Cervical Cancer Screening in the Brazilian National Health System according to Skin Color: Regional Inequalities in Brazil (2021-2023)

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Rastreamento para Câncer do Colo do Útero no Sistema Único de Saúde segundo Raça/Cor da Pele: Desigualdades Regionais no Brasil (2021-2023)

Detección del Cáncer de Cuello Uterino en el Sistema Único de Salud según Raza/Color de Piel: Desigualdades Regionales en el Brasil (2021-2023)

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ABSTRACT

Introduction: Cervical cancer is a public health problem that can be prevented through HPV vaccination and screening. **Objective:** To verify the number of cervical cancer screening tests performed and estimate the screening coverage in the National Health System (SUS) according to skin color in Brazil, regions, and state capitals of residence. **Method:** Descriptive study with data from the Cancer Information System on women aged 25 to 64 years assisted by SUS between 2021 and 2023. Screening coverage was calculated based on the number of women examined in the target age group (25-64 years) registered in this system divided by the population of women who are exclusive users of SUS in the same age group and multiplied by 100 in Brazil, regions, and capitals of residence. **Results:** There was an increase in the number of exams recorded and an 84.7% reduction in exams without skin color information over the period. Screening coverage among women aged 25 to 64 was 39.03% in Brazil. White women had higher coverage (43.71%) compared to non-white women (36.20%) and indigenous women (37.58%). The highest coverage was observed in the Southeast and South regions for white women, in the North, Northeast, and Southeast regions for non-white women, and in the North, Midwest, and South regions for indigenous women. The capitals reflected the regional pattern. **Conclusion:** Racial and regional differences to perform screening tests have been observed, being non-white and indigenous women more vulnerable.

Key words: Uterine Cervical Neoplasms; Mass Screening/statistics & numerical data; Unified Health System; Health Information Systems/statistics & numerical data; Racial Groups.

RESUMO

Introdução: O câncer do colo do útero é um problema de saúde pública que pode ser prevenido por meio da vacinação contra o HPV e o rastreamento. **Objetivo:** Verificar o número de exames de rastreamento para câncer do colo do útero realizados e estimar a cobertura de rastreamento no Sistema Único de Saúde (SUS) segundo raça/cor da pele, no Brasil, Regiões e capitais de residência. **Método:** Estudo descritivo com dados do Sistema de Informação de Câncer em mulheres de 25 a 64 anos atendidas no SUS entre 2021 e 2023. A cobertura de rastreamento foi calculada a partir do número de mulheres examinadas na faixa etária-alvo (25-64 anos), registrado nesse sistema, dividido pela população de mulheres usuárias exclusivas do SUS na mesma faixa etária e multiplicado por 100 no Brasil, Regiões e capitais de residência. **Resultados:** Observaram-se aumento no número de exames registrados e redução de 84,7% dos exames sem informação sobre cor da pele ao longo do período. A cobertura de rastreamento entre mulheres de 25 a 64 anos foi de 39,03% no Brasil. Mulheres brancas apresentaram maior cobertura (43,71%) em comparação com as não brancas (36,20%) e indígenas (37,58%). Entre as Regiões, as maiores coberturas foram observadas no Sudeste e Sul para mulheres brancas, no Norte, Nordeste e Sudeste para não brancas e no Norte, Centro-Oeste e Sul para indígenas. As capitais expressaram o padrão regional. **Conclusão:** Há diferenças raciais e regionais na realização do exame de rastreamento, com maior vulnerabilização de mulheres não brancas e indígenas.

Palavras-chave: Neoplasias do Colo do Útero; Programas de Rastreamento/estatística & dados numéricos; Sistema Único de Saúde; Sistemas de Informação em Saúde/estatística & dados numéricos; Grupos Raciais.

RESUMEN

Introducción: El cáncer de cuello uterino es un problema de salud pública que se puede prevenir mediante la vacunación contra el VPH y la detección precoz. **Objetivo:** Verificar el número de pruebas de detección del cáncer de cuello uterino realizadas y estimar la cobertura de detección en el Sistema Único de Salud (SUS) según la raza/color de piel, en el Brasil, regiones y capitales de residencia. **Método:** Estudio descriptivo con datos del Sistema de Información sobre el Cáncer en mujeres de 25 a 64 años atendidas en el SUS entre 2021 y 2023. La cobertura de detección se calculó a partir del número de mujeres examinadas en el grupo de edad objetivo (25-64 años) registrado en este sistema, dividido entre la población de mujeres usuarias exclusivas del SUS en el mismo grupo de edad y multiplicado por 100 en el Brasil, regiones y capitales de residencia. **Resultados:** Se observó un aumento en el número de exámenes registrados y una reducción del 84,7% de los exámenes sin información sobre el color de piel a lo largo del período. La cobertura de detección entre las mujeres de 25 a 64 años fue del 39,03% en el Brasil. Las mujeres blancas presentaron una mayor cobertura (43,71%) en comparación con las no blancas (36,20%) y las indígenas (37,58%). Entre las regiones, las mayores coberturas se observaron en el sudeste y el sur para las mujeres blancas, en el norte, el nordeste y el sudeste para las no blancas y en el norte, el centro-oeste y el sur para las indígenas. Las capitales reflejaron el patrón regional. **Conclusión:** Existen diferencias raciales y regionales en la realización de las pruebas de detección, lo que aumenta la vulnerabilidad de las mujeres no blancas e indígenas.

Palabras clave: Neoplasias del Cuello Uterino; Tamizaje Masivo/estadística & datos numéricos; Sistema Único de Salud; Sistemas de Información en Salud/estadística & datos numéricos; Grupos Raciales.

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INTRODUCTION

Although avoidable, cervical cancer is still one of the main causes of illness and death of Brazilian women. The high morbimortality of this disease arises from inequalities of access to prevention strategies as vaccination against the human papilloma virus (HPV) and screening[1,2].

In some Northern European countries, morbidity and mortality by this cancer were significantly reduced with the implementation of well-structured organized screening programs[3]. In Brazil, the actions of cervical cancer control gained momentum with the creation of the program *Viva-Mulher* in the 90s, which expanded the access to cytopathological exam (Pap smear)[4].

Morbimortality by cervical cancer in Brazil remains elevated and fails to achieve the results observed in other countries, including Chile[5] in Latin America, although the National Health System (SUS) offers the population screening exams. The effectiveness of the screening to reduce the disease's burden in the country is compromised by inequalities of access and utilization of health services that reflect regional inequities and among the most vulnerable population groups. Given all its specificities, it is important to monitor the execution and expansion of the screening program.

Black, Brown and Indigenous women are frequently diagnosed in more advanced stages of cervical cancer than White women[6]. Skin color is a social health determinant related to socioeconomic conditions influencing risk of sickening and access to prevention and treatment[7].

Certain population groups face more barriers to access health services resulting in worst outcomes. The incidence and mortality by cervical cancer is higher in Brazilian Black (Black and Brown) and indigenous women[8], in addition to other markers of disparities as more years of potential of life lost (YPLL) in Black men due to external causes[9], high hospital mortality and poor use of hospital resources in Black, Brown and Indigenous individuals[10], and least access to local anesthetics and pre-natal follow-up in pregnant Black and Brown women[11].

These findings reinforce the necessity of continuous investigation of health racial disparities in Brazil. Understand how these disparities evolve in the context of cervical cancer screening is essential to support policies that expand the coverage and promote equity.

The objective of this study is to investigate the number of cervical cancer screening exams performed and estimate the coverage of screening exams by SUS per skin color in Brazil, regions and capitals of residence.

METHOD

Descriptive study to estimate the coverage of women screened for cervical cancer in SUS based on information registered in the cancer information system (Siscan)[12] according to skin color in Brazil, regions and capitals of residence between 2021 and 2023.

The data utilized on cervical cancer screening were obtained from Siscan[12]. The number of exams according to skin color performed was investigated in the panel "Cervical cytology – per residence" and the number of women examined in the panel "Cervical cytology – per patients" for Brazil, federative units (FU) and municipalities of the capitals, both found at Tabnet on-line[13] of the Computer Department of the National Health System (DATASUS) on March 24, 2025.

The population estimated by skin color was obtained from the Brazilian Census of 2022 of the "*Instituto Brasileiro de Geografia e Estatística (IBGE)*"[14], and the estimate of private health insurance per skin color, from the National Health Survey (PNS) of 2019[15].

The following variables were selected from Siscan: a) age between 25-64 years; b) skin color; c) FU of residence; d) municipality of residence; e) exams performed between 2021 and 2023; f) motive of the exam: screening.

Initially, the number and percent of annual screening cytopathological exams registered at Siscan were described according to skin color in Brazil and great regions. The absolute difference between the number of exams registered and the population estimated by the Census 2022 for women in the target-age (25-64 years) in Brazil, regions and capitals of residence was evaluated too.

The mean screening coverage according to skin color in SUS was calculated as the rate among the number of women aged 25-64 years screened in the period 2021-2023, corresponding to the recommended triennial periodicity of the exam and the population of private uninsured women in the same age range in 2022 (mid-period population). The result was multiplied by 100. Calculation was made for Brazil, regions and capitals of residence.

The calculation of the private uninsured population was based on the number of women aged 25-64 years of the Census 2022, except those who claimed they had private health insurance according to PNS 2019.

Usually, for the calculation of the screening coverage, the reduction of the uninsured population who are assisted exclusively by SUS is performed based on information of the national health supplementary agency (ANS)[16,17]. However, there are no information of the private insured population according to skin color in this system.

Therefore, it was decided to utilize the data from PNS 2019, a household-based investigation with sample representativeness of the Brazilian population, that allows to estimate the proportion of the private insured individuals per skin color[15]. Further details about the

history and sample process can be found in former publications[18].

The categories skin color were grouped in White, non-White (Yellow, Brown and Black) and Indigenous to reduce the bias of inconsistencies of the records of this variable in the national health card (CNS), wherein Siscan data are obtained, because the category Yellow registered discrepancies with the population profile estimated by the Census 2022 (Table 2). The inclusion of this variable separately in the calculation of the coverage could potentially compromise the validity of the results.

A proportion test was applied to evaluate differences of coverage among racial groups with level of significance of 5%.

The prevalence ratios (PR) and respective confidence intervals of 95% were calculated to compare screening tests of racial groups in the regions, the reference was the White population due to higher screening coverage. The Midwest was taken as reference to compare PR of racial groups in the regions due to lower screening coverage. Software R version 4.2.3[19] was utilized to process and analyze the data.

The review by the Ethics Committee was waived because only secondary deidentified data were utilized in compliance with Directive 510/16[20] of the National Health Council.

RESULTS

Cervical cytopathological screening tests (Pap smears) registered between 2021 and 2023 increased. The lack of the variable skin color declined significantly, dropping from 5.63% in 2021 to 0.86% in 2024, revealing improvement of completion of 84.7% for this variable during the period (Table 1).

Between 2021 and 2023, 5.5 million exams in women self-claimed Yellow have been registered, 22-fold higher than the estimated population of this category by the Census 22 (247 thousand women) and 2-fold higher than Brown women (Table 2).

For women aged 25-64 years exclusively assisted by SUS, the mean screening coverage in Brazil was 39.03%. The South (50.4%) and the Southeast (45.96%) regions had high coverage while the North (34.04%) and Midwest (27.61%) had the lowest coverage (Table 3).

The analysis of the coverage per skin color revealed that White women (43.71%) presented the highest proportion of screened women followed by Indigenous (37.58%) and Non-White (36.20%) (Table 3). Regionally, the coverage of White women was higher in the South (59.53%) and Southeast (47.84%) while in the Northeast (46.87%) and Southeast (44.43%) non-White women registered the higher numbers. The highest coverage for indigenous women was registered in the South (54.13%), Midwest (49.87%) and North (42.83%) (Table 3).

There are expressive differences of prevalence of screening exams among racial groups. In Brazil, White women presented high frequency of exams performed compared to non-White (PR=1.21). However, the prevalence of exams performed was higher for non-White women in the North, Northeast and Midwest regions (PR = 0.41; 0.52; 0.76, respectively). Among Indigenous women, variation was larger yet, 0.37 in the North to 4.62 in the Southeast (Table 4).

The general pattern in the capitals was similar to that observed in the regions, with high coverage for White women in the South and Southeast regions and for non-White women in the North and Northeast regions. The exception were Indigenous women who had high coverage only in the Northern capitals. The profile observed for PR is consistent with those of regional analyzes (Table 4).

The PR per region (reference = Midwest) and skin color shows that the prevalence among White women was higher in the South (PR = 2.58) and Southeast (PR = 2.07) regions, while low PR was found in the North and Northeast regions. For non-White women, the highest prevalence was identified in the Northeast (PR = 1.55), Southeast (PR = 1.47) and North (PR = 1.29), while in the South it was slightly lower than in the Midwest (PR = 0.92). The prevalence of screening was low for Indigenous women in the North, Northeast and Southeast regions, standing out the South region, close to the reference (PR = 1.09). Considering the general population, prevalence is higher in the South (PR = 1.81) and Southeast (PR = 1.66) and lower in the North (PR = 1.23) and Northeast (PR = 1.46) (Table 5).

DISCUSSION

The mean coverage of the cervical cytopathological exam in SUS based on individual records of Siscan[12] for 25-64 years old women was 39.03%. White women (43.71%) had the highest coverage, 1.21-fold higher than Yellow, Black and Brown (non-White, 36.20%) and 1.16-fold higher than Indigenous women (37.58%).

Despite the increase of the number of exams performed in SUS between 2021 and 2023 in the country, this growth can be partially attributed to the impact of the COVID-19 pandemic which caused a decline of the offer of cancer screening exams resulting in a substantial reduction of the volume of exams registered between 2020 and 2021. Pre-pandemic levels resumed since 2022[21,22]. In addition, the expansion of the implementation of Siscan in Brazil may have contributed for this rise, although

Table 1. Number and percent of cervical cytopathological exams (%) per year and skin color, Brazil and regions of residence, 2021-2023

Regions	Skin color	2021	%	2022	%	2023	%
Brazil	White	2,005,040	41.10	2,259,127	40.76	2,751,121	40.19
	Black	295,420	6.06	339,695	6.13	450,740	6.59
	Yellow	1,482,609	30.39	1,778,333	32.08	2,463,611	35.99
	Brown	795,690	16.31	896,572	16.18	1,083,556	15.83
	Indigenous	24,485	0.50	27,370	0.49	36,952	0.54
	Not informed	274,626	5.63	241,706	4.36	58,694	0.86
	Total	4,877,870	100.00	5,542,803	100.00	6,844,674	100.00
North	White	39,259	10.36	46,798	10.02	63,563	9.91
	Black	12,459	3.29	15,381	3.29	20,730	3.23
	Yellow	227,350	60.00	284,995	61.03	404,611	63.11
	Brown	77,739	20.52	96,671	20.70	131,113	20.45
	Indigenous	10,543	2.78	12,443	2.66	18,100	2.82
	Not informed	11,564	3.05	10,683	2.29	3,012	0.47
	Total	378,914	100.00	466,971	100.00	641,129	100.00
Northeast	White	263,343	17.12	294,085	16.99	353,843	16.88
	Black	100,967	6.56	115,998	6.70	148,480	7.08
	Yellow	655,134	42.60	773,119	44.66	1,022,543	48.77
	Brown	416,123	27.06	459,360	26.53	546,030	26.04
	Indigenous	6,801	0.44	7,415	0.43	9,175	0.44
	Not informed	95,595	6.22	81,290	4.70	16,621	0.79
	Total	1,537,963	100.00	1,731,267	100.00	2,096,692	100.00
Midwest	White	107,571	32.11	124,425	31.56	156,186	31.29
	Black	18,684	5.58	21,867	5.55	28,574	5.72
	Yellow	136,114	40.63	164,684	41.78	221,329	44.34
	Brown	59,700	17.82	70,329	17.84	84,847	17.00
	Indigenous	3,611	1.08	3,983	1.01	5,625	1.13
	Not informed	9,308	2.78	8,913	2.26	2,619	0.52
	Total	334,988	100.00	394,201	100.00	499,180	100.00
Southeast	White	712,684	46.38	829,184	47.28	1,031,271	46.86
	Black	119,847	7.80	138,528	7.90	193,865	8.81
	Yellow	385,213	25.07	458,993	26.17	683,326	31.05
	Brown	201,791	13.13	223,654	12.75	265,129	12.05
	Indigenous	958	0.06	673	0.04	1,014	0.05
	Not informed	116,234	7.56	102,823	5.86	26,173	1.19
	Total	1,536,727	100.00	1,753,855	100.00	2,200,778	100.00
South	White	882,183	80.99	964,635	80.62	1,146,258	81.47
	Black	43,463	3.99	47,921	4.01	59,091	4.20
	Yellow	78,798	7.23	96,542	8.07	131,802	9.37
	Brown	40,337	3.70	46,558	3.89	56,437	4.01
	Indigenous	2,572	0.24	2,856	0.24	3,038	0.22
	Not informed	41,925	3.85	37,997	3.18	10,269	0.73
	Total	1,089,278	100.00	1,196,509	100.00	1,406,895	100.00

Source: Siscan[12].

Table 2. Number of cervical cytopathological exams per woman performed per skin color between 2021 and 2023, population size and absolute difference among population and number of exams recorded by region and capitals

Place of residence	White			Black			Yellow			Brown			Indigenous		
	Exams	Population*	Difference	Exams	Population*	Difference	Exams	Population*	Difference	Exams	Population*	Difference	Exams	Population*	Difference
Brazil	**6,756,037**	**25,420,693**	**18,664,656**	**1,042,951**	**6,057,860**	**5,014,909**	**5,489,599**	**247,007**	**-5,242,592**	**2,665,948**	**25,590,659**	**22,924,711**	**82,925**	**259,024**	**176,099**
North	**144,027**	**919,243**	**775,216**	**46,564**	**394,208**	**347,644**	**879,932**	**9,199**	**-870,733**	**294,569**	**2,986,875**	**2,692,306**	**38,230**	**94,470**	**56,240**
Belém	6,189	**100,000**	93,811	2,889	**44,958**	42,069	37,523	**1,083**	-36,440	15,244	**247,033**	231,789	12	600	588
Boa Vista	2,391	**27,119**	24,728	807	**8,860**	8,053	21,371	**196**	-21,175	1,205	**67,097**	65,892	784	4,376	3,592
Macapá	1,603	**26,664**	25,061	848	**14,998**	14,150	16,663	**169**	-16,494	4,270	**74,493**	70,223	234	278	44
Manaus	22,375	**133,209**	110,834	2,824	**30,520**	27,696	200,137	**1,360**	-198,777	37,147	**401,854**	364,707	1,761	5,535	3,774
Palmas	4,193	**25,897**	21,704	1,294	**10,507**	9,213	9,869	**344**	-9,525	4,619	**48,928**	44,309	14	194	180
Porto Velho	4,999	**34,136**	29,137	1,352	**12,291**	10,939	18,248	**459**	-17,789	8,407	**81,960**	73,553	172	659	487
Rio Branco	5,056	**23,632**	18,576	1,576	**9,238**	7,662	28,851	**372**	-28,479	8,048	**67,250**	59,202	169	409	240
Northeast	**870,889**	**3,968,651**	**3,097,762**	**349,410**	**2,069,937**	**1,720,527**	**2,338,035**	**23,412**	**-2,314,623**	**1,358,875**	**9,064,892**	**7,706,017**	**21,776**	**79,862**	**58,086**
Aracaju	5,496	**54,277**	48,781	2,568	**26,929**	24,361	21,997	**458**	-21,539	14,070	**105,197**	91,127	15	624	609
Fortaleza	3,377	**236,383**	233,006	634	**52,111**	51,477	21,877	**1,110**	-20,767	6,413	**456,328**	449,915	15	1,003	988
João Pessoa	9,463	**99,520**	90,057	2,325	**23,430**	21,105	36,045	**403**	-35,642	8,140	**128,800**	120,660	53	803	750
Maceió	15,335	**95,767**	80,432	4,760	**31,962**	27,202	35,105	**802**	-34,303	26,826	**159,336**	132,510	39	690	651
Natal	14,621	**96,967**	82,346	2,199	**22,379**	20,180	26,820	**479**	-26,341	10,542	**106,701**	96,159	7	425	418
Recife	18,273	**175,889**	157,616	7,262	**57,557**	50,295	79,684	**979**	-78,705	19,753	**222,830**	203,077	40	904	864
Salvador	7,620	**125,917**	118,297	32,598	**272,258**	239,660	44,440	**927**	-43,513	40,384	**381,304**	340,920	62	1,482	1,420
São Luís	11,513	**83,265**	71,752	6,235	**54,124**	47,889	29,379	**371**	-29,008	29,232	**177,883**	148,651	41	511	470
Teresina	6,873	**61,423**	54,550	5,169	**38,069**	32,900	28,925	**359**	-28,566	34,008	**160,941**	126,933	29	347	318
Midwest	**372,321**	**1,727,002**	**1,354,681**	**65,961**	**427,171**	**361,210**	**499,603**	**18,844**	**-480,759**	**206,148**	**2,402,704**	**2,196,556**	**12,419**	**33,901**	**21,482**
Brasília	34,059	**345,280**	311,221	9,717	**91,209**	81,492	79,894	**4,241**	-75,653	19,696	**407,102**	387,406	73	1,824	1,751
Campo Grande	29,908	**119,460**	89,552	3,475	**19,512**	16,037	20,970	**2,991**	-17,979	5,010	**116,148**	111,138	374	2,622	2,248
Cuiabá	5,881	**58,999**	53,118	2,398	**26,274**	23,876	14,902	**1,068**	-13,834	6,974	**102,931**	95,957	24	494	470
Goiânia	23,574	**191,601**	168,027	4,154	**34,076**	29,922	29,348	**1,600**	-27,748	15,455	**208,080**	192,625	10	633	623
Southeast	**2,486,636**	**12,488,640**	**10,002,004**	**436,310**	**2,719,669**	**2,283,359**	**1,476,629**	**161,835**	**-1,314,794**	**668,381**	**9,366,635**	**8,698,254**	**2,486**	**31,937**	**29,451**
Belo Horizonte	56,050	**310,937**	254,887	20,622	**98,246**	77,624	90,255	**1,676**	-88,579	25,837	**299,776**	273,939	30	762	732
Rio de Janeiro	60,169	**849,084**	788,915	28,299	**301,248**	272,949	98,324	**3,448**	-94,876	20,586	**707,662**	687,076	42	2,289	2,247
São Paulo	16,475	**1,895,067**	1,878,592	2,042	**359,251**	357,209	7,232	**69,246**	62,014	3,516	**1,138,859**	1,135,343	5	5,350	5,345
Vitória	9,686	**45,566**	35,880	4,335	**12,450**	8,115	16,084	**233**	-15,851	5,598	**40,469**	34,871	12	205	193
South	**2,882,164**	**6,317,157**	**3,434,993**	**144,706**	**446,875**	**302,169**	**295,400**	**33,717**	**-261,683**	**137,975**	**1,769,553**	**1,631,578**	**8,014**	**18,854**	**10,840**
Curitiba	113,988	**408,877**	294,889	3,783	**22,241**	18,458	15,406	**6,885**	-8,521	5,843	**103,486**	97,643	30	602	572
Florianópolis	46,548	**130,305**	83,757	4,050	**10,958**	6,908	4,765	**745**	-4,020	2,491	**25,052**	22,561	25	399	374
Porto Alegre	90,140	**298,121**	207,981	20,490	**51,525**	31,035	10,207	**754**	-9,453	2,693	**47,778**	45,085	142	813	671

Source: Siscan[12] and Census 2022[14].
Note: *Population per skin color was removed from Census 2022.

Table 3. Number of women screened for cervical cancer, SUS exclusive users and coverage (%) in Brazil, regions and capitals of residence according to skin color, 2021-2023

Place of residence	White			Non-White			Indigenous			Proportion test	General population		
	Women examined	Health-uninsured population	Coverage	Women examined	Health-uninsured population	Coverage	Women examined	Health-uninsured population	Coverage	*p*	Women examined	Health-uninsured population	Coverage
Brazil	**6,756,037**	**15,457,809**	**43.71**	**9,198,498**	**25,409,531**	**36.2**	**82,925**	**220,678**	**37.58**	**< 0.05**	**16,037,460**	**41,088,018**	**39.03**
North	**144,027**	**900,379**	**15.99**	**1,221,065**	**3,133,507**	**38.97**	**38,230**	**89,267**	**42.83**	**< 0.05**	**1,403,322**	**4,123,153**	**34.04**
Belém	6,189	98,541	6.28	55,656	281,979	19.74	12	589	2.04	< 0.05	61,857	381,109	16.23
Boa Vista	2,391	27,087	8.83	23,383	75,972	30.78	784	4,327	18.12	< 0.05	26,558	107,386	24.73
Macapá	1,603	26,621	6.02	21,781	89,202	24.42	234	278	84.17	< 0.05	23,618	116,101	20.34
Manaus	22,375	131,273	17.04	240,108	414,450	57.93	1,761	5,346	32.94	< 0.05	264,244	551,070	47.95
Palmas	4,193	25,828	16.23	15,782	59,542	26.51	14	194	7.22	< 0.05	19,989	85,564	23.36
Porto Velho	4,999	34,028	14.69	28,007	93,703	29.89	172	659	26.1	< 0.05	33,178	128,390	25.84
Rio Branco	5,056	23,597	21.43	38,475	76,424	50.34	169	409	41.32	< 0.05	43,700	100,430	43.51
Northeast	**870,889**	**3,584,081**	**24.29**	**4,046,320**	**8,632,750**	**46.87**	**21,776**	**62,554**	**34.81**	**< 0.05**	**4,938,985**	**12,279,385**	**40.22**
Aracaju	5,496	53,849	10.21	38,635	129,503	29.83	15	590	2.54	< 0.05	44,146	183,942	23.99
Fortaleza	3,377	227,648	1.48	28,924	474,751	6.09	15	941	1.59	< 0.05	32,316	703,340	4.59
João Pessoa	9,463	98,381	9.62	46,510	150,458	30.91	53	792	6.69	< 0.05	56,026	249,632	22.44
Maceió	15,335	94,781	16.18	66,691	188,041	35.47	39	677	5.76	< 0.05	82,065	283,499	28.95
Natal	14,621	95,495	15.31	39,561	126,938	31.17	7	425	1.65	< 0.05	54,189	222,859	24.32
Recife	18,273	170,634	10.71	106,699	271,279	39.33	40	833	4.8	< 0.05	125,012	442,746	28.24
Salvador	7,620	122,407	6.23	117,422	565,360	20.77	62	1,400	4.43	< 0.05	125,104	689,168	18.15
São Luís	11,513	82,931	13.88	64,846	228,942	28.32	41	511	8.02	< 0.05	76,400	312,384	24.46
Teresina	6,873	60,949	11.28	68,102	194,863	34.95	29	340	8.53	< 0.05	75,004	256,151	29.28
Midwest	**372,321**	**1,614,427**	**23.06**	**771,712**	**2,549,866**	**30.26**	**12,419**	**24,904**	**49.87**	**< 0.05**	**1,156,452**	**4,189,196**	**27.61**
Brasília	34,059	326,397	10.43	109,307	467,186	23.39	73	1,506	4.85	< 0.05	143,439	795,090	18.04
Campo Grande	29,908	117,665	25.42	29,455	136,239	21.62	374	2,559	14.62	< 0.05	59,737	256,463	23.29
Cuiabá	5,881	58,495	10.05	24,274	128,342	18.91	24	484	4.96	< 0.05	30,179	187,321	16.11
Goiânia	23,574	185,980	12.68	48,957	234,629	20.87	10	608	1.64	< 0.05	72,541	421,218	17.22
Southeast	**2,486,636**	**5,198,332**	**47.84**	**2,581,320**	**5,809,477**	**44.43**	**2,486**	**24,015**	**10.35**	**< 0.05**	**5,070,442**	**11,031,825**	**45.96**
Belo Horizonte	56,050	294,065	19.06	136,714	376,053	36.35	30	718	4.18	< 0.05	192,794	670,836	28.74
Rio de Janeiro	60,169	705,048	8.53	147,209	856,916	17.18	42	2,081	2.02	< 0.05	207,420	1,564,045	13.26
São Paulo	16,475	1,290,760	1.28	12,790	1,259,552	1.02	5	4,539	0.11	0.2675	29,270	2,554,851	1.15
Vitória	9,686	45,092	21.48	26,017	52,660	49.41	12	199	6.03	< 0.05	35,715	97,950	36.46
South	**2,882,164**	**4,841,242**	**59.53**	**578,081**	**2,075,353**	**27.85**	**8,014**	**14,805**	**54.13**	**< 0.05**	**3,468,259**	**6,931,400**	**50.04**
Curitiba	113,988	379,400	30.04	25,032	129,807	19.28	30	602	4.98	< 0.05	139,050	509,810	27.27
Florianópolis	46,548	127,748	36.44	11,306	36,637	30.86	25	392	6.38	< 0.05	57,879	164,776	35.13
Porto Alegre	90,140	281,121	32.06	33,390	97,196	34.35	142	790	17.97	< 0.05	123,672	379,106	32.62

Source: Siscan[12], Census 2022[14] and National Health Survey[15].

Table 4. Coverage (%) and cervical cancer screening prevalence ratio in Brazil, regions and capitals of residence according to skin color, 2021-2023

Place of residence	White		Non-White		Indigenous	
	Coverage	PR*	Coverage	PR*	Coverage	PR*
Brazil	**43.71**	**Ref.**	**36.2**	**1.21 (1.21–1.21)**	**37.58**	**1.16 (1.16–1.17)**
North	**15.99**	**Ref.**	**38.97**	**0.41 (0.41–0.41)**	**42.83**	**0.37 (0.37–0.38)**
Belém	6.28	Ref.	19.74	0.32 (0.31–0.33)	2.04	3.08 (1.76–5.40)
Boa Vista	8.83	Ref.	30.78	0.29 (0.28–0.30)	18.12	0.49 (0.45–0.52)
Macapá	6.02	Ref.	24.42	0.25 (0.23–0.26)	84.17	0.07 (0.07–0.08)
Manaus	17.04	Ref.	57.93	0.29 (0.29–0.30)	32.94	0.52 (0.50–0.54)
Palmas	16.23	Ref.	26.51	0.61 (0.59–0.63)	7.22	2.25 (1.36–3.73)
Porto Velho	14.69	Ref.	29.89	0.49 (0.48–0.51)	26.1	0.56 (0.49–0.64)
Rio Branco	21.43	Ref.	50.34	0.43 (0.41–0.44)	41.32	0.52 (0.46–0.58)
Northeast	**24.29**	**Ref.**	**46.87**	**0.52 (0.52–0.52)**	**34.81**	**0.70 (0.69–0.71)**
Aracaju	10.21	Ref.	29.83	0.34 (0.33–0.35)	2.54	4.02 (2.43–6.62)
Fortaleza	1.48	Ref.	6.09	0.24 (0.24–0.25)	1.59	0.93 (0.56–1.54)
João Pessoa	9.62	Ref.	30.91	0.31 (0.30–0.32)	6.69	1.44 (1.11–1.87)
Maceió	16.18	Ref.	35.47	0.46 (0.45–0.46)	5.76	2.81 (2.07–3.81)
Natal	15.31	Ref.	31.17	0.49 (0.48–0.50)	1.65	9.28 (4.46–19.38)
Recife	10.71	Ref.	39.33	0.27 (0.27–0.28)	4.8	2.23 (1.65–3.02)
Salvador	6.23	Ref.	20.77	0.30 (0.29–0.31)	4.43	1.41 (1.10–1.79)
São Luís	13.88	Ref.	28.32	0.49 (0.48–0.50)	8.02	1.73 (1.29–2.32)
Teresina	11.28	Ref.	34.95	0.32 (0.32–0.33)	8.53	1.32 (0.93–1.87)
Midwest	**23.06**	**Ref.**	**30.26**	**0.76 (0.76–0.76)**	**49.87**	**0.46 (0.46–0.47)**
Brasília	10.43	Ref.	23.39	0.45 (0.44–0.45)	4.85	2.15 (1.72–2.69)
Campo Grande	25.42	Ref.	21.62	1.18 (1.16–1.19)	14.62	1.74 (1.58–1.91)
Cuiabá	10.05	Ref.	18.91	0.53 (0.52–0.55)	4.96	2.03 (1.37–3.00)
Goiânia	12.68	Ref.	20.87	0.61 (0.60–0.62)	1.64	7.73 (4.17–14.25)
Southeast	**47.84**	**Ref.**	**44.43**	**1.08 (1.08–1.08)**	**10.35**	**4.62 (4.45–4.80)**
Belo Horizonte	19.06	Ref.	36.35	0.52 (0.52–0.53)	4.18	4.56 (3.21–6.48)
Rio de Janeiro	8.53	Ref.	17.18	0.50 (0.49–0.50)	2.02	4.22 (3.13–5.70)
São Paulo	1.28	Ref.	1.02	1.25 (1.23–1.29)	0.11	11.64 (4.82–27.83)
Vitória	21.48	Ref.	49.41	0.43 (0.43–0.44)	6.03	3.56 (2.06–6.17)
South	**59.53**	**Ref.**	**27.85**	**2.14 (2.13–2.14)**	**54.13**	**1.10 (1.08–1.12)**
Curitiba	30.04	Ref.	19.28	1.56 (1.54–1.58)	4.98	6.03 (4.25–8.55)
Florianópolis	36.44	Ref.	30.86	1.18 (1.16–1.20)	6.38	5.71 (3.91–8.35)
Porto Alegre	32.06	Ref.	34.35	0.93 (0.92–0.94)	17.97	1.78 (1.54–2.07)

Source: Siscan[12], Census 2022[14] and National Health Survey[15].
Note: *Prevalence ratio and confidence interval of 95%.

Table 5. Coverage (%) and prevalence ratio of cervical screening by region and skin color, Brazil, 2021-2023

Place of residence	White		Non-White		Indigenous		General population	
	Coverage	PR*	Coverage	PR*	Coverage	PR*	Coverage	PR*
Midwest	23.06	**Ref.**	30.26	**Ref.**	49.87	**Ref.**	27.61	**Ref.**
North	15.99	0.69 (0.69–0.70)	38.97	1.29 (1.28–1.29)	42.83	0.86 (0.85–0.87)	34.04	1.23 (1.23–1.24)
Northeast	24.29	1.05 (1.05–1.06)	46.87	1.55 (1.55–1.55)	34.81	0.70 (0.69–0.71)	40.22	1.46 (1.45–1.46)
Southeast	47.84	2.07 (2.07–2.08)	44.43	1.47 (1.47–1.47)	10.35	0.21 (0.20–0.22)	45.96	1.66 (1.66–1.67)
South	59.53	2.58 (2.57–2.59)	27.85	0.92 (0.92–0.92)	54.13	1.09 (1.06–1.11)	50.04	1.81 (1.81–1.82)

Source: Cancer Information System[12], Census[14] and National Health Survey[15].
Note: *Prevalence ratio and confidence interval of 95%.

still incomplete across the country[23]. The improvement in filling out skin color derives, probably, from being mandatory in SUS information systems since the last trimester of 2022[24].

The analysis of consistency revealed that the number of exams in the category Yellow exceeded expressively the population estimated by the Census 2022 as earlier described. This discrepancy may arise from local cultural issues of the process related to self-claimed skin color and flaws in completing the national health card by health professionals operating the system, in addition to potential errors of data coding[25]. This scenario exposes fragilities of the quality of the information skin color and draws attention to the necessity of improving collection and validation of these data in SUS' administrative systems. The findings of the present study indicate racial and geographical differences of Pap smear screening coverage in SUS for women in the target-age (25-64 years) between 2021 and 2023. The coverages were higher in the South and Southeast regions and lower in the North and Midwest. White women presented high coverage in the South (59.53%), non-White in the Northeast (46.87%) and Indigenous in the South (54.13%). Comparing with the PR for White women, it has been observed high prevalence for non-White women in the North, Northeast and Midwest regions (PR=0.41, 0.52 and 0.76, respectively) and Indigenous (PR=0.37, 0.70 and 0.46).

In addition, the PR of performance of exams stratified by racial group taking as reference the Midwest region varied across regions. Comparing White and non-White women, the prevalence is high among White women of the South and Southeast regions while for non-White women, the prevalence is higher in the North, Northeast and Southeast regions. The discrepancy is particularly accentuated in the Southeast for Indigenous women where the prevalence is extremely low compared to the reference. The prevalence was more elevated for the general population of the South (PR = 1.81) and Southeast (PR = 1.66) regions, followed by the Northeast (PR = 1.46) and North (PR = 1.23).

This scenario was also observed by Silva, Alcantara, Tomazelli et al.[16] who while utilizing SUS's outpatient information system (SIA/SUS) to estimate a proxy of coverage of cytopathological exam, identified lower coverage in the North, Northeast and Midwest regions with nearly 25% for Brazil. In complementation, health population investigations found higher screening coverage for White women living in the South regions and lower in Black and Brown women living in the North and Northeast regions[26,27].

The analysis of the volume per women revealed that the number of exams performed out of the capitals is higher than that observed in the capitals. More than half of the exams of the regions were performed in countryside municipalities or metropolitan regions. The difference among the volume of exams can be partially explained by better implementation of Siscan in these areas, further to a possible high concentration of health-insured women in the capitals, which reroutes part of the exams to private hospitals. Therefore, part of the women who submitted to cervical cancer screening at the capitals is not captured by SUS information system.

The current investigation found that the coverage of cytopathological exam in the target-age varies between 27% in the Midwest and 50% in the South, with marked differences according to skin color and region of residence reflecting disparities of access to health services. The analysis of access and utilization of health services conducted by Szwarcwald et al.[28] showed that the indicators tend to be better in the Southeast and South than in the North and Northeast, especially regarding medical visits in the last 12 months. In addition, Black and Brown women are assisted less than White women and non-White women have more odds of being discriminated perceived in the access to health services mainly due to socioeconomic factors[29,30].

In high-income countries, the incidence and mortality by this type of cancer has been declining when compared to other countries[31,32], which is usually attributed to the implementation of screening program with ample populational coverage and adequate control of the disease's risk factors.

However, the impact of screening in Brazil has not being as robust as in high-income countries. Mortality by cervical cancer is declining since 1980, most of all in the 90s when screening was implemented. The effect of screening over the incidence and mortality rates, however, is softened by the disparities and difficulties of access, mainly in the countryside of the North and Northeast regions[33,34].

The differentiated access to health system by certain population groups influences the adherence, cytopathological exams and health outcomes. Some factors as low family income, younger ages, non-White skin color, high number of children, no medical consultation in the last 12 months and no private health insurance are associated with not submitting to cytopathological exam[35,36].

The success of cervical cancer control is contingent not only on screening exams but also the capacity of detection and timely treatment[37,38]. In Brazil, approximately 50% of the cases are diagnosed at advanced stages, being Black, Brown and Indigenous women more likely to be diagnosed late than White

women. This association is also related to education, living with spouse and utilization of public health services[6]. The lack of an organized program with active search and adequate follow-up of women with altered exams contributes to consolidate these disparities[4].

Internationally, the goal of the global strategy to accelerate the elimination of cervical cancer as public health problem[39] until 2030 determines that 90% of the girls need to be vaccinated against HPV until 15 years of age, 70% of the women screened with high-performance test until 35 years of age and again at 45 years of age and 90% of the women diagnosed with cervical cancer or precursor lesions should be treated.

In addition to the coverage below the recommended in Brazil, cervical cancer screening is based on cytopathological exam (Pap smear) which is less sensitive than the DNA HPV test. The recent incorporation of DNA HPV test in SUS is an opportunity to qualify the screening[40,41]. However, to ensure effectiveness of the screening it is necessary to identify and track the most vulnerable groups, as women who had ever been screened or are delayed. The results of the present study allow to identify regions, capitals and population groups at high risk to develop the disease and can be useful to plan the implementation of an organized screening in the country.

There are some limitations of the study, most of all due to the intrinsic factors related to the utilization of secondary information as the uneven quality of the data in different Brazilian regions. In addition, the incomplete implementation of the system mainly in the Southeast region, where the low implementation in the state of São Paulo, one of the most populated in Brazil, compromises significantly the completeness and representativeness of the data[23].

A significant limitation is the erroneous completion of the variable skin color in Siscan[12] because it hinders the analysis of the screening coverage of this variable. Due to the characteristics of the Indigenous population with their own health information system, it is possible that sub-notification of their data in Siscan has occurred.

Another limitation is the utilization of the data of PNS 2019[15] to estimate the population assisted exclusively by SUS, since the sample of Indigenous and Yellows is not fully representative of the population, which may affect the reduction of the number of health private insured women in relation to the general population thus overestimating the screening coverage in the country.

Further to the aforementioned limitations, the lack of an integrated and standardized information system results in fragmentation of the information across different data source where data collection, most of all of skin color is heterogeneous.

CONCLUSION

The study indicates racial and regional differences of coverage of screening exams being non-White and Indigenous women more vulnerable. Despite the recent expansion of actions to prevent and control cervical cancer in SUS in the last decades, disparities of access and utilization of health system still persist which directly impact healthcare.

To face racial and regional disparities it is indispensable the implementation of an organized screening program that addresses not only the search and call of women in the age-range and adoption of high-performance tests but also the restructuring of the line of care for cervical cancer in SUS.

The strengthening of active search, qualification of information systems and equity access to the entire line of care are essential measures to advance in the elimination of cervical cancer as a public health problem in Brazil.

CONTRIBUTIONS

Édnei César de Arruda Santos Junior, Caroline Madalena Ribeiro and Gulnar Azevedo e Silva contributed to the conception and design of the study, acquisition, analysis and interpretation of the data, writing and critical review. Beatriz Cordeiro Jardim contributed to the analysis of the data, interpretation of the results, and writing. All the authors approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

DATA AVAILABILITY STATEMENT

Data created and revised during the writing of the manuscript are available at the repositories of DATASUS https://datasus.saude.gov.br/acesso-a-informacao/sistema-de informacao-do-cancer-siscan colo-do-utero-e-mama/ and IBGE https://sidra.ibge.gov.br/pesquisa/censo-demografico/demografico-2022/universo-populacao-por-cor-ou-raca. https://www.ibge.gov.br/estatisticas/sociais/saude/29540-2013-pesquisa-nacional-de-saude.html?edicao=9177&t=microdados.

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