteristic that restricts access to health services.

H4 hypothesis, which includes total household income, yielded statistically significant results. However, it is important to note that the sign associated with this variable is negative, which indicates that individuals with incomes between 1 and 2 SMMLV are less likely to seek hospital services. On the other hand, individuals with incomes above 4 SMMLV support H4 hypothesis, as there is a statistically significant and positive relationship between their income and the likelihood of seeking hospital services.

Hypotheses H5 and H6, related to the effect of the healthcare payment system and the quality of service, were found to be statistically significant. However, their coefficients are negative, suggesting that affiliation to the subsidized healthcare payment system is not sufficient to guarantee access to health services, and poor service quality may discourage individuals from seeking care in hospitals.

The characterization of individuals and families through clustering analysis provides valuable insights into their social reality. Cluster 1, which contains the largest amount of information, represents the majority of the population in Colombia. It is characterized by lower-middle income, affiliation to the subsidized healthcare payment system, medium or basic education level, advanced age and poor or bad health status. These individuals adjust to their reality and seek care in hospital services.

PUBLIC POLICY RECOMMENDATIONS

Based on the results, the following aspects are proposed for the development of sectoral public policy guidelines aimed at reducing access barriers to hospital health services in Colombia. Democratic participation and involvement of different stakeholders are essential for collective goal-setting and achieving common good.

Governmental entities should play a mediating role in the implementation of policies, and it is crucial for these policies to be accepted and recognized by different social groups to ensure their legitimacy. Legislative support is also necessary to provide a legal framework for these policies.

Achieving greater equity in income distribution (Mostajo Guardia, 2000) is important for reducing barriers to accessing health services. Sectoral policies should focus on investing in infrastructure and technology to ensure the provision of quality and affordable services.

Regional and inter-sectoral plans and programs should be implemented to improve the coverage and quality of health services by removing barriers to access to primary healthcare.

Geographical access can be improved by establishing primary healthcare centers in remote or hard-to-reach areas. Health education programs focusing on prevention and treatment can also help reduce the need for healthcare.

The guidelines presented here could be adjusted or expanded according to the needs of different territorial contexts, and are not exhaustive.

CONCLUSIONS

This study provides valuable findings that can contribute significantly to the advancement of healthcare in Colombia. It offers insights into the likelihood of individuals seeking health services, which could improve the planning and management of health services, as well as ensure more effective and equitable healthcare.

In addition, this study has identified various characteristics that define patients, which facilitates the grouping into different clusters and the implementation of specific measures for each of them in order to improve the quality of care and to reduce access barriers to health services.

This study has corroborated some previous hypotheses and has identified the barriers that hinder access to hospital services for the population in Colombia, thanks to the use of empirical methods that help support these theories. It is important to note that the results obtained in this study are consistent with previous research (Carrillo *et al.*, 2011), (Ali *et al.*, 2021), (Richardson *et al.*, 2012), (Gelberg *et al.*, 1997), (Devillanova and Frattini, 2016), (Garcia-Ramirez *et al.*, 2020), (Murillo *et al.*, 2018), which reinforces the idea that access health services barriers are a real and complex problem in Colombia.

It is important to note that, despite the limitations in obtaining primary databases, the data provided by ANDA through the DANE have allowed to obtain results consistent with the reality of Colombia. However, in the future, it is essential to work with a broader and more robust database to ensure a more precise analysis of the ethnic variable and its impact on access to hospital services.

It is recommended that future studies include other relevant variables such as distance to hospital facilities, time of care, scheduled appointments, among others, which will expand the existing literature and deepen the analysis of this problem. It would be especially useful to conduct empirical studies to test hypotheses and provide a more comprehensive analysis of the current situation.

Implementing strategies based on these findings can help reduce access barriers and improve the quality in Colombia, aiming for a more equitable and effective healthcare system., especially for those who are in remote areas or have fewer economic resources. It is also expected that the findings of this study will inspire future research and progress towards a fairer and more efficient health system in the country.

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APPENDIX

Appendix 1: Multinomial Logistic Regression.

	Multinomial Logistic Regression		Number of Observations		=	3 443
				LR chi2(14)	=	91.74
				Prob> chi2	=	0.0000
	Log likelihood = -2267.1789			Pseudo-R2	=	0.0204
Attended_alservicioHospitalario	Coefficient	Robust Standard Errors	z	P>z	95% Confidence Interval	
Sex	.4142587	.0717215	5.78	0.000*	.2736872	.5548302
Age						
Young Adult	.3197895	.1586534	2.02	0.044*	.0088345	.6307445
Adult	.6695113	.1565209	4.28	0.000*	.3627359	.9762867
Senior Citizen	.6343228	.1705292	3.72	0.000*	.3000917	.968554
Ethnicity						
Black, mulatto (Afro-descendant), Afro-Colombian	-.136974	.1894574	-0.72	0.470	-.5083036	.2343556
None of the above	-.1331786	.1547107	-0.86	0.389	-.4364059	.1700488
Income_home						
Between 1 and 2 SMLMV	-.1765383	.0901891	-1.96	0.049*	-.3533057	.0002291
Between 2 and 3 SMLMV	-.0874322	.1335627	-0.65	0.513	-.3492104	.174346
Greater than 4 SMLMV	.3261881	.1299036	2.51	0.012*	.0715817	.5807944
Type of health insurance affiliation						
Special (FF.MM, Ecopetrol)	-.1012434	.2033262	-0.50	0.619	-.4997554	.2972686
Subsidized	-.2726547	.0855922	3-19.	0.001*	-.4404124	-.1048971
Quality of the service						
Good	-.0619609	.1234492	-0.50	0.616	-.3039169	.1799951
Poor	-.0629845	.1409787	-0.45	0.655	-.3392977	.2133287
Very Poor	-.5164614	.2168366	2 - 38	0.017*	-.9414533	-.0914695
Doesn't know	.4048025	.3986067	1.02	0.310	-.3764523	1186057
Constant	-1.129.861	.2662648	4-24	0.000	-165.173	-.6079912

Source: compiled by the authors.

Appendix 2: Cluster 1.

Characteristics by group category			
Group: CLUSTER 1/3 (Count: 2798 - Percentage: 80.31)			
Variable label	Characteristic categories	Test-value	Histogram
Per Capita Income	Minimum and one SMMLV	41,53	*****
Health care payment system	Subsidized (eps-s)	29,11	*****
Monthly household income	Minimum and one SMMLV	26,44	*****
Studies	No	19,74	*****
Education level	Elementary	17,22	*****
Education level	None	9,97	*****
Education level	High school education	9,40	*****
Present	Does not study	8,71	*****
Health conditions ... in general are	Deficient	8,67	*****
Health conditions ... in general are	Poor	7,08	*****

Source: compiled by the authors.

Appendix 2: Cluster 2.

Characteristics by group category			
Group: CLUSTER 2 / 3 (Count: 569 - Percentage: 16.33)			
Variable label	Characteristic categories	Test-value	Histogram
Per Capita Income	Between 1 and 2 SMLMV	30,88	*****
Monthly household income	Greater than 5 SMLMV	22,12	*****
Monthly household income	Between 3 and 4 SMLMV	22,02	*****
Health care payment system	Contributive (EPS)	21,31	*****
Education level	University	19,29	*****
Education level	Graduate school	18,10	*****
Scheme	Special (armed forces)	15,08	*****
Per Capita Income	Between 2 and 3 SMLMV	14,54	*****
present	Studies	8,10	*****
monthly household income	Between 2 and 3 SMLMV	7,73	*****
Health conditions ... in general are	Very good	7,08	*****

Source: compiled by the authors.

Appendix 2: Cluster 3.

Characteristics by group category			
Group: CLUSTER 3 / 3 (Count: 117 - Percentage: 3.36)			
Variable label	Characteristic categories	Test-value	Histogram
Studies	Yes	31,73	*****
Education level	Missing category	31,73	*****
Age	Young	8,53	*****
Present	Studies	6,44	*****
Age	Adult	4,89	****
Health care payment system	Contribution (EPS)	4,80	****
monthly household income	Between 2 and 3 SMLMV	3,80	***
Sex	Female	3,69	***
Health conditions ... in general are	Good	3,53	***
Per Capita Income	Between 2 and 3 SMLMV	3,37	***

Source: compiled by the authors.