ORIGINAL ARTICLE

Cancer incidence and mortality in the Metropolitan Area of Bucaramanga, Colombia, 2013-2017

Incidencia y mortalidad por cáncer en el Área Metropolitana de Bucaramanga, Colombia, 2013-2017

Helio Caballero Rojas,[1,2,3] **Claudia Milena Hormiga,**[1,2,3] **Claudia Janeth Uribe Pérez,**[1,2,3] **Erika Eliana Meza**[3]

1 Universidad Autónoma de Bucaramanga, Bucaramanga, Colombia. **2** Universidad Autónoma de Bucaramanga, Grupo de investigación Estudio Genético de Enfermedades Complejas, Bucaramanga, Colombia. **3** Universidad Autónoma de Bucaramanga, Registro Poblacional de Cáncer del Área Metropolitana de Bucaramanga, Bucaramanga, Colombia.

Check for updates
CrossMark

OPEN ACCESS

Citation: Caballero RH, Hormiga CM, Uribe PCJ, Meza EE. **Cancer incidence and mortality in the Metropolitan Area of Bucaramanga, Colombia, 2013-2017.** Colomb Med (Cali), 2026; 57(1):e2026979 http://doi.org/10.25100/cm.v57i1.6979

Received: 01 Sep 2025
Revised: 01 Feb 2026
Accepted : 30 Mar 2026
Published: 30 Mar 2026

Keywords
Incidence; Mortality; Neoplasms; Public Health Surveillance; Population Health; Registries; Colombia.

Palabras clave
Incidencia; Mortalidad; Neoplasias; Vigilancia en Salud Pública; Salud Poblacional; Sistema de Registros; Colombia.

Copyright: © 2026 Universidad del Valle

Abstract

Introduction

Cancer is a global public health problem. Population-Based Cancer Registries (PBCRs) are essential tools for characterizing the epidemiology of the disease and evaluating the impact of public health interventions aimed at controlling it.

Aim

To estimate cancer incidence and mortality in the Metropolitan Area of Bucaramanga (AMB) during 2013-2017.

Methods

Descriptive retrospective population-based study of incidence and mortality. Invasive cancer cases were obtained from the Population-Based Cancer Registry of the AMB database, and population and mortality data from the National Administrative Department of Statistics (DANE). Crude and age-standardized incidence and mortality rates were calculated, both overall and sex-specific.

Results

During the study period, 11,815 incident cancer cases were recorded, excluding non-melanoma skin cancer. Age-standardized incidence rates per 100,000 person-years were 173.6 in men and 179.6 in women. The leading sites were prostate, stomach, and colorectal in men, and breast, thyroid, and colorectal in women. The age-standardized mortality rates were 117.56 per 100,000 man-years and 89.91 per 100,000 woman-years.

Conclusions

Incidence and mortality rates for most sites are higher than those observed in the previous five-year periods. PBCRs are the main cancer surveillance tool and are essential for formulating and evaluating public cancer-control policies.

Conflict of interest

The authors of this manuscript report no conflicts of interest.

Funding

This research was funded by the Universidad Autónoma de Bucaramanga (UNAB) and the National Cancer Institute (INC), through funding agreement No. 2024-0019 of 2024 for the Population-Based Cancer Registry of the Metropolitan Area of Bucaramanga.

CRediT authorship contribution statement

H.C.R.: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Supervision. **C.M.H.:** Conceptualization, Writing - review & editing. **C.J.U.P.:** Conceptualization, Writing - review & editing. **E.E.M.:** Investigation (data collection), Data curation.

Data Availability

Individual-level RPC-AMB microdata are not publicly available due to confidentiality standards for cancer patient information and the research ethics commitments described in the Methods section. Aggregated data supporting the results of this study, including incidence and mortality tables by site, sex, and five-year period, may be requested from the corresponding author upon reasonable request, subject to approval by the RPC-AMB.

Corresponding author

Helio Caballero Rojas, e-mail: hcaballero292@unab.edu.co.

Resumen

Introducción

El cáncer es un problema de salud pública a nivel global. Los Registros de Cáncer de Base Poblacional (RCBP) son herramientas esenciales para caracterizar la epidemiología de la enfermedad y evaluar el impacto de las intervenciones de salud pública orientadas a su control.

Objetivo

Estimar la incidencia y la mortalidad por cáncer en el Área Metropolitana de Bucaramanga (AMB) durante 2013-2017.

Métodos

Estudio descriptivo retrospectivo de base poblacional sobre la incidencia y la mortalidad. Los casos invasivos se obtuvieron del Registro Poblacional de Cáncer del AMB y los datos de población y defunciones del Departamento Administrativo Nacional de Estadística (DANE). Se calcularon tasas brutas y estandarizadas por edad, así como tasas globales y específicas por sexo.

Resultados

Se registraron 11,815 casos incidentes de cáncer, excluyendo el cáncer de piel no melanoma. Las tasas de incidencia estandarizadas por edad, por 100,000 personas-año, fueron de 173.6 en hombres y 179.6 en mujeres. Las principales localizaciones fueron la próstata, el estómago y el colorrectal en hombres, y la mama, la tiroides y el colorrectal en mujeres. Las tasas de mortalidad estandarizadas por edad fueron de 117.56 por 100,000 hombres-año y de 89.91 por 100,000 mujeres-año.

Conclusiones

Las tasas de incidencia y de mortalidad en la mayoría de las localizaciones superan las de los quinquenios anteriores. Los RCBP son la principal herramienta de vigilancia y son fundamentales para formular y evaluar políticas públicas de control del cáncer.

Remark

1) Why was this study conducted?

Periodic updates of cancer incidence and mortality estimates for the AMB are needed to continue the epidemiological surveillance initiated by the RPC-AMB in 2003 and to document changes in the disease burden over time.

2) What were the most relevant results of the study?

A total of 11,815 incident cases and 6,963 cancer deaths were identified during the five-year period 2013-2017, with sustained increases in incidence and mortality rates compared with the two previous five-year periods. Prostate, stomach, and colorectal cancers were the most frequent sites among men, whereas breast, thyroid, and colorectal cancers were the most frequent among women.

3) What do these results contribute?

They confirm a growing trend in the cancer burden in northeastern Colombia, provide evidence to prioritize surveillance and screening for gastric, breast, prostate and colorectal cancers, and constitute the baseline against which the impact of the new health care model and the COVID-19 pandemic will be assessed in the next five-year period.

Introduction

Cancer is one of the major global public health threats, with an increasing health, social, and economic burden[1,2]; it is responsible for nearly one in six deaths worldwide (16.8%) and nearly one quarter of deaths (22.8%) from noncommunicable diseases (NCDs) globally. The disease accounts for three in ten premature NCD deaths among people aged 30-69 years worldwide and ranks among the three leading causes of death in this age group in 177 of 183 countries[3]. According to estimates from the Global Cancer Observatory (GLOBOCAN), 19.3 million new cancer cases were recorded in 2020 (18.1 million excluding non-melanoma skin cancer) and nearly 10 million cancer deaths (9.9 million excluding non-melanoma skin cancer). Considering population growth and aging, and assuming that incidence rates remain constant across countries, the number of new cases is projected to increase by 47% by 2040 and to double by 2070 compared with 2020 [4]. However, these projections may be higher given the increasing prevalence of certain cancer risk factors[5,6].

Mortality projections indicate that cancer will overtake cardiovascular disease as the leading cause of premature death in most countries during this century, a shift already observed in most countries with a very high Human Development Index (HDI). In contrast, cardiovascular disease remains the leading cause of premature death in most countries with medium and high HDI[7,8]. Colombia, classified as a high-HDI country, is part of the group of 57 countries in which cancer is already the leading cause of premature death among people under 70 years of age[8].

The rapid increase in incidence and mortality, together with changes in patterns of occurrence characterized by a relative reduction in cancers associated with infection and poverty, such as cervical, liver, or stomach cancer, and an increase in cancers typical of societies with greater economic development, such as breast, lung, colorectal, and prostate cancer[9], calls for adjustments in the priorities of national cancer-control plans. These plans must be comprehensive, ranging from epidemiological surveillance to palliative care, and their successful implementation affects both public health and countries' economies[5].

Population-Based Cancer Registries (PBCRs) are epidemiological surveillance tools that continuously and systematically document new cancer cases in geographically defined populations and serve as the source of incidence and survival estimates at the territorial level. Their linkage with mortality information systems enables a comprehensive assessment of the impact of prevention, screening, and treatment interventions. For these reasons, PBCRs are internationally recognized as the fundamental instrument for cancer monitoring and for guiding population-level cancer control policies[10,11].

Colombia currently has six operational PBCRs located in Bucaramanga, Barranquilla, Cali, Manizales, Medellín, and Pasto, all linked to Colombia's National Cancer Information System[12] and coordinated by the National Cancer Institute (INC). This system is supported by a robust national regulatory framework based on Laws 1384 of 2010 (Sandra Ceballos Law)[13] and Law 2291 of 2023[14], which establish that population-based and institutional cancer registries are integral parts of the Public Health Surveillance System.

The Population-Based Cancer Registry of the Metropolitan Area of Bucaramanga (RPC-AMB), with more than twenty-five years of uninterrupted operation, has become a reference source of cancer epidemiological information with recognized national and international experience[15]. In addition to being linked to Colombia's Cancer Information System, the RPC-AMB has provided technical assistance and training to strengthen the capacities of other population-based cancer registries in the country and in Latin America, and its data contribute to the global cancer statistics compiled by the International Agency for Research on Cancer (IARC)[16].

This article describes cancer incidence and mortality by sex and site in the Metropolitan Area of Bucaramanga during 2013-2017.

Materials and Methods

A descriptive, retrospective, population-based study of morbidity and mortality was conducted using incident cancer cases recorded by the RPC-AMB during the 2013-2017 five-year period, based on the database updated as of December 2024, and cancer deaths recorded by the National Administrative Department of Statistics (DANE) for the same period.

Geographic area

The AMB comprises four municipalities in the department of Santander: Bucaramanga, Floridablanca, Girón, and Piedecuesta, and is one of the six metropolitan areas recognized in Colombia. According to DANE population projections for 2023, the AMB had 1,316,192 inhabitants, predominantly urban (94.3%) and female (52.1%)[15]. Owing to its hospital infrastructure and the availability of specialized public and private oncology services, the AMB has become the main center for cancer diagnosis and treatment in northeastern Colombia.

Population-Based Cancer Registry of the Metropolitan Area of Bucaramanga

The RPC-AMB began operations in April 2000 at the Faculty of Health Sciences of the Universidad Autónoma de Bucaramanga (UNAB), initially as a research project of UNAB's Complex Disease Genetics study group. Since 2020, it has been reconfigured as an institutional program of UNAB's Office of Research. The Registry is currently funded by UNAB and by the National Cancer Institute (INC)[15].

Data collection and processing method

The RPC-AMB conducts active and systematic surveillance of incident cases through periodic searches in pathology and hematology laboratories, imaging and radiodiagnostic centers, clinics, hospitals, oncology units, oncology centers, specialized oncology and palliative care clinics, and social support groups for cancer patients in the AMB. Mortality databases provided by the INC, the departmental health secretariat, or the Ministry of Health and Social Protection are also sources of new cases for the Registry and are used to update information on previously identified cases[15].

Case definition

All men and women, with no age restriction, who were usual residents in the urban and rural areas of the AMB and had received a first-time diagnosis of a primary malignant neoplasm (single or multiple) at any anatomical site, or of a central nervous system (CNS) tumor, regardless of behavior, were considered cases[15]. Eligibility was restricted to invasive malignant neoplasms, that is, those coded as behavior /3 according to the International Classification of Diseases for Oncology, third edition, and its subsequent revisions (ICD-O 3.1-3.2); in situ carcinomas (/2), benign neoplasms (/0), and lesions of uncertain behavior (/1) were not included. Hematological neoplasms included leukemias, lymphomas, multiple myeloma, and other malignant hematological neoplasms classified as /3, in accordance with the criteria established by the International Agency for Research on Cancer (IARC) / International Association of Cancer Registries (IACR).

Diagnostic confirmation was accepted through both microscopic methods (cytology of fluids, peripheral blood, and bone marrow, as well as histology of primary or metastatic tumors) and non-microscopic methods (clinical evaluation, surgical findings, imaging diagnosis, or biomarker determination). The death certificate was accepted as the only source of information when no other information on the case existed. For registry purposes, a resident was defined as any person who had lived continuously in the AMB for at least six months preceding the date of diagnosis[15].

The RPC-AMB complies with confidentiality standards, following IARC parameters and research ethics commitments. Only RPC-AMB staff have access to case-level information, allowing thorough control of duplicate records[15,17,18].

Information on deaths was obtained from DANE, the official agency that collects, organizes, and codes the underlying cause of death using the 10th revision of the International Classification of Diseases (ICD-10)[19]. The CanReg5 software, designed by IARC for PBCRs, was used to systematize information on incident cases, enabling assessment of internal data consistency, identification and removal of duplicates, and the identification of multiple primary tumors. Additionally, the data were validated using the IARCTools and Registry Plus™ Link Plus version 2.0 software[20,21].

For incidence rate estimation, the denominator used was the AMB population for the study period, as projected by DANE[22]. Crude and directly standardized rates were calculated using the world standard population proposed by Segi and corrected by Doll[23]. Analyses were performed using Stata 14 and in CanReg, version 5.00, software created by IARC in collaboration with IACR and available free of charge to all IACR members[21].

Ethical considerations

The RPC-AMB operates in accordance with the confidentiality guidelines of the IARC and the IACR, which require that information be handled exclusively by authorized registry staff, with no contact with patients or intervention in their clinical care, and that results be disseminated only in an aggregated and anonymized manner. Given that this study involved secondary epidemiological surveillance based on pre-existing institutional data, with no intervention in individuals' biological, physiological, or social variables, the study is classified as research without risk under Resolution 8430 of 1993 issued by the Colombian Ministry of Health. The Population-Based Cancer Registry of the Metropolitan Area of Bucaramanga received technical endorsement from the research office of the Faculty of Health of the Universidad Autónoma de Bucaramanga and institutional ethics approval from UNAB under code CIEI-UNAB-001-2017 and approval record CIEI No. 085 of 2017.

Results

During the 2013-2017 five-year period, 11,815 incident cancer cases were recorded in the AMB, excluding non-melanoma skin cancer, corresponding to an annual age-standardized incidence rate of 175.7 new cases per 100,000 person-years. Of all malignant tumors, 56.7% occurred in women; 83.7% were microscopically verified (cytology, hematology, or pathology); 5.0% were detected solely by death certificate; and 11.3% were detected through clinical procedures (Table 1).

Table 1. Distribution of incident cancer cases by anatomical site, sex, basis of diagnosis, and ICD-10 code in the Metropolitan Area of Bucaramanga, 2013-2017.

Site	Total	Men			Women			ICD-10 codes*
		n	%DCO	%MV	n	%DCO	%MV	
Oral cavity and pharynx	256	149	2.7	87.2	107	0.9	93.5	C00-C14
Esophagus	120	86	4.7	76.7	34	5.9	82.4	C15
Stomach	989	598	4.7	87.6	391	8.2	80.6	C16
Colon, rectum, and anus	1,043	462	3.2	88.5	581	3.8	89.7	C18-C21
Liver	260	134	20.1	41.8	126	21.4	41.3	C22
Pancreas	207	104	16.3	30.8	103	15.5	38.8	C25
Lung	552	307	16.6	64.2	245	11.4	71.8	C33-C34
Melanoma, skin	139	66	3.0	92.4	73	1.4	95.9	C43
Breast	1,671	9	0.0	88.9	1,662	1.1	94.1	C50
Cervix	441	-	-	-	441	2.3	93.0	C53
Uterus, part unspecified	310	-	-	-	310	1.6	95.5	C54-C55
Ovary	258	-	-	-	258	7.0	74.8	C56
Prostate	1,262	1,262	4.0	76.4	-	-	-	C61
Bladder	121	80	7.5	82.5	41	4.9	80.5	C67
Brain and CNS	266	148	4.7	79.7	118	8.5	78.8	C70-C72
Thyroid	987	149	0.7	95.3	838	0.5	95.2	C73
Lymphoma	760	390	3.6	92.6	370	2.7	89.7	C81-C90; C96
Leukemia	453	238	2.9	93.3	215	6.0	88.8	C91-C95
Other	1,720	931	6.3	80.2	789	9.4	72.2	-
All sites excluding C44	11,815	5,113	5.7	80.2	6,702	4.4	86.3	-

***ICD-10** codes: International Statistical Classification of Diseases, 10th revision. % DCO: percentage of cases detected solely by death certificate (Death Certificate Only). %MV: percentage of microscopically verified cases. CNS: central nervous system

Table 2. Cases and crude and age-standardized incidence rates per 100,000 person-years by cancer site and sex in the Metropolitan Area of Bucaramanga, 2013-2017.

Site	Both				Men				Women			
	n	%	CR	ASR	n	%	CR	ASR	n	%	CR	ASR
Oral cavity and pharynx	256	2.2	4.5	3.8	149	2.9	5.5	5.0	107	1.6	3.6	2.8
Esophagus	120	1.0	2.1	1.6	86	1.7	3.2	2.7	34	0.5	1.1	0.8
Stomach	989	8.4	17.4	14.1	598	11.7	22.0	19.9	391	5.8	13.1	9.8
Colon, rectum, and anus	1,043	8.8	18.3	14.9	462	9.0	17.0	15.6	581	8.7	19.5	14.4
Liver	260	2.2	4.6	3.7	134	2.6	4.9	4.6	126	1.9	4.2	3.0
Pancreas	207	1.8	3.6	2.9	104	2.0	3.8	3.4	103	1.5	3.4	2.4
Lung	552	4.7	9.7	7.9	307	6.0	11.3	10.2	245	3.7	8.2	6.2
Melanoma, skin	139	1.2	2.4	2.1	66	1.3	2.4	2.2	73	1.1	2.5	2.0
Breast	1,671	14.1	29.3	25.2	9	0.2	0.3	0.3	1,662	24.8	55.9	44.9
Cervix	441	3.7	7.7	6.5	-	-	-	-	441	6.6	14.8	11.8
Uterus, part unspecified	310	2.6	5.4	4.7	-	-	-	-	310	4.6	10.4	8.4
Ovary	258	2.2	4.5	3.9	-	-	-	-	258	3.8	8.7	7.0
Prostate	1,262	10.7	22.1	18.2	1,262	24.7	46.2	42.7	-	-	-	-
Bladder	121	1.0	2.1	1.7	80	1.6	2.9	2.6	41	0.6	1.4	1.0
Brain and CNS	266	2.3	4.7	4.3	148	2.9	5.4	5.2	118	1.8	4.0	3.6
Thyroid	987	8.4	17.3	15.2	149	2.9	5.5	5.1	838	12.5	28.2	23.7
Lymphoma	760	6.4	13.3	11.6	390	7.6	14.3	13.5	370	5.5	12.4	9.9
Leukemia	453	3.8	8.0	7.8	238	4.7	8.7	8.9	215	3.2	7.2	6.7
Other neoplasms	1,720	14.6	30.1	25.8	931	18.2	34.1	31.5	789	11.8	26.5	21.1
All sites excluding C44	11,815	100.0	207.2	175.7	5,113	100.0	187.5	173.6	6,702	100.0	225.2	179.6

CR: crude rate per 100,000 person-years. ASR: age-standardized rate per 100,000 person-years.

The mean age at diagnosis was 59.12 years in women and 63.7 years in men. Excluding non-melanoma skin cancer, the most frequent malignant tumors in women originated in the breast (24.8%), thyroid (12.5%), colon, rectum, and anus (8.7%), cervix (6.6%), and stomach (5.8%). In men, the most frequent cancer types were prostate (24.7%), stomach (11.7%), colon, rectum, and anus (9.0%), lymphoid tissue, including lymphomas (7.6%), and trachea, bronchus, and lung (6.0%) (Table 2).

Sex-specific annual age-standardized incidence rates (ASRs), including all malignant tumors and excluding non-melanoma skin cancer, were 179.6 new cases per 100,000 woman-years and 173.6 new cases per 100,000 man-years. The ASRs per 100,000 person-years for the five most frequent sites by number of cases in women were 44.9 (breast), 23.7 (thyroid), 14.4 (colon, rectum, and anus), 11.8 (cervix), and 9.8 (stomach). In men, the ASRs for the most frequent cancers by number of cases were 42.7 (prostate), 19.9 (stomach), 15.6 (colon, rectum, and anus), 13.5 (lymphomas), and 10.2 (trachea, bronchus, and lung) (Table 2).

Table 3. Mortality, crude and age-standardized rates per 100,000 person-years by cancer site and sex in the Metropolitan Area of Bucaramanga, 2013-2017.

Site	Both				Men				Women			
	n	%	CR	ASR	n	%	CR	ASR	n	%	CR	ASR
Oral cavity and pharynx	168	2	2.99	2.44	107	3	3.95	3.65	61	2	2.10	1.55
Esophagus	107	2	1.91	1.48	79	2	2.91	2.64	28	1	0.96	0.67
Stomach	843	12	15.01	12.10	515	15	18.99	17.49	328	9	11.30	8.22
Colon, rectum, and anus	618	9	11.01	8.82	301	9	11.10	10.41	317	9	10.92	7.67
Liver	217	3	3.87	3.14	103	3	4.20	4.03	114	3	3.55	2.49
Pancreas	183	3	3.26	2.61	96	3	3.54	3.31	87	2	3.00	2.07
Lung	496	7	8.83	7.11	284	8	10.47	9.76	212	6	7.30	5.28
Melanoma, skin	64	1	1.14	0.90	30	1	1.11	0.99	34	1	1.17	0.84
Breast	611	9	10.88	9.07	6	0	0.22	0.21	605	17	20.85	16.19
Cervix	207	3	3.69	3.03	-	-	-	-	207	6	7.13	5.45
Uterus, part unspecified	102	1	1.82	1.52	-	-	-	-	102	3	3.51	2.68
Ovary	166	2	2.96	2.47	-	-	-	-	166	5	5.72	4.43
Prostate	544	8	9.69	7.47	544	16	20.06	18.26	-	-	-	-
Bladder	91	1	1.62	1.25	64	2	2.36	2.16	27	1	0.93	0.62
Lymphoma	217	3	3.87	3.19	113	3	4.17	3.90	104	3	3.58	2.63
Leukemia	376	5	6.70	5.94	190	6	7.01	6.73	186	5	6.41	5.23
Other neoplasms	1,953	28	32.88	26.68	978	29	34.03	31.40	975	27	31.80	23.23
All sites excluding C44	6,963	100	124.019	100.7	3,410	100	127.024	117.56	3,553	100.0	121.211	89.91

CR: crude rate per 100,000 person-years. ASR: age-standardized rate per 100,000 person-years.

Table 4. Comparison of age-standardized incidence and mortality rates by cancer type and sex in the Metropolitan Area of Bucaramanga, by five-year period, 2003-2007, 2008-2012, and 2013-2017.

Cancer type	Incidence ASR			Mortality ASR		
	2003-2007	2008-2012	2013-2017	2003-2007	2008-2012	2013-2017
Women						
Breast	41.9	41.2	44.9	11.4	10.8	16.19
Thyroid	9.7	14.5	23.7	NR	NR	NR
Colon and rectum	12.2	13.7	14.4	6.7	6.7	7.6
Cervix	17.3	13	11.8	5.7	5.7	5.4
Stomach	10.3	10.2	9.8	9	9	8.22
Men						
Prostate	50.5	40.9	42.7	12.9	11.3	18.26
Stomach	22.4	17.1	19.9	20.1	15.2	17.4
Colon and rectum	13.3	14.3	15.6	7.4	8.1	10.41
Lung	11.6	10.3	10.2	13.7	13.7	9.76
Lymphoma	9.6	9.1	13.5	5.1	5.1	3.9

ASR: age-standardized rate per 100,000 person-years. NR: not reported in the previous five-year periods.

Regarding cancer mortality in the Metropolitan Area of Bucaramanga (Table 3), a total of 6,963 deaths were recorded, of which 51% occurred among women and 49% among men. In the general population, the age-standardized mortality rate from cancer was 100.7 deaths per 100,000 person-years; 117.56 deaths per 100,000 man-years in men, and 89.91 deaths per 100,000 woman-years in women. For the general population, the most frequent causes of cancer mortality were stomach (12%), breast (9%), colon and rectum (9%), prostate (8%), and lung (7%); in men, prostate (16%), stomach (15%), colon and rectum (9%), and lung (8%); in women, the most frequent causes of cancer mortality were breast (17%), stomach (9%), colon and rectum (9%), and lung (6%).

Sex-specific age-standardized mortality rates showed that, in men, the highest mortality rate corresponded to prostate cancer, with 18.26 deaths per 100,000 man-years, followed by stomach cancer (17.49), colon and rectum (10.41), and lung (9.76). In women, the highest mortality rate corresponded to breast cancer, with 16.19 deaths per 100,000 woman-years, followed by stomach cancer (8.22), colon and rectum (7.67), cervix (5.45), and lung (5.28) (Table 3).

When these results were compared with those of the previous five-year periods, cancer incidence and mortality, in both the number of cases and the magnitude of rates, showed significant increases. Specifically, compared with the 2008-2012 five-year period, the standardized rate for both sexes increased by 15%, and the number of cases increased by 30.8% (Table 4).

Discussion

This article reports cancer incidence and mortality during the 2013-2017 five-year period in the Metropolitan Area of Bucaramanga, extending the data series generated by the RPC-AMB for the 2003-2007[24] and 2008-2012[25] periods. In terms of quality, the present five-year period shows an improvement over previous ones, evidenced by a lower proportion of cases identified solely by death certificate.

The increase in incidence and mortality rates for the 2013-2017 period relative to previously reported periods is similar to that of other Colombian PBCRs that contribute data to the IARC for global cancer statistics (Cali, Manizales, Pasto), which also showed a considerable increase in the number of cases between these two periods, ranging from 23% in Cali to 51% in Manizales[26,27]. Part of this increase could be explained by continuous improvements in the completeness and timeliness of the RPC-AMB, resulting from strengthened case-finding strategies, the incorporation of new information sources, and optimization of validation mechanisms. However, the magnitude of the increase and its consistency with observations from other registries in the country also suggest a real rise in the cancer burden, associated with population aging, the ongoing epidemiological transition, and the increasing prevalence of modifiable risk factors.

Regarding age-standardized incidence rates for all cancer sites in men and women, these increased compared with the previous five-year period and were similar to those observed in the populations of Manizales and Pasto. However, the standardized incidence rates for the AMB, Manizales, and Pasto in both sexes remained below those of Cali in both periods. Although the number of new cases during 2013-2017 was higher among women in the four cities, the proportion of female cases was greater in the AMB, Pasto, and Manizales, where the male-to-female ratio in the ASRs was below 1, unlike in Cali.

The profile of the leading cancer sites in the 2013-2017 period shows relevant changes compared with the 2008-2012 period that are not attributable to changes in coding criteria, as ICD-O version 3.2 was used in both periods. Regarding the five cancer sites with the highest incidence in women, the order from the previous period was maintained: breast cancer remains the most frequent cancer among AMB women, with a clear increase in the age-standardized incidence rate compared with the previous five-year periods reported by the RPC-AMB (44.9 vs. 41.2 vs. 41.9)[24,25], although it was lower than the global rate reported by GLOBOCAN for 2017 (67.1 per 100,000 woman-years)[4]; thyroid cancer ranks second (23.7 vs. 14.5 vs. 9.7), followed by colorectal cancer (14.4 vs. 13.7 vs. 12.2), while cervical cancer remains in fourth place (11.8 vs. 13.0 vs. 17.3), followed by stomach cancer (9.8 vs. 10.2 vs. 10.3)[24,25].

Breast cancer is the neoplasm with the highest incidence in women across all PBCRs in the country. The AMB figures are close to those of Manizales, higher than those of Pasto, and lower than those of Cali and the national estimate (48.3 per 100,000 woman-years). Cali and Manizales show a cancer-site distribution pattern similar to that of the AMB, with comparable rates. In contrast, Pasto shows a different profile, where cervical cancer ranks third, followed by stomach and colon, rectum, and anus cancer, while breast and thyroid cancer retain first and second place, respectively[26-28].

In men in the AMB, the pattern observed in the previous period was maintained for the five most frequent tumors, including the order of the three leading cancer sites: prostate cancer remained in first place (42.7 vs. 40.9 vs. 50.5), followed by stomach cancer (19.9 vs. 17.1 vs. 22.4), and, in third place, colon, rectum, and anus cancer (15.6 vs. 14.3 vs. 13.3), with a clear upward trend in rates relative to 2008-2012 in all cases. Additionally, for this period, lymphomas were the fourth most frequent cancer (13.5 vs. 9.1 vs. 9.6), while trachea, bronchus, and lung cancer ranked fifth (10.2 vs. 10.3 vs. 11.6). The increase in the lymphoma rate displaced trachea, bronchus, and lung cancer by one position, as the latter generally maintained its rate relative to the 2008-2012 period[25]. These cancer types are also those with the highest incidence reported by PBCRs across the country. However, Cali and Manizales report higher standardized rates than the AMB, except for lymphomas, where the AMB showed a clear increase relative to the previous period[26,27].

AMB mortality data for the 2013-2017 period are a cause for concern. The all-cancer age-standardized mortality rate (ASMR) reached 100.7 deaths per 100,000 person-years, representing an increase of approximately 20% compared with the 2008-2012 period, when 84.6 deaths per 100,000 person-years were recorded [25]. When disaggregated by sex, men experienced an increase of nearly 24%, with an ASMR of 117.5 per 100,000 man-years, while in women the increase was 15%, with an ASMR close to 90 per 100,000 woman-years. These figures exceed those reported by other PBCRs in the country: Pasto reported ASMRs of 97.8 in men and 95.1 in women[28], and Manizales reported values of 92.9 and 76.0, respectively[26], placing the AMB as the region with the highest cancer mortality burden among the Colombian registries compared.

When analyzing mortality by specific site, gastric cancer remains the most lethal cancer in the AMB population, with an ASMR of 12.1 deaths per 100,000 person-years, a figure lower than those of the two previous periods (12.8 and 14.0, respectively), and consistent with national statistics from Infocancer Colombia, where gastric cancer also accounts for the highest proportion of cancer deaths (12%); however, compared with the Pasto population-based registry, the ASMR in the

AMB is considerably lower[28]. From an epidemiological standpoint, gastric cancer shows important geographic variation, with higher incidence and mortality rates in Asia and South America, as well as an increase in early-onset cases in people under 50 years of age[29]. Modifiable and non-modifiable risk factors for gastric cancer, and their interaction, have significant implications for disease risk and progression, suggesting the need to improve screening strategies and methods, timely access to care, and individualized patient management[30].

Breast cancer ranks second as a cause of cancer death in the general population (9% of deaths). The ASMR increased by approximately 50% between five-year periods, rising from 10.8 deaths per 100,000 woman-years during 2008-2012 to 16.19 in the period analyzed, a deterioration that likely reflects the difficulties the health system faced in ensuring timely access to screening, diagnosis, and initiation of treatment during that period[31].

Breast cancer is a public health priority, as it will be one of the main contributors to the global increase in the cancer burden by 2070, with a projected increase from 2.1 million to 4.4 million annual cases. This increase is mainly attributed to demographic changes, such as population aging, as well as growing exposure to risk factors associated with socioeconomic transition. In countries with high and very high HDI, such as Colombia, the absolute increase in cases will be substantial, although smaller in relative terms than in low-HDI countries[32]. Although breast cancer is not entirely preventable, a significant proportion of cases can be avoided through public health policies aimed at modifying risk factors such as obesity and sedentary lifestyle, especially in postmenopausal women. Early detection is also critical to reducing both mortality and morbidity associated with this cancer.

In this regard, the country must improve the breast cancer diagnostic process, which is hindered by structural inequity in access to the health system, considerable delays in care, underdiagnosis at early stages, and deficiencies in imaging services[33]. It should be noted that the study period is not covered by the changes brought about by Statutory Law 1751 of 2015 (*Ley Estatutaria*)[34] or by the new health care model that began implementation in 2018 with Resolution 3280 of 2018[35], which introduced comprehensive care pathways, including opportunistic screening pathways for breast cancer and other cancers. Nevertheless, breast cancer mortality rates reported by other population-based registries in Colombia, such as Pasto (ASMR of 11.8 deaths per 100,000 woman-years), Manizales (ASMR of 10.3 deaths per 100,000 woman-years)[26], and Cali (ASMR of 13.8 deaths per 100,000 woman-years)[27], are considerably lower, suggesting the need for special attention from municipal and departmental health authorities, as well as academia, to address and further examine these territorial differences.

The third most frequent cause of cancer death, colorectal cancer (9.0%), shows a considerable increase compared with the two previous five-year periods: from 7.4 deaths per 100,000 person-years in 2003-2007 and 2008-2012 to an ASMR of nearly 9 deaths per 100,000 person-years in the study period. Mortality increased in both men and women, with ASMRs of 10.41 deaths per 100,000 man-years and 7.67 deaths per 100,000 woman-years; these rates were higher than those reported by the cancer registries of Pasto[28] and Manizales[26], but very similar to the colorectal cancer mortality rate in the city of Cali[27]. Although incidence and mortality rates are high in low-HDI countries compared with medium- or high-HDI countries such as Colombia, a sustained increase in this cancer among people under 50 years of age stands out, suggesting that screening in people over 40 years of age could become a central component of early colorectal cancer screening programs[36].

As for prostate cancer, it is the malignant tumor with the highest incidence and mortality among Colombian men. IARC modeling projections estimate that annual cases worldwide will increase from 1.3 million in 2018 to 2.9 million by 2070, a doubling mainly explained by population aging in low- and middle-income countries, where the greatest relative growth is anticipated[32]. In the AMB, the crude mortality rate for prostate cancer, calculated for the general population, nearly doubled compared with the 2003-2007 five-year period, increasing from 5.1 deaths per 100,000 person-years to 9.7 in the 2013-2017 period. When analyzing

men specifically, the ASMR during the study period was 18.26 deaths per 100,000 man-years, considerably higher than in the previous five-year periods: 11.3 (2008-2012) and 12.9 (2003-2007). These figures were similar to those reported for the Cali population[27] and higher than those of Manizales and Pasto[26,28]. The emphasis on reducing prostate cancer mortality focuses on early diagnosis and timely treatment of advanced cancers, since there is no evidence that they can be prevented through lifestyle changes or public health interventions[37].

Cervical cancer (CC) is the leading cause of cancer death among Colombian women aged 30 to 59 years, and its geographic and social distribution reflects the deep inequities that persist in the country's health system[38]. Specifically, a recent study using data from the RPC-AMB showed wide disparities in survival by educational level and health insurance affiliation scheme among women diagnosed between 2008 and 2016[39]. Although CC is one of the few cancers showing a global downward trend toward 2070, with an estimated reduction in cases in high-HDI countries such as Colombia from 176,000 to 116,000 annually, its control depends on the effective implementation of HPV vaccination and screening. According to the reviewed modeling studies, even in low-coverage settings such as Uganda, by 2070 vaccination alone could reduce cumulative cases by 40%, and, when combined with one or two screening rounds over the lifetime, the reduction could reach 60%[32]. These findings have direct implications for the country, where HPV vaccination must be strengthened to increase public trust and ensure effective coverage. It is likewise necessary to overcome organizational problems and low coverage rates in screening and diagnostic services[40], as well as fragmentation of care[41], which persist despite an organized national screening program.

Effective implementation of vaccination and screening depends on overcoming access barriers, particularly among vulnerable populations and in rural areas of the country. Implementation research is central to this process: for example, HPV DNA self-sampling strategies (using a kit to collect a cervicovaginal or urine sample, which is then sent to a laboratory for analysis) have been documented and have shown generally high acceptability both in high-income countries and in Latin America and the Caribbean[42-47], making them an important option for improving screening coverage.

A possible limitation of the study is the potential inclusion of patients treated at oncology institutions in the Metropolitan Area of Bucaramanga but residing in other regions of northeastern Colombia, given the AMB's role as a referral center for cancer diagnosis and treatment. However, the RPC-AMB applies standardized residence criteria, considering as cases only people who habitually resided in one of the municipalities within the coverage area for at least six months before diagnosis, with verification through multiple information sources. Although these procedures follow international recommendations for population-based cancer registries, the possibility of residence misclassification in a small number of cases cannot be entirely ruled out.

Conclusions

Population-based cancer registries are recognized worldwide as the most relevant tool for cancer surveillance. The RPC-AMB, with more than 25 years of uninterrupted activity, has generated high-quality epidemiological data that have been fundamental for monitoring the cancer burden in northeastern Colombia.

The study period shows a considerable increase in both cancer incidence and mortality in the Metropolitan Area of Bucaramanga. These figures will be compared with those of the following five-year period, 2018-2022, in which two aspects should be considered: first, the impact of the new health care model through the Comprehensive Health Care Policy and its Comprehensive Health Care Model; and second, the impact of the COVID-19 pandemic.

References

1. Schlander M, van Harten W, Retèl VP, Pham PD, Vancoppenolle JM, Ubels J, et al. The socioeconomic impact of cancer on patients and their relatives: Organisation of European Cancer Institutes task force consensus recommendations on conceptual framework, taxonomy, and research directions. Lancet Oncol. 2024;25(4):e152–e163. doi: 10.1016/S1470-2045(23)00636-8. [PubMed] [CrossRef] [Google Scholar]

2. Chen S, Cao Z, Prettner K, Kuhn M, Yang J, Jiao L, et al. Estimates and projections of the global economic cost of 29 cancers in 204 countries and territories from 2020 to 2050. JAMA Oncol. 2023;9(4):465–472. doi: 10.1001/jamaoncol.2022.7826. [PubMed] [CrossRef] [Google Scholar]

3. Bray F, Laversanne M, Weiderpass E, Soerjomataram I. The ever-increasing importance of cancer as a leading cause of premature death worldwide. Cancer. 2021;127(16):3029–3030. doi: 10.1002/cncr.33587. [PubMed] [CrossRef] [Google Scholar]

4. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–263. doi: 10.3322/caac.21834. [PubMed] [CrossRef] [Google Scholar]

5. Wild CP, Weiderpass E, Stewart BW, editors. World Cancer Report: Cancer Research for Cancer Prevention. Lyon: International Agency for Research on Cancer; 2020. https://publications.iarc.fr/586 [Google Scholar]

6. Star J, Bandi P, Nargis N, Islami F, Yabroff KR, Minihan AK, et al. Updated review of major cancer risk factors and screening test use in the United States, with a focus on changes during the COVID-19 pandemic. Cancer Epidemiol Biomarkers Prev. 2023;32(7):879–888. doi: 10.1158/1055-9965.EPI-23-0114. [PubMed] [CrossRef] [Google Scholar]

7. Martinez R, Lloyd-Sherlock P, Soliz P, Ebrahim S, Vega E, Ordunez P, et al. Trends in premature avertable mortality from non-communicable diseases for 195 countries and territories, 1990-2017: a population-based study. Lancet Glob Health. 2020;8(4):e511–e523. doi: 10.1016/S2214-109X(20)30035-8. [PubMed] [CrossRef] [Google Scholar]

8. Fadelu T, Rebbeck TR. The rising burden of cancer in low- and middle-human development index countries. Cancer. 2021;127(16):2864–2866. doi: 10.1002/cncr.33586. [PubMed] [CrossRef] [Google Scholar]

9. Zhao J, Xu L, Sun J, Song M, Wang L, Yuan S, et al. Global trends in incidence, death, burden and risk factors of early-onset cancer from 1990 to 2019. BMJ Oncol. 2023;2(1):e000049. doi: 10.1136/bmjonc-2023-000049. [CrossRef] [Google Scholar]

10. Piñeros M, Saraiya M, Baussano I, Bonjour M, Chao A, Bray F. The role and utility of population-based cancer registries in cervical cancer surveillance and control. Prev Med. 2021;144:106237. doi: 10.1016/j.ypmed.2020.106237. [PubMed] [CrossRef] [Google Scholar]

11. Piñeros M, Znaor A, Mery L, Bray F. A global cancer surveillance framework within noncommunicable disease surveillance: making the case for population-based cancer registries. Epidemiol Rev. 2017;39(1):161–169. doi: 10.1093/epirev/mxx003. [PubMed] [CrossRef] [Google Scholar]

12. Instituto Nacional de Cancerología . Sistema de Información de Cáncer en Colombia - SICC. Bogotá: Instituto Nacional de Cancerología; https://www.infocancer.co [Google Scholar]

13. Congreso de Colombia . Diario Oficial. Bogotá, D.C.: 2010. Ley 1384 de 2010, por la cual se establecen las acciones para la atención integral del cáncer en Colombia (Ley Sandra Ceballos)https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=39368 [Google Scholar]

14. Congreso de la República . Congreso de Colombia. Bogotá, D.C.: 2023. Ley 2291 de 2023: por medio de la cual se transforma la naturaleza jurídica del Instituto Nacional de Cancerología Empresa Social del Estado, se define su objeto, funciones, estructura y régimen legal.https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=204543 [Google Scholar]

15. Hormiga-Sánchez CM, Uribe-Pérez CJ, Meza-Durán EE. Registro poblacional de cáncer del Área Metropolitana de Bucaramanga: veinticinco años de trayectoria. MedUNAB. 2025;27(3):351–360. doi: 10.29375/01237047.4708. [CrossRef] [Google Scholar]

16. Bray F, Colombet M, Mery L, Piñeros M, Znaor A, Zanetti R, et al. Cancer incidence in five continents. Vol. XI. Lyon: International Agency for Research on Cancer; 2021. https://publications.iarc.who.int/597 [Google Scholar]

17. Parkin DM, Bray F. Evaluation of data quality in the cancer registry: principles and methods part II. Completeness. Eur J Cancer. 2009;45(5):756–764. doi: 10.1016/j.ejca.2008.11.033. [PubMed] [CrossRef] [Google Scholar]

18. Jensen OM, Parkin DM, MacLennan R, Muir CS, Skeet RG. Registros de cáncer: principios y métodos. Lyon: International Agency for Research on Cancer; 1995. https://publications.iarc.who.int/Book-And-Report-Series/Iarc-Scientific-Publications/Registros-De-C%C3%A1ncer-Principios-Y-M%C3%A9todos-1995 [Google Scholar]

19. World Health Organization . International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), 2016 version. Geneva: WHO; 2016. https://icd.who.int/browse10/2016/en [Google Scholar]

20. Centers for Disease Control and Prevention . Registry Plus Link Plus, version 2.0. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2007. https://www.cdc.gov/national-program-cancer-registries/registry-plus/link-plus.html [Google Scholar]

21. International Association of Cancer Registries . CanReg5, version 5.00.44k. Lyon: IACR; 2023. https://www.iacr.com.fr/CanReg5/ [Google Scholar]

22. DANE Proyecciones de población. https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/proyecciones-de-poblacion

23. Boniol M, Heanue M. In: Cancer incidence in five continents. Vol. IX. Curado MP, Edwards B, Shin HR, Storm H, Ferlay J, Heanue M, Boyle P, editors. Lyon: International Agency for Research on Cancer; 2007. Age-standardisation and denominators; pp. 99–101. [Google Scholar]

24. Uribe C, Osma S, Herrera V. Cancer incidence and mortality in the Bucaramanga metropolitan area, 2003-2007. Colomb Med (Cali) 2012;43(4):290–297. doi: 10.25100/cm.v43i4.1196. [PubMed] [CrossRef] [Google Scholar]

25. Uribe PCJ, Serrano-Gómez S, Hormiga SCM. Incidencia y mortalidad por cáncer en Bucaramanga, Colombia. 2008-2012. Colomb Med (Cali) 2018;49(1):73–80. doi: 10.25100/cm.v49i1.3632. [PubMed] [CrossRef] [Google Scholar]

26. Arias-Ortiz N, Rodríguez-Betancourt JD. Trends in cancer incidence and mortality in Manizales, Colombia, 2008-2017. Colomb Med (Cali) 2022;53(1):e2044920. doi: 10.25100/cm.v53i1.4920. [PubMed] [CrossRef] [Google Scholar]

27. Bravo LE, Garcia LS, Collazos P, Carrascal E, Grillo-Ardila EK, Millan E, et al. Epidemiología del cáncer en Cali, 60 años de experiencia. Colomb Med (Cali) 2022;53(1):e2005050. doi: 10.25100/cm.v53i1.5050. [PubMed] [CrossRef] [Google Scholar]

28. Yépez CMC, Bravo GLM, Jurado FD, Mena HJ, Casas HM. Incidence and mortality by cancer in the Pasto municipality, Colombia. 2013-2017. Colomb Med (Cali) 2022;53(1):e2054952. doi: 10.25100/cm.v53i1.4952. [PubMed] [CrossRef] [Google Scholar]

29. Sundar R, Nakayama I, Markar SR, Shitara K, Van Laarhoven HWM, Janjigian YY, et al. Gastric cancer. Lancet. 2025;405(10494):2087–2102. doi: 10.1016/S0140-6736(25)00052-2. [PubMed] [CrossRef] [Google Scholar]

30. Mamun TI, Younus S, Rahman MH. Gastric cancer-Epidemiology, modifiable and non-modifiable risk factors, challenges and opportunities: an updated review. Cancer Treat Res Commun. 2024;41:100845. doi: 10.1016/j.ctarc.2024.100845. [PubMed] [CrossRef] [Google Scholar]

31. Wiesner-Ceballos C, Puerto D, Diaz-Casas S, Sánchez O, Hernando-Murillo R, Bravo LE. Políticas basadas en la evidencia científica: el caso del control del cáncer de mama en Colombia. Rev colomb cancerol. 2020;24(3):98–107. doi: 10.35509/01239015.261. [CrossRef] [Google Scholar]

32. Soerjomataram I, Bray F. Planning for tomorrow: global cancer incidence and the role of prevention 2020-2070. Nat Rev Clin Oncol. 2021;18(10):663–672. doi: 10.1038/s41571-021-00514-z. [PubMed] [CrossRef] [Google Scholar]

33. Duarte C, Salazar A, Strasser-Weippl K, de Vries E, Wiesner C, Arango-Gutiérrez A, et al. Breast cancer in Colombia: a growing challenge for the healthcare system. Breast Cancer Res Treat. 2021;186(1):15–24. doi: 10.1007/s10549-020-06091-6. [PubMed] [CrossRef] [Google Scholar]

34. Congreso de la República . Diario Oficial. Bogotá, D.C.: 2015. Ley Estatutaria 1751 de 2015: por medio de la cual se regula el derecho fundamental a la salud y se dictan otras disposiciones.https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=60733 [Google Scholar]

35. Ministerio de Salud y Protección Social . Ministerio de Salud y Protección Social. Bogotá, D.C.: 2018. Resolución 3280 de 2018: por medio de la cual se adoptan los lineamientos técnicos y operativos de la Ruta Integral de Atención para la Promoción y Mantenimiento de la Salud y la Ruta Integral de Atención en Salud para la Población Materno Perinatal y se establecen las directrices para su operación.https://www.minsalud.gov.co/Normatividad_Nuevo/Resoluci%C3%B3n%20No.%203280%20de%2020183280.pdf [Google Scholar]

36. Song M. Global epidemiology and prevention of colorectal cancer. Lancet Gastroenterol Hepatol. 2022;7(7):588–590. doi: 10.1016/S2468-1253(22)00089-9. [PubMed] [CrossRef] [Google Scholar]

37. James ND, Tannock I, N'Dow J, Feng F, Gillessen S, Ali SA, et al. The Lancet Commission on prostate cancer: planning for the surge in cases. Lancet. 2024;403(10437):1683–1722. doi: 10.1016/S0140-6736(24)00651-2. [PubMed] [CrossRef] [Google Scholar]

38. Bermedo-Carrasco S, Waldner CL. The role of socio-demographic factors in premature cervical cancer mortality in Colombia. BMC Public Health. 2016;16:981. doi: 10.1186/s12889-016-3645-1. [PubMed] [CrossRef] [Google Scholar]

39. Chayo I, Uribe PCJ, de Vries E, Pinheiro PS. The impact of health insurance affiliation and socioeconomic status on cervical cancer survival in Bucaramanga, Colombia. Cancer Epidemiol. 2023;85:102375. doi: 10.1016/j.canep.2023.102375. [PubMed] [CrossRef] [Google Scholar]

40. García-López T, León-Hernández J, García-Perdomo H, Pacheco R. Evaluación de un programa de detección temprana de cáncer cervicouterino en Colombia. Rev Colomb Cancerol. 2017;21(3):143–151. doi: 10.1016/j.rccan.2017.09.001. [CrossRef] [Google Scholar]

41. Arrivillaga M, Ruiz MD, Medina M. Atención en salud de mujeres con lesiones precursoras de cáncer de cuello uterino: evidencia cualitativa de la fragmentación del sistema de salud en Colombia. Rev Gerenc Polit Salud. 2019;18(37):1–20. doi: 10.11144/Javeriana.rgps18-37.asml. [CrossRef] [Google Scholar]

42. Arrossi S, Paolino M, Thouyaret L, Laudi R, Campanera A. Evaluation of scaling-up of HPV self-collection offered by community health workers at home visits to increase screening among socially vulnerable under-screened women in Jujuy Province, Argentina. Implement Sci. 2017;12(1):17. doi: 10.1186/s13012-017-0548-1. [PubMed] [CrossRef] [Google Scholar]

43. Arrossi S, Thouyaret L, Herrero R, Campanera A, Magdaleno A, Cuberli M, et al. Effect of self-collection of HPV DNA offered by community health workers at home visits on uptake of screening for cervical cancer (the EMA study): a population-based cluster-randomised trial. Lancet Glob Health. 2015;3(2):e85–e94. doi: 10.1016/S2214-109X(14)70354-7. [PubMed] [CrossRef] [Google Scholar]

44. Torrado-García LM, Martínez-Vega RA, Rincon-Orozco B. A novel strategy for cervical cancer prevention using cervical-vaginal self-collected samples shows high acceptability in women living in low-income conditions from Bucaramanga, Colombia. Int J Womens Health. 2020;12:1197–1204. doi: 10.2147/IJWH.S265130. [PubMed] [CrossRef] [Google Scholar]

45. Dartibale CB, Prado GDC, Carobeli LR, Meirelles LEDF, Damke GMZF, Damke E, et al. Recent HPV self-sampling use for cervical cancer screening in Latin America and Caribbean: a systematic review. Front Oncol. 2022;12:948471. doi: 10.3389/fonc.2022.948471. [PubMed] [CrossRef] [Google Scholar]

46. Narvaez L, Viviano M, Dickson C, Jeannot E. The acceptability of HPV vaginal self-sampling for cervical cancer screening in Latin America: a systematic review. Public Health Pract (Oxf) 2023;6:100417. doi: 10.1016/j.puhip.2023.100417. [PubMed] [CrossRef] [Google Scholar]

47. Nishimura H, Yeh PT, Oguntade H, Kennedy CE, Narasimhan M. HPV self-sampling for cervical cancer screening: a systematic review of values and preferences. BMJ Glob Health. 2021;6(5):e003743. doi: 10.1136/bmjgh-2020-003743. [CrossRef] [Google Scholar]