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Decomposing income-related inequality in cervical screening in 67 countries

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Abstract
Objectives The development of successful policies to reduce income-related inequalities in cervical cancer screening rates requires an understanding of the reasons why low-income women are less likely to be screened. We sought to identify important determinants contributing to inequality in cervical screening rates.
Methods We analyzed data from 92,541 women aged 25–64 years, who participated in the World Health Survey in 2002–2003. Income-related inequality in Pap screening was measured using the concentration index (CI). Using a decomposition method for the CI, we quantified the contribution to inequality of age, education level, marital status, urbanicity and recent health-care need.
Results There was substantial heterogeneity in the contributions of different determinants to inequality among countries. Education generally made the largest contribution (median = 15%, interquartile range [IQR] = 23%), although this varied widely even within regions (e.g., 5% in Austria, 28% in Hungary). The contribution of rural residence was greatest in African countries (median = 10%, IQR = 13%); however, there was again substantial within-region variation (e.g., 26% in Zambia, 2% in Kenya).
Conclusions Considerable heterogeneity in the contributions of screening determinants among countries suggests interventions to reduce screening inequalities may require country-specific approaches.

Keywords Cervical cancer screening · Socioeconomic inequality · Decomposition

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Introduction

Cervical cancer disproportionately affects poor, socially marginalized women around the world. The major burden of cervical cancer is in developing countries, where over 80% of the 500,000 cases and 300,000 deaths each year occur (Sankaranarayanan and Boffetta 2010). Striking inequalities exist not only between better- and worse-off nations, but also between more and less socioeconomically advantaged groups within countries (Parikh et al. 2003). Between- and within-country inequalities in cervical cancer incidence and deaths primarily reflect inequalities in cervical screening coverage, as well as differences in risk factors for exposure to human papillomavirus (HPV) (IARC 2005).

Studies conducted in high-income countries, including those with universal health-care access, have found that women from socioeconomically disadvantaged backgrounds are less likely to receive cervical cancer screening (Baker and Middleton 2003; Maxwell et al. 2001; Moser et al. 2009; Puig-Tintoré et al. 2008; Siahpush and Singh 2002; Sutton and Rutherford 2005; Todorova et al. 2009; Eaker et al. 2001; Alves et al. 2009; Akers et al. 2007). Much more limited data exist on socioeconomic inequalities in cervical cancer screening within developing countries, where most research has relied on small sub-national samples (Chan et al. 2002; Martins et al. 2009; Arrossi et al. 2008; Lazcano-Ponce et al. 1997; Wellensiek et al. 2002). Cross-national comparisons of inequality in cervical screening have focused mainly on between-country inequalities in average screening rates. For example, a recent comparison of cervical screening coverage in 57 countries reported that 63 and 19% of women of age 25–64 years in high- and low-income countries, respectively, had been screened for cervical cancer in the past 3 years (Gakidou et al. 2008). Furthermore, in both high- and low-income countries, research on socioeconomic inequalities in screening has typically focused on comparisons of extreme socioeconomic groups rather than assessing screening across the entire socioeconomic spectrum. In cross-country comparisons, inequality measures that compare only extreme groups may lead to very different country rankings than methods that account for the entire distribution of socioeconomic position (Gwatkin et al. 2007).

We contribute to the literature on cross-national differences in cervical screening in two respects. First, we calculate and report cross-population comparable within-country summary measures of income-related inequality in cervical cancer screening that account for the full distribution of socioeconomic position. Second, we decompose income-related health inequalities within countries into constituent socio-demographic and behavioral determinants. This decomposition allows identification of the relative contributions of other factors in explaining income-related inequality on a country-by-country basis. Identifying determinants that contribute substantially to income-related inequality may reveal potential areas to intervene to reduce screening inequalities.

Methods

Data

The World Health Survey (WHS) is a large cross-sectional study conducted in 70 high-, middle-, and low-income countries in 2002–2003. It was designed to provide a comprehensive assessment of population health, including socio-demographics, adult and child morbidity and mortality, risk factors, health-care expenditures, and coverage of health interventions (Ustun et al. 2003). Using a multistate cluster design, random national samples were obtained for all participating countries except China, Comoros, the Republic of Congo, Côte d'Ivoire, India, and the Russian Federation.

Full details of the surveys are available on the WHS Web site (WHO). Briefly, adults aged 18 years and older who were living in private households were eligible to be interviewed. Face-to-face interviews were conducted in all countries except Australia, Israel, Luxembourg, and Norway. In these countries, computerized telephone interviews were employed. Interviewers were lay people with at least a high school education who had attended a training session. All questionnaires were translated into local languages and modified for cultural appropriateness according to standard World Health Organization (WHO) protocol.

Measures

The WHS included two questions related to cervical cancer screening that were asked of all women aged 18–70 years: (1) "When was the last time you had a pelvic examination, if ever?" and (2) "The last time you had the pelvic examination, did you have a PAP smear test?" Women were asked the latter only if they reported having a pelvic examination in the past 3 years. Interviewers provided prepared descriptions of pelvic examination and Pap smear test in cases where the interviewee seemed unsure of the procedures (WHO 2002) To maintain consistency with a previous analysis of cervical screening using the WHS data, our analyses included women between 25 and 64 years of age (Gakidou et al. 2008).

We used permanent income as our variable for socioeconomic status, which was estimated using the asset-based approach developed by Ferguson et al. (2003). This approach uses household ownership of assets (e.g., a car, a radio), access to services (e.g., electricity, drinking water), and known predictors of income (e.g., age, education) to estimate permanent household income. Assets for each country are chosen to estimate country-specific distributions of permanent income that can then be adjusted to an internationally comparable scale to enable cross-country comparisons. Asset-based measures of permanent income have been validated against reported household income and expenditures using household survey data from Greece, Peru, and Pakistan (Ferguson et al. 2003). This approach has also been applied in several previous studies (Gakidou et al. 2007; Gakidou and Vayena 2007; Pongou et al. 2006; Vapattanawong et al. 2007).

For the decomposition analysis, we examined variables that have been found to be associated with both cervical screening and permanent income: age, education level, marital status, and urbanicity (Palencia et al. 2010; Akers et al. 2007; Arrossi et al. 2008; Leyden et al. 2005; Albuquerque et al. 2009). We also included a variable indicating whether or not the woman reported needing health care for herself or her child within the past year (Winkler et al. 2008). Age and education were continuous variables, measured in years. Marital status and urbanicity were coded as indicator variables (never married vs. married/cohabitating, separated/divorced/widowed vs. married/cohabitating, and urban/peri-urban vs. rural residence).

Of the 110,658 women aged 25–64 years who participated in the WHS, data for both cervical screening and permanent income were available for 92,541 women. The surveys from Turkey and Norway had missing data on income, cervical screening, or both, and were excluded from the analysis. We also excluded Myanmar because income was missing for 81% of the eligible subjects. For the decomposition analysis, the sample size was reduced to 89,371 because we excluded women who had missing data on any of the five determinants. Netherlands, Australia, and Slovenia had missing data on urbanicity for all subjects, so we performed the decomposition analysis without urbanicity as a determinant for these three countries. Finally, unweighted analyses are reported for Austria, Denmark, Germany, Greece, Guatemala, Italy, The Netherlands, Slovenia, and the UK because probability-sampling weights were not available for these countries.

Statistical analysis

We measured within-country income-related inequalities in cervical screening rates using the concentration index (CI) (Wagstaff et al. 1991; Kakwani et al. 1997). The CI quantifies the magnitude of inequality portrayed by the concentration curve, a plot of the share of health accounted for by cumulative proportions of individuals ranked according to socioeconomic position. Figure 1 shows the relative concentration curves for cervical screening for Guatemala and Spain. The curves extend below the diagonal 45° line of equality for both countries, indicating the presence of inequality to the disadvantage of the poor. However, inequality was more prominent in Guatemala, where the poorest 50% of women obtained just over 20% of the country's total cervical screenings, compared to just over 40% in Spain.

The CI is defined as twice the area between the concentration curve and the line of equality (Wagstaff et al. 1991). The index ranges from −1 to 1, with 0 representing complete equality. For a positive health variable such as cervical screening, positive values of the index indicate inequality to the disadvantage of the poor, and negative values indicate inequality to the disadvantage of the rich. The relative CI can be written as:

$$\mathrm{CI} = \frac{2}{n\mu}\sum_{i=1}^{n} y_i R_i - 1, \quad (1)$$

where μ is the overall screening rate, y_i is the screening status of the ith individual, and R_i is the ith individual's rank in the income distribution (Wagstaff et al. 1991). We applied the normalization formula proposed by Wagstaff (2005) to correct for the fact that the maximum values of the CI are bounded by the overall prevalence when the health variable is binary. This was accomplished by dividing the CI by $1 - \mu$. This normalized CI was used to measure relative inequalities in other studies with binary health outcomes (Khadr 2009; Harper and Lynch 2007). We refer to the normalized CI as W. The absolute concentration index (ACI) is calculated by multiplying the CI by the mean of the health variable (μ). We report confidence intervals for W and ACI, with standard errors corrected for heteroskedasticity and autocorrelation of the rank variable (O'Donnell et al. 2007).

Wagstaff et al. (2003) showed that the CI can be decomposed by relating the health outcome y_i to a set of k potential determinants, x_{ki}:

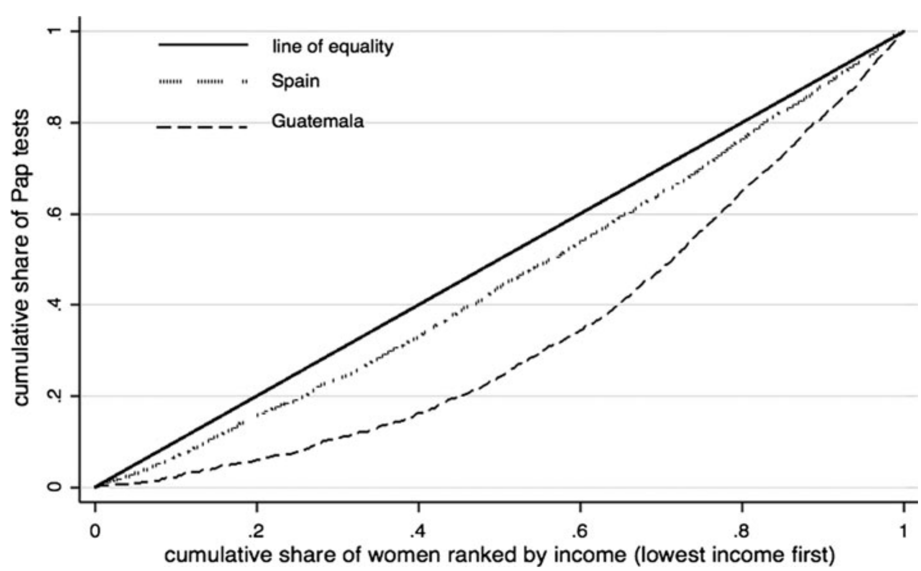

Fig. 1 Concentration curves for cervical screening rates in Guatemala and Spain, World Health Survey 2002–2003

$$y_i = \alpha + \sum_k \beta_k x_{ki} + \varepsilon_k \quad (2)$$

where the β_k are regression coefficients and ε_i is an error term. Although the assumption of linearity of this equation is necessary for the decomposition, it can be extended to allow for binary health outcomes (Gravelle 2003).

The proportional contribution of each x_k to overall socioeconomic inequality will be the same whether one considers decomposing relative or absolute inequality. Because we mainly focus on cross-country comparisons of absolute inequality, we decomposed the ACI using the following equation:

$$\text{ACI} = \sum_k \beta_k \text{ACI}_k + \text{ACI}_\varepsilon \quad (3)$$

where β_k are the regression coefficients from Eq. 2, ACI_k is the absolute concentration index for x_k, and ACI_ε represents the portion of inequality that cannot be explained by variation in the x_k across income. The first term ($\beta_k\text{ACI}_k$) thus measures the combined contribution to overall income-related inequality in screening of each determinant's effect on screening and its association with income. Both the determinant's effect on screening and its association with income can be either negative or positive, thus the contribution can also be negative or positive. For example, if higher education increases the likelihood of screening (positive β_k) and is more concentrated among the well off (positive ACI_k), education will make a positive contribution to the overall ACI. A negative contribution indicates that there is either no pro-rich inequality in the determinant (ACI_k is negative) or that the determinant decreases the likelihood of screening (β_k is negative).

Using this method, we examined the magnitude of income-related screening inequality due to differences in age, marital status, urbanicity, education, and a measure of recent health-care need. Because cervical screening was measured as a binary variable, we used a probit model with marginal effects in the decomposition analysis (O'Donnell et al. 2007). It has been noticed that the contributions obtained using the probit model may change depending on the reference category chosen for the determinants in the model (Yiengprugsawan et al. 2010). Marital status was our only variable with possible alternate reference categories; thus, we checked the decomposition results using the different reference categories, detecting no important differences. We proceeded with the probit model using currently married/cohabitating as the reference. The decomposition analysis was performed for all countries with statistically significant screening inequality (i.e., the 95% confidence interval for the CI excluded zero, the value signifying no inequality).

The WHS had missing data ranging from 0.4 to 35.2% by country for the questions on cervical screening. To address the missing data problem, we compared the demographic profiles of subjects with missing data on the cervical screening questions to those with data, finding no large discrepancies. We also performed sensitivity analyses for calculation of the concentration indices under four hypothetical scenarios. To do this, we generated four data sets by making assumptions about observations that were missing for Pap screening and income as follows: (1) unscreened, income = 10th percentile of income distribution; (2) unscreened, income = 90th percentile; (3) screened, income = 10th percentile; (4) screened, income = 90th percentile. All analyses were performed using Stata, version 11.

Results

There were wide variations in cervical screening rates among countries, ranging from <1% in Ethiopia and Bangladesh to 83% in Austria (Table 1). In 15 countries, all located in Asia or Africa, <5% of women had a Pap screen in the past 3 years. Country-specific means for each of the determinants included in the decompositions are also presented in Table 1.

Table 2 shows the normalized (W) and absolute concentration indices (ACI) along with their corresponding 95% confidence intervals for each of the 67 countries. There was statistically significant income-related screening inequality in 50 countries. Country rankings on inequality were highly dependent on whether we examined *W* or ACI. For example, although Laos had the largest *W*, it ranked 44th in terms of absolute inequality (ranks are found in the last two columns of Table 2).

The Americas had the largest inequality among regions (median ACI = 0.058, interquartile range [IQR] = 0.043), with Guatemala and Paraguay ranked number one and two out of all countries in terms of absolute inequality (ACI = 0.128 and 0.079, respectively). However, there was substantial variation even among countries in the Americas region, with Mexico and Ecuador having low levels of inequality (ACI = 0.023 and 0.035, respectively). In general, we observed substantial heterogeneity in the magnitude of inequality among countries, even within regions. For example, screening inequality in China (ACI = 0.067) was substantially greater than in Vietnam (ACI = 0.009), and in South Africa (ACI = 0.056) was much greater than in neighboring Zimbabwe (ACI = 0.013).

Table 3 presents the regression coefficients (β_k) and ACI for the determinants in the decomposition analysis. The β_k for income are positive in all countries, indicating that there is still an association between income and cervical screening after controlling for the other determinants. In the majority of countries, higher education level, urban

Table 1 Pap screening rates and characteristics of the determinants for women of age 25–64 years by World Health Survey by country, 2002–2003

WHO region	Country	Number of women	Percentage had Pap screen in past 3 years	Average age	Percentage urban	Percentage never married	Percentage divorced, separated, widowed	Average years of education	Percentage received health care[a]
Africa	Burkina Faso	1,596	5.1	38.9	13.7	1.3	8.1	0.5	51.7
	Chad	1,404	5.6	36.8	16.6	2.4	17.6	0.6	24.2
	Comoros	618	7.9	41.5	31.7	11.2	21.1	2.5	49.6
	Congo	783	23.4	38.5	93.2	23.3	19.0	4.5	57.2
	Côte d'Ivoire	803	7.2	37.2	72.4	19.0	15.9	3.8	54.5
	Ethiopia	1,654	0.8	38.4	12.3	4.2	17.2	1.7	43.6
	Ghana	1,509	2.8	40.3	42.5	7.8	20.3	4.6	63.7
	Kenya	1,691	3.5	37.6	15.5	11.1	16.1	7.9	78.0
	Malawi	1,735	2.6	38.3	9.5	2.6	24.6	3.6	78.3
	Mali	982	4.3	40.5	25.8	6.4	13.3	0.5	34.8
	Mauritania	1,415	3.8	39.3	48.6	8.4	22.2	2.0	44.3
	Mauritius	1,509	13.6	41.8	42.8	8.0	13.7	8.0	73.2
	Namibia	1,525	13.6	38.9	40.3	45.1	12.1	7.4	43.6
	Senegal	764	10.9	39.1	44.8	9.8	13.9	1.7	56.9
	South Africa	817	19.3	40.2	56.6	40.3	16.8	8.8	43.0
	Swaziland	726	3.7	40.2	25.8	26.1	9.8	6.2	22.9
	Zambia	1,300	3.4	38.5	32.9	7.0	25.4	5.3	75.9
	Zimbabwe	1,662	9.4	39.4	39.4	4.5	28.2	6.9	63.9
Americas	Brazil	2,065	71.8	41.9	85.7	14.6	17.7	6.8	77.0
	Dominican Republic	1,686	66.0	40.6	65.7	7.2	24.8	7.8	77.5
	Ecuador	1,427	47.0	40.9	84.8	11.8	12.5	8.4	70.9
	Guatemala	2,020	40.3	39.7	45.7	7.0	13.7	3.8	75.2
	Mexico	15,869	63.8	41.2	79.4	12.2	13.6	7.1	76.8
	Paraguay	1,922	51.4	41.1	56.2	20.1	7.7	7.6	81.3
	Uruguay	1,074	62.4	43.3	74.9	16.7	21.5	11.3	64.9
Eastern Mediterranean	Morocco	1,782	4.6	41.2	63.0	14.2	10.5	2.8	72.8
	Pakistan	1,696	2.3	38.9	27.4	3.5	5.0	1.4	70.7
	Tunisia	1,857	9.8	41.2	63.8	18.4	6.8	5.4	77.8
	United Arab Emirates	399	21.0	38.4	76.3	7.0	7.9	10.3	56.4
Europe	Austria	465	83.2	43.3	69.9	15.8	21.2	11.1	74.1
	Belgium	372	73.1	43.0	81.3	14.9	29.2	13.7	81.2
	Bosnia and Herzegovina	379	39.8	41.9	45.6	8.9	13.0	9.7	58.5
	Croatia	396	65.3	46.4	65.3	7.9	12.9	11.0	85.0
	Czech Republic	335	73.6	42.8	76.8	6.4	19.3	12.2	87.8
	Denmark	370	68.1	44.3	63.5	10.0	11.4	12.8	96.8
	Estonia	435	53.0	45.3	72.0	11.8	27.9	13.1	75.6
	Finland	358	66.3	47.0	65.2	8.8	19.0	12.9	88.6
	France	445	75.9	43.0	43.8	14.8	21.8	14.1	81.6
	Georgia	893	12.8	43.3	56.2	16.2	14.5	12.7	38.6
	Germany	478	74.1	45.4	87.2	11.8	25.1	11.2	73.2
	Greece	321	44.9	44.8	73.5	5.3	8.7	10.3	76.3
	Hungary	538	63.8	45.6	66.5	8.2	22.6	12.0	80.3
	Ireland	371	39.3	43.9	57.4	12.7	11.7	12.8	66.7
	Israel	443	45.2	41.8	90.5	10.6	10.9	13.8	91.7
	Italy	370	67.6	44.4	68.6	20.6	14.9	11.8	80.3
	Kazakhstan	2,457	80.3	41.3	81.5	10.1	28.7	13.4	61.0
	Latvia	335	77.5	45.7	68.0	10.8	36.6	12.6	65.7
	Luxembourg	253	81.8	42.4	100.0	8.7	12.6	12.2	90.5
	Netherlands	455	51.6	47.4		13.6	27.2	12.9	88.4
	Portugal	357	57.8	45.4	50.6	13.2	13.7	6.6	81.6

Table 1 continued

WHO region	Country	Number of women	Percentage had Pap screen in past 3 years	Average age	Percentage urban	Percentage never married	Percentage divorced, separated, widowed	Average years of education	Percentage received health care[a]
	Russia	1,648	78.2	45.0	90.1	7.5	34.4	13.0	67.8
	Slovakia	822	61.3	39.4	82.2	16.8	23.4	13.4	89.5
	Slovenia	204	73.0	44.4		16.8	17.8	11.8	76.5
	Spain	2,195	60.3	44.7	79.6	12.8	8.8	10.2	77.6
	Sweden	371	71.0	46.6	51.5	7.9	17.1	13.3	72.8
	Ukraine	1,007	73.7	45.3	71.3	4.9	22.6	13.3	69.4
	UK	471	60.7	43.4	92.6	13.3	24.1	12.4	74.9
Southeast Asia	Bangladesh	2,095	0.4	39.7	17.6	0.9	14.0	2.6	91.9
	India	3,390	3.1	39.8	11.4	1.5	9.7	2.3	66.2
	Nepal	3,486	2.8	39.7	14.6	1.5	8.2	1.5	59.2
	Sri Lanka	2,274	1.5	42.2	15.4	8.1	9.0	8.7	66.2
Western Pacific	Australia	1,520	72.1	44.5		10.7	15.9	13.3	94.0
	China	1,497	21.0	42.5	29.6	2.2	3.6	6.9	64.3
	Laos	1,938	3.2	40.1	28.2	4.1	11.8	3.6	18.2
	Malaysia	2,566	29.8	40.1	64.0	9.2	8.3	8.3	58.7
	Philippines	4,022	9.3	40.8	51.5	8.7	8.9	8.6	36.4
	Vietnam	1,448	6.5	40.7	16.1	6.4	5.7	7.3	56.4

[a] A woman received health care for herself or a child in the past 1 year

residence, younger age, and health-care need were associated with an increased probability of screening. Concentration indices for the determinants are mostly consistent across countries, demonstrating that rural residence, divorced/separated/widowed status, and, especially, lower education level, tend to be more concentrated among the poor.

The percent contributions of each of the determinants to overall income-related screening inequality are presented in Table 4. In general, there was heterogeneity in the contributions of different determinants to inequality, although some general trends did emerge. Besides income itself, education made the largest contribution to explaining inequality (median = 15%, IQR = 23%), although its contribution varied widely even within regions (e.g., 5% in Austria, 28% in Hungary). The contribution of rural residence was greatest in African countries (median = 10%, IQR = 13%), although there was again substantial within-region variation (e.g., 26% in Zambia, 2.3% in Kenya). With a few exceptions, income-related screening inequality in European countries was minimally explained by urban/rural residence (median = 0.3%, IQR = 5%). Many countries had small contributions for marital status; however, there were also a few countries that had large negative contributions (for example, Finland and Sweden with −38.8 and −34.4%, respectively). These negative contributions resulted because unmarried and divorced/widowed women were both more likely to be screened than married women (i.e., β_ks were positive), but also more likely to be poor (negative concentration indices). Finally, with few exceptions, age generally made small contributions to screening inequality, largely because it had weak effects on the likelihood of screening.

The percentage of inequality unexplained by the determinants was <10% in 21 of the 50 countries examined in the decomposition analysis. For the most part, the unexplained portion of the ACI was large in eastern Mediterranean and southeast Asian countries, moderate in countries in Africa, the Western Pacific, and the Americas (median = 21, 9, and 11%, respectively), and smallest in European countries (median = 6.8%).

In the sensitivity analysis, we found that the ACIs for our complete case analysis were close to the ACIs for each of the four scenarios for the majority of countries (see Supplemental Table 1).

Discussion

This study confirms the existence of widespread pro-rich inequality in cervical screening around the world. In line with previous findings, our results point to a high degree of screening inequality in southern and eastern Europe and the Americas (Todorova et al. 2009; Palencia et al. 2010; Arrossi et al. 2008). We extend the results of a previous cross-country comparison of cervical screening that used the WHS data in two important ways (Gakidou et al. 2008). First, in contrast to the previous study, which presented

Table 2 Proportion of women who had a Pap test in the past 3 years by income quintile, and normalized and absolute concentration indices for Pap screening among women of age 25–64 years, World Health Survey 2002–2003

WHO region	Country	Percent of women who had a Pap test in the past 3 years by income quintile					Normalized concentration index, W (95% CI)		Absolute concentration index × 10^1, ACI (95% CI)		Rank (largest to smallest)	
		1	2	3	4	5					W	ACI
Africa	Burkina Faso	6.7	3.4	3.6	4.3	7.8	0.048	(−0.17 to 0.26)	0.023	(−0.08 to 0.13)	66	65
	Chad	1.0	4.1	5.6	8.4	12.6	0.419	(0.30–0.53)	0.222	(0.16–0.28)	5	39
	Comoros	9.0	6.4	6.5	10.4	6.9	0.061	(−0.12 to 0.24)	0.045	(−0.09 to 0.18)	63	62
	Congo	17.8	22.9	18.9	19.8	35.7	0.161	(−0.02 to 0.35)	0.289	(−0.04 to 0.62)	44	30
	Côte d'Ivoire	4.8	3.1	6.5	8.6	11.8	0.246	(0.08–0.41)	0.163	(0.06–0.27)	31	46
	Ethiopia	0.3	0.9	0.0	1.0	1.9	0.383	(0.03–0.74)	0.032	(0.00–0.06)	9	63
	Ghana	1.6	1.8	2.9	4.0	15.4	0.311	(0.11–0.51)	0.084	(0.03–0.14)	18	59
	Kenya	0.9	2.2	2.1	5.1	7.4	0.393	(0.23–0.56)	0.134	(0.08–0.19)	8	49
	Malawi	2.5	4.4	0.7	3.3	2.5	0.048	(−0.16 to 0.25)	−0.012	(−0.07 to 0.04)	67	67
	Mali	2.0	2.2	5.3	3.1	11.3	0.321	(0.15–0.49)	0.133	(0.06–0.21)	13	50
	Mauritania	1.6	1.2	4.7	5.9	6.3	0.307	(0.15–0.47)	0.114	(0.05–0.17)	19	53
	Mauritius	11.0	8.9	13.6	11.9	21.3	0.199	(0.11–0.29)	0.233	(0.12–0.34)	39	37
	Namibia	5.7	6.7	8.0	18.0	27.9	0.435	(0.34–0.53)	0.503	(0.39–0.61)	4	15
	Senegal	8.3	7.4	9.1	14.5	15.0	0.181	(0.02–0.35)	0.176	(0.02–0.34)	41	43
	South Africa	6.3	18.5	14.8	18.5	44.1	0.356	(0.21–0.51)	0.556	(0.32–0.79)	10	12
	Swaziland	1.8	1.6	6.3	2.1	10.5	0.346	(0.09–0.61)	0.125	(0.03–0.22)	11	52
	Zambia	2.6	2.6	1.5	3.2	8.4	0.272	(0.06–0.49)	0.092	(0.02–0.17)	24	57
	Zimbabwe	4.9	10.7	10.0	8.8	14.3	0.151	(−0.01 to 0.32)	0.128	(−0.01 to 0.27)	48	51
Americas	Brazil	55.4	68.9	68.3	76.0	88.4	0.296	(0.24–0.36)	0.599	(0.48–0.72)	21	9
	Dominican Republic	51.2	62.1	81.4	67.7	74.2	0.195	(0.11–0.28)	0.437	(0.25–0.63)	40	21
	Ecuador	35.2	45.0	57.4	48.1	51.2	0.141	(0.04–0.24)	0.352	(0.10–0.60)	52	27
	Guatemala	10.2	21.9	37.9	58.2	69.6	0.532	(0.49–0.58)	1.282	(1.17–1.39)	2	1
	Mexico	57.3	61.9	63.9	65.1	69.6	0.101	(0.07–0.13)	0.232	(0.17–0.30)	59	38
	Paraguay	32.4	44.6	45.6	57.0	71.0	0.314	(0.25–0.37)	0.785	(0.63–0.94)	16	2
	Uruguay	48.1	56.4	63.8	61.2	75.5	0.246	(0.16–0.33)	0.577	(0.38–0.78)	30	10
Eastern Mediterranean	Morocco	3.7	5.8	1.1	7.2	7.4	0.119	(−0.09 to 0.33)	0.052	(−0.04 to 0.14)	57	61
	Pakistan	1.2	2.4	2.6	3.4	6.4	0.312	(0.12–0.51)	0.094	(0.04–0.15)	17	56
	Tunisia	6.3	7.8	10.3	11.3	14.9	0.203	(0.10–0.30)	0.179	(0.09–0.27)	38	42
	United Arab Emirates	11.3	27.7	11.1	19.8	35.0	0.144	(−0.01 to 0.30)	0.238	(−0.02 to 0.50)	50	36
Europe	Austria	68.4	75.6	84.6	87.9	91.8	0.315	(0.17–0.46)	0.445	(0.24–0.65)	15	19
	Belgium	56.5	68.9	76.5	70.6	85.4	0.203	(0.07–0.34)	0.404	(0.13–0.68)	37	22
	Bosnia and Herzegovina	34.5	28.3	44.7	44.8	46.2	0.153	(−0.03 to 0.33)	0.366	(−0.07 to 0.80)	46	24
	Croatia	31.2	60.2	64.8	71.8	74.3	0.267	(0.13–0.40)	0.605	(0.30–0.91)	26	8
	Czech Republic	75.7	70.7	74.8	69.1	75.9	0.058	(−0.14 to 0.25)	0.112	(−0.27 to 0.49)	65	54
	Denmark	43.8	67.8	72.6	69.9	70.3	0.098	(−0.03 to 0.22)	0.215	(−0.06 to 0.49)	60	40
	Estonia	37.8	33.5	42.6	58.5	62.6	0.253	(0.15–0.36)	0.631	(0.37–0.89)	29	7
	Finland	49.9	67.7	65.1	60.6	74.1	0.122	(0.00–0.24)	0.272	(0.00–0.54)	56	31
	France	42.5	80.4	82.5	83.8	80.1	0.269	(−0.04 to 0.58)	0.492	(−0.07 to 1.06)	25	18
	Georgia	8.4	6.0	12.2	15.6	19.3	0.264	(0.14–0.39)	0.295	(0.16–0.43)	28	28
	Germany	68.3	67.6	73.3	75.0	80.5	0.139	(0.02–0.25)	0.269	(0.05–0.49)	54	32
	Greece	31.4	29.1	44.8	41.3	62.4	0.266	(0.15–0.38)	0.662	(0.37–0.95)	27	5
	Hungary	38.6	56.2	71.1	61.0	78.3	0.285	(0.17–0.40)	0.658	(0.40–0.92)	22	6
	Ireland	19.9	28.8	35.7	50.7	45.5	0.220	(0.10–0.34)	0.526	(0.24–0.81)	34	14
	Israel	32.8	35.0	49.9	46.5	56.2	0.178	(0.06–0.30)	0.440	(0.14–0.74)	42	20
	Italy	72.1	59.4	66.3	70.8	69.9	0.061	(−0.06 to 0.18)	0.134	(−0.13 to 0.40)	64	48
	Kazakhstan	74.7	82.6	78.5	82.0	82.6	0.096	(−0.02 to 0.21)	0.151	(−0.03 to 0.33)	61	47
	Latvia	61.6	61.1	78.8	85.6	85.6	0.324	(0.14–0.51)	0.565	(0.25–0.88)	12	11
	Luxembourg	79.2	69.4	76.7	86.9	88.9	0.243	(0.06–0.43)	0.362	(0.09–0.63)	32	26
	Netherlands	46.4	47.6	42.7	56.4	65.9	0.151	(0.05–0.26)	0.379	(0.12–0.64)	47	23

Table 2 continued

WHO region	Country	Percent of women who had a Pap test in the past 3 years by income quintile					Normalized concentration index, *W* (95% CI)		Absolute concentration index × 10^1, ACI (95% CI)		Rank (largest to smallest)	
		1	2	3	4	5					*W*	ACI
	Portugal	18.7	56.0	45.5	69.1	71.3	0.318	(0.17–0.47)	0.775	(0.41–1.14)	14	3
	Russia	60.5	69.7	76.9	80.3	77.0	0.142	(−0.01 to 0.29)	0.267	(−0.02 to 0.55)	51	33
	Slovakia	47.0	60.8	69.1	40.8	70.1	0.208	(0.07–0.35)	0.495	(0.17–0.82)	35	16
	Slovenia	62.5	79.0			78.4	0.273	(0.09–0.46)	0.547	(0.18–0.92)	23	13
	Spain	44.0	51.4	53.2	64.0	72.3	0.207	(0.14–0.28)	0.495	(0.33–0.66)	36	17
	Sweden	62.5	57.0	75.0	71.4	75.8	0.177	(0.00–0.35)	0.365	(0.00–0.73)	43	25
	Ukraine	67.9	73.4	72.7	64.7	85.9	0.107	(−0.03 to 0.25)	0.207	(−0.06 to 0.48)	58	41
	UK	56.8	61.0	54.9	64.2	63.4	0.069	(−0.04 to 0.18)	0.165	(−0.10 to 0.43)	62	45
Southeast Asia	Bangladesh	0.2	0.2	0.0	0.4	1.4	0.438	(0.10–0.78)	0.016	(0.00–0.03)	3	66
	India	1.1	3.4	2.5	4.2	4.6	0.223	(0.08–0.36)	0.067	(0.03–0.11)	33	60
	Nepal	0.7	1.7	1.4	3.7	6.3	0.400	(0.26–0.54)	0.107	(0.07–0.14)	7	55
	Sri Lanka	0.8	2.1	0.5	1.1	2.7	0.157	(−0.11 to 0.43)	0.024	(−0.02 to 0.06)	45	64
Western Pacific	Australia	59.2	70.0	72.8	71.1	78.3	0.126	(0.04–0.21)	0.254	(0.09–0.42)	55	34
	China	3.9	10.6	22.1	28.1	33.4	0.402	(0.33–0.48)	0.665	(0.54–0.79)	6	4
	Laos	0.9	1.2	0.6	2.1	9.3	0.559	(0.41–0.71)	0.169	(0.12–0.21)	1	44
	Malaysia	26.8	26.8	22.6	30.4	39.9	0.140	(0.08–0.20)	0.293	(0.16–0.42)	53	29
	Philippines	5.0	5.8	6.0	11.5	16.3	0.297	(0.23–0.37)	0.252	(0.19–0.31)	20	35
	Vietnam	4.6	6.9	3.2	8.7	8.1	0.148	(0.01–0.29)	0.089	(0.00–0.17)	49	58

only the prevalence of screening across countries and by income quintiles, we calculate summary measures of within-country inequalities that facilitate cross-country comparisons. Second, we go beyond quantifying the magnitude of screening inequality to explore sources of inequality using decomposition analyses.

We found Guatemala to have the greatest pro-rich inequality in absolute terms, followed by Paraguay, Portugal, and China. In general, our results suggest substantial heterogeneity both in the magnitude of inequality and the contributions of the determinants to inequality, even among countries in close geographic proximity and with similar economic and development status. In the decomposition analysis, income remained a strong determinant of inequality, with education also making substantial contributions in many countries. Other determinants such as urbanicity, age, and marital status were more variable, contributing to inequality in some countries but not in others. There were also several instances when a determinant made positive contributions in some countries (indicating it contributed to pro-rich inequality) and negative contributions in other countries (contributing to pro-poor inequality). These observations suggest that national environments (e.g., social, policy) may play an important role in conditioning the strength and direction by which specific individual socio-demographic determinants contribute to inequalities in screening.

This study is unique in how we measure socioeconomic inequalities in cervical screening. Unlike previous studies, which have relied primarily on descriptive statistics (Gakidou et al. 2008) and ratios comparing socioeconomic groups (Baker and Middleton 2003; Arrossi et al. 2008; Puig-Tintoré et al. 2008; Martins et al. 2009; Moser et al. 2009), we used the CI as a summary measure of inequality. The CI has several useful features: it accounts for the entire distribution of socioeconomic status, it is sensitive to the socioeconomic gradient in health so that pro-rich and pro-poor inequality corresponds to positive and negative values of the index for a positive health outcome, and it can be decomposed into a linear combination of the CIs of its determinants (Wagstaff et al. 1991, 2003). Furthermore, our decision to focus on absolute screening inequalities differs from the approach taken in most other studies (Alves et al. 2009; Arrossi et al. 2008; Baker and Middleton 2003; Martins et al. 2009; Moser et al. 2009; Puig-Tintoré et al. 2008; Todorova et al. 2009; Winkler et al. 2008). The ACI reflects two dimensions that are important in measuring the burden of socioeconomic inequalities at the population level: (1) the magnitude of socioeconomic inequality among women who receive screening and (2) the overall rates of screening in the population. As an example to illustrate the importance of these two dimensions, the relative indices (*W*) for France and Zambia were nearly identical (0.269 and 0.272,

Table 3 Regression coefficients (β) and absolute concentration indices (ACI) for determinants in the decomposition analysis, World Health Survey 2002–2003

WHO region	Country	Age		Income		Urban		Single		Divorced		Education		Recent health care[a]	
		β	ACI	β	ACI	β	ACI	β	ACI	β	ACI	β	ACI	β	ACI
Africa	Chad	−0.002	−0.006	0.027	0.311	0.015	0.060	−0.006	0.017	−0.003	−0.003	−0.001	0.263	0.047	0.022
	Côte d'Ivoire	−0.004	−1.228	0.000	0.400	0.016	0.111	−0.036	0.044	−0.002	−0.026	0.003	1.563	0.006	0.052
	Ethiopia	0.000	0.057	0.002	0.473	0.003	0.097	−0.002	0.021	0.005	0.018	0.000	0.794	0.005	0.016
	Ghana	−0.001	0.251	0.016	0.424	−0.004	0.141	−0.017	0.024	−0.002	0.000	0.001	1.307	0.013	0.021
	Kenya	0.000	−0.012	0.023	0.366	0.012	0.027	−0.022	0.032	−0.004	−0.030	0.002	0.988	−0.010	0.010
	Mali	−0.001	0.156	0.011	0.330	0.035	0.080	−0.022	−0.002	−0.011	−0.001	0.000	0.220	0.028	0.041
	Mauritania	−0.001	−0.399	0.003	0.455	0.012	0.175	−0.022	−0.002	−0.012	0.006	−0.001	0.882	0.015	0.043
	Mauritius	0.003	0.262	0.061	0.332	0.050	0.034	−0.113	−0.001	−0.034	−0.026	−0.001	0.871	0.070	−0.022
	Namibia	−0.002	−0.772	0.064	0.476	0.060	0.137	−0.060	−0.011	−0.032	−0.019	0.002	1.528	0.070	0.031
	Senegal	−0.004	0.236	0.021	0.442	0.002	0.144	−0.084	0.019	−0.048	0.019	0.007	0.838	0.025	0.027
	South Africa	−0.004	−0.283	0.050	0.483	0.058	0.129	−0.094	−0.043	0.029	−0.009	0.015	1.145	0.059	−0.006
	Swaziland	0.000	−0.235	0.037	0.234	−0.004	0.086	−0.006	0.017	−0.005	−0.020	0.002	0.940	0.044	0.003
	Zambia	−0.002	−1.024	0.004	0.387	0.021	0.119	−0.014	0.010	−0.009	−0.029	0.001	1.093	0.009	0.000
Americas	Brazil	−0.003	0.540	0.087	0.441	−0.019	0.065	−0.191	−0.011	−0.085	−0.006	0.016	1.522	0.132	0.020
	Dominican Republic	−0.002	0.026	0.096	0.341	−0.002	0.090	−0.292	0.011	−0.082	−0.008	0.014	1.197	0.211	0.010
	Ecuador	0.001	1.075	0.062	0.336	0.081	0.052	−0.221	0.014	−0.041	0.004	0.008	1.262	0.174	0.006
	Guatemala	0.000	0.833	0.256	0.456	0.057	0.162	−0.189	0.016	−0.077	0.000	0.009	1.722	0.193	0.041
	Mexico	0.001	0.689	0.062	0.366	−0.017	0.091	−0.381	0.019	−0.086	−0.004	0.008	1.362	0.168	−0.001
	Paraguay	−0.007	0.422	0.146	0.428	0.055	0.145	−0.197	0.010	−0.102	0.003	0.011	1.646	0.129	0.026
	Uruguay	−0.003	−0.403	0.121	0.357	−0.080	0.053	−0.009	−0.009	−0.008	−0.013	0.018	1.211	0.206	0.015
Eastern Mediterranean	Pakistan	−0.002	0.456	0.008	0.414	0.013	0.089	−0.060	−0.011	−0.007	−0.005	0.002	0.941	0.012	0.005
	Tunisia	0.000	0.210	0.004	0.471	0.000	0.167	−0.006	0.017	−0.068	0.001	0.001	1.690	0.013	0.022
Europe	Austria	0.002	−1.131	0.144	0.333	0.041	−0.003	0.076	−0.022	0.022	−0.041	0.006	0.344	0.177	0.008
	Belgium	−0.005	−0.249	0.133	0.327	−0.025	−0.024	0.019	−0.042	0.100	−0.071	0.005	0.584	0.022	0.014
	Croatia	−0.007	−1.005	0.071	0.445	0.120	0.063	−0.249	−0.013	−0.025	−0.035	0.021	0.941	0.191	0.009
	Estonia	−0.004	−0.531	0.131	0.341	0.092	0.017	−0.116	−0.044	0.049	−0.043	0.017	0.651	0.141	0.011
	Finland	−0.004	−0.446	0.109	0.310	0.047	−0.014	0.055	−0.060	0.089	−0.085	0.009	0.612	0.050	0.010
	Georgia	−0.005	0.161	0.026	0.330	0.068	0.154	−0.115	0.007	−0.031	−0.015	0.011	0.703	0.058	0.031
	Germany	−0.005	−1.658	0.048	0.358	−0.048	0.022	0.003	−0.027	−0.001	−0.078	0.007	0.477	0.142	0.005
	Greece	0.001	−2.008	0.150	0.424	−0.166	0.071	0.219	−0.003	−0.062	−0.019	0.013	1.257	0.154	0.014
	Hungary	−0.009	−0.847	0.141	0.308	−0.026	0.028	−0.372	−0.007	0.005	−0.043	0.018	1.038	0.256	0.013
	Ireland	−0.008	0.260	0.086	0.393	−0.109	0.000	−0.208	−0.024	−0.016	−0.035	0.019	0.594	0.130	−0.015
	Israel	0.003	−0.369	0.092	0.409	−0.017	−0.009	0.082	−0.010	0.127	−0.040	0.010	0.829	0.066	0.014
	Latvia	−0.004	−1.197	0.249	0.197	−0.053	0.022	−0.001	−0.010	0.080	−0.054	0.008	0.450	0.180	0.029

Table 3 continued

WHO region	Country	Age		Income		Urban		Single		Divorced		Education		Recent health care[a]	
		β	ACI	β	ACI	β	ACI	β	ACI	β	ACI	β	ACI	β	ACI
	Luxembourg	0.002	−0.272	0.138	0.291	0.001	0.061	0.051	−0.023	0.071	−0.047	−0.005	0.637	0.115	0.016
	Netherlands	0.002	−0.757	0.137	0.297			0.010	−0.033	0.035	−0.112	0.000	0.331	0.073	0.000
	Portugal	−0.004	−2.241	0.126	0.403	−0.083	0.050	−0.304	0.009	−0.218	−0.036	0.019	1.157	−0.057	0.007
	Slovakia	−0.002	−0.917	0.214	0.255	0.019	0.009	−0.254	0.006	−0.021	−0.031	−0.007	0.392	−0.018	0.004
	Slovenia	−0.006	−1.637	0.183	0.312			−0.153	0.024	−0.027	−0.068	−0.008	0.693	0.047	−0.024
	Spain	−0.002	−1.002	0.054	0.375	0.103	0.028	−0.325	0.002	−0.065	−0.026	0.020	1.210	0.121	0.001
	Sweden	0.000	−0.953	0.132	0.278	0.018	0.018	0.055	−0.045	0.122	−0.080	0.013	0.591	0.088	0.013
Southeast Asia	Bangladesh	0.000	0.362	0.000	0.478	0.005	0.074	−0.030	0.006	0.008	−0.002	0.000	1.124	−0.001	−0.007
	India	−0.002	0.739	0.012	0.352	0.007	0.045	−0.002	0.004	−0.021	−0.007	0.001	1.008	0.011	0.007
	Nepal	0.000	0.252	0.015	0.437	−0.001	0.086	−0.060	−0.011	−0.007	−0.005	0.000	0.771	0.017	0.030
Western Pacific	Australia	−0.005	−0.307	0.072	0.278			−0.123	−0.032	0.043	−0.047	0.007	0.410	0.210	−0.002
	China	−0.009	−0.283	0.148	0.499	0.074	0.079	−0.174	0.003	0.020	−0.006	−0.010	1.069	0.053	0.006
	Laos	−0.001	0.468	0.016	0.509	0.003	0.147	−0.008	0.008	−0.006	−0.010	0.000	1.165	0.028	0.025
	Malaysia	−0.004	0.365	0.084	0.320	−0.042	0.107	−0.314	0.018	−0.153	−0.019	0.014	0.974	0.058	−0.008
	Philippines	−0.002	0.556	0.044	0.426	0.025	0.088	−0.067	0.018	−0.030	0.000	0.005	0.996	0.040	0.003
	Vietnam	−0.001	0.635	0.019	0.340	−0.015	0.071	−0.009	−0.009	−0.046	−0.001	0.001	0.849	0.017	0.001

[a] A woman received health care for herself or a child in the past 1 year

Table 4 Percentage contribution of determinants to income-related inequality in cervical screening, World Health Survey 2002–2003

WHO region	Country	Age	Income	Urban	Marital Status	Education	Recent health care[a]	Unexplained
Africa	Chad	0.1	47.2	5.2	−0.7	−2.1	5.8	58.8
	Côte d'Ivoire	48.1	−0.7	15.8	−14.0	42.6	2.9	12.8
	Ethiopia	−0.6	34.2	9.8	1.4	6.0	2.6	44.4
	Ghana	−3.1	79.4	−6.4	−4.7	12.2	3.2	20.6
	Kenya	0.0	61.8	2.3	−4.3	15.3	−0.7	29.8
	Mali	−1.5	32.5	26.1	0.4	0.0	10.9	31.6
	Mauritania	2.0	11.9	18.0	−0.4	−6.4	5.8	42.9
	Mauritius	3.5	87.3	7.3	4.3	−3.0	−6.7	18.1
	Namibia	3.4	59.9	16.2	2.5	4.9	4.2	8.8
	Senegal	−8.9	83.9	2.7	−22.2	50.6	5.9	−20.3
	South Africa	2.4	46.2	14.3	7.2	33.0	−0.7	−2.7
	Swaziland	0.3	65.3	−2.5	0.0	15.7	0.9	20.2
	Zambia	19.4	15.2	26.3	1.2	9.1	0.0	31.1
Americas	Brazil	−2.4	64.5	−2.1	4.5	39.9	4.5	−8.9
	Dominican Republic	−0.1	75.1	−0.4	−5.5	39.1	4.7	−13.4
	Ecuador	4.0	58.3	11.6	−9.2	29.2	2.8	3.4
	Guatemala	−0.3	90.5	7.2	−2.3	12.2	6.1	−13.3
	Mexico	2.4	97.3	−6.8	−29.7	49.7	−0.4	−13.5
	Paraguay	−3.9	79.3	10.1	−2.9	22.7	4.2	−9.6
	Uruguay	1.9	73.8	−7.3	0.3	37.2	5.4	−11.3
Eastern Mediterranean	Pakistan	−10.4	34.0	12.7	1.6	16.3	0.7	99.5
	Tunisia	−0.3	9.3	−0.1	−1.0	6.9	1.5	49.7
Europe	Austria	−5.7	104.8	−0.2	−5.6	4.8	3.3	−1.8
	Belgium	2.6	94.5	1.3	−17.2	5.9	0.7	12.5
	Croatia	10.8	52.1	12.5	6.7	32.6	2.8	−19.4
	Estonia	3.3	70.6	2.5	4.7	17.8	2.4	−1.5
	Finland	6.8	120.2	−2.3	−38.8	19.4	1.7	−6.2
	Georgia	−2.7	29.0	35.7	−1.2	25.1	6.2	16.9
	Germany	25.7	56.2	−3.4	−0.1	10.7	2.3	8.5
	Greece	−3.9	96.1	−17.6	0.6	24.5	3.2	−2.2
	Hungary	11.0	66.2	−1.1	3.6	28.3	5.2	−17.2
	Ireland	−4.6	78.6	0.1	12.7	25.8	−4.5	−6.8
	Israel	−3.0	86.9	0.3	−13.4	19.4	2.1	7.7
	Latvia	7.8	90.4	−2.2	−7.9	6.5	9.8	−4.4
	Luxembourg	−1.6	107.0	3.4	−12.1	−8.7	4.9	11.0
	Netherlands	−3.8	113.7		−12.1	0.2	0.1	1.9
	Portugal	10.7	66.7	−5.5	6.7	28.5	−0.5	−6.5
	Slovakia	3.8	105.5	0.3	−1.9	−5.4	−0.1	−3.1
	Slovenia	18.1	105.3		−3.3	−10.0	−2.1	−10.0
	Spain	3.7	41.0	5.8	2.0	47.9	0.3	−2.6
	Sweden	−0.6	102.2	0.9	−34.4	21.2	3.1	8.9
Southeast Asia	Bangladesh	−2.0	4.9	21.1	−13.9	17.1	0.4	194.3
	India	−15.2	58.1	4.0	1.8	8.1	0.9	42.0
	Nepal	−0.6	62.6	−0.4	1.6	0.2	4.9	78.4
Western Pacific	Australia	6.4	76.3		7.1	11.3	−1.3	−3.3
	China	3.9	111.0	8.7	−1.0	−15.4	0.5	−3.5
	Laos	−2.3	49.2	3.0	−0.1	1.4	4.1	44.8
	Malaysia	−5.0	95.5	−15.9	−9.7	47.0	−1.7	12.8
	Philippines	−4.2	75.7	8.7	−5.0	19.6	0.5	5.1
	Vietnam	−7.4	73.6	−11.8	0.7	6.4	0.1	58.9

[a] A woman received health care for herself or a child in the past 1 year

respectively), yet the prevalence of screening in the two countries was vastly different (76 and 3.4%, respectively). This difference is captured by the ACI, indicating that absolute inequalities in screening are five times larger in France (0.049) than Zambia (0.009). Another important advantage of the ACI is that, unlike W, it does not depend on whether one examines inequality in health (screening) or inequality in ill health (no screening) (Clarke et al. 2002).

This study has some limitations, in particular the reliance of the WHS on self-reported data. Self-reports of cervical screening may be inaccurate because women may have a limited ability to accurately report whether a Pap test was performed in the context of other gynecologic/obstetric care. For example, a meta-analysis of 37 studies from developed countries found that, compared to medical records, women tend to over-report their participation in Pap screening (Howard et al. 2009). In addition, the WHS only asked about Pap screening within the past 3 years. Although this shorter time interval probably reduces recall bias, it also means that we could not account for women who had been screened more than 3 years ago. This is unfortunate because several countries recommend screening at longer intervals than 3 years. For example, in Ecuador and South Africa, the recommendation is that women be screened once every 5 years and once every 10 years, respectively (IARC 2005). In fact, evidence suggests that even one Pap test every 10 years reduces the risk of cancer by 64% (IARC 1986). Finally, as previously stated, random national samples were not obtained in China, Comoros, the Republic of Congo, Côte d'Ivoire, India, and the Russian Federation. Thus, estimates of screening inequality cannot be taken as nationally representative in these countries.

With regard to the decomposition analysis, there were several countries where the proportion of the income-related CI that the determinants did not explain was large. These tended to be countries with low screening rates, mainly in Asia and Africa. It is possible that in these countries, our model did not capture some important determinants that predict screening inequality: for example, within-country geographic variability in screening availability, health insurance status, and knowledge and perceptions about screening (Forbes et al. 2002). To the extent that these unmeasured variables are correlated with income, there may be an overestimation of the residual effect of income in our study. While this is an important limitation to consider when interpreting some of the results, our decomposition model did explain a large proportion of inequality in many countries, particularly those in Europe and the Americas. Finally, because we were dealing with a binary health outcome, electing to preserve the absolute value judgment of the ACI, the bounds issue (the fact that the bounds of the CI depend on the mean of the health variable) was left unsolved, meaning that ACI may tend to be underestimated for high prevalence countries. Erreygers (2009) has also proposed a corrected CI, which may be useful if one wants to examine the relationship between average health and socioeconomic inequality (Van de Poel et al. 2008). However, for the purpose of cross-country comparisons of inequality, Erreygers' index preserves the same ranking of distributions as the ACI (Erreygers 2009).

In this study, we present comparable measures of income-related inequality in cervical screening across a comprehensive list of high- and low-income countries from all regions of the world. The widespread inequalities we observed suggest that many countries should consider targeting interventions to improve screening among socioeconomically disadvantaged women. This requires an understanding of the reasons that low-income women are less likely to be screened and that is why the decomposition results are so valuable. Finally, we of course acknowledge that in several developing countries, average rates of screening are extremely low, to the point where even measuring inequality seems somewhat futile. However, our results do suggest that it may be beneficial for countries planning to implement or scale up cervical screening programs to specifically consider issues of equality when designing programs and policies.

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