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Lifetime prevalence of cervical cancer screening in 55 low- and middle-income countries

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58 **Key points**

59 **Question:** What is the lifetime prevalence of cervical cancer screening in low- and middle-

60 income countries?

61 **Findings:** In this cross-sectional study based on self-reported data collected in 55 countries

62 between 2005 and 2018, the country-level median lifetime prevalence of cervical cancer

63 screening was 44%, with a range of 0.3% to 97.4%.

64 **Meaning:** Although there was a wide range of variation in self-reported cervical cancer screening

65 prevalence among these countries, the findings support the need to increase the rate of screening.

66 **Importance:** The World Health Organization is developing a global strategy to eliminate

67 cervical cancer, with goals for screening prevalence among women aged 30 to 49 years.

68 However, evidence on prevalence levels of cervical cancer screening in low- and middle-income

69 countries (LMICs) is sparse.

70 **Objective:** To determine lifetime cervical cancer screening prevalence in LMICs, and its

71 variation across and within world regions and countries.

72 **Design, Setting, and Participants:** Cross-sectional, population-based analysis of nationally

73 representative household surveys carried out in 55 LMICs between 2005 and 2018. The median

74 response rate across surveys was 93.8% (range, 64.0%-99.3%). The population-based sample

75 consisted of 1,136,289 women aged 15 years or older of whom 0.6% had missing information for

76 the survey question on cervical cancer screening.

77 **Exposures:** World region, country, countries' economic, social, and health system

78 characteristics, and individuals' sociodemographic characteristics.

79 **Main Outcomes and Measures**: Self-report of having ever had a screening test for cervical

80 cancer.

81 **Results**: 1,129,404 women were included in the analysis of whom 542,475 were aged 30 to 49

82 years. A country-level median of 43.6% (interquartile-range [IQR], 13.9%-77.3%; range, 0.3%-

83 97.4%) of women aged 30 to 49 self-reported to have ever been screened, with countries in Latin

84 America and the Caribbean having the highest prevalence (country-level median, 84.6%; IQR,

85 65.7%-91.1%; range, 11.7%-97.4%) and those in sub-Saharan Africa the lowest prevalence

86 (country-level median, 16.9%; IQR, 3.7%-31.0%; range, 0.9%-50.8%). There was large variation

87 in the self-reported lifetime prevalence of cervical cancer screening among countries within

88 regions, and among countries with similar levels of per capita gross domestic product and total

89 health expenditure. Within countries, women who lived in rural areas, had low education, or had

90 low household wealth were generally least likely to self-report to have ever been screened.

91 **Conclusion and Relevance:** In this cross-sectional study of data collected in 55 LMICs between

92 2005 and 2018, there was wide variation between countries in the self-reported lifetime

93 prevalence of cervical cancer screening. However, the median prevalence was 44%, supporting

94 the need to increase the rate of screening.

Introduction

95

96   Cervical cancer was estimated to be the fourth most common cause of cancer incidence and

97   mortality among women globally in 2018.[1] Deaths due to cervical cancer are largely preventable

98   through regular screening combined with early-stage treatment and, more recently, through

99   vaccination against the human papillomavirus (HPV).[2,3] While scaling up HPV vaccination could

100 prevent many cases of cervical cancer in the future,[4,5] HPV vaccination coverage is currently still

101 very low in LMICs.[6,7] Increasing effective screening for cervical cancer in LMICs is, thus,

102 indispensable to achieve a rapid reduction in cervical cancer incidence and mortality.

103

104 The World Health Organization (WHO) Director-General's call for action on cervical cancer in

105 2018 emphasized the importance of increasing cervical cancer screening in LMICs as being key

106 to eliminating cervical cancer as a public health problem globally.[8] Implementing and

107 maintaining effective screening programs requires an in-depth understanding of current screening

108 rates, how they are changing over time, and which population groups within countries are not

109 reached. However, despite its importance for policy makers in LMICs and recommended use as

110 an indicator for measuring progress towards achieving both universal health coverage and global

111 non-communicable disease (NCD) goals,[9–11] the only available international comparison of

112 cervical cancer screening rates with nationally representative data is based on the World Health

113 Surveys.[12,13] These surveys were conducted in 2002-2003 and are, thus, at least 17 years old.

114

115 In an effort to inform the design and monitoring of interventions to improve coverage with

116 cervical cancer screening, this study aimed to determine the proportion of women aged 30 to 49

117 years in LMICs who self-reported to have ever been screened for cervical cancer, and how these

118 estimates vary across regions, countries, and population groups within countries.

119

Methods

Ethics

This analysis of pseudonymized data (i.e., data that could not be linked to individuals without additional information that was not available to the analysts) was considered exempt for non-human subjects research by the institutional review board of the Heidelberg University Medical Faculty.

Data sources

We requested access to the most recent nationally representative WHO STEPwise approach to Surveillance (STEPS) survey conducted since 2005 for all countries that the World Bank categorized as low-income, lower middle-income, or upper middle-income at any time since 2005.[14] To be included in this study, a country must have been an LMIC (as per the World Bank categorization) at the time of the survey's data collection. We preferred STEPS surveys because they use the same standardized questionnaire, ask about all commonly applied cervical cancer screening techniques, sample a wide age range of women, and are the official approach developed by the WHO for monitoring NCD risk factors at the population level.

If an eligible STEPS dataset was not available for a country that was an LMIC at any time since 2005, or we could not gain access to it, we conducted a systematic search in September 2019 using the Google search engine, the International Household Survey Network (IHSN) central data catalogue, and the Global Health Data Exchange (GHDx) to identify the most recent nationally representative household survey with data on cervical cancer screening prevalence for that country (see eMethods 1 in the Supplement for details). Surveys were eligible if they were

143 conducted in 2005 or later, collected data on at least three ten-year-age groups older than 15

144 years, and asked female respondents about whether they had ever been screened for cervical

145 cancer. We excluded surveys with a response rate below 50%. The sampling strategy and

146 response rate calculation for each survey is detailed in eMethods 2 and 3 in the Supplement.

147 Response rate calculations were categorized according to the American Association for Public

148 Opinion Research definitions RR1, RR2, RR5, and COOP1.[15]

149

150 *Outcome definition*

151 The outcome for the present analysis was defined as self-reporting to have ever undergone a

152 screening test for cervical cancer or cervical precancerous lesions. The survey questions are

153 detailed in eMethods 4 in the Supplement.

154

155 *Statistical analysis*

156 This analysis proceeded in four steps. First, we estimated self-reported lifetime prevalence of

157 cervical cancer screening by country and calculated the country-level median prevalence (as well

158 as the range and interquartile range) globally and by World Bank region. We restricted the

159 sample for analysis to women aged 30 to 49 years in our primary analysis for this step because

160 the WHO recommends prioritizing cervical cancer screening in this age group.[16]

161

162 Second, to ascertain health system performance for cervical cancer screening relative to a

163 country's wealth and expenditure on health, we plotted the self-reported lifetime prevalence of

164 cervical cancer screening for women aged 30 to 49 years against the country's gross domestic

165 product (GDP) per capita and total health expenditure per capita (both in constant 2011

166 international dollars[17]) in the year of survey data collection. We show an ordinary least squares

167   regression line through these point estimates, weighting each country equally, for visual

168   orientation only (as opposed to statistical inference).

169

170   Third, to explore reasons for differences in screening prevalence between countries, we plotted

171   the self-reported lifetime prevalence of cervical cancer screening for women aged 30 to 49 years

172   separately against each of eight country-level indicators. We used all country-level indicators as

173   independent variables that we hypothesized may be causally related to a country's cervical cancer

174   screening prevalence and were available in the public domain for the majority of the study

175   countries. These indicators were measures of economic development (GDP per capita), human

176   development (the Human Development Index [HDI] and the Gender-related Development Index

177   [GDI]), investments into the health system (total health expenditure per capita), health worker

178   density (number of nurses and midwives per 1,000 people and combined number of physicians,

179   nurses, and midwives per 1,000 people), and gender discrimination (the Gender Inequality Index

180   [GII] and the 2014 Social Institutions and Gender Index [SIGI]).

181

182   Fourth, to ascertain which population groups were most likely to self-report to have ever been

183   screened, we regressed, separately for each country, self-reporting to have ever had a cervical

184   cancer screening test on ten-year age group, educational attainment, household wealth quintile,

185   rural versus urban residence, and a binary indicator for current self-reported tobacco smoking.

186   The computation of the household wealth quintiles is detailed in the Supplement (eMethods 5).

187   We fitted covariate-unadjusted and covariate-adjusted Poisson regression models with cluster-

188   robust standard errors (using the sandwich estimator of variance) that were adjusted for clustering

189   at the level of the primary sampling unit. We adhere to the term "risk" when interpreting the

190 resulting risk ratios (RRs) even though risk in this analysis depicts a desirable (reporting to have

191 undergone screening) rather than an undesirable outcome.

192

193 All analyses were complete-case analyses. All primary analyses accounted for the multi-stage

194 random sampling of the surveys by use of sampling weights and adjusted standard errors for

195 clustering at the level of the primary sampling unit. As a robustness check for the fourth step of

196 this analysis and given ongoing debate as to when regression in survey data should account for

197 sampling weights,[18] we also fitted Poisson regression models without using sampling weights.

198 We provide further details on the statistical analysis in the Supplement (eMethods 6). Analyses

199 were conducted in R version 3.6.1 and Stata 15.

200

201 **Results**

202 *Sample characteristics*

203 Out of a total of 142 countries that were classified as an LMIC at any point since 2005, we

204 obtained individual-level STEPS survey data from 20 LMICs and included, from the systematic

205 search, survey datasets from an additional 35 LMICs (eFigure 1 and eFigure 2 in the

206 Supplement). Of the 55 included surveys, 20 surveys asked women whether they had ever

207 undergone at least one of the three commonly used screening modalities (Pap smear test, visual

208 inspection of the cervix with acetic acid [VIA], or HPV test), 28 surveys asked only about Pap

209 smear tests, and seven surveys asked about cervical cancer screening without specifying a

210 screening modality. The survey-level median response rate was 93.8% (IQR, 86.2%-96.8%;

211 range, 64.0%-99.3%; **Table 1**). The country-level median percent of women aged 30 to 49 years

212 with missing information on whether they had ever received a cervical cancer screening was

213 0.5% (IQR, 0.1%-3.4%; range, 0.0%-12.6%). 1,129,404 women with outcome data, of whom

214   542,475 were aged 30 to 49 years, were included in the analyses (eTable 1 in the Supplement).

215   Detailed sample characteristics are shown in eTable 2-4 in the Supplement.

216

217   *Lifetime prevalence of cervical cancer screening by region and country*

218   A country-level median of 43.6% (IQR, 13.9%-77.3%) of women aged 30 to 49 years self-

219   reported to have ever had a cervical cancer screening test, ranging from 0.3% in Egypt (95% CI,

220   0.1%-0.6%) to 97.4% in Colombia (95% CI, 97.0%-97.8%). With a country-level median of

221   84.6% (IQR, 65.7%-91.1%; range, 11.7%-97.4%), countries in Latin America and the Caribbean

222   had the highest self-reported lifetime prevalence of cervical cancer screening, whereas countries

223   in sub-Saharan Africa had the lowest (country-level median, 16.9%; IQR, 3.7%-31.0%; range,

224   0.9%-50.8%) (**Figure 1**; eFigure 3-5 and eTable 5 in the Supplement). There was substantial

225   variation across countries within regions.

226

227   *Benchmarking to countries' gross domestic product and total health expenditure*

228   Both GDP per capita and total health expenditure per capita appeared to be positively associated

229   with the self-reported lifetime prevalence of cervical cancer screening in a country (**Figure 2**).

230   Countries that performed well relative to their GDP per capita in the year of the survey included

231   Belarus, Belize, Bhutan, Bolivia, Brazil, Chile, Colombia, the Dominican Republic, Ecuador, El

232   Salvador, Guatemala, Honduras, Jamaica, Moldova, Nicaragua, Peru, and St. Vincent and the

233   Grenadines.

234

235   *Country-level variables associated with lifetime prevalence of cervical cancer screening*

236   In addition to GDP per capita and total health expenditure per capita, a higher HDI and more

237   gender equality as indicated by the GDI, GII, and SIGI appeared to be positively associated with

238   a country's lifetime prevalence of cervical cancer screening (**Figure 3**). A higher density of

239   nurses and midwives, as well as of all health workers, statistically accounted for less of the

240   variability in the self-reported lifetime prevalence of cervical cancer screening between countries

241   ($R^2 = 0.05$ and $R^2 = 0.09$, respectively) than the other country-level variables. The apparent

242   associations shown in Figure 3 were similar when using weighting to adjust for differences in

243   individual-level characteristics between countries (eFigure 8-11 in the Supplement).

244

245   *Individual-level variables associated with cervical cancer screening*

246   While there was some heterogeneity among countries, living in an urban area (compared to a

247   rural area), having had secondary or tertiary education (compared to only having completed

248   primary education or less), being in the two highest household wealth quintiles (compared to the

249   bottom two household wealth quintiles), and being aged 30 to 49 years (compared to 20 to 29

250   years) all appeared to be associated with a higher probability of self-reporting to have ever had a

251   cervical cancer screening test in most countries (**Figure 4;** eFigure 12-13; eTable 6-11 in the

252   Supplement). The relationship between age and self-reported lifetime prevalence of cervical

253   cancer screening had an inverted "U" shape in all regions, with middle-aged women having the

254   highest self-reported prevalence (eFigure 14 in the Supplement). There was no apparent

255   association between currently smoking (compared to having never smoked or smoked in the past)

256   and self-reporting of ever having had a cervical cancer screening test in 32 out of 46 countries

257   that collected smoking data (eFigure 15; eTable 12 in the Supplement). Currently being married

258   appeared to be associated with a higher probability of self-reporting to have ever had a cervical

259   cancer screening test in 41 out of 55 countries (eFigure 16; eTable 13 in the Supplement). Risk

260   ratios with 95% confidence intervals from covariate-unadjusted and covariate-adjusted

261 regressions are shown in eTable 14-24 in the Supplement. The regression results were similar

262 when not using sampling weights (eFigure 17-24; eTable 6-13; eTable 25-35 in the Supplement).

263

264 Countries with a lower GDP per capita at the time of the survey tended to have larger relative

265 differences in lifetime cervical cancer screening prevalence by education, household wealth, and

266 urban versus rural residency than countries with a higher GDP per capita (eFigure 25-30 in the

267 Supplement). This was not the case when examining absolute rather than relative differences

268 (eFigure 25-30 in the Supplement).

269

270 **Discussion**

271 Overall, the country-level median lifetime prevalence of self-reported cervical cancer screening

272 was 44% in this sample of 55 LMICs, which represent 72% of the world's population in

273 LMICs.[19] Screening prevalence was generally highest among countries in Latin America and the

274 Caribbean, and lowest among countries in sub-Saharan Africa. In addition, the highly populous

275 countries of Indonesia (survey in 2014-15), India (survey in 2015-16), and China (survey in

276 2008-10) had a comparatively low self-reported lifetime screening prevalence among women

277 aged 30 to 49 years. Within countries, women in rural areas and those who were less educated or

278 lived in a less wealthy household tended to be least likely to self-report having ever been

279 screened for cervical cancer.

280

281 The low prevalence of self-reported cervical cancer screening identified in this study is especially

282 concerning given that this analysis examined lifetime prevalence of screening as opposed to the

283 prevalence of being screened in the past three to five years as recommended by the WHO,[16] the

284 limited sensitivity of available screening tests,[20,21] often poorly functioning referral systems for

285   positive cervical cancer screening tests in LMICs,[22,23] and low quality of care for cervical cancer

286   diagnosis and treatment in many of these settings.[22,24,25] Nonetheless, while the majority of

287   countries (37 of 55) included in this study missed the target of 70% cervical cancer screening

288   prevalence proposed by the WHO,[26] the analyses identified large differences in self-reported

289   lifetime prevalence among regions and among countries within regions. Relative to their GDP per

290   capita and total health expenditure per capita, many countries in Latin America and the

291   Caribbean, as well as some countries in other regions (e.g., Belarus, Bhutan, or Moldova)

292   achieved high self-reported lifetime prevalence levels of cervical cancer screening. Reasons for

293   these countries' high performance may include having national cervical cancer control programs

294   in place that provide cervical cancer screening to women free of charge in primary healthcare

295   system structures at the local level,[27,28] integration of screening services into comprehensive

296   cervical cancer control activities,[28,29] as well as trialing and implementation of programs to reach

297   underserved sociodemographic groups.[30,31]

298

299   GDP per capita, total health expenditure per capita, HDI, GDI, GII, and SIGI all statistically

300   accounted for a substantial degree of the variation in self-reported lifetime prevalence of cervical

301   cancer screening between countries. The comparatively strong apparent association between

302   indices of gender equality and self-reported lifetime prevalence of cervical cancer screening

303   suggests that cultural and societal values influence women's demand for and/or access to cervical

304   cancer screening.[32] The density of nurses and midwives, as well as the density of healthcare

305   workers in general, statistically accounted for only relatively little (less than ten percent) of the

306   variation between countries, suggesting that other factors may be more important determinants of

307   screening rates, such as the distribution of healthcare workers within countries, if healthcare

308   workers have been trained and equipped to conduct cervical cancer screens, and whether women

309   seek out or consent to screenings.[33]

310

311   *Limitations*

312   This study has several limitations. First, 28 of the 55 included surveys asked women only

313   whether they had undergone a Pap smear test rather than cervical cancer screening more

314   generally. However, available documentation on cervical cancer screening practices in these

315   countries suggests that it is unlikely that a substantial degree of cervical cancer screening was

316   conducted through modalities other than Pap smear testing in all but three (Guatemala, Mexico,

317   and Nepal) of these 28 countries prior to the data collection period of the included survey (see

318   eMethods 7 and eTable 36 in the Supplement). Nevertheless, this study's estimates of self-

319   reported lifetime prevalence of cervical cancer screening in these three countries may be

320   underestimates of the true prevalence. Second, this study's estimates relied entirely on self-report.

321   This probably led to an overestimation of the true lifetime cervical cancer screening prevalence

322   because it is likely that most women who had a cervical cancer screening remember the event

323   (given that these screenings are generally perceived as being uncomfortable[34,35]), while some

324   women who did not have a screening in the past probably reported having had one due to social

325   desirability bias.[36] However, because the awareness of the recommendation to have a regular

326   screening, and thus the expected degree of bias from social desirability bias, is fairly low in

327   LMICs,[37,38] it is unlikely that social desirability bias led to a substantial overestimation of self-

328   reported cervical cancer screening prevalence in this study. Third, the surveys were conducted in

329   different years ranging from 2005 to 2018. Each country's performance should thus be

330   interpreted as the performance in the given year rather than as the country's current performance.

331   Under the assumption that cervical cancer screening prevalence has been increasing in LMICs

332   over time, this study likely underestimates the current prevalence of cervical cancer screening in

333   the study countries. To avoid confounding by time in the analyses with country-level independent

334   variables, this analysis used values for country-level variables for the year of the survey's data

335   collection. This, however, was not possible for the SIGI, for which values were only available for

336   2014 and 2019. Fourth, the 55 LMICs in this analysis are unlikely to be representative of all

337   LMICs globally.

338

339   *Conclusions*

340   In this cross-sectional study of data collected in 55 LMICs between 2005 and 2018, there was

341   wide variation between countries in the self-reported lifetime prevalence of cervical cancer

342   screening. However, the median prevalence was 44%, supporting the need to increase the rate of

343   screening.

344

354

355 **Role of the Funder/Sponsor:** The funders had no role in the design and conduct of the study;

356 analysis and interpretation of the data; preparation, review, or approval of the manuscript; or

357 decision to submit the manuscript for publication.

358

359 **Access to Data and Data Analysis:** JL and PG had full access to all the data in the study and

360 take responsibility for the integrity of the data and the accuracy of the data analysis.

361

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497 **Figure 1.** Self-reported lifetime prevalence of cervical cancer screening among women
498 aged 30 to 49 years, by country

499 Abbreviations: LMIC, low- or middle-income country at the time of the survey year

500 The numbers show the percent of women aged 30 to 49 years in each country who reported to have ever had a cervical cancer
501 screening test. Solid grey coloring indicates that there was no eligible survey or we could not obtain access to the dataset.
502 Prevalence estimates are shown for the countries and survey years listed in Table 1. A map with aged-standardized estimates based
503 on the WHO World Standard Population is shown in eFigure 3 in the Supplement.
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508 **Figure 2.** Self-reported lifetime prevalence of cervical cancer screening among women
509 aged 30 to 49 years by GDP per capita and total health expenditure per capita

510 Abbreviations: S. Asia, E. Asia, & Pacific, South Asia, East Asia, and Pacific.

511 Countries are indicated by their ISO 3 code. GDP per capita and total health expenditure per capita is in constant 2011 international
512 dollars for the year in which each survey was conducted. Health expenditure per capita was not available for Iraq. The vertical bars
513 depict the 95% confidence interval for each point estimate. The grey line depicts an Ordinary Least Squares regression (with each
514 country having the same weight) of lifetime cervical cancer screening prevalence in a country onto GDP per capita or total health
515 expenditure per capita. The standardized regression coefficient for this Ordinary Least Squares regression was 0.47 (95% CI, 0.23-
516 0.71) and 0.49 (95% CI, 0.25-0.73), respectively. The sample was restricted to women aged 30 to 49 years. Estimates among all
517 women and estimates adjusted for differences in individual-level characteristics between countries are shown in eFigure 6, 8 and 10
518 in the Supplement.
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523 **Figure 3.** Self-reported lifetime prevalence of cervical cancer screening among women
524 aged 30 to 49 years by human development index, gender equality indices, and health
525 worker density

526 Abbreviations: S. Asia, E. Asia, & Pacific, South Asia, East Asia, and Pacific.

527 Countries are indicated by their ISO 3 code. A GDI value was not available for St. Vincent & the Grenadines. A GII value was not
528 available for Ghana, St. Vincent & the Grenadines, and Timor-Leste. The vertical bars depict the 95% confidence interval for each
529 point estimate. Each grey line depicts an Ordinary Least Squares regression (with each country having the same weight) of lifetime
530 cervical cancer screening prevalence in a country onto the country-level variables HDI, GDI, GII, SIGI, density of medical nurses and
531 midwives, and health worker density. The standardized regression coefficient for this Ordinary Least Squares regression was 0.53
532 (95% CI, 0.30-0.76), 0.62 (95% CI, 0.41-0.83), -0.40 (95% CI, -0.66- -0.15), -0.72 (95% CI, -0.92- -0.52), 0.24 (95% CI, -0.02-0.50),
533 0.22 (95% CI, -0.04-0.48), and 0.30 (95% CI, 0.04-0.56), respectively. The sample was restricted to women aged 30 to 49 years.
534 Estimates among all women and estimates adjusted for differences in individual-level characteristics between countries are shown in
535 eFigure 7, 9 and 11 in the Supplement.
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540 **Figure 4.** Relative and absolute differences in the probability of having ever been
541 screened for cervical cancer by individuals' sociodemographic characteristics

542 Abbreviations: ref., reference category

543 Risk ratios are shown on a logarithmic scale. Countries are indicated by their ISO 3 code. Except for panel D, regressions were
544 adjusted for age as a continuous variable with restricted cubic splines with five knots placed at the fifth, 27.5th, 50th, 72.5th and 95th
545 percentiles. All regressions were run separately for each country, used sampling weights, and adjusted standard errors for clustering
546 at the level of the primary sampling unit. The horizontal bars depict the 95% confidence interval for each point estimate. In panel C,
547 the upper limit of the confidence interval was truncated for the risk ratio in Cote d'Ivoire. An alternative panel C that compares top
548 20% versus bottom 20% wealth (instead of top 40% versus bottom 40%) is shown in eFigure 11 in the Supplement. Risk ratios from
549 Poisson regressions without using sampling weights are shown eFigure 15-22 in the Supplement. Exact estimates are provided in
550 eTable 6-12 in the Supplement.

Table 1. Survey characteristics by region and country[a,b]

Country	ISO code	Survey	Year[c]	Response rate[d] (%)	Missing outcome[e] (%)	Sample size (all ages)	Age range (y)	Sample size (30-49 y)	Median age (30-49 y)	GDP per capita (int. $)[f]	Female population in 2019[g] (thousands)
Latin America and the Caribbean											
Belize	BLZ	CAMDI	2005-6	92.7	0.8	1,425	19-94	562	40	7,924	196
Costa Rica	CRI	ENSA	2006	95.0	12.1	2,474	18-101	772	40	11,558	2,525
Bolivia	BOL	DHS	2008	95.9	0.6	16,699	15-49	7,782	38	5,525	5,733
El Salvador	SLV	FESAL	2008	90.0	0.2	11,983	15-49	6,094	37	6,309	3,430
Jamaica	JAM	RHS	2008	96.7	0.5	8,217	15-49	4,532	39	8,593	1,485
Paraguay	PRY	ENDSSR	2008	95.1	0.1	6,536	15-44	2,666	36	9,028	3,464
Chile	CHL	ENS	2009-10	85.0	7.2	2,916	15-100	1,036	40	18,924	9,610
Nicaragua	NIC	ENDESA	2011	93.8	0.1	15,257	15-49	7,183	37	4,163	3,320
Honduras	HND	DHS	2011-12	93.2	0.0	22,019	15-49	9,677	38	4,028	4,877
Argentina	ARG	ENFR	2013	70.7	0.5	17,951	18-98	6,891	38	19,638	22,939
Brazil	BRA	PNS	2013	77.0	0.0	34,282	18-101	14,546	38	15,062	107,316
Dominican Republic	DOM	DHS	2013	94.1	0.4	8,990	15-49	4,347	39	12,183	5,373
Ecuador	ECU	ENSANUT	2012	NA	0.2	17,808	15-50	10,121	38	10,286	8,683
Peru	PER	DHS	2013	97.3	7.0	20,808	15-49	11,398	39	11,734	16,362
St. Vincent & the Grenadines	VCT	STEPS	2013	67.8	0.2	1,937	18-69	902	39	10,259	54
Mexico	MEX	SAGE	2014	81.0	0.0	2,799	18-98	368	40	17,150	65,172
Guatemala	GTM	DHS	2014-15	96.8	0.1	25,557	15-49	11,224	38	7,220	8,922
Colombia	COL	DHS	2015	86.6	0.0	26,670	21-49	17,235	38	13,115	25,626
Guyana	GUY	STEPS	2016	66.7	0.1	1,588	18-69	690	39	7,285	390
Haiti	HTI	DHS	2016-17	99.3	0.0	2,495	35-64	1,368	41	1,654	5,705
Europe and Central Asia											
Russia	RUS	SAGE	2007-10	87.7	1.0	2,777	19-99	215	41	23,063	78,269
Kyrgyzstan	KGZ	STEPS	2013	NA	0.7	1,665	25-64	840	40	3,117	3,242
Moldova	MDA	STEPS	2013	83.5	11.5	2,637	18-69	939	39	5,638	2,105
Bulgaria	BGR	EHS	2014	72.5	13.4	2,897	15-85	802	40	16,324	3,600
Romania	ROU	EHS	2014	NA	0.0	8,728	15-85	2,616	40	19,802	9,946
Georgia	GEO	STEPS	2016	75.7	1.3	2,903	17-70	1,000	40	9,256	2,091
Belarus	BLR	STEPS	2016-17	87.1	7.8	2,692	18-69	1,095	41	16,978	5,052
Azerbaijan	AZE	STEPS	2017	97.3	5.1	1,580	18-69	632	40	15,929	5,032
Tajikistan	TJK	STEPS	2016-17	94.4	4.9	1,539	18-70	773	39	2,854	4,623
Mongolia	MNG	SISS	2018	92.0	0.3	10,765	15-49	6,764	39	12,209	1,635

Middle East and Northern Africa

Country	Code	Survey	Year								
Egypt	EGY	DHS	2015	98.9	0.0	8,687	15-59	3,653	38	10,243	49,665
Iraq	IRQ	STEPS	2015	98.8	4.0	2,355	18-102	1,148	39	14,964	19,418
Algeria	DZA	STEPS	2016-17	93.2	2.1	3,823	18-69	1,928	39	13,908	21,303
Iran	IRN	STEPS	2016	98.4	4.5	15,260	18-100	6,712	38	18,664	41,024
Lebanon	LBN	STEPS	2017	69.9	8.2	2,167	16-70	1,022	39	11,647	3,911 [h]
Morocco	MAR	STEPS	2017	89.0	4.0	3,398	18-100	1,535	39	7,509	18,379
South Asia, East Asia, and Pacific											
China	CHN	SAGE	2008-10	98.9	5.2	7,601	18-93	785	42	8,683	698,159
Philippines	PHL	DHS	2013	98.3	0.0	24,832	15-49	12,269	39	6,282	53,801
Bhutan	BTN	STEPS	2014	96.9	1.9	1,712	18-69	887	38	7,954	358
Nepal	NPL	SOSAS	2014	97.0	2.0	1,007	15-100	394	38	2,385	15,562
Timor-Leste	TLS	STEPS	2014	96.3	7.8	1,407	18-69	668	39	6,467	640
Indonesia	IDN	IFLS	2014-15	90.5	0.0	16,518	15-101	7,151	37	10,181	134,356
India	IND	DHS	2015-16	96.7	0.0	677,463	15-49	331,512	38	5,944	656,288
Sri Lanka	LKA	DHS	2016	98.9	0.1	18,288	15-49	13,968	39	11,447	11,090
Sub-Saharan Africa											
Ghana	GHA	SAGE	2008-09	92.1	12.4	2,407	18-114	294	40	2,729	15,002
Cote d'Ivoire	CIV	DHS	2011-12	93.0	0.3	9,802	15-49	4,130	37	5,192	12,742
Namibia	NAM	DHS	2013	93.8	0.9	9,641	15-64	3,969	38	9,600	1,286
Botswana	BWA	STEPS	2014	64.0	2.3	2,687	15-69	1125	38	16,175	1,190
Eswatini	SWZ	STEPS	2014	81.8	7.3	2,135	15-70	821	38	9,309	585
Lesotho	LSO	DHS	2014	97.1	0.0	6,211	15-49	2,596	37	2,811	1,077
Benin	BEN	STEPS	2015	98.6	3.5	2,702	18-69	1,273	36	1,987	5,910
Kenya	KEN	STEPS	2015	95.0	0.3	2,681	18-69	1,197	37	2,798	26,452
Zimbabwe	ZWE	DHS	2015	96.2	0.0	9,481	15-49	4,211	37	2,509	7,662
South Africa	ZAF	DHS	2016	83.1	0.4	5,939	15-95	2,014	38	12,246	29,699
Sudan	SDN	STEPS	2016	95.0	8.2	4,606	18-69	2,143	37	4,357	21,425
Total	NA	NA	NA	93.8 (86.2 – 96.8)[i]	0.6 (0.1 – 4.7)[i]	1,129,404 [j]	15 – 114	542,475	39 (38 – 39.5)[9]	9,256 (5,582 – 12,681)[i]	2,259,850[j]

Abbreviations: y, years; GDP, Gross Domestic Product; int. $, constant 2011 international dollars; NA, not available. CAMDI, Central America Diabetes Initiative; DHS, Demographic Health and Surveillance Survey[39]; EHS, European Health Survey; ENFR, Encuesta Nacional de Factores de Riesgo; ENS, Encuesta Nacional de Salud; ENSA, Encuesta Nacional de Salud; FESAL, Encuesta Nacional de Salud Familiar; ENSANUT, Encuesta Nacional de Salud y Nutrición; ENDSSR, Encuesta Nacional de Demografía y Salud Sexual y Reproductiva; ENDESA, Encuesta Nicargaüense de Demografía y Salud; IFLS-5, Indonesia Family Life Survey Wave 5; PNS, Pesquisa Nacional de Saúde; RHS, Reproductive Health Survey; SAGE, Study on global AGEing and adult health; SISS, Social Indicator Sample Survey; SOSAS, Surgeons OverSeas Assessment of Surgical need; STEPS, STEPwise approach to Surveillance.
[a] Values are unweighted (i.e., do not account for the multi-stage cluster sampling used by the included surveys).
[b] Sample size, median age, and age range are shown for those with a non-missing outcome variable.

[c] Year(s) in which the data collection for the survey was carried out.
[d] This is the women's response rate.
[e] This is the percent of female participants who had a missing response for the survey question assessing whether she had ever undergone a screening test for cervical cancer.
[f] This is GDP per capita in constant 2011 international dollars (as estimated by the World Bank[17]) for the year of the survey's data collection. In case of a multi-year data collection period, we calculated the mean GDP per capita in constant 2011 international dollars across years.
[g] Population in 2019 as estimated by United Nations, Population Division, Department of Economic and Social Affairs (2019).[19]
[h] This is the combined number of Lebanese citizens and Syrian refugees living in Lebanon in 2017 as estimated by the UN Refugee Agency (UNHCR).[40]
[i] This is the median value and interquartile range with each country having the same weight.
[j] This is the sum across all countries.