



Inequities in cervical cancer screening among Colombian women: A multilevel analysis of a nationwide survey



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ABSTRACT

Objectives: To identify factors associated with whether women in Colombia have had a Pap test, evaluate differences in risk factors between rural and urban residence, and evaluate the contextual effect of the lack of education on having ever had a Pap test.

Method: Data used were from the 2010 Colombian National Demographic and Health Survey; 40,392 women reported whether they have had a Pap test. A multilevel mixed logistic regression model was developed with random intercepts to account for clustering by neighbourhood and municipality. The model evaluated whether having a rural/urban area of residence modified the effect of identified risk factors and if the prevalence of no education at the neighbourhood level acted as a contextual effect. **Results:** Most women (87.3%) reported having at least one Pap test. Women from lower socioeconomic quintiles ($p = 0.002$), who were unemployed ($p < 0.001$), and whose final health decisions depended on others ($p < 0.001$) were less likely to have had a Pap test. Women with children were more likely to have had the test ($p < 0.001$), and the effects of education ($p = 0.03$), type of health insurance ($p = 0.01$), age ($p < 0.001$), and region ($p < 0.001$) varied with having a rural/urban area of residence. Women living in rural areas (specifically younger ones, with no health insurance, living in the Atlantic and Amazon-Orinoquia regions, and with no education) were less likely to have had a Pap test when compared to those living in urban areas. Furthermore, women living in a neighbourhood with a higher prevalence of no education were less likely to have ever had a Pap test ($p = 0.005$).

Conclusions: In Colombia, the probability of having had a Pap test is associated with personal attributes, area of residence, and prevalence of no education in the neighbourhood. Efforts to improve access to cervical cancer screening should focus on disadvantaged women with limited education, low socioeconomic status, and no health insurance or subsidised insurance, especially those in rural/isolated areas.

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1. Introduction

Although cervical cancer (CC) is considered a preventable disease [1,2], worldwide it is ranked third for incident cancer cases and fourth for cancer-related mortality [3–5]. In South America, CC

is the second most incident cancer and first for cancer mortality among women between 15 and 44 years [5]. In Colombia, CC is the second most common cancer [6] and has a proportional mortality of 12%, making it the second most common cause of cancer mortality [7].

The Pap smear, or Pap test, is used globally to screen for pre-cancerous lesions of the cervix [8]. Hence, failure to have a Pap test has been considered a risk factor for CC [9]. The Colombian recommendations for CC screening state that women between 25 and 69 years (or younger who have experienced intercourse) should have free access to Pap testing; however, a Colombian committee of experts advised starting CC screening at 21 years of

Abbreviations: AIC, Akaike's Information Criterion; CC, cervical cancer; NDHS, National Demographic and Health Survey; ROC, receiver operating characteristic; SGSSS, Sistema General de Seguridad Social en Salud (General Social Security System in Health); UOR, unadjusted odds ratio; VPC, variance partition coefficient.

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age [10]. The recommended frequency of Pap testing in Colombia is 1–1.3 which means if two consecutive annual tests are negative, subsequent tests should be repeated every third year [10]. In spite of these recommendations, Pap test coverage in Colombia is lower than in other Latin American countries [11]. Furthermore, the CC screening programme is decentralised in Colombia; health insurance companies and their network of health care providers are responsible for Pap testing [12].

Studies conducted in Colombia have identified differences in access to Pap testing between rural and urban areas and among geographic region of residence [13,14], educational level [15], wealth quintile [15], age group [15,16], and type of health insurance [16]. Colombia has an insurance-based health care system, the *Sistema General de Seguridad Social en Salud* (SGSSS – the General Social Security System in Health), with two schemes: contributory and subsidised [17]. Workers and retired individuals with the ability to pay belong to the contributory system, and those unable to pay are part of the subsidised system [17,18]. Public teachers and universities workers, members of the military forces, police, and employees of the Colombian Oil Company have special health insurance plans [18]. Differences in access to health care benefits between the contributory and subsidised systems have been reported [19–21] which mainly affect disadvantaged populations [19,22,23]. The SGSSS has been criticised for not considering geographical, social, and cultural contexts, increasing barriers to access health care [24].

While residential context influences participation in Pap testing [25], previous studies exploring factors affecting Pap test uptake in Colombia [13,15] have not considered the influence of contextual factors on the probability of having a Pap test. The aim of this study was to identify socio-demographic factors related to ever having had a Pap test among sexually active women aged 18–49 years in Colombia, considering the influence of neighbourhood and municipality where women live. The specific objectives of this study were to: identify factors associated with whether women in Colombia have had a Pap test, evaluate differences in risk factors between rural and urban residence, and evaluate the contextual effect of the lack of education on having had a Pap test.

2. Material and methods

2.1. Study population and data

Data for this study were part of the 2010 National Demographic and Health Survey (NDHS), a Colombian nationwide survey assessing different aspects of women's health. The NDHS included information from 53,521 women, aged 13–49 years representing 51,447 households [13]. The data were collected using random, cluster, and multistage sampling. Households were grouped with others of similar characteristics and proximity, creating groups of houses (hereinafter called neighbourhoods) with an average of ten households. The NDHS subdivided Colombia into five geographic regions (Amazon-Orinoquía, Pacific, Central, Atlantic, and Eastern).

In the NDHS, only women 18 years or older, who had not had a hysterectomy, and who had experienced intercourse, were eligible to answer questions about CC prevention. Consequently, this work is based on the responses of the 40,410 (out of the original 53,521) women who met this eligibility criterion for answering questions related to CC screening (Pap test). Women, who self-declared they had heard about Pap smears and have ever had a Pap test, were classified as “1 = have had a Pap test”; otherwise, they were classified as “0 = have not had a Pap test”. This was the outcome variable of interest for this study.

The Ethical Committee of the *Asociación Probienestar de la Familia Colombiana (Profamilia)* provided ethical approval prior to data collection. Also, *Profamilia* obtained consent from participants

before the administration of the NDHS. To conduct the present analysis using the 2010 NDHS database, the University of Saskatchewan Research Ethics exempted the project.

2.2. Statistical analysis

The frequencies of women who had a Pap test were calculated according to socio-demographic factors of interest, including: age, whether women had children, whether they had the final say on their own health (who makes decisions related to the woman's health), educational level, wealth quintile, working status, rural/urban area of residence, region of residence, and type of health insurance (Table 1). Considering the sampling procedure and the resulting hierarchical structure of the data (Fig. 1), a three-level mixed model (first level: women, second level: neighbourhoods, and third level: municipalities) for a binomial outcome with a logit link function and Laplacian approximation was used. The errors for the second and third levels were considered as random effects to account for variation in the probability that women would have a Pap test among municipalities and neighbourhoods. Multilevel modelling has the advantage of examining how both group and individual factors impact the outcome variable [26], considering the potential clustering of outcomes within groups [27]. This technique also allows an exploration of the potential contextual effects of group membership [28]. The average number of observations and proportion of replications per level were examined for each of these random intercepts. The geographic region (group of departments) was considered as a predictor in the fixed portion of the model.

Unconditional analyses between each predictor and the outcome in the multilevel model were conducted and unadjusted odds ratios (UOR) were computed. Risk factors with unconditional p -values ≤ 0.2 [27] were retained for consideration in the multivariable analysis. A manual backward selection strategy was used to build the multivariable model, removing the predictor with the highest p -value, one at a time until only variables with $p < 0.05$ remained. Categorical variables with more than two categories were assessed using a type-3 likelihood ratio test. The linearity assumption of age was tested using a quadratic term. Age was used as a four-category variable given that the linearity assumption was not met ($p < 0.001$). Observations with missing values were removed from the analysis. Potential confounders were retained in the final model if including the variable changed the coefficients of other variables of interest by $>10\%$. Interactions were assessed between the retained main effects in the multivariable model and rural/urban residence; interactions were considered significant if $p < 0.05$. Post hoc comparisons were used to explore differences across multiple categories. A contextual effect measuring the prevalence of no education in the neighbourhoods was examined for an association with having had a Pap test. Finally, an interaction was examined between the prevalence of no education within each neighbourhood and an individual woman's educational level.

Population-averaged odds ratios (OR) and their corresponding 95% confidence intervals (95% CI) were computed using population-averaged coefficients (β^{PA}) calculated from the final multivariable model. Using subject-specific coefficients (β^{SS}) from the final multivariable model, the following formula was employed: $\beta^{PA} \approx \beta^{SS} / \sqrt{1 + 0.346[\sigma_v^2 + \sigma_\mu^2]}$ [27], where σ_v^2 was the municipality level variance and σ_μ^2 represented the neighbourhood level variance.

In the null model, the variance partition coefficient (VPC) was computed for the neighbourhood and municipality levels to measure clustering in the probability of having had a Pap test. The VPCs were computed using the latent response

Table 1

Distribution of women who have and have not had a Pap test by socio-demographic factors and unadjusted odds ratios (UOR) with corresponding 95% CI computed in a three-level logistic model ($n = 40,392$).

	All women ($n = 40,410$)	Have had a Pap test ^a		UOR (95% CI)
		Yes	No	
Age group		35,264 (87.3%)	5128 (12.7%)	
41–49 years	9540 (23.61%)	9113 (25.84%)	423 (8.25%)	12.84 (11.48–14.37)
33–40 years	9799 (24.25%)	9315 (26.42%)	478 (9.32%)	11.85 (10.64–13.19)
25–32 years	11,251 (27.84%)	10,331 (29.3%)	915 (17.84%)	6.65 (6.10–7.24)
18–24 years	9820 (24.3%)	6505 (18.45%)	3312 (64.59%)	Ref.
Educational level				
No education	1029 (2.55%)	794 (2.25%)	233 (4.54%)	0.78 (0.65–0.93)
Primary	11,355 (28.1%)	10,203 (28.93%)	1150 (22.43%)	1.69 (1.54–1.86)
Secondary	18,722 (46.33%)	16,175 (45.87%)	2536 (49.45%)	1.03 (0.69–1.12)
Higher	9304 (23.02%)	8092 (22.95%)	1209 (23.58%)	Ref.
Wealth quintiles				
Lowest	9700 (24%)	7943 (22.52%)	1751 (34.15%)	0.60 (0.52–0.69)
Lower	10,335 (25.58%)	9033 (25.62%)	1298 (25.31%)	0.80 (0.70–0.91)
Middle	8474 (20.97%)	7530 (21.35%)	937 (18.27%)	0.87 (0.77–0.99)
Higher	6586 (16.3%)	5929 (16.81%)	656 (12.79%)	0.94 (0.82–1.07)
Highest	5315 (13.15%)	4829 (13.69%)	486 (9.48%)	Ref.
Working status				
No	4182 (10.35%)	3135 (8.89%)	1045 (20.38%)	0.38 (0.35–0.41)
Yes	36,228 (89.65%)	32,129 (91.11%)	4083 (79.62%)	Ref.
Type of health insurance				
Non-affiliated	4627 (11.45%)	3653 (10.36%)	973 (18.97%)	0.30 (0.27–0.33)
Subsidised	20,691 (51.2%)	17,630 (49.99%)	3049 (59.46%)	0.51 (0.47–0.55)
Special	1112 (2.75%)	1033 (2.93%)	79 (1.54%)	1.21 (0.95–1.55)
Contributory	13,980 (34.6%)	12,948 (36.72%)	1027 (20.03%)	Ref.
Area of residence				
Rural	10,948 (27.09%)	9264 (26.27%)	1682 (32.8%)	0.86 (0.79–0.93)
Urban	29,462 (72.91%)	26,000 (73.73%)	3446 (67.2%)	Ref.
Region of residence				
Amazon-Orinoquia	6923 (17.13%)	5697 (16.16%)	1223 (23.85%)	0.69 (0.55–0.86)
Pacific	5875 (14.54%)	5190 (14.72%)	683 (13.32%)	1.00 (0.82–1.23)
Central	9948 (24.62%)	9028 (25.6%)	914 (17.82%)	1.28 (1.07–1.55)
Atlantic	8399 (20.78%)	7114 (20.17%)	1281 (24.98%)	0.70 (0.58–0.84)
Eastern	9265 (22.93%)	8235 (23.35%)	1027 (20.03%)	Ref.
Have had children				
Yes	33,294 (82.39%)	30,690 (87.03%)	2586 (50.43%)	10.22 (9.46–11.05)
No	7116 (17.61%)	4574 (12.97%)	2542 (49.57%)	Ref.
Final say on own health				
Someone else	4914 (12.16%)	3489 (9.89%)	1423 (27.75%)	0.30 (0.28–0.33)
Woman and other	4612 (11.41%)	4083 (11.58%)	529 (10.32%)	0.41 (0.83–1.01)
Woman alone	30,884 (76.43%)	27,692 (78.53%)	3176 (61.93%)	Ref.

Note: All χ^2 tests were significant (p -values < 0.0001).

^a 18 missing values in the outcome variable (excluded from analysis).

variables approach [29]. For the neighbourhood level, the $VPC = \sigma_v^2 / (\sigma_v^2 + \sigma_\mu^2 + 3.29)$, and for the municipality level, the $VPC = \sigma_v^2 / (\sigma_v^2 + \sigma_\mu^2 + 3.29)$.

Akaike's Information Criterion (AIC) was used to compare the fit of competing models [27]. The adequacy of the final model was

assessed using plots of the standardised residuals for the neighbourhood and municipality levels, and receiver-operating characteristic (ROC) curves. Statistical analyses were completed in STATA 12 (StataCorp LP, College Station, TX, USA) at a 5% level of significance.

3. Results

The mean age of the 40,410 women, who provided information on CC screening, was 32.4 years ($SD = 9.0$); socio-demographic characteristics of the sample are presented in Table 1. In total, 87.3% of 40,392 women reported having had a Pap test. Only 18 women ($< 0.1\%$) had missing information about having had a Pap test.

The average numbers of women per neighbourhood and municipality were 8.2 and 156, respectively. Clustering by individual household was not included, as the average number of participating women per household was less than two and 72.9% (29,469/40,410) of units were not replicated. In the null multilevel model (including only the random intercepts), 4.8% and 5.6% of the total variability in the dependent variable was explained by the neighbourhood and municipality levels, respectively. All of the risk

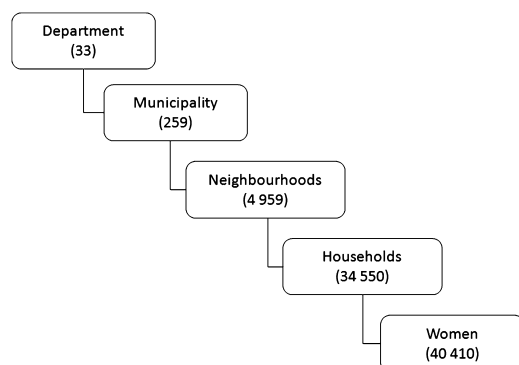


Fig. 1. Hierarchical structure of the 2010 NDHS data.

factors examined were unconditionally associated with the likelihood of having had a Pap test, p -values < 0.0001 (Table 1). Similar associations were also identified in a sub-group analysis of women aged 25–49 years (data not shown).

3.1. Multilevel multivariable analysis

Rural/urban residence was initially removed from the model during the backward selection process; all other variables were retained. However, rural/urban residence was identified as a confounder of the variable describing whether the women had the final say on their own health. Additionally, rural/urban residence modified the effect of education ($p = 0.03$), type of insurance ($p = 0.01$), age group ($p < 0.001$), and region of residence ($p < 0.001$). The model with four interaction terms with rural/urban residence fit substantially better (AIC = 22,691) than the model without rural/urban residence interactions (AIC = 22,729).

The prevalence of no education within the neighbourhoods was a contextual factor also associated with having had a Pap test ($p = 0.005$) (AIC = 22,688). Finally, the interaction between the prevalence of no education within the neighbourhoods and the educational level of women was significant ($p = 0.009$). Thus, the final model including the contextual effect and interactions, as described above, had the best fit of those examined (AIC = 22,683); this model is presented in the Appendix. Standardised residuals for the neighbourhoods and municipalities were within the acceptable range of ± 3 standard deviations from zero. The ROC curve suggested the model had good discrimination power (area under the curve = 0.87, 95% CI 0.87–0.88).

As summarised in Table 2, being in the lowest wealth quintile decreased the likelihood of having had a Pap test when compared to being in the highest quintile (OR = 0.7, $p < 0.001$). Women whose final health decisions depended on somebody else were less likely to have had a Pap test than those who made their own health care decisions (OR = 0.62, $p < 0.001$). Also, Pap testing was less likely among those who were unemployed compared to those who were employed (OR = 0.63, $p < 0.001$). In contrast, women with children were more likely to have had a Pap test compared to those who did not have children (OR = 5.52, $p < 0.001$).

The difference in the odds of having a Pap test among age groups, type of insurance, and region of residence varied based on rural/urban residence. In both rural and urban areas, women in the youngest age group, living in the Amazon-Orinoquía and Atlantic

Table 2

Population-averaged odds ratios (OR), 95% CI, and p -values for risk factors for having had a Pap test among Colombian women from the final multivariable model. Effect estimates reported here were not modified by other variables but were adjusted for other factors in the final three-level logistic regression model ($n = 40,392$).

Predictors	OR	95% CI	p^*
Wealth quintiles			
Lowest	0.70	(0.58–0.84)	<0.001
Lower	0.85	(0.72–1.00)	0.05
Middle	0.91	(0.79–1.06)	0.23
Higher	0.90	(0.78–1.04)	0.14
Highest	Ref.		
Working status			
No	0.63	(0.57–0.69)	<0.001
Yes	Ref.		
Have had children			
Yes	5.52	(5.06–6.02)	<0.001
No	Ref.		
Final say on own health			
Someone else	0.62	(0.57–0.67)	<0.001
Woman and other	1.00	(0.90–1.11)	0.99
Woman alone	Ref.		

* p -values for subject specific coefficients.

regions, with subsidised insurance, and those with no insurance were less likely to have had a Pap test (Table 3). For instance, women living in rural (OR = 0.63, $p < 0.001$) and urban (OR = 0.55, $p < 0.001$) areas with subsidised insurance had lower odds of having Pap testing compared to women with contributory insurance.

After accounting for other risk factors, women living in rural areas were less likely to have a Pap test than women in urban areas (Fig. 2, Table 4). However, the difference between women with limited-to-no education and those with higher education was greater for those living in neighbourhoods with a higher prevalence of no education in both rural and urban areas (Table 4). For instance, among women living in neighbourhoods with 0% prevalence of no education, the odds of having a Pap test for women with no education living in rural areas were 0.32 (95% CI 0.20–0.49) times that of women with higher education living in rural areas.

4. Discussion

The proportion of women who have had at least one Pap test varies across and within countries [14,15,30–33]. In this 2010 study, we found that 87% of the women in Colombia have ever had a Pap test. Other Colombian studies have identified similar results.

Table 3

Population-averaged odds ratios, 95% CI, and p -values for risk factors for having had a Pap test from the final three-level multivariable model. Variables reported here include interactions between rural/urban residence and age group, type of insurance, and region.

Comparisons	OR	95% CI	p^*
Women living in rural areas			
Age group			
18–24 vs. 25–32 years	0.26	(0.22–0.30)	<0.001
18–24 vs. 33–40 years	0.20	(0.16–0.23)	<0.001
18–24 vs. 41–49 years	0.22	(0.18–0.27)	<0.001
25–32 vs. 33–40 years	0.76	(0.63–0.92)	<0.01
Type of health insurance			
Subsidised vs. contributory	0.63	(0.50–0.80)	<0.001
Subsidised vs. special	0.59	(0.44–0.78)	<0.001
Subsidised vs. non-affiliated	1.73	(1.47–2.04)	<0.001
Non-affiliated vs. contributory	0.37	(0.28–0.48)	<0.001
Non-affiliated vs. special	0.35	(0.19–0.65)	<0.001
Region of residence			
Amazon-Orinoquía vs. Eastern	0.63	(0.47–0.85)	<0.01
Amazon-Orinoquía vs. Central	0.38	(0.29–0.50)	<0.001
Atlantic vs. Central	0.48	(0.37–0.63)	<0.001
Atlantic vs. Pacific	0.60	(0.45–0.79)	<0.001
Eastern vs. Central	0.60	(0.46–0.80)	<0.001
Pacific vs. Central	0.47	(0.35–0.63)	<0.001
Women living in urban areas			
Age group			
18–24 vs. 25–32 years	0.29	(0.26–0.32)	<0.001
18–24 vs. 33–40 years	0.17	(0.15–0.20)	<0.001
18–24 vs. 41–49 years	0.14	(0.12–0.16)	<0.001
25–32 vs. 33–40 years	0.60	(0.52–0.70)	<0.001
25–32 vs. 41–49 years	0.47	(0.40–0.56)	<0.001
33–40 vs. 41–49 years	0.79	(0.66–0.94)	<0.01
Health insurance regimen			
Subsidised vs. contributory	0.55	(0.50–0.61)	<0.001
Subsidised vs. special	0.59	(0.44–0.78)	<0.001
Subsidised vs. non-affiliated	1.23	(1.09–1.38)	<0.001
Non-affiliated vs. contributory	0.45	(0.40–0.51)	<0.001
Non-affiliated vs. special	0.48	(0.36–0.64)	<0.001
Region of residence			
Amazon-Orinoquía vs. Central	0.65	(0.50–0.84)	<0.001
Atlantic vs. Central	0.58	(0.47–0.72)	<0.001
Atlantic vs. Pacific	0.63	(0.49–0.80)	<0.001
Eastern vs. Central	0.61	(0.49–0.76)	<0.001
Eastern vs. Pacific	0.66	(0.51–0.86)	<0.01
Pacific vs. Central	0.70	(0.53–0.94)	<0.01

Note: Non-statistically significant comparisons ($p \geq 0.05$) are not presented in this table.

* p -values for subject specific coefficients.

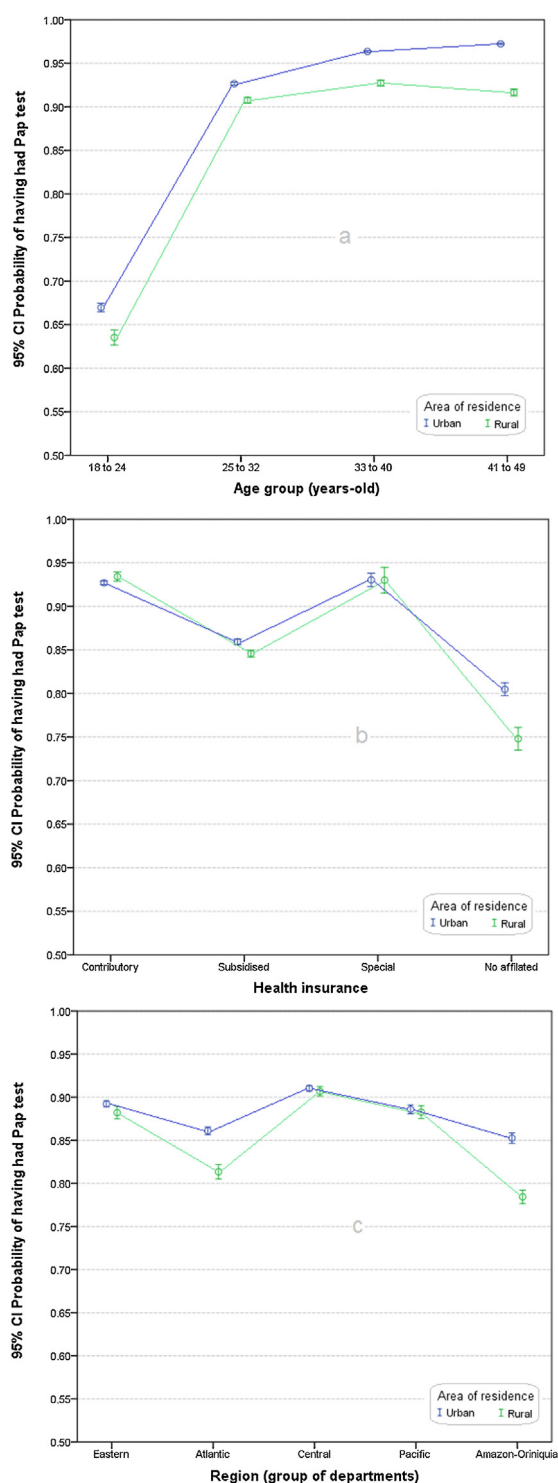


Fig. 2. Probability of having a Pap test among women living in rural and urban areas according to age group, type of health insurance, region of residence, and educational level. In most comparisons, living in rural settings decreased the probability of having had a Pap test, particularly among young women (a), those with no insurance or with subsidised health insurance (b), and women living in the Atlantic and the Amazon-Orinoquía regions (c).

In 2006, in Medellín (Eastern region), about 85% of women reported having had a Pap test [32], and in 2005, in a nationwide sample, 90% of women between 25 and 69 years reported having a recent Pap test [15]. In contrast, a 1998–1999 study found that 67% of women had a Pap test in a municipality located in the Eastern

region [14], and another study in 2007 identified that 56% of university students living in a city located in the Pacific region had at least one Pap test [33]. Notwithstanding, our results provide a recent nationwide figure of Pap testing among Colombian women, evaluating differences by socioeconomic and contextual factors.

Several Colombian [15,16,32] and Latin American studies [34] suggest the existence of substantial differences in Pap test access based on the socioeconomic conditions of women. Moreover, living in rural areas exacerbated other challenges to Pap testing. Soneji and Fukul [34] found that rural residence significantly decreased the probability of having a recent Pap test in Nicaragua, Ecuador, and Peru. In Colombia, women living in rural regions have a lower health status [35] and face high poverty levels, poor possibilities for having a job and receiving a fair income, and limited access to housing, education and health care [36]. Other problems in rural Colombia are the distance between one's home and a health care centre [14,24], violence and war, high vulnerability of youth and women [37], and a lack of knowledge about the SGSSS and the health care rights that citizens have [38].

We observed that having a rural/urban residence modified the effect of age, type of health insurance, region, and education on having had a Pap test. Other authors have reported that younger women have reduced probabilities of having Pap test [14,16,25,31,32], especially if residing in rural areas [14]. Although better coverage of subsidised health insurance in rural areas has been reported in Colombia [21], people with subsidised health insurance receive 40% less health care compared to those with contributory health insurance [21]. In this regard, our results also show that women in rural areas with subsidised insurance have a lower probability of having had a Pap test. This finding supports that having health insurance does not ensure accessing health care services in Colombia [24]. Not having health insurance is also a critical factor for not having a Pap test [15,25], especially in rural areas [15]. Barriers for enrolling, co-payments established by health insurance companies, or lack of specialists are difficulties faced by rural people with no insurance in Colombia [39]. Additionally, Pap screening in the Atlantic and Amazon-Orinoquía regions is particularly poor [40], especially in rural areas, as we identified.

Our study demonstrates the remarkable role of education at the individual and neighbourhood levels. Limited access to education decreases the Pap test uptake, particularly in rural locations. Education is critical to access information about CC screening programmes [15,32,34], know the role of the human papillomavirus infection [41] and other risk factors [30], and decrease myths about the Pap test [42]. Moreover, lack of awareness of Colombian citizen health care rights makes Colombians more vulnerable by limiting their capacity to access health services and perpetuating the ineffectiveness of bureaucracy [24]. This highlights the importance of education in access to health care in Colombia, including Pap testing. Coughlin et al. [43] have suggested that the context has a supplementary role in the uptake of Pap tests. We found that the differences among women with different educational backgrounds were greater in areas that had a higher prevalence of no education, suggesting that the impact of education on Pap testing goes beyond individual educational achievement. Additionally, negative opinions of neighbours or peers about Pap screening influence the willingness of women to have the test [44,45]. Certain attitudes of partners could make participating in CC screening programmes difficult [44]; machismo and jealousy of partners are obstacles women experience when seeking a Pap test, especially if the health care provider is male [45,46]. In contrast, support from partners, children, and family members increases women's likelihood of having a Pap test [44]. Furthermore, feeling ownership of one's body is described as a critical factor for Pap test uptake [45,46], explaining why women

Table 4

Population-averaged odds ratios, 95% CI, and *p*-values for risk factors for having had a Pap test from the final three-level multivariable model. Variables reported here include interactions between rural/urban residence and educational level, considering three scenarios of prevalence of no education in neighbourhoods.

Comparisons	Prevalence of no education in neighbourhoods where women lived								
	0%			20%			50%		
	OR	95% CI	<i>p</i> [*]	OR	95% CI	<i>p</i> [*]	OR	95% CI	<i>p</i> [*]
Between urban and rural areas^a									
No education vs. no education	2.14	(1.35–3.39)	<0.001	2.14	(1.35–3.39)	<0.001	2.14	(1.35–3.39)	<0.001
Primary vs. primary	1.39	(1.04–1.87)	0.03	1.39	(1.04–1.87)	0.03	1.39	(1.04–1.87)	0.03
Secondary vs. secondary	1.76	(1.34–2.31)	<0.001	1.76	(1.34–2.31)	<0.001	1.76	(1.34–2.31)	<0.001
Higher vs. higher	1.63	(1.14–2.35)	0.01	1.63	(1.14–2.35)	0.01	1.63	(1.14–2.35)	0.01
Within women living in rural areas									
No education vs. primary	0.43	(0.30–0.61)	<0.001	0.43	(0.34–0.55)	<0.001	0.44	(0.29–0.65)	<0.001
No education vs. secondary	0.43	(0.30–0.62)	<0.001	0.31	(0.24–0.42)	<0.001	0.20	(0.12–0.33)	<0.001
No education vs. higher	0.32	(0.20–0.49)	<0.001	0.19	(0.11–0.32)	<0.001	0.09	(0.03–0.27)	<0.001
Primary vs. secondary	0.99	(0.85–1.15)	0.88	0.73	(0.59–0.90)	0.003	0.46	(0.27–0.76)	0.003
Primary vs. higher	0.74	(0.55–0.98)	0.04	0.44	(0.27–0.72)	0.001	0.21	(0.07–0.63)	0.005
Secondary vs. higher	0.74	(0.57–0.97)	0.03	0.61	(0.37–0.99)	0.05	0.45	(0.14–1.41)	0.17
Within women living in urban areas									
No education vs. primary	0.66	(0.47–0.94)	0.02	0.66	(0.48–0.92)	0.01	0.67	(0.39–1.14)	0.14
No education vs. secondary	0.52	(0.37–0.73)	<0.001	0.38	(0.27–0.54)	<0.001	0.24	(0.13–0.44)	<0.001
No education vs. higher	0.42	(0.29–0.59)	<0.001	0.25	(0.15–0.42)	<0.001	0.12	(0.04–0.37)	<0.001
Primary vs. secondary	0.78	(0.69–0.89)	<0.001	0.57	(0.46–0.72)	<0.001	0.36	(0.21–0.62)	<0.001
Primary vs. higher	0.63	(0.54–0.73)	<0.001	0.38	(0.24–0.60)	<0.001	0.18	(0.06–0.54)	0.002
Secondary vs. higher	0.80	(0.72–0.89)	<0.001	0.66	(0.42–1.04)	0.07	0.49	(0.15–1.53)	0.22

^{*} *p*-values for subject specific coefficients.

^a Computed for women aged 18–24 years, living in the Amazon-Orinoquía region, and with no health insurance.

who made their own health care decisions were more likely to have had a Pap test.

Unemployment has been also associated with lack of autonomy and decreased access to information about the Pap test [25], explaining why not working was associated with lower reports of Pap test uptake. Notwithstanding, having a job in Colombia does not necessarily mean having health insurance [47] despite affiliation with a health insurance provider is mandatory for employees and self-employed individuals [17]. Another obstacle for having Pap testing is that women are implicitly acknowledging to family and peers that they are or have been sexually active [44,48]; fear of negative reactions from parents or others in authority could be a barrier for Pap screening by young and single women [44]. On the other hand, having children has been associated with increased uptake of Pap tests [15,25,48] because women want to be healthy so they can look after their families [44], and also because maternity often exposes them to health care services.

One of the limitations of the present study is that self-reported information might not represent the actual Pap test coverage in Colombia. Test uptake could be overestimated or underestimated because of social desirability and lead to misclassification bias [31]. Using objective measures about CC screening has been recommended to overcome this problem [49]. Because this was a cross-sectional study, caution is necessary in assuming cause-effect relationships between risk factors and Pap test uptake, particularly for factors where risk changes over time.

In conclusion, 13% of the women who participated in this study and were eligible for CC screening in Colombia never had a Pap test. This nationwide study demonstrates the continued presence of inequities and a social gradient for the uptake of Pap tests which need to be considered when planning and evaluating CC programmes. The likelihood of having had a Pap test was lowest among poor, unemployed, and women whose health care decisions depended on others. Furthermore, having a rural residence decreased the probability of Pap testing among younger women, those with no health insurance, living in isolated regions, and those with limited-to-no education. A context of high prevalence of no education in the neighbourhood decreased Pap test uptake,

particularly among women living in rural areas. Specific strategies should be developed to consider individual and contextual factors when designing new approaches to increase participation of women in CC screening programmes. Efforts to improve access to CC screening should focus on disadvantaged populations, especially among those living in rural/isolated areas.

Conflict of interest

Authors declare no conflict of interest.

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Authorship contribution

S. Bermedo-Carrasco designed the study, conducted the analyses, interpreted the results, and drafted the manuscript; J.N. Peña-Sánchez contributed to the study design, analyses and interpretation of the results; R. Lepnurm collaborated with the interpretation of the results; M. Szafron collaborated with the methodology and interpretation of the results; and C. Waldner contributed in the methodology, data analysis, and interpretation of the results. All the authors critically reviewed the manuscript and approved the final version submitted to the journal.

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Appendix

Final multilevel model of ever having had a Pap test.

$$\log\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X_{\text{wealth}} + \beta_2 X_{\text{final_say}} + \beta_3 X_{\text{children}} + \beta_4 X_{\text{work}} + \beta_5 X_{\text{education}} + \beta_6 X_{\text{insurance}} + \beta_7 X_{\text{region}} + \beta_8 X_{\text{Rural/urban}} + \beta_9 X_{\text{age}} + \beta_{10} X_{\text{neighbourhood_prev_no_Educ}} + \beta_{11} X_{\text{neighbourhood_prev_no_Educ}} X_{\text{education}} + \beta_{12} X_{\text{Rural/urban}} X_{\text{education}} + \beta_{13} X_{\text{Rural/urban}} X_{\text{insurance}} + \beta_{14} X_{\text{Rural/urban}} X_{\text{age}} + \beta_{15} X_{\text{Rural/urban}} X_{\text{region}} + \nu + \mu,$$

where the subscripted names represent:

- wealth: wealth quintile; reference category = highest;
- final_say: final say on health; reference category = respondent alone;
- children: having had children or not; reference category = no;
- work: current working status; reference category = yes;
- education: educational level; reference category = higher;
- insurance: type of insurance; reference category = contributory;
- region: regions of the country; reference category = Eastern;
- rural/urban: rural/urban area of residence; reference category = urban;
- age: group of age; reference category = 18–24 years;
- neighbourhood_prev_no_Educ: prevalence of no education within neighbourhoods;
- ν error at the municipality level;
- μ error at the neighbourhood level.

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