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Inequalities in Pap smear screening for cervical cancer in Brazil

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ABSTRACT

Objective. To examine the risk factors associated with never being screened for cervical cancer (CC) in Brazil.

Methods. Using the National Household Sample Survey 2008 (PNAD), we analyzed data from 102,108 Brazilian women ages 25–64 years. The patients were analyzed as having been or never having been screened with a Pap smear (Yes/No). Age-adjusted prevalence of never-screening was analyzed using a Chi-squared test. Crude and adjusted models using Poisson regression were performed.

Results. The prevalence of never-screened women for CC was 12.9%, 11.5% and 22.2% in Brazil in general, urban and rural areas, respectively. The Brazilian region with the highest prevalence of never-screening was the North (17.4%, 14.7% and 27.3% in general, urban and rural areas, respectively). The factors associated with a higher risk for never being screened were the following: poverty, younger age, lower educational level, non-white skin color, a greater number of children, no supplemental health insurance and not having visited a doctor in the past 12 months.

Conclusion. Socioeconomic and demographic conditions lead to inequalities in access to Pap smear screening in Brazil. Public health policy addressing these risk groups is necessary.

Introduction

Cervical cancer (CC) is the third most commonly diagnosed cancer and the fourth leading cause of cancer deaths in females worldwide. More than 85% of these cases and deaths occur in developing countries (Jemal et al., 2011). CC incidence in the United States has declined dramatically over the past decades due to the widespread use of cytology screening programs, and consequently the early diagnosis and treatment of precancerous lesions (Pierce Campbell et al., 2012). CC represents an important public health problem in Latin America and Caribbean (LA) (Arrossi et al., 2008; Azevedo et al., 2010; Brasil, 2011a; Collins et al., 2006; Drain et al., 2002; Luciani and Andrus, 2008; Munoz et al., 2008; Sankaranarayanan, 2006; Sankaranarayanan et al., 2001; Villa, 2012) as the second most common cancer in women in this region. If the current scenario remains unchanged, the incidence is expected to increase by more than 75% by 2025.

According to the Brazilian National Cancer Institute (INCA), 17,540 new cases of CC with an estimated incidence rate of 17 cases per 100,000 women were expected in 2012 (Brasil, 2011b).

The two main prevention strategies for CC include the introduction of human papillomavirus (HPV) vaccine and Pap smear screening programs (Brasil, 2011b; Jemal et al., 2011; Munoz et al., 2008; Murillo et al., 2008; Villa, 2012). Pap smear screening was introduced in LA in the early 1960s (Murillo et al., 2008). In Brazil, the national CC screening opportunistic program was launched in 1998 (Brasil, 2011a; Murillo et al., 2008; Schmidt et al., 2011). Following WHO recommendations, the Ministry of Health and INCA recommend cytological screening every three years after two consecutive annual negative smears for women between 25–64 years (Brasil, 2011a). The coverage of the Pap smear program in Brazil ranges from 73% (Gakidou et al., 2008) to 84.5% (Brasil, 2010).

The goal of this study is to evaluate risk factors associated with never having been screened for CC, describing inequalities in screening in Brazil as a whole, Brazilian major regions, and in urban and rural populations.

Materials and methods

This study was a cross-sectional analysis using data from the National Household Sample Survey 2008 (PNAD) (Brasil, 2010). PNAD is a survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) with a complex population-based sampling plan in three stages. From the 5,564 Brazilian municipalities in 2008, a total of 851 municipalities, 7818 census tracts and 150,591 households were sampled for PNAD,

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guaranteeing representativeness for Brazil. Additional details have been previously described (Brasil, 2010).

PNAD interviewed 391,868 participants. Among them, 290,269 were 20 years of age or older, and 52% were women (Brasil, 2010). All of the women replied to the question about Pap smear screening: "When was the last time you had a preventive screening test for cervical cancer?" The answer was categorized as having being screened or never having been screened. We selected for analysis all women aged 25 to 64 years, for a total of 102,108 women.

Age-adjusted frequencies of never being screened for CC were described for all five Brazilian major-regions (North, Northeast, Central-West, Southeast and South) and for urban and rural populations. In Brazil, municipal law and the census define urban and rural areas. Urban areas include all areas corresponding to cities (municipalities), villas (districts) or isolated urban areas. The rest are considered to be rural areas (Brasil, 2010).

The data were analyzed according to per-capita family income in *Reais* (quintiles; Q5 is the poorest), age in years (25–30; 31–40; 41–50 and 51–60), education in years completed (0–4; 5–8; 9–11 and ≥12), skin color (white/non-white), number of children (0; 1–2; 3–5; 6–10; ≥11), having had a doctor's visit in the past 12 months (yes/no), and having supplemental health insurance (yes/no). The number of women in each category was weighted by the entire population.

Chi-squared tests for heterogeneity or for trend were performed for bivariate analyses. Crude and adjusted models of Poisson regression using the Wald test for trend or for heterogeneity were also performed. Confounding was previously defined as a difference of 10% or higher between crude and adjusted estimates. All of the analyses were performed using STATA, version 12.

Results

The sample of the current study consisted of 102,108 Brazilian women aged 25 to 64 years. The characteristics of the sample are shown in Table 1 for the country as a whole and by urban and rural area populations. The proportion of poor women (Q5) was higher in rural (46.1%) than in urban areas (18.1%). Moreover, women living in rural areas were poorest, showed lower education levels (0–4 years: urban = 16.3% and rural = 42.0%), had a higher probability of not having seen a doctor in the past 12 months (urban = 17.2% vs. rural = 22.9%), and had no supplemental health insurance (urban = 66.7% vs. rural = 92.7%).

Fig. 1 shows the age-adjusted frequency distribution of never-screened women in Brazil, the country's major regions, and in urban and rural populations. For Brazil in general, the prevalence of never being screened was 12.9%. This prevalence was lower in urban (11.5%) than in rural areas (22.2%). The Northern region showed the highest value (17.4%), increasing to 27.3% in the rural population.

Bivariate analysis for Brazil and by urban and rural areas are shown in Table 2. All of the factors analyzed were strongly associated with never being screened for CC (p-values <0.001). Family income was associated with prevalence, as the highest CC prevalence values occurred among the poorest women (21.7%; 19.0% and 29.1% in Brazil, urban and rural areas, respectively). By age, the highest prevalence of CC occurred among younger women (25–30 years: 17.3%; 15.4%; 30.0% in Brazil, urban and rural areas, respectively). In addition, lower education, non-white skin color, a greater number of children, not having visited a physician in the past 12 months, and not having supplemental health insurance were associated with a higher prevalence of CC. The prevalence of never being screened among women who visited a doctor in the last 12 months was slightly higher than 5%.

Crude and adjusted analyses are displayed in Table 3 for Brazil and by residence area. Note that differences between crude and adjusted models were frequently higher than 10%, suggesting confounding. After adjustment, lower income increased the risk of never being screened [2.19 (95%CI 1.91; 2.50); p-value < 0.001]. In general, a younger age, a lower educational level, a non-white skin color, a greater

Table 1
The characteristics of the sample of Brazilian women aged 25–64 years from Brazil and by urban and rural area.

Variable	Brazil		Urban		Rural		p-value*
	N	Prevalence (%)	N	Prevalence (%)	N	Prevalence (%)	
Income (quintile)							<0.001
Q1 (richest)	9,542,865	19.9	9,190,086	22.2	352,779	5.4	
Q2	9,148,260	19.1	8,493,681	20.6	654,579	9.9	
Q3	8,773,409	18.3	7,780,000	18.8	993,409	15.1	
Q4	9,924,441	20.8	8,385,194	20.3	1,539,247	23.5	
Q5 (poorest)	10,497,181	21.9	7,471,901	18.1	3,025,280	46.1	
Age							0.002
51–64 years	12,300,531	24.7	10,592,037	24.6	1,708,494	25.4	
41–50 years	12,997,350	26.1	11,316,112	26.3	1,681,238	25.1	
31–40 years	14,500,365	29.4	12,535,331	29.1	1,965,034	29.3	
25–30 years	9,920,522	19.9	8,561,825	20.0	1,358,697	20.2	
Education							<0.001
≥12 years	20,573,369	41.4	19,536,915	45.4	1,036,454	15.4	
9–11 years	7,282,121	14.6	6,606,363	15.4	675,758	10.1	
5–8 years	12,035,765	24.2	9,852,485	22.9	2,183,280	32.5	
0–4 years	9,827,513	19.8	7,009,542	16.3	2,817,971	42.0	
Skin color							<0.001
White	25,206,152	50.7	22,436,736	52.2	2,769,416	41.3	
Non-white	24,487,158	49.3	20,543,582	47.8	3,943,576	58.7	
Number of children							<0.001
0	167,817	0.4	147,177	0.4	20,640	0.3	
1–2	23,109,180	56.4	20,607,635	60.4	2,501,545	41.8	
3–5	14,634,070	35.7	12,158,542	34.2	2,475,528	41.3	
6–10	2,852,525	7.0	1,967,901	5.6	884,624	14.8	
11 or more	219,170	0.5	112,158	0.3	107,012	1.8	
Visited the doctor in the past 12 months							<0.001
Yes	40,771,061	82.0	35,593,563	82.8	5,177,498	77.1	
No	8,947,707	18.0	7,411,742	17.2	1,535,965	22.9	
Health insurance							
Yes	14,850,064	29.9	28,693,829	33.3	538,588	8.0	<0.001
No	34,868,704	70.1	14,311,476	66.7	6,174,875	92.0	

National Household Sample Survey (PNAD) 2008.
* X^2 Test.

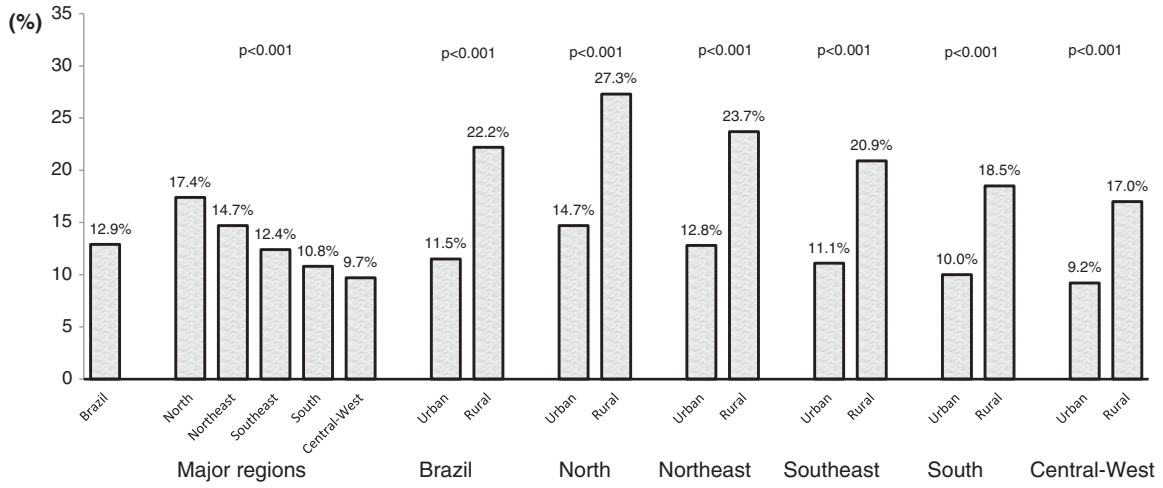

Fig. 1. Age-adjusted prevalence of never-screened for cervical cancer among Brazilian women aged 25–64 years (n = 102,108) from Brazil, Brazilian major regions and by urban or rural area. National Household Sample Survey (PNAD) 2008.

number of children (except in urban area; p-value = 0.099), not having supplemental healthcare insurance and not reporting a visit to a doctor in the past 12 months showed a higher relative risk for never having been screened for CC in all populations.

Discussion

Our findings highlight the following risk factors leading to inequalities in access to Pap smear screening in Brazil: poverty, youth, a lower education level, a non-white skin color, a greater number of children, not having seen a doctor in the last 12 months, and no supplemental health insurance. The poorest Brazilian regions (North and Northeast) showed the highest prevalence of never being screened for CC. Unsurprisingly, these regions have the highest national incidence and mortality rates for CC (Azevedo et al., 2010; Brasil, 2012). In the Northern region, the incidence of CC is higher than the incidence of breast cancer. In 2010, Brazil showed an age-standardized mortality rate of 4.04 per 100,000 women for CC. The highest rates were in the

Table 2
Age-adjusted prevalence of never having been screened for cervical cancer among women aged 25–64 years from Brazil and by urban and rural area (n = 102,108).

Variables	Brazil		Urban area		Rural area	
	Prevalence	p-value	Prevalence	p-value	Prevalence	p-value
Income (quintile)						
Q1 (richest)	6.6	<0.001**	6.6	<0.001**	9.8	<0.001**
Q2	8.9		8.6		12.5	
Q3	11.6		10.9		15.8	
Q4	15.9		14.4		21.6	
Q5 (poorest)	21.7		19.0		29.1	
Age						
51–60 years	10.2	<0.001**	9.1	<0.001**	17.8	<0.001**
41–50 years	11.9		10.5		20.5	
31–40 years	14.1		12.5		24.4	
25–30 years	17.3		15.4		30.0	
Education		<0.001**		<0.001**		<0.001**
≥12 years	8.7		8.5		13.5	
9–11 years	12.2		11.4		19.1	
5–8 years	15.0		13.4		22.5	
0–4 years	17.1		14.8		23.8	
Skin color		<0.001*		<0.001*		<0.001*
White	10.6		9.6		18.0	
Non-white	15.4		13.5		25.1	
Number of children		<0.001**		<0.001**		<0.001**
0	4.6		4.7		9.0	
1–2	8.7		8.0		15.4	
3–5	11.8		10.2		19.7	
6–10	15.2		12.4		24.0	
11 or more	21.7		16.3		32.1	
Visited the doctor in the past 12 months		<0.001*		<0.001*		<0.001*
Yes	9.4		8.6		15.4	
No	29.3		25.8		45.7	
Health insurance						
Yes	5.3	<0.001*	5.1	<0.001*	8.2	<0.001*
No	16.5		14.9		24.0	

National Household Sample Survey (PNAD) 2008.
* Chi-squared test for heterogeneity.
** Chi-squared test for trend.

Table 3
Factors associated with never having been screened for cervical cancer among women aged 25–64 years from Brazil and by residence area (n = 102,108). Crude and adjusted prevalence ratios using Poisson regression.

Variables	Brazil				Urban area				Rural area			
	Crude		Adjusted +		Crude		Adjusted +		Crude		Adjusted +	
	PR (95%CI)	p-value	PR (95%CI)	p-value	PR (95%CI)	p-value	PR (95%CI)	p-value	PR (95%CI)	p-value	PR (95%CI)	p-value
Income (quintile)												
Q1 (richest)	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**
Q2	1.79 (1.63;1.96)		1.32 (1.16;1.51)		1.74 (1.59;1.92)		1.32 (1.15;1.53)		1.69 (1.25;2.29)		1.25 (0.89;1.73)	
Q3	2.33 (2.13;2.55)		1.57 (1.38;1.79)		2.24 (2.04;2.46)		1.63 (1.41;1.87)		1.99 (1.48;2.68)		1.24 (0.90;1.71)	
Q4	2.99 (2.74;3.26)		1.88 (1.66;2.13)		2.81 (2.57;3.08)		1.91 (1.67;2.19)		2.48 (1.86;3.29)		1.54 (1.15;2.05)	
Q5 (poorest)	3.72 (3.40;4.08)		2.19 (1.91;2.50)		3.42 (3.12;3.76)		2.21 (1.91;2.55)		2.65 (1.99;3.53)		1.71 (1.26;2.33)	
Age												
51–60 years	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**	1.00	<0.001**	1.00	0.017**
41–50 years	0.82 (0.77;0.86)		0.83 (0.78;0.88)		0.84 (0.79;0.90)		0.84 (0.78;0.90)		0.77 (0.69;0.85)		0.79 (0.71;0.89)	
31–40 years	1.00 (0.95;1.05)		0.93 (0.88;0.99)		1.07 (1.00;1.13)		0.96 (0.89;1.03)		0.84 (0.76;0.92)		0.83 (0.73;0.94)	
25–30 years	1.62 (1.54;1.77)		1.32 (1.23;1.42)		1.78 (1.68;1.88)		1.33 (1.23;1.45)		1.21 (1.11;1.32)		1.20 (1.05;1.37)	
Education		<0.001**		<0.001**		<0.001**		<0.001**		<0.001**		<0.001**
≥12 years	1.00		1.00		1.00		1.00		1.00		1.00	
9–11 years	1.20 (1.13;1.28)		1.25(1.15;1.35)		1.18 (1.10;1.26)		1.23 (1.12;1.34)		1.09 (0.91;1.29)		1.40 (1.14;1.76)	
5–8 years	1.43 (1.35;1.51)		1.50 (1.40;1.61)		1.34 (1.27;1.42)		1.46 (1.35;1.58)		1.20 (1.04;1.38)		1.60 (1.31;1.95)	
0–4 years	2.50 (2.36;2.64)		2.28 (2.11;2.45)		2.30 (2.17;2.43)		2.17 (2.00;2.35)		1.88 (1.63;2.17)		2.36 (1.90;2.93)	
Skin color		<0.001*		0.006*		<0.001*		0.028*		<0.001*		0.027*
White	1.00		1.00		1.00		1.00		1.00		1.00	
Non-white	1.43 (1.37;1.50)		1.07 (1.02;1.13)		1.40 (1.33;1.47)		1.06 (1.00;1.12)		1.28 (1.16;1.41)		1.12 (1.01;1.24)	
Number of children		<0.001**		0.001**		<0.001**		0.099**		<0.001**		<0.001**
0	1.00		1.00		1.00		1.00		1.00		1.00	
1–2	0.58 (0.45;0.74)		0.75 (0.58;0.97)		0.53 (0.40;0.70)		0.70 (0.53;0.94)		0.88 (0.48;1.61)		0.95 (0.55;1.61)	
3–5	0.72 (0.56;0.93)		0.70 (0.54;0.91)		0.64 (0.48;0.84)		0.65 (0.49;0.87)		1.01 (0.55;1.85)		0.93 (0.54;1.59)	
6–10	1.30 (1.01;1.67)		0.92 (0.71;1.19)		1.14 (0.86;1.51)		0.84 (0.62;1.12)		1.45 (0.78;2.67)		1.14 (0.67;1.95)	
11 or more	2.04 (1.51;2.76)		1.19 (0.88;1.61)		1.79 (1.25;2.56)		1.08 (0.75;1.56)		1.97 (1.04;3.74)		1.40 (0.80;2.44)	
Visited the doctor in the past 12 months		<0.001*		<0.001*		<0.001*		<0.001*		<0.001*		<0.001*
Yes	1.00		1.00		1.00		1.00		1.00		1.00	
No	1.72 (1.68;1.75)		1.57 (1.53;1.61)		1.74 (1.71;1.78)		1.59 (1.55;1.64)		1.53 (1.47;1.60)		1.50 (1.43;1.57)	
Health insurance												
Yes	1.00	<0.001*	1.00	<0.001*	1.00	<0.001*	1.00	<0.001*	1.00	<0.001*	1.00	<0.001*
No	3.13 (2.93;3.34)		1.83 (1.67;2.00)		2.86 (2.68;3.05)		1.78 (1.62;1.96)		3.36 (2.58;4.37)		1.92 (1.40;2.62)	

National Household Sample Survey (PNAD) 2008.
PR: Prevalence ratio.
95%CI: 95% confidence interval.
+ Adjusted.
* Wald test for heterogeneity.
** Wald test for trend.

North and Northeast, with 8.10 and 4.63 per 100,000 women, respectively, and the lowest rates were in the Southeast and the South (3.20 and 3.57 per 100,000 women, respectively).

To the best of our knowledge, this is the first report discussing inequalities in Pap smear screening for Brazil, Brazilian major-regions and residence areas using a national population-based survey. Our findings are consistent with previously published information. Determinants and barriers for CC screening have been described, indicating that cultural and religious factors, competing health needs, limited resources, poorly developed healthcare services and limited information on CC prevention are the major players (Murillo et al., 2008). Previous Brazilian studies described low income (Borges et al., 2012; Martins et al., 2009), low education levels (Borges et al., 2012; Gasperin et al., 2011; Martins et al., 2009), a young age (Muller et al., 2008), and a non-white skin color (Bairros et al., 2011; Muller et al., 2008) as associated with never being screened for CC. Poverty, a recognized distal determinant of health, is central to understanding inequalities in access of Pap smear programs. In addition, fear of the test results and shame were reported as the main barriers to access CC screening in a cross-sectional study in Rio de Janeiro (Rafael Rde and Moura, 2010). In this sense, the low coverage is not the unique possible explanation for Pap smear barriers. Misconceptions regarding Pap smears are also an educational problem, leading to a delay in CC diagnosis (Lourenco et al., 2012).

In the United States, the proportion of never being screened among women aged 22–30 years was 9.0% in 2010 (CDC, 2013). Our findings indicated that the prevalence of never being screened among women aged 25–30 years was approximately two-fold higher (15.9%), and three-fold higher among the rural population (30.0%). A previous Brazilian study described a prevalence of 14.7% among women aged 18–69 years of age who had not been screened in the previous three years (Borges et al., 2012). The prevalence for never-screened women aged 25–59 years was 19.1% and 16.5%, in Fortaleza and Rio de Janeiro, respectively (Martins et al., 2009).

There is a need for more population-based studies in Latin America describing the prevalence of never-screened women. For example, in Argentina, women who are poor, unmarried, unemployed or inactive, with a lower education level, reduced access to health care, and over the age of 65 were found to under-utilize screening programs (Arrossi et al., 2008). Substantial changes occurred in the socioeconomic patterns of preventive CC screening among Argentinean women, leading to an increase from 51.6% to 60.5% in the proportion of screened women between 2005 and 2009 (De Maio et al., 2012).

In Brazil, screening for CC is a major component of the national policy for cancer control (de Andrade, 2012; Dias et al., 2010). In this context, the Pap smear is considered to be an opportunistic program. Our findings indicate a higher prevalence of never-screened women in those who had not visited a doctor in the past 12 months. It is more concerning that, among women who visited the doctor, 5% were never-screened, indicating that the health system is not offering the test to a subset of this population. The most important factor limiting the national governmental politics in Brazil is the insufficient number of screened women (de Andrade, 2012). Alternatives, such as the use of mobile units (Mauad et al., 2010) or a door-to-door CC screening (Mauad et al., 2002), may overcome deficiencies in access to Pap smear screening.

The Brazilian healthcare system has shown significant progress in recent decades (Paim et al., 2011), especially in controlling non-communicable disease (Schmidt et al., 2011). The system is a complex public-private network composed of three subsectors: public (SUS), private and private health insurance subsectors (Paim et al., 2011). All of these entities can perform Pap smear screening that is free-of-charge to the patient. According to data from PNAD, healthcare utilization in Brazil increased by 174% from 1981 to 2008 (Paim et al., 2011). Previous reports indicated that the number of women aged 25 to 59 years who reported at least one Pap smear over the previous three years has increased approximately 25%, reaching 84.6% in 2008 (Brasil, 2010; Schmidt et al., 2011). Despite this increase in access to healthcare, it has not been enough to substantially decrease the CC incidence and mortality rates (de Andrade, 2012).

Unfortunately, the marked reductions in incidence and mortality observed in most developed countries after the introduction of well-organized screening programs have not been observed in Brazil or in most Latin American countries (Arrossi et al., 2008; de Andrade, 2012; Gakidou et al., 2008; Luciani and Andrus, 2008; Munoz et al., 2008). The main challenges to changing this reality include screening of high-risk populations using a high-quality screening test, adequate and timely diagnoses, and the treatment for those with positive screening results (Murillo et al., 2008; Sankaranarayanan et al., 2001).

We lack a reliable Pap smear national register, which would allow for us to know if women are being screened as recommended and if treatment is received in case of a positive result (de Andrade, 2012). SISCOLO is a Brazilian Pap smear registry launched in 1999 with the objective of identifying the number of performed tests (Dias et al., 2010). We believe that this registry could be improved and help to identify if the high-risk populations have been covered by the test.

Additional data sources should play an important role to understanding inequalities in Pap smear screening, such as those described in the present study using PNAD.

On the other hand, advances have demonstrated a link between HPV infection and CC (Brasil, 2011b; Munoz et al., 2008). The incorporation of the prophylactic HPV vaccination in Brazil could aid in the reduction in CC incidence. It is also extremely important that women continue to receive screening services (Collins et al., 2006) because currently vaccines are being given to adolescent girls only (Cuzick, 2010). Even vaccinated girls should begin screening when they reach the recommended age as the vaccines do not provide protection for 30% chronic infections by oncogenic HPV types (Jemal et al., 2011). The future of CC control will require a diversified strategy (Collins et al., 2006) for vaccine and for non-vaccine births cohorts (Lynge et al., 2009).

Our study has certain limitations. First, the validity of the question used to define the outcome (never having been screened) may underestimate the actual prevalence of never-screened women. Moreover, we cannot exclude memory bias, but we believe that it did not strongly distort our results.

The skin color variable was collected by PNAD in five categories (black, white, mestizo, indigenous and yellow). However, due to a low proportion of participants in certain categories (yellow 0.4%, indigenous 0.5% and black 8%), we analyzed this variable in a dichotomous way (white/non-white). The validity of this approach is not established; however, we believe that our findings that non-white women are at a higher risk of never being screened is not significantly biased. Lastly, the study was not able to detect cohort effects. The study addresses 25–64-year-old women, and there are differences that could be attributable to knowledge level, feminine emancipation, social inclusion and others factors that are impossible to control for in this analysis. However, PNAD provides a good opportunity to access data of excellent methodological quality and national representativeness.

There is a need to improve Pap smear programs (Gakidou et al., 2008; Sankaranarayanan et al., 2001) and to eliminate all barriers to access and utilization of health care services in order to decrease the CC mortality rate. We must direct our efforts to specific social groups, particularly those at higher risk, and to create a qualified registry of national coverage to monitor screening, diagnosis and treatment.

Conclusion

Our findings note inequalities in Pap smear screening in Brazil. Socioeconomic and demographic risk factors most likely contribute to the high CC incidence and mortality rates in the country. Improvements in Pap smear programs directed towards high-risk populations should be a priority in health policy.

Conflicts of interest statement

The authors declare that there are no conflicts of interests.

References

Arrossi, S., Ramos, S., Paolino, M., Sankaranarayanan, R., 2008. Social inequality in Pap smear coverage: identifying under-users of cervical cancer screening in Argentina. Reprod. Health Matters 16, 50–58.

Azevedo, E., Silva, G., Girianelli, V.R., Gamarra, C.J., Bustamante-Teixeira, M.T., 2010. Cervical cancer mortality trends in Brazil, 1981–2006. Cad. Saude Publica 26, 2399–2407.

Bairros, F.S., Meneghel, S.N., Dias-Da-Costa, J.S., et al., 2011. Racial inequalities in access to women's health care in southern Brazil. Cad. Saude Publica 27, 2364–2372.

Borges, M.F., Dotto, L.M., Koifman, R.J., Cunha Mde, A., Muniz, P.T., 2012. Prevalence of uterine cervical cancer testing in Rio Branco, Acre State, Brazil, and factors associated with non-participation in screening. Cad. Saude Publica 28, 1156–1166.

Brasil, 2010. Ministério do Planejamento, Orçamento e Gestão. Instituto Brasileiro de Geografi a e Estatística - IBGE. Pesquisa Nacional por Amostra de Domicílios. Um Panorama da Saúde no Brasil. Acesso e utilização dos serviços, condições de saúde e fatores de risco e proteção à saúde 2008. IBGE, Rio de Janeiro ([accessed Dec 2, 2012]. Available in:<http://www.ibge.gov.br/home/estatistica/populacao/panorama_saude_brasil_2003_2008/PNAD_2008_saude.pdf>).

Brasil, 2011a. Diretrizes Brasileiras para o rastreamento do câncer do útero. INCA, Rio de Janeiro ([accessed Dec 2, 2012]. Available in: <http://www1.inca.gov.br/inca/Arquivos/Diretrizes_rastreamento_cancer_colo_utero.pdf>).

Brasil, 2011b. Brasil. Ministério da Saúde. Instituto Nacional de Câncer. Estimativa 2012: incidência do câncer no Brasil. INCA, Rio de Janeiro ([accessed Dec 2, 2012]. Available in: <http://www.inca.gov.br/estimativa/2012/index.asp?ID=5>).

Brasil, 2012. Ministério da Saúde. Instituto Nacional de Câncer. [Internet] Atlas de mortalidade por câncer. ([accessed Dec 2, 2012]. Available in: <http://mortalidade.inca.gov.br/Mortalidade/>).

Cdc, 2013. Cervical cancer screening among women aged 18–30 years - United States, 2000–2010. MMWR Morb. Mortal Wkly. Rep. 61, 1038–1042.

Collins, Y., Einstein, M.H., Gostout, B.S., et al., 2006. Cervical cancer prevention in the era of prophylactic vaccines: a preview for gynecologic oncologists. Gynecol. Oncol. 102, 552–562.

Cuzick, J., 2010. Long-term cervical cancer prevention strategies across the globe. Gynecol. Oncol. 117, S11–S14.

De Andrade, J.M., 2012. Limitations of the success of screening for cervical cancer in Brazil. Rev. Bras. Ginecol. Obstet. 34, 245–247.

De Maio, F.G., Linetzky, B., Ferrante, D., 2012. Changes in the social gradients for Pap smears and mammograms in Argentina: evidence from the 2005 and 2009 National Risk Factor Surveys. Public Health 126, 821–826.

Dias, M.B.K., Gláucia, J., Assis, T.M., 2010. Cervix Cancer Screening in Brazil: Analysis of Siscolo Data from 2002 to 2006. Epidemiol. Serv. Saúde 19, 293–306.

Drain, P.K., Holmes, K.K., Hughes, J.P., Koutsky, L.A., 2002. Determinants of cervical cancer rates in developing countries. Int. J. Cancer 100, 199–205.

Gakidou, E., Nordhagen, S., Obermeyer, Z., 2008. Coverage of cervical cancer screening in 57 countries: low average levels and large inequalities. PLoS. Med 5, e132.

Gasperin, S.I., Boing, A.F., Kupek, E., 2011. Cervical cancer screening coverage and associated factors in a city in southern Brazil: a population-based study. Cad. Saude Publica 27, 1312–1322.

Jemal, A., Bray, F., Center, M.M., Ferlay, J., Ward, E., Forman, D., 2011. Global cancer statistics. CA Cancer J. Clin. 61, 69–90.

Lourenco, A.V., Fregnani, C.M., Silva, P.C., Latorre, M.R., Fregnani, J.H., 2012. Why are women with cervical cancer not being diagnosed in preinvasive phase? An analysis of risk factors using a hierarchical model. Int. J. Gynecol. Cancer 22, 645–653.

Luciani, S., Andrus, J.K., 2008. A Pan American Health Organization strategy for cervical cancer prevention and control in Latin America and the Caribbean. Reprod. Health Matters 16, 59–66.

Lynge, E., Antilla, A., Arbyn, M., Segnan, N., Ronco, G., 2009. What's next? Perspectives and future needs of cervical screening in Europe in the era of molecular testing and vaccination. Eur. J. Cancer 45, 2714–2721.

Martins, L.F., Valente, J.G., Thuler, L.C., 2009. Factors related to inadequate cervical cancer screening in two Brazilian state capitals. Rev. Saude Publica 43, 318–325.

Mauad, E.C., Gomes, U.A., Nogueira, J.L., Melani, A.G., Lemos, D.L., Hidalgo, G.S., 2002. Prevention of cervical cancer in a poor population in Brazil. Fam. Pract. 19, 189–192.

Mauad, E.C., Nicolau, S.M., Gomes, U.A., et al., 2010. Can mobile units improve the strategies for cervical cancer prevention? Diagn. Cytopathol. 38, 727–730.

Muller, D.K., Dias-Da-Costa, J.S., Luz, A.M., Olinto, M.T., 2008. Coverage of Pap smear tests in the city of Sao Leopoldo, Rio Grande do Sul State, Brazil. Cad. Saude Publica 24, 2511–2520.

Munoz, N., Franco, E.L., Herrero, R., et al., 2008. Recommendations for cervical cancer prevention in Latin America and the Caribbean. Vaccine 26 (Suppl. 11), L96–L107.

Murillo, R., Almonte, M., Pereira, A., et al., 2008. Cervical cancer screening programs in Latin America and the Caribbean. Vaccine 26 (Suppl. 11), L37–L48.

Paim, J., Travassos, C., Almeida, C., Bahia, L., Macinko, J., 2011. The Brazilian health system: history, advances, and challenges. Lancet 377, 1778–1797.

Pierce Campbell, C.M., Menezes, L.J., Paskett, E.D., Giuliano, A.R., 2012. Prevention of invasive cervical cancer in the United States: past, present, and future. Biomarkers Prev. 21, 1402–1408.

Rafael Rde, M., Moura, A.T., 2010. Barriers to implementation of cervical cancer screening: a household survey in the coverage area of the Family Health Program in Nova Iguacu, Rio de Janeiro State, Brazil. Cad Saude Publica 26, 1045–1050.

Sankaranarayanan, R., 2006. Overview of cervical cancer in the developing world. FIGO 26th Annual Report on the Results of Treatment in Gynecological Cancer. Int. J. Gynaecol. Obstet. 95 (Suppl. 1), S205–S210.

Sankaranarayanan, R., Budukh, A.M., Rajkumar, R., 2001. Effective screening programmes for cervical cancer in low- and middle-income developing countries. Bull. World Health Organ. 79, 954–962.

Schmidt, M.I., Duncan, B.B., Azevedo, E., et al., 2011. Chronic non-communicable diseases in Brazil: burden and current challenges. Lancet 377, 1949–1961.

Villa, L.L., 2012. Cervical cancer in latin america and the Caribbean: the problem and the way to solutions. Cancer Epidemiol. Biomarkers Prev. 21, 1409–1413.