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RESEARCH ARTICLE

Breast Cancer Screening in Latin America: The Challenge to Move from Opportunistic to Organized-Systematic Screening

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ABSTRACT

Background: Breast cancer is the leading cause of death from cancer among women in Latin America. Most Latin American countries started national mammogram screening programs a decade ago. The implementation level and effects of screening programs in Latin America have not been evaluated.

Aim: To evaluate the association between screening programs implementation and breast cancer mortality in selected North American and European countries compared to a group of Latin American countries with national screening programs.

Methods: The study applied an ecological design with secondary data from official national and international sources. Join point regression analysis was conducted to describe the trends in mortality rates in a group of five Latin American countries (Brazil, Chile, Colombia, Costa Rica and Mexico) with five Non-Latin American countries (Canada, Spain, Sweden, United Kingdom and the United States of America). The association between screening and mortality rates was explored using correlation and linear regression. National cancer plans were assessed to describe screening strategies among selected countries.

Results: A significant reduction in standardized breast cancer mortality rates was observed in all Non-Latin American countries with an Average Annual Percent Change (AAPC) of -2.00 ($p<.05$, 95%CI [-3.33, -0.70]) for the period 2010-2020. In contrast, Latin American countries reported a significant increase in the AAPC of +1.38 ($p<.05$, 95%CI [0.86,1.76]) in breast cancer mortality rates for the period 2010-2020. For Latin American countries, with screening rates below 50%, there was no correlation between screening and mortality rates for the period 1985-2020 ($r = -0.17$, $p = .78$). For non-Latin American countries, with screening rates over 70%, the linear regression model explained significantly 55% of the variance in mortality rates (R2aj =.55, F (5,14) = 5.69, p = .005), with a negative and significant effect of mammogram screening on mortality rates ($\beta = -0.14$, $p = .01$). The National Plans analysis revealed an opportunistic screening model for Latin American countries and an organized-systematic model in Non-Latin American countries.

Conclusion: There is an association between the level of implementation of screening programs and mortality rates from breast cancer. Latin American countries should transform their opportunistic strategy into an organized-systematic model.

Introduction

Breast cancer is the leading cause of death from cancer in Latin America[1]. Incidence rates for breast cancer are also the highest for cancer in the region. Countries such as Brazil, Chile, and Colombia are experiencing a very strong increase in incidence rates [2]. The Panamerican Health Organization has identified breast cancer prevention as a public health priority for the region[3]. Most Latin American countries have included breast cancer prevention and mammogram screening in their national cancer plans during the last decade[4,5].

Mammogram screening has been shown to be an effective strategy to reduce mortality associated with breast cancer. The highest benefit is achieved through biannual screening for women between 50-74 years old[6,7]. However, there is emerging evidence of benefit in women over 40 and the topic is being revisited by a number of independent groups such as the US Preventive Services Task Force, who has already made public a new draft recommendation expanding mammogram screening for women over 40[8].

Most North American and Western European countries started organized-systematic screening programs based in primary care in the early 90s.There is consistent evidence from a number of clinical trials showing a 20% to 25% reduction in breast cancer mortality associated with systematic mammogram screening in different populations[6,7]. However, clinical trials might differ from observational studies where implementation of screening practices at the primary care level and adherence of target populations at community level could differ. These factors could affect the effectiveness of interventions. Berry et al (2005) found a high variability in the reduction of deaths from breast cancer in different models. The proportion of the total reduction in the rate of death from breast cancer attributed to screening varied in different models from 28 to 65 percent[9]. In addition, screening strategies can differ and might change over time given cultural and organizational factors that can affect adherence of the population and implementation practices[10]. Differences in effectiveness between opportunistic and organized-systematic screening have been reported in different studies[11,12]. Opportunistic screening refers to screening offered in a clinical encounter, while organized-systematic screening integrates local monitoring, catch-up and follow-up strategies for populations mostly at the primary care level[13].

Latin America has a strong tradition of developing preventive programs targeting infectious diseases. However, cancer prevention is a relatively new topic for primary care in Latin America. Many countries started breast cancer screening programs around 2010. Most have included mammogram screening as a key health policy in their National Cancer Plans[4]. However, the extent of policy implementation and current national levels of breast cancer screening are not clear in those Latin American countries who started a national breast cancer screening program more than a decade ago. There is a lack of information on whether the effect observed during the first decade of screening programs in North America and Europe is also observed in Latin America, and what screening levels are required to have an impact on mortality rates. The implementation of good screening practices could accelerate the process to achieve the minimum adherence levels required to have a significant effect on breast cancer mortality[14].

This study analyzes the association between mammogram screening practices and breast cancer mortality rates in a selected group of Non-Latin American countries in comparison to a selected group of Latin American countries that initiated national screening programs a decade ago. The study also analyzes characteristics of screening strategies in Latin American and Non-Latin American countries to identify key practices to improve breast cancer prevention.

Methods

An ecological research design using secondary data was developed to compare breast cancer mortality, mammogram screening rates, and screening practices between a selected group of five Latin American and five Non-Latin American countries.

The Latin American countries selected were Brazil, Chile, Colombia, Costa Rica, and Mexico. These countries were selected considering four criteria: population size, diversity of human development indexes (HDI), development of public health/primary care and magnitude of breast cancer mortality as one of the top three causes of death from cancer in women. The countries were selected to include a broad spectrum of population size, and diversity in the developmental levels of public health/primary care as expressed by traditional indicators such as immunization rates. The last criterion was the existence of a national mammogram screening program for at least one decade. Non-Latin American countries included were Canada, Spain, Sweden, United Kingdom, and the United States of America. They were selected based on equivalent criteria to those applied to Latin American countries. The countries selected have a wide spectrum of population size

and consolidated mammogram screening programs two or more decades old and have experienced breast cancer as a major public health problem. Another criterion applied to all countries was the availability of reliable epidemiologic information on breast cancer incidence, mortality rates and screening rates over time.

Secondary data was obtained from various sources. Epidemiologic information on breast cancer was obtained from the Global Cancer Observatory (GCO) from the International Agency for Research on Cancer (IARC). The data presented in the GCO are considered the best available in each country worldwide and allow comparisons between countries in different periods of time. Incidence rates, mortality rates and mortality to incidence ratios over time were obtained from the GCO platform. Breast cancer screening rates were obtained from official information reported by the Organization for Economic Cooperation and Development (OECD) library that publishes accessible periodic information at national levels from more than 100 countries. National reports and cancer plans were also reviewed to compare information over time. To describe screening practices at a country level, national cancer plans were reviewed using the information provided by the International Cancer Control Partnership (ICCP). The ICCP is a group of international organizations engaged in cancer control planning efforts that was established in 2012 and includes more than 110 countries including those selected in this study. They assist national health authorities and have designed a standardized framework to develop national cancer plans accessible for review on their platform. Specific sources of epidemiologic information and screening practices are provided in figures and tables in the results section[15,16,17]. A descriptive analysis of the information by country and region was performed to compare standardized breast cancer mortality rates and screening rates. To identify changes in mortality rate trends, join point regression was estimated for every selected country and period using the join point Regression Program, Version 5.0.2 (Statistical Research and Applications Branch, National Cancer Institute). This method uses age-standardized mortality rates as inputs to identify the year(s) when a trend change is produced, calculate the annual percentage change (APC) in rates between trend-change points, and estimate the average annual percentage change (AAPC) in the whole periods of interest. The program determines the optimal number of join points through a grid search method and establishes their significance with a Monte Carlo permutation test. Trends are described as increasing or decreasing when the annual percent change (APC) for the specified period is statistically significant ($p < .05$); otherwise, the APC is described as stable. The APC represents the average percentage increase or decrease in cancer rates per year for a specified period. The average annual percent change (AAPC) is a weighted average of the APCs for each segment, using the length of the segments as weights. When there are no join points or changes in trends, the APC is constant, so it is equal to the AAPC.

To evaluate the association between mammogram screening and breast cancer mortality rates among Latin American and non-Latin American selected countries, we tested for correlations and linear regressions. For the linear regression analysis, we used the mammogram screening rate percentage as the independent variable and the age-standardized mortality rates as the dependent variable, and we controlled for the fixed effect of the countries. To assess whether the proposed model could be adequate and generalizable to the population, we performed several diagnostic analyses, including the Bonferroni outliers test, the Shapiro-Wilk test for the assumption of normality in the residuals, the Durbin-Watson test for the independence of the model residuals, and the non-constant variance score test to check the assumption that the variance was constant among the different predictor values.

To analyze screening program strategies, we conducted a focused literature review including official repositories and platforms targeting national information on breast cancer screening plans. The main sources of information identified were: International Cancer Control Partnership (ICCP, 2023) platform (2023) that publishes National Cancer Plans, the World Health Organization platform on breast cancer (WHO, 2023), the Pan-American Health organization (PAHO, 2023) and the Organization for Economic Cooperation and Development library (OECD, 2023). We also conducted a convenience search for relevant references published in these documents. Information was analyzed using screening dimensions of the performance indicators framework published by Muratov et al (2020) on behalf of the European Commission Initiative on Breast Cancer (ECIBC). The framework was adapted to include breast cancer health policies and organization strategies as suggested by WHO and PAHO authorities. The final framework included five health policy and organizational components: availability of national guidelines for cancer screening, identification of target population, free or low access mammogram screening, traceability of practices on target

population and local and national registries on screening practices. Four key performance indicators were included: screening coverage at local/primary care level, participation rate, recall rate for screening and recall rate for diagnosis.

This study was reviewed and approved by the Ethical Committee at the Faculty of Medicine of Pontificia Universidad Católica de Chile (ID 230228003) and funded by the Center for Cancer Control and Prevention (CECAN) Chile; Fondo de Financiamiento de Centros de Investigación en Áreas Prioritarias (FONDAP ID 152220002).

Results

The general profile of countries included in this study in 2020 is presented in Table 1. Latin American countries present more variability in human development indexes and health status indicators, while Non-Latin American countries present more homogenous indicators. Selected countries have a wide spectrum of population sizes. Latin American countries present Human Developed Indexes (HDI) in the high (0.7 to 0.799) and very high (≥ 0.8) range while all Non-Latin American countries are in the very high range. Health status indicators of selected countries present more variability. In Latin America, only Chile and Costa Rica report infant mortality rates below 10/1000 live births and immunization rates for the third doses of Hepatitis B over 90%. All Non-Latin American countries report infant mortality rates below 10/1000 and only Canada presented immunization rates below 90% in 2020. Standardized breast cancer mortality rates in 2020 were similar in selected Latin-American and Non-Latin American countries while the mortality to incidence ratio, an estimate of case fatality ratio, was significantly higher in selected Latin American compared to Non-Latin American countries (t (8) = 9.66, p <.001, 95%CI [0.08, 0.13]).

Table 1. Health profile of Latin American and non-Latin American countries included in the study.

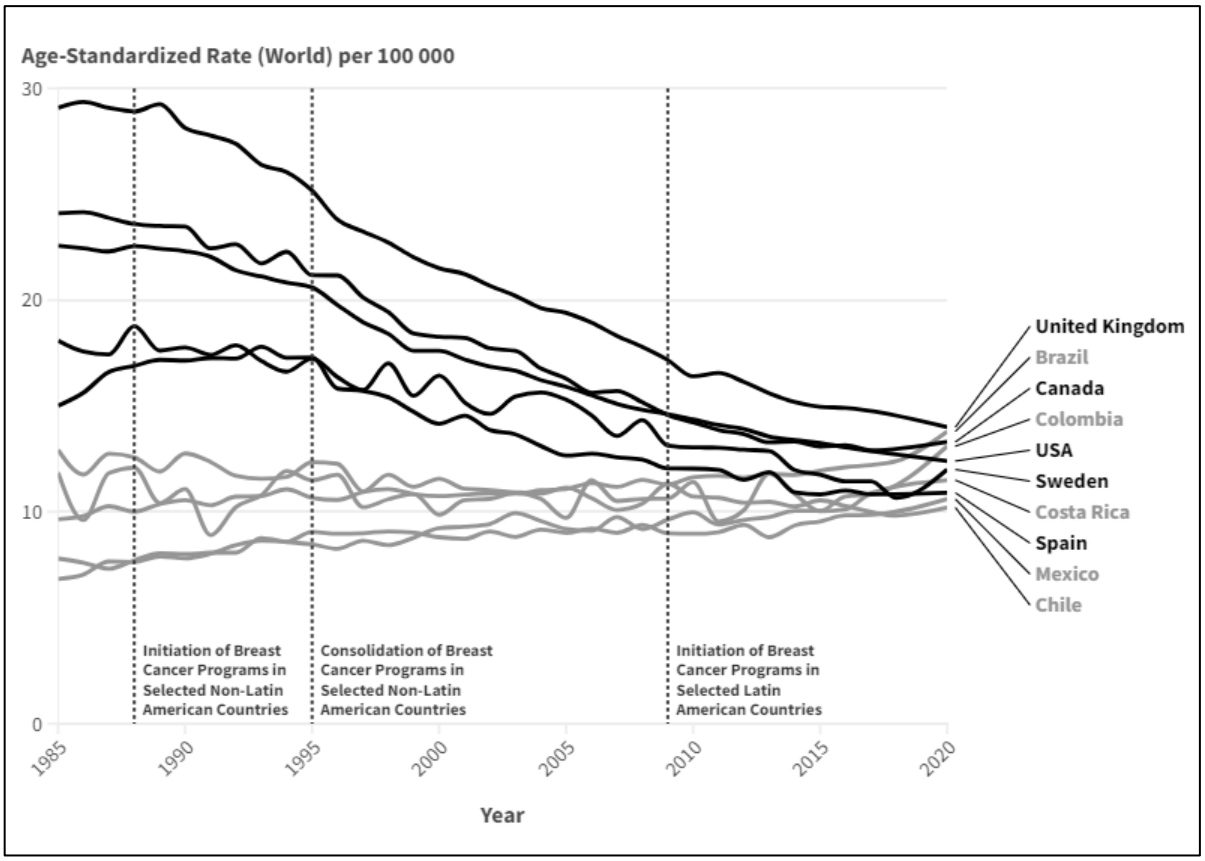
Country	Population[1] (Millions)	Human Development Index[2] 2020	Infant Mortality Rates[3] (deaths per 1000 live births) 2020	Immunization Rates Hep B[3] (3rd Dose) 2020	Breast Cancer Mortality Rates[4] (ASR) 2020	Breast Cancer Mortality to Incidence Ratio[4] (ASR) 2020
Latin American countries						**0.254**
Brazil	213.19	0.758	13.13	77	13.8	0.223
Chile	19.3	0.852	5.77	93	10.2	0.273
Colombia	51.84	0.752	11.35	88	13.1	0.271
Costa Rica	5.12	0.809	6.73	92	11.5	0.242
Mexico	125.99	0.756	11.77	77	10.6	0.262
Non-Latin American countries						**0.148**
Canada	37.89	0.931	4.38	84	13.3	0.162
Spain	47.36	0.899	2.71	94	10.6	0.137
Sweden	10.37	0.942	2.15	97	12.0	0.143
United Kingdom	67.06	0.924	3.62	93	14.0	0.160
USA	335.94	0.920	5.44	91	12.4	0.137

ASR: Age Standardized Rates (world) per 100 000 [1]United Nations Department of Economic and Social Affairs Population Division https://population.un.org/wpp/ [2]United Nations Development Program. Human Development Index https://hdr.undp.org/data-center/country-insights#/ranks [3] UNICEF Data warehouse. Data by country https://data.unicef.org/country/ [4] International Agency for Research on Cancer (IARC). Global cancer observatory https://gco.iarc.fr/overtime/en

Figure 1 shows standardized trends in breast cancer mortality rates from 1985 to 2020. All Non-Latin American countries reported a reduction in age standardized mortality rates in this period. In contrast, most Latin American countries reported an increase in mortality rates in the same period. A join point regression model was conducted for the statistical analysis of trends and inflection points of mortality rates for each country and region for the 1985-2020 period (Table 2). The analysis showed a significant decrease in the average annual percentage change (AAPC) for Non-Latin American

for 1990-2009 (-2.22, $p<.05$, 95%CI [-2.32, -2.11]) and for the 2010-2020 period (-2.00, $p<.05$, 95%CI [-3.33, -0.70]). In contrast, Latin American countries showed a no-change trend in the AAPC for the period 1990-2009 (+0.16, $p>.05$, 95%CI [-0.01,0.32]) and a significant increase in the AAPC estimate for the period 2010-2020 (+1.38, $p<.05$, 95%CI [0.86,1.76]).

Figure 1. Breast cancer age-standardized rate (world adjusted) for selected Latin American and Non-Latin America countries over time[1].



Country	Change 1990-2009	Change 2010-2020
Latin America		
Brazil	0.729	2.159
Chile	-1.43	-0.523
Colombia	1.626	3.127
Costa Rica	-0.451	0.095
Mexico	1.178	1.637
Non-Latin America		
Canada	-8.895	-0.925
Spain	-5.093	-1.142
Sweden	-4.634	-1.041
United Kingdom	-10.96	-2.399
USA	-7.697	-1.961

[1]International Agency for Research on Cancer (IARC). Global cancer observatory https://gco.iarc.fr/overtime/en

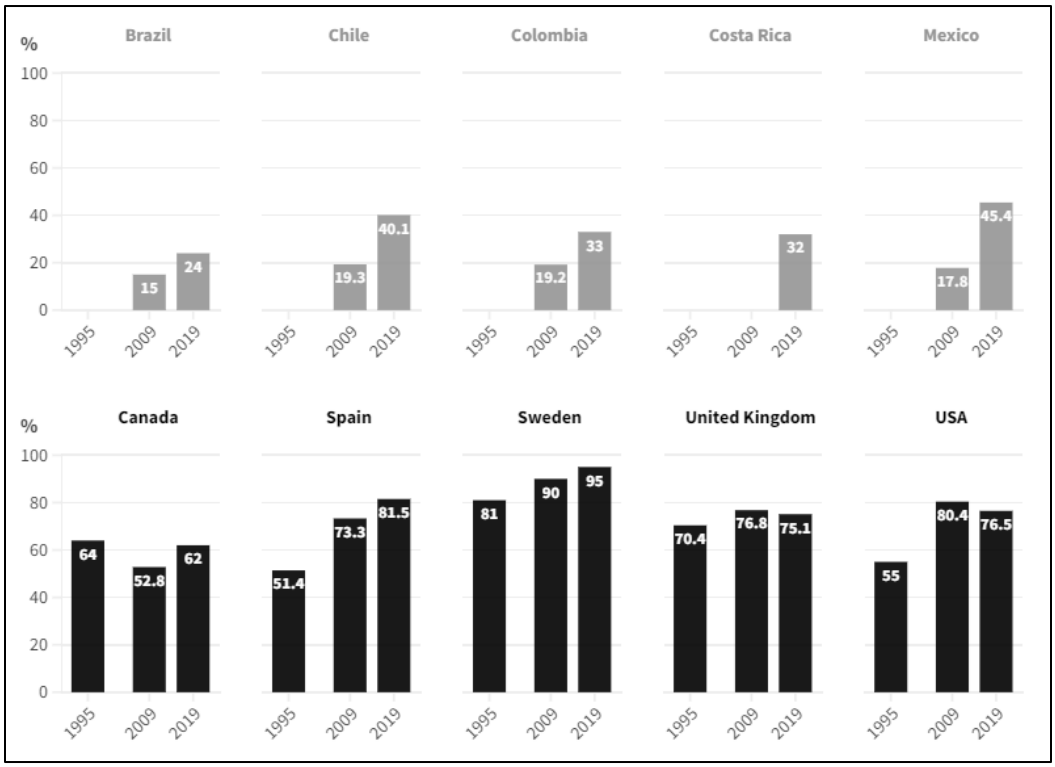
Table 2. Average Annual Percent Change (AAPC) and joinpoints for breast cancer mortality rates by country and period[1]

Country	1990-2009				2010-2020			
	Join points	AAPC	Lower CI95%	Upper CI95%	Join points	AAPC	Lower CI95%	Upper CI95%
Latin America	**0**	**0.16**	**-0.01**	**0.32**	**1**	**1.38***	**0.86**	**1.76**
Brazil	0	0.37*	0.18	0.55	1	1.71*	1.43	1.92
Chile	0	-0.83*	-1.21	-0.45	0	-0.7*	-1.31	-0.13
Colombia	0	0.98*	0.56	1.41	1	3.06*	2.08	2.75
Costa Rica	0	0	-0.61	0.61	0	0.53	-3.32	-3.91
Mexico	1	0.77*	0.57	1.01	0	1.68*	0.98	2.33
Non-Latin America	**0**	**-2.22***	**-2.32**	**-2.11**	**0**	**-2.00***	**-3.33**	**-0.70**
Canada	1	-2.46*	-2.63	-2.29	1	-0.66*	-0.92	-0.44
Spain	2	-1.81*	-1.98	-1.6	1	-1.1*	-1.73	-0.54
Sweden	0	-1.35*	-1.79	-0.92	1	-1.32*	-2.5	-0.59
United Kingdom	3	-2.58*	-2.69	-2.49	0	-1.73*	-2.44	-1.18
USA	3	-2.23*	-2.29	-2.18	1	-1.48*	-1.54	-1.41

*Indicates that the AAPC (Average Annual Percent Change) is significantly different from zero at the alpha = 0.05 level. Regional AAPCs were estimated after averaging mortality rates for every year between the countries.

[1]International Agency for Research on Cancer (IARC). Global cancer observatory https://gco.iarc.fr/overtime/en

Figure 2. Mammogram screening rates (%) by country in 1995, 2009, and 2019 or the closest year available for selected Latin American[1,2] and Non-Latin American countries[2,3,4,5,6,7].

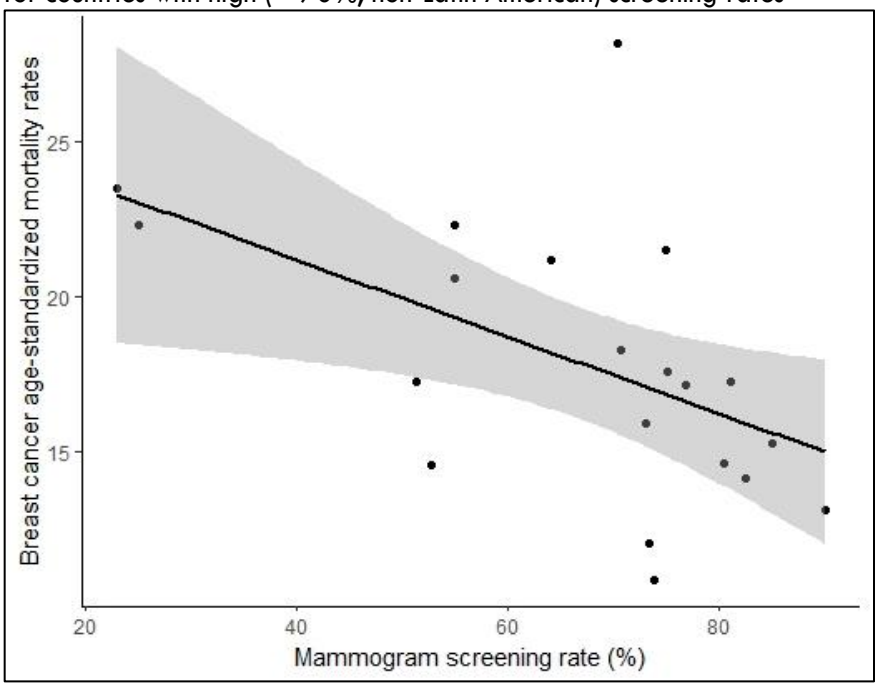


[1]OECD (2022), Primary Health Care for Resilient Health Systems in Latin America, OECD Health Policy Studies, OECD Publishing,Paris, https://doi.org/10.1787/743e6228-en. [2]OECD (2021) Health at Glance: Breast Cancer Care https://www.oecd-ilibrary.org/sites [3]Breen N et al, 2011. [4] OECD (2006) Health Care Quality Indicators https://www.oecd.org/els/health-systems/36262514.pdf [5]Gaudette L et al, 1996 [6]Moss SM et al, 1996 [7]Ministerio de Sanidad y Consumo, España, 2007 https://www.sergas.es/Docs/Avalia-t/AATRM200601.pdf

Breast cancer screening rates for the 1995-2019 period are presented in Figure 2. Selected Non-Latin American countries began their mammogram screening programs between 1985 and 1990. Selected Latin American countries started their breast cancer screening programs between 2005-2010. After five to ten years of program development most Non- Latin American countries achieved screening rates between 50% and 70%. They sustained or increased their rates for the following 25 years to achieve levels over 70%. In contrast, after five to ten years of initiating mammogram screening, selected Latin American countries achieved rates between 20% and 45%.

The association between screening and breast cancer mortality rates was explored using correlations and linear regression models. For Latin American countries, the correlation between mammogram screening and breast cancer mortality rates for the period 1985-2021 was small, negative, and non-significant (r = -0.17, p = .78). The prediction of mortality rates from screening rates at the level reported in Latin American countries showed that mammogram screening was not associated with mortality rates (β = -0.02, p = .78, IC95% [-0.22, 0.19]). The model did not significantly explain the variance in mortality rates (R2aj =-.29, F (1,3) = 0.09, p = .78). For non-Latin American countries, the correlation between mammogram screening and breast cancer mortality rates was medium, negative, and significant (r = -0.52, p = .02). Linear regression results for this model, controlling for the fixed effect of country, showed that the effect of mammogram screening was negative and significant, (β = -0.14, p = .01), meaning that for every percentual point of increase in the mammogram screening rates, breast cancer age-standardized rates decrease in 0.14, beyond differences between the countries. Figure 3 shows this significant association between breast cancer mortality rates and screening for Non-Latin American countries, that achieved 70% or higher rates. The model significantly explained 55% of the variance in mortality rates (R2aj =.55, F (5,14) = 5.69, p = .005). Without controlling for the country effect, the screening effect is also significant (β = -0.12, p = .02), and the model represents the data significantly well (R^2_{aj} =.23, F (1,18) = 6.57, p = .02).

Figure 3. Association between mammogram screening and age-standardized breast cancer mortality rates for countries with high (> 70%, non-Latin American) screening rates



Significant association between mammogram screening and mortality rates (β = -0.14, p = .01).

The association between screening and breast cancer mortality rates was explored using correlations and linear regression models. For Latin American countries, the correlation between mammogram screening and breast cancer mortality rates for the period 1985-2021 was small, negative, and non-significant (r = -0.17, p = .78). The prediction of mortality rates from screening rates showed that mammogram screening was not associated with mortality rates in Latin American selected countries (β = -0.02, p = .78, IC95% [-0.22, 0.19]). The model did not significantly explain

the variance in mortality rates (R2aj =-.29, F (1,3) = 0.09, p = .78). For non-Latin American countries, the correlation between mammogram screening and breast cancer mortality rates was medium, negative, and significant (r = -0.52, p = .02). Linear regression results for this model showed that the effect of mammogram screening was negative and significant, (β = -0.14, p = .01), meaning that for every percentual point of increase in the mammogram screening rates, the breast cancer age-standardized rates decreased by 0.14, beyond differences between the countries. Figure 3 shows the significant association between breast cancer mortality rates and screening for Non-Latin American countries that achieved rates of 70% or higher. The model significantly explained 55% of the variance in mortality rates (R2aj =.55, F (5,14) = 5.69, p = .005). Without controlling for the country effect, the effect of screening is also significant (β = -0.12, *p* = .02), and the model represents the data significantly well (R^2_{aj} =.23, *F* (1,18) = 6.57, *p* = .02).

Several diagnostic analyses were performed to assess whether the proposed model could be adequate and generalizable to the population. No outliers or influential cases were observed, according to the Bonferroni outliers test (no studentized residuals with $p < .05$). The assumption of normality in the residuals was checked with the Shapiro-Wilk test, which provided evidence to accept normality ($W = 0.97$, $p = .83$). To check for the independence of the model residuals, we used the Durbin-Watson test. Results indicated that the assumptions were met (DW = 2.18, p = .49) since the statistic was around 2 and was not significant. Finally, the Non-constant variance score test supported that the variance was constant among the different predictor values (X2(1) = 2.61, p = .11). Taken together, these diagnostic analyses support the hypothesis of association between mammogram screening and breast cancer mortality rates beyond the sample.

Table 3 presents the main characteristics of breast cancer screening programs in Latin American countries and compares those characteristics with countries that reported organized-systematic screening programs such as European Union countries and the United Kingdom. The table shows that all selected countries have national policies for breast cancer in place, i.e., they have national cancer plans that include breast cancer screening, a defined target population and a free or low-cost access policy. However, compared with countries at the European Union and the United Kingdom, Latin American countries do not develop systematically pro-active interventions such as regular catch-up practices for non-adherent women and do not have follow-up and recall systems in place.

Table 3. Characteristics of national screening programs and key performance indicators

	Brazil	Chile	Colombia	Costa Rica	Mexico	European Union	UK
Health policies and organizational strategies							
National guidelines for mammogram screening	+	+	+	+	+	+	+
Free access or low-cost mammogram tests	+	+	+	+	+	+	+
Target population identified	+	+	+	+	+	+	+
Pro-active catch up, follow-up and recall systems in place for mammogram screening	-	-	-	-	-	+	+
Local screening registration systems Traceability systems at local level	-	-	-	-	-+	+	+
National screening registration systems Aggregate periodic information on screening rates over defined periods time	-+	-+	-+	-+	-+	+	+
Performance indicators							
Screening coverage: Number of women screened over time in a defined population	-+	-+	-+	-+	-+	+	+
Participation Rate: Number of women screened from those invited to participate	-	-	-	-	-	+	+
Recall rate for screening. N of women not screened in the defined period contacted to complete screening	-	-	-	-	-	+	+
Recall rate for diagnosis. N of women with positive screening undergoing further assessment	-	-	-	-	-	+	+

No breast cancer screening traceability systems were found in Latin American countries. In most cases, national registries were based on cross sectional estimates of number of mammograms performed/population at risk rather than number of women with screening mammogram/target population/time. In some cases (e.g., Chile, Colombia) information for one-time self-reports of mammogram screening was available. Self-reports are prone to many limitations including recall bias and the difficulty of differentiating between diagnostic, opportunistic or systematic screening. Therefore, no continuous local individual-based registries or national registries of breast cancer screening over time were found in Latin American countries. The lack of traceability systems prevents Latin American countries from reporting key performance indicators for breast cancer screening. In contrast, several institutions and organizations support breast cancer screening, monitoring, and traceability in Non-Latin American countries. The European Commission Initiative on Breast Cancer (ECIBC, 2023) provides guidelines on key performance indicators for breast cancer screening strategies and gathers information from country members. Country members report on local screening practices at a national and European level. A similar function is fulfilled by the National Health System (NHS, 2023) in the United Kingdom through its National Breast Cancer Screening Program. In the United States, the National Cancer Institute provides information on cancer screening rates and practices based on several sources, but mainly the Center for Disease Control and Prevention Database and the National Health Surveys (National Cancer Institute, 2023). The Canadian Partnership Against Cancer (2017) includes several regional organizations that provide quality assurance indicators for breast cancer screening and monitoring at a national level.

Discussion

This study shows that Latin American countries with opportunistic screening strategies are experiencing an increasing trend in breast cancer mortality rates compared to countries with organized-systematic screening strategies that reported a significant decrease in mortality rates.

Selected Latin American countries represent over two thirds of the population in the region with high or very high human development indexes. A woman with breast cancer in one of these countries has significantly more risk of dying the disease (on average 1.7 times higher) than a woman with breast cancer in one of the Non-Latin American countries with organized screening programs. The information provided in this study is consistent with findings by Huang J et al. (2021) reporting a decreasing trend in mortality rates in countries with very high human development index (HDI) but an increase in incidence rates, which they attributed to increasing risk factor prevalence or overdiagnosis.[18] Overdiagnosis and lead time bias could explain, in part, differences in fatality or survival rates between populations. However, when comparing standardized mortality rates between countries, as we did in our study, potential confounding for overdiagnosis or lead time bias is cancelled.[19] In this study we compared screening strategies with adjusted standardized mortality rate; therefore, overdiagnosis and lead time bias did not significantly affect the results. The statistical decreasing trend in breast cancer mortality observed in countries with organized screening programs vs. Latin American countries with opportunistic programs cannot be explained by overdiagnosis or lead time bias.

The extent and organization of breast cancer screening programs seem to be essential factors to affect survival and mortality. The Independent UK Panel on Breast Cancer Screening and the United States Preventive Services Task Force among other organizations have concluded that 25% of breast cancer mortality reduction is associated with mammogram screening.[7,8] However, the analysis of observational studies included in these systematic reviews has shown that there is significant variability on the effect of screening programs when analyzing observational studies with different attendance rates. In line with those findings, our study shows that countries that achieved 70% or higher screening rates experienced a decrease in breast cancer mortality rates that is not observed in Latin American countries with 40% or less mammogram screening rates. With screening rates below 50% most of the women at risk will only get opportunistic detection with severe consequences. In a study conducted by Wallbaum et al (2021) in Chile, which uses opportunistic screening, the authors studied over 4500 women with breast cancer in Santiago and found that only 31% of women were detected through mammogram screening and from those, 58% were diagnosed with stage I breast cancer. In contrast, 69% were diagnosed through clinical suspicion and of those, only 17% were diagnosed in stage I or earlier[20]. Similar results were reported by Rosa DD et al (2020), finding that only 34% of the 2950 women participating in the Amazonia III breast cancer prospective study were diagnosed through screening mammograms, and only 26% were in stage I at diagnosis[21].

Organized screening programs can contribute to improved coverage, reduced mortality, and

reduced health disparities[11,14,22]. Latin American selected countries in this study do not comply with the key performance indicators defined for organized screening programs. Most of these indicators are registered at the primary care level and include coverage (i.e., participation rate, annual screening rates) and follow-up indicators (abnormal call rate, diagnostic assessment, diagnostic interval). These indicators should be translated into local and national registries that will allow policy makers to monitor breast cancer screening programs and introduce adjustments[13]. In contrast, opportunistic screening is based in clinical contact between health providers and patients without traceability of screening activities or local individual-based registries. In the European Union, implementation of organized screening programs has improved mammogram screening rates by 25% and has produced an incremental 10% reduction in breast cancer mortality[14]. Peisl S et al (2019) compared a group of 989 women in Switzerland that received opportunistic or organized screening and observed that women in the organized program presented more frequently with in situ rather than invasive cancer and were less likely to undergo radiation therapy[11]. On the other hand, the existence of an opportunistic screening program in Brazil for the last 10 years has maintained screening rates at about 30% with significantly lower rates and early-stage diagnosis in underserved populations[22].

Many Latin American countries have experienced significant advances in breast cancer prevention during the last decade. These are reflected in the existence of cancer national plans, national guidelines for breast cancer prevention and the removal of financial barriers for mammogram screening. However, when compared to consolidated programs such as the ones in place in the European Union or the United Kingdom, Latin American programs lack the local governance and monitoring needed for implementing effective programs and transit from opportunistic to organized systematic screening[23]. Muratov et al (2020) developed a list of key performance indicators that included critical local screening coverage, recall rate and follow-up rates[13]. Following those criteria could contribute to improve screening rates in Latin American countries.

Unorganized screening programs like the ones observed in Latin American countries in our study expose the target population of women to several barriers that prevent them from accessing a screening mammogram. Puschel et al (2010) described several organizational and cultural factors that prevented women from getting mammograms in the Chilean primary care system, even if the test was provided with no copayment. Clinical bureaucratic factors such as the requirement for a professional order for a mammogram or having to wait months to receive the results were some of the organizational barriers identified. Cultural factors identified included the belief that a mammogram is only needed if there are symptoms, or that self-breast examination is the best way to detect cancer early[24]. These factors have also been identified in subsequent studies in different populations in Latin America[25,26,27]. Most of these cultural and organizational factors can be more effectively addressed through an organized screening program where bureaucratic barriers are reduced, and a preventive ecological model is developed at the local level. In this model, women can receive consistent information about breast cancer screening from many sources and not only their primary care provider. In this way, misbeliefs and misinformation can be more thoroughly addressed[28].

Many countries in Latin America have implemented organized preventive programs in primary care in areas other than cancer with excellent results. For example, Chile, Costa Rica and Colombia achieved immunization rates coverage for DTP3 and measles that are equal or higher than the average coverage reported for OECD countries[29]. Chile and Costa Rica achieved immunization rates in 2020 for the third dose of Hepatitis B that were higher than Canada and the United States[30]. The strong reduction in infant mortality rates of Chilean children under the age of five, reaching levels similar to those of OECD countries, is another example of the national contributions of systematic primary care program development[31]. A randomized clinical trial developed in primary care in Chile applied the principles of organized preventive programs and showed that mammogram screening adherence improved from about 10% to 70% in the intervention group after two years of intervention[32]. The effect of the model expanded to the whole local community and continued to show an impact 10 years later[33]. The extensive experience in infant health and infectious diseases in the Latin American primary health care system can be translated to the new scenario of diseases like breast cancer. The principles of organized screening programs are similar to those applied to other preventive programs in primary care and are both feasible and practical for implementation. This study shows that implementing systematic practices to breast cancer screening could contribute to more organized programs and reduce the burden of breast cancer in Latin America.

This study has some limitations that are important to address. First, it is based on secondary data to obtain country-based estimates. Secondary data might not be standardized to obtain comparable estimates. Sources of information between countries might be variable and unreliable. In this study, we included standardized estimates provided by official international sources such as the International Agency for Research and Cancer (IARC) to analyze cancer incidence and mortality rates and the Organization for Cooperation and Economic Development (OCDE) for screening rates. We also obtained information from the International Cancer Control Partnership (ICCP) on national guidelines for breast cancer screening. When information was scattered or not completely comparable, other specific sources were consulted and referenced. On occasions, the closest year of an estimate was used and reported. Second, the design is prone to ecological bias given that populations and not individuals were compared over time. An effort was made to keep the analysis at the country level and to include only nationwide indicators, avoiding local or regional reports. The group of countries included might have introduced a selection bias. A different result could have been obtained if other Latin American and Non-Latin American countries were included. The selection criteria were made explicit and were based on including Latin American countries that represent a great proportion of the Latin American population, but also with national breast cancer programs and national screening estimates. Non-Latin American countries were selected based on their diverse population size, consolidation of breast cancer screening programs and reliable public health indicators.

Conclusion

This study shows the association between highly organized breast cancer screening programs and the reduction of breast cancer mortality over time, compared to the lack of effect of opportunistic programs developed in Latin American countries. Local performance indicators at the primary care level are essential to transform opportunistic into organized-systematic breast cancer screening programs in Latin America.

Conflicts of Interest Statement

The authors report No Conflicts of interest.

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