

Article

Maternal deaths databases analysis: Ecuador 2003-2013

Antonio Pino, María Albán, Alejandra Rivas, Erika Rodríguez

Pontifical Catholic University of Ecuador, Quito, Ecuador

Significance for public health

General agreement on maternal mortality reduction suggests that to reach the millennium target a health system must be able to provide essential, and emergency obstetric care in a well allocate, geographic, ethnic, and socioeconomic distribution of resources. *Patterns of inequity in health status, health care provision, and health risks* are demonstrable in Ecuadorian maternal deaths, but at levels below of those three decades ago. However, a predominant factor seems unclear to explain the variable association found processing national databases. It could mean that every pattern of health systems development played a role in maternal mortality, but also that factors different than those registered by the statistics system may remain hidden and that some random influences are not even considered in an explanatory model yet. To use maternal mortality to assess health system development might contribute to a general improvement in system performance.

Abstract

Background: Maternal mortality ratio in Ecuador is the only millennium goal on which national agencies are still making strong efforts to reach 2015 target. The purpose of the study was to process national maternal death databases to identify a specific association pattern of variable included in the death certificate.

Design and methods: The study processed mortality databases published yearly by the National Census and Statistics Institute (INEC). Data analysed were exclusively maternal deaths. Data corresponds to the 2003-2013 period, accessible through INEC's website. Comparisons are based on number of deaths and use an ecological approach for geographical coincidences.

Results: The study identified variable association into the maternal mortality national databases showing that to die at home or in a different place than a hospital is closely related to women's socioeconomic characteristics; there was an association with the absence of a public health facility. Also, to die in a different place than the usual residence could mean that women and families are searching for or were referred to a higher level of attention when they face complications.

Conclusions: Ecuadorian maternal deaths showed *Patterns of inequity in health status, health care provision and health risks*. A predominant factor seems unclear to explain the variable association found processing national databases; perhaps every pattern of health systems development played a role in maternal mortality or factors different from those registered by the statistics system may remain hidden. Some random influences might not be even considered in an explanatory model yet.

Introduction

Maternal mortality reduction efforts around the world took shape during the 80s, and 90s when two milestone ideas emerged, the *Three Delay Model* (TDM)¹ and the proposal of Essential Obstetric Care (EOC).² The Safe Motherhood Initiative³ launched by World Health Organization (1987) developed a well-documented set of information resources, and a toolkit of intervention alternatives⁴ spread worldwide. In 2000 the millennium goals were stated, maternal mortality goal was to *Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio*.⁵ However, maternal mortality in Ecuador and many other Latin American countries is the only millennium goal on which national agencies are still making strong efforts to reach the 2015 target.⁶

The foundation for those ideas was based on the hypothesis that health systems development to reach the capacity to provide essential obstetric care would be the rationale to fight against maternal mortality; a plausible approach at that time in an era where the non-developed world was more uniformly poor, socio-economically speaking, than it is nowadays. National efforts in many cases achieved important reductions;⁷ however, the intensity of the reduction in Ecuador has reached a level where additional decreasing seems to be a completely new challenge. The trend of maternal mortality ratio per 100,000 live births comparing 1990-2003 with 2004-2013 period shows a clear difference in slope inclination ($t=5.03$, $P=0.00006345$), to regain a sustained declining trend will require the use of alternative sources of information to made adjustments in the decision-making processes that have been in place for a long time.

Maternal mortality also has a clear socioeconomic relationship identified worldwide *The risk of a woman in a developing country dying from a maternal-related cause during her lifetime is about 23 times higher compared to a woman living in a developed country. Maternal mortality is a health indicator that shows very wide gaps between rich and poor, urban and rural areas, both between countries and within them*.⁸

The purpose of the present study is to process the national maternal death databases that collect data for statistical purposes (not for research), to provide some empirical evidence on the relationship between the variables that are registered in the death certificate and annually published officially by the national statistics agency. The idea is to identify a specific pattern of associations in women's characteristics that help to understand better if the rationale of the proposed health systems development to cope essential obstetric care as a strategy to reduce maternal mortality is still applicable today as it was in former times or some adjustments need to be explored. To improve the strength of this attempt to build possible variable associations TDM, EOC, and socioeconomic determinants were utilised as a framework. On the other hand, pregnancy-induced hypertension (PIH) has been the leading maternal mortality cause in Ecuador for a long period, then a comparison of PIH with all the rest of causes grouped was included

in the analysis.

One clear limitation for building a model using data registered by the statistics national system is the fact that a cross-sectional/ecological design is only able to offer a relational level of association where only proxy plausible data bindings can be drawn while a causal model would require a different approach. It was not feasible for the investigators to pool other databases published by the *Instituto Nacional de Estadísticas y Censos* (INEC) (for example, birth register, health activities, etc.) neither the team had resources to perform spatial analysis using geographical frameworks and tools. It is an exploratory phase of research that hopefully will encourage institutional efforts to mine the huge amount of data available, which are regularly collected but remain underutilised in most non-developed countries. This endeavor is nowadays possible because data gathered are accessible for everybody.

Design and methods

The study processed mortality databases published yearly by the INEC.⁹ Databases (Excel format) were downloaded from INEC's website in March 2015. It was exclusively those reporting maternal deaths [classified under the International List of Causes of Death (ICD) code O Chapter X], corresponding to the 2003 to 2013 period, which was already accessible through INEC's website. The variables available for this study, in the INEC's maternal death set of databases for the mentioned years, included: i) year of death; ii) place of death and place of residence: Ecuador is organised into three levels of administration; in descending order: province, canton, and parish; for this study, data were re-coded as canton's main town and countryside. Also, data are reported by area (urban/rural/peripheral); iii) age: re-coded for the present study in under 18 - over 35 years old, and 18 to 35 years old; iv) marital status: registered as common law partner, married, single, divorced, separated, widow. For comparisons were reclassified into two categories: No partner (separated, widow, divorced, single), and Partner (married, common-law partner); v) level of education: registered as None, Literacy Center, Elementary, High School, Basic Education, Middle level, Postsecondary cycle, High, Postgraduate, Ignored; vi) literacy: registered as Illiterate and Literate; vii) facility where death occurred: registered as Hospital or home/another place; viii) PIH. Differentiated between those classified with the ICE code O10-O16, and the rest of causes (O00-O99).

The only variable added to the INEC's deaths database was the presence of Ministry of Health and Social Security hospital facility in the canton of residence.¹⁰

Place of residence and place of death were matched to identify those deaths occurred in the same canton of residence and those occurred in a different canton, considering that hospitals are located predominantly in canton's main town. It is difficult to associate place of death and the presence of a health facility with availability or access to essential obstetric care by the population. But on the other hand, any given health system should work by a referral system that, once it is accessed, theoretically could offer the level of care needed. Because of that, to relate place of death and presence of a health facility is only an attempt to associate *ecologically* two variables but not to infer any causal relationship between them.

Cultural issues are an important part of maternal mortality dynamics that must be taken into consideration when the topic is investigated.¹¹ Although, an ethnic identification is not present in the data gathered by the certificate of death and is not included in the study.

The study was performed from March 2015 till January 2016, including variable definition standardisation to have a comparable study period. Variables were recoded to a dichotomic format grouping subcategories into two well-differentiated groups, which allow the building of

2x2 contingency tables to facilitate the processing and interpretation of statistical tests. The aim was to identify statistical associations between outcome variables (to die at home, canton of death, and presence of a hospital in the canton of death) with exposure variables (marital status, residence area, age groups, literacy PIH). The statistical tool used was a 2x2 contingency tables to calculate odds ratio and Chi-square. Logistic regression analysis was performed to adjust these bivariable calculations to the complete set of variables. Also, multidimensional

Table 1. Ecuador: general characteristics of maternal deaths reported by national statistics institute, 2003-2013.

Characteristics	N. (%)
Residence area	
Urban	1254 (65.9)
Rural	574 (30.2)
Peripheral*	65 (3.4)
No data	9 (0.5)
Marital status	
Common-law partner	540 (28.4)
Single	574 (30.2)
Married	599 (31.5)
Divorced	17 (0.9)
Separated	78 (4.1)
Widow	15 (0.8)
Ignored	57 (3.0)
No data	22 (1.2)
Literacy	
Yes	1689 (88.8)
No	147 (7.7)
Ignored	50 (2.6)
No data	16 (0.8)
Educational level	
None	164 (8.6)
Literacy Centre	19 (1.0)
Elementary	775 (40.7)
High School	558 (29.3)
Basic Education	111 (5.8)
Middle level	34 (1.8)
Postsecondary cycle	14 (0.7)
High	93 (4.9)
Postgraduate	2 (0.1)
Ignored	111 (5.8)
No data	21 (1.1)
Pregnancy induced hypertension	
PIH	599 (31.5)
Others	1303 (68.5)
Extremes of reproductive age	
<18 and >35	728 (38.3)
Reproductive age	1174 (61.7)
Parish of death same of parish of residence	
Same	1046 (55.0)
Different	856 (45.0)
Canton of death same of canton of residence	
Same	1231 (64.7)
Different	671 (35.3)
Death in the canton's main town	
Main town	1631 (85.8)
Country side	271 (14.2)
Death in a hospital	
Hospital	1341 (70.5)
Home or other	561 (29.5)

*Human settlements surrounding cities, but not as scattered as in rural areas. Source: INEC.

mensional scaling analysis was used to provide evidence on the relation between the whole set of variables. Comparisons are based on number of deaths and not on maternal mortality ratio because the intention was to identify a model of variable association rather than an epidemiological distribution of risks. On the other hand, data corresponds to a nationwide registration of deaths system that uses the death certificate as the primary data source.

Data were processed using *Statistical Package for the Social Sciences* (PUCE license), initial drafts were written down, and several revisions were needed to reach the final version.

Results

Trend slopes for the number of maternal deaths classified under the ICD codes O10-O16, compared with the number of deaths classified under other causes, 2003-2013 ($t=3.02$ $P=0.0026$) shows statistically significant difference. The number of deaths classified as other than PIH had a clear tendency to increase (Slope=7.218, Standard Error=1.978), while PIH deaths had a stable trend slightly increasing (Slope=0.609, Standard Error=0.936). One explanation provided by national health officers is that since 2007 death register has been improving both logistically and technically.

A total of 1902 maternal deaths is included in the INEC's databases between 2003 and 2013. Pregnancy induced hypertension coded O10-O16, stands for 599 cases, the remaining 1303 were classified using other codes of the O series (chapter XV) of the ICD. In 1046 (73.9%) cases there was a coincidence in the register of the place of residence (parish level) with the place of death. While 1231 (64.7%) deaths, occurred in the same canton where the parish of residence is located

and 1631 (85.8%) deaths happened in the main town of the canton. Mothers dying lived in 198 cantons out of 277 total Cantons of Ecuador. Also, 50 out of the 198 cantons were, at least, one maternal death was registered in the period does not have a Ministry of Public Health Hospital. It does not mean that every canton could be considered as a local health system with basic and comprehensive emergency obstetric and new-born care¹² because the distribution of resources in Ecuador is uneven.

The distribution of deaths for the period is presented in Table 1. Most of the deaths correspond to women of urban residence. A wide variation in marital status is observed in the case series. The level of illiteracy is almost three times higher than the national level (2.8%).¹³ Every single educational level register deaths but women with education ranging from elementary to high school are over-represented in the series. Almost one-third of the cases in 11 years are classified under codes O10-O16. Women under 18 years old and over 35 years old represent a 38.3% of the cases while the number of births in those age groups in 2013 was 19% for the whole country.

The percentage of births attended by health professionals in Ecuador was 94.7% in 2013,⁹ and it was 90% between 2007-2012, estimated by the Demographic and Health Survey.¹³ This source also reports 4.7% of home births attended by traditional birth attendants, 4.2% of home births attended by family members, and 0.7% of home births without any person caring the mother directly. The Ministry of Public Health is the major provider of health care. Nationwide, it has 80 *Basic* hospitals (provide short stay hospitalisation including basic obstetric care), 30 *General* hospitals (most of them provide hospitalisation for basic and comprehensive obstetric care), and six specialised obstetric hospitals able to manage comprehensive obstetric care (Table 2).¹⁴

Once adjusted to the model, to die at home or in a different place than a hospital was related to living in a non-urban area and living outside of the canton's main town. Additionally, those who died at home or

Table 2. Ecuador: comparison of number of maternal deaths at a home or other place than a hospital, related with socioeconomic variables and health facility presence, 2003-2013.

Variables	Place of death		χ^2 (P)	OR* (IL-SL)
	Home or other (%)	Hospital		
Marital status (n= 1823)				
No partner (separated, widow, divorced, single)	210	474	1.4 (0.235)	1.064 (0.833-1.36)
Partner (married, common-law partner)	320	819		
Residence area (n=1893)				
Urban	288 (23.0)	966	80.09 (<0.001)	3.6 (2.05-6.2)
Rural	242 (42.2)	332		
Peripheral	31 (47.7)	34		
Age (n=1902)				
Under 18 and over 35 years old	238 (32.7)	490	5.79 (0.016)	1.27 (0.995-1.62)
18 to 35 years old	323 (22.5)	851		
Literacy (n=1836)				
Illiterate	69 (46.9)	78	23.82 (<0.001)	1.385 (0.898-2.14)
Literate	470 (27.8)	1219		
Canton's main town (n=1902)				
Main town	356 (21.8)	1275	323.7 (<0.001)	0.07 (0.046-0.107)
Countryside	205 (75.7)	66		
Die in same canton of residence (n=1902)				
No	97 (14.4)	574	112.76 (<0.001)	0.339 (0.255-0.45)
Yes	464 (37.7)	767		
MoH hospital in canton of death (n=1902)				
No	84 (40.6)	123	13.7 (<0.001)	2.47 (1.7-3.58)
Yes	477 (28.1)	1218		
Pregnancy induced hypertension (n=1902)				
Yes	120 (20.0)	479	37.64 (<0.001)	0.55 (0.42-0.72)
Others	441 (33.8)	862		

*The logistic regression model had an omnibus $P>0.001$, a Nagelkerke R Square=0.324, and a Hosmer and Lemeshow Test=0.050.

in a different place than a hospital, had a greater chance to die in the same canton of residence, in a place where there is no a MoH hospital, and with a diagnostic different from PIH. It seems that socioeconomic characteristics of the mothers, cause of death and resources allocation are involved in a nationwide model of maternal mortality (Table 3).

In case a woman dying in a different canton than that of her residences, one possible explanation is because she and her family had to travel (by their initiative or referred by a health personnel) to procure higher level of attention than the resolution capacity of the facility near home. The results showed no relationship between socio-demographic variables like the place of residence, marital status, and extremes of reproductive age. However, illiterate women tend to die in the same canton of residence. Whereas, dying in a hospital and dying in the canton's main town, are clearly related to dying in a Canton different from the usual residence of the mother. Also, when the death was classified as due to PIH, the likelihood of moving out from the canton of residence was higher than the chance of dying in the same canton.

In a stratified analysis, the likelihood of dying in a hospital or canton's main town (where hospitals are usually located) showed the same trend of moving out from the canton of residence to die in a different canton whether the mother was finally registered as dying for PIH or by any other cause (Table 4).

The absence of a MoH hospital was related to the probability of dying at home but showed no other plausible association with the rest of variables.

There is no proximity pattern between part or the complete set of variables included in the analysis which means the absence of a statistical model to explain any particular way to die beyond the dichotomic relationships described before. It is so, either at the national level (as shown in Figure 1 and Table 5) or for the mothers who died at home (Stress=0.058).

Discussion

General agreement on maternal mortality reduction suggested that to reach the millennium target a health system must to be able to provide essential and emergency obstetric care in a well-allocated geographic, ethnic, and socioeconomic distribution of resources. The results of the present study identified variable association into the maternal mortality national databases showing that to die at home or in a different place than a hospital are closely related to socio-economic conditions and absence of public health facilities. Also, to die in a different place than the usual residence could mean that the health system is referring patients or women and families are searching for a higher level of attention when they face complications, perhaps too late to save a life. Cultural traditions and beliefs outstanding role in maternal mortality has been widely discussed; unfortunately, maternal mortality databases do not include variables related neither to cultural background nor their ethnic group.

Published evidence on current discussion on maternal mortality intervention approaches provides some orientation on comprehensive health systems development as the future to cope maternal mortality. Using the search engine *Pubmed*, there are no published jobs processing maternal death databases. The data visualisation tool from University of Washington¹⁴ shows the attributable risk of iron deficiency for maternal hemorrhage and maternal sepsis, and intimate partner violence for complications of abortion.

Only 28 out of 75 countries are on track to achieve Millennium Development Goal (MDG) 4 by 2015 and only 20 for MDG5. Additionally, no Latin American countries are on track for MDG5. It is necessary to adjust the targets for each country according to its economic and political order to evaluate its performance.¹⁴ On the other hand; the *three*

Table 3. Ecuador: comparison of number of maternal deaths in the same canton of residence or in a different canton with socioeconomic variables and health facility presence, 2003-2013.

Variables	Canton of death		χ^2 (P)	OR* (IL-SL)
	Other than residence	Same than residence		
Residence area				
Urban	446	808	2.82 (0.24)	2.03 (1.2-3.5)
Rural	196	378		
Peripheral	29	36		
Marital status				
No partner (separated, widow, divorced, single)	247	437	0.184 (0.668)	1.15 (0.93-1.42)
Partner (married, common-law partner)	400	739		
Age				
Under 18 and more than 35	248	480	0.760 (0.383)	0.97 (0.78-1.2)
18 to 35 years old	423	751		
Literacy				
Illiterate	35	112	9.638 (0.002)	0.72 (0.47-1.12)
Literate	618	1071		
Canton main town				
Main town	651	980	107.728 (<0.001)	7.7 (4.5-13.3)
Countryside	20	251		
Place of death				
Home or other	97	464	112.76 (<0.001)	0.34 (0.25-0.45)
Hospital	574	767		
Pregnancy induced hypertension				
Yes	231 (38.6%)	368	4.134 (0.042)	1.05 (0.84-1.3)
Others	440 (33.8%)	863		
Ministry of Health hospital in canton of death (n=1902)				
No	108	99	29.04 (<0.001)	3.16 (2.26-4.4)
Yes	563	1132		

*The logistic regression model had an omnibus $P > 0.001$, a Nagelkerke R Square = 0.184, and a Hosmer and Lemeshow Test = 0.283.

delay model suggests that maternal mortality is characterised by factors depending on both, the population and the health system. One of the major constraints women and their family face when complications arise during pregnancy and mainly during delivery is the decision-making process to seek for help and to arrive at a place where she could be treated. *Addressing gaps in facility readiness and provider competencies for emergency obstetric care, alongside improving coverage of institutional deliveries, are critical to improving maternal outcomes.*¹⁵ All in all, there is no standard formula – fast-track countries deploy tailored strategies and adapt quickly to change.¹⁶ Eichler and colleagues, assess the evidence on efforts to enhance health initiatives addressed to improve maternal health status, one conclusion is *We found no direct evidence on the impact of performance-based incentives on neonatal health services or mortality of mothers and new-borns. A number of studies describe approaches to rewarding quality as well as increases in the quantities of services provided, although how quality is defined and monitored is not always clear.*¹⁷ The present study results indicate socioeconomic characteristics of maternal deaths, the cause of death and resources allocation are involved in a nationwide model of deaths registered as occurred at home. In China, provincial maternal mortality surveillance systems showed that Provinces from remote regions had the highest risk of maternal mortality, followed by provinces from inland regions and coast regions.¹⁸ In a cross-sectional study in 29 countries in Africa, Asia, Latin America and the Middle East showed statistically significant relationship between low education levels and serious maternal outcomes, maternal near miss and death.¹⁹ In Burkina Faso, Cambodia, Indonesia, and Morocco, strategies to improve maternal and neonatal health have focused on the expansion of the network of health facilities with increased uptake of facility birthing, scaling up of the production of midwives, reduction of financial barriers, and late attention for improving the quality of care.²⁰ World Health Organisation Multicountry Survey on Maternal and Newborn Health in 29 countries from Africa, Asia, Latin America and the Middle East showed Maternal near-miss cases were eight times more frequent in women with pre-eclampsia, and increased 60 times

more frequent in women with eclampsia.²¹

Paraphrasing the Priorities in Health²² publication, *income growth and technical progress, in the broadest sense, worked to [...] reduce maternal mortality to levels not easy to imagine 30 years ago.* Perhaps a new approach corresponds to the development level reached for some national health systems, where a mixture of interventions ranging from community-based initiatives to third level health care interventions could contribute to addressing the current situation. For example, the strategy used in the UK to reduce maternal morbidity and mortality is a warning system for early detection; they surveyed 205 obstetric anaesthetists who agreed with the six most important physiological parameters were: heart rate, respiratory rate, temperature, systolic and diastolic blood pressure and oxygen saturation.²³ Considering that education, training, licensure and regulation of midwives improve the use of resources and outcomes, some strategies include preventive care, promotion of normal reproductive processes and emergency treatment available.²⁴ The absence of commodities (especially misoprostol), limitations in the scope of practice for midwives, and gaps in the inclusion of maternal health indicators in the national data systems have impeded efforts to scale up programs nationally.²⁵

The last argument means a new stage in health systems development. Nevertheless, the idea of local health systems has been in place for decades, but it is hard to find examples of such kind of development oriented to EOC. In Ecuador the attempt of the Health Authority is clear in this sense and governmental levels of the organisation have been explicitly issued in 2011.²⁶

The *Patterns of Inequity in Health Status, Health Care Provision and Health Risks*,²² are still demonstrable in Ecuadorian maternal deaths, but at levels below those two or three decades ago. It is hard to explain every death and subsets of deaths using national data, but it clearly shows that in-depth evaluation is needed. However, a predominant factor seems unclear to explain the variable association found processing national databases. It could mean that every pattern of health systems development played a role in maternal mortality, but also that factors different from those registered by the statistics system may remain

Table 4. Ecuador: comparison of number of maternal deaths in cantons where ministry of health hospitals are not available related with socioeconomic variables, 2003-2013.

Variables	Ministry of health hospital available		χ^2 (P)	OR* (IL-SL)
	No	Yes		
Marital status				
No partner (separated, widow, divorced, single)	70	614	0.245 (0.620)	0.9 (0.67-1.26)
Partner (married, common-law partner)	125	1014		
Residence area (n=1893)				
Urban	136	1118	0.001 (0.999)	0.76 (0.34-1.7)
Rural	62	512		0.94 (0.39-2.3)
Peripheral	7	58		
Age (n=1902)				
Under 18 and more than 35	90	638	2.66 (0.103)	1.25 (0.91-1.7)
18 to 35 years old	117	1057		
Literacy (n=1836)				
Illiterate	16	131	0.004 (0.95)	1.1 (0.63-1.9)
Literate	181	1508		
Canton main town (n=1902)				
Main town	177	1454	0.011 (0.915)	0.93 (0.52-1.65)
Countryside	30	241		
Place of death (n=1902)				
Home	84 (15.0%)	477	13.7 (<0.001)	2.2 (1.67-3.5)
Hospital	123 (9.2%)	1218		
Pregnancy induced hypertension (n=1902)				
Yes	60	539	0.677 (0.411)	0.92 (0.66-1.3)
Others	147	1156		

*The logistic regression model had an omnibus $P > 0.001$, a Nagelkerke R Square = 0.067, and a Hosmer and Lemeshow Test = 0.286.

hidden and that some random influences are not even considered in an explanatory model yet. Ideally, a national statistics system should permit a country to merge different databases and analyse data to explain reality effectively and to provide evidence for decision-making.

Table 5. Stress and fit measures.

Variable	Value
Normalized Raw Stress	0.06449
Stress-I	0.25394 ^a
Stress-II	0.73482 ^a
S-Stress	0.16290 ^b
Dispersion Accounted For	0.93551
Tucker's Coefficient of Congruence	0.96722

PROXSAL minimizes Normalized Raw Stress. ^aOptimal scaling factor = 1.069; ^bOptimal scaling factor = 0.918.

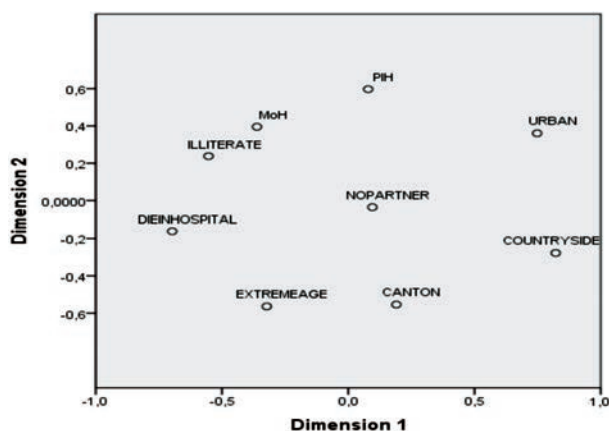


Figure 1. Ecuador: multidimensional scaling proximities representation of variables (dichotomic) in INEC's databases for maternal deaths, 2003-2013.

Correspondence: Antonio Pino, Pontifical Catholic University of Ecuador, PUCE, Avenida 12 de Octubre 1076, Vicente Ramón Roca, Quito, Ecuador. Tel.: +593.9.87285680.

E-mail: mapinobedon@gmail.com

Key words: Maternal mortality; death certificates; Ecuador.

Acknowledgments: the authors would like to thank Mrs. Marie Dahlstrom for her review of the final draft and the PUCE authorities for support research.

Contributions: AP, research management, conception and design, acquisition, analysis, and interpretation of data, drafting the work, revising critically the work for important intellectual content; MA, conception and design, drafting the work, revising critically the work for important intellectual content; AR, acquisition, analysis, and interpretation of data, revising critically the work for important intellectual content; ER, acquisition, analysis, and interpretation of data, revising critically the work for important intellectual content.

Conflict of interest: the authors declare no potential conflict of interest.

Received for publication: 15 February 2016.

Accepted for publication: 13 June 2016.

©Copyright A. Pino, et al., 2016

Licensee PAGEPress, Italy

Journal of Public Health Research 2016;5:692

doi:10.4081/jphr.2016.692

This work is licensed under a Creative Commons Attribution NonCommercial 4.0 License (CC BY-NC 4.0).

References

1. Thaddeus S. Too far to walk: maternal mortality in context. *Soc Sci Med* 1994;38:1091-110.
2. United Nations Children's Fund, World Health Organization, United Nations Found on Population Activities. Guidelines for monitoring the availability and use of obstetric services New York: United Nations Children's Fund; 1997.
3. Islam M. The safe motherhood initiative and beyond. *Bull World Health Organ* 2007;85:735.
4. Impact toolkit: A guide and tools for maternal mortality programme assessment. Technical annexes on the use of evaluation tools. 2016. Available from: https://www.abdn.ac.uk/iahs/content-images/Module_5.pdf
5. United Nations. Millennium Development Goals and Beyond 2015. Available from: http://www.un.org/millenniumgoals/pdf/Goal_5_fs.pdf
6. Ministerio de Salud Pública del Ecuador. Rectificación: los índices de la mortalidad materna. *El Universo*; 2015. Available from: <http://www.eluniverso.com/noticias/2015/10/08/nota/5172101/indic-es-mortalidad-materna>
7. Hogan MC, Foreman KJ, Naghavi M, et al. Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet* 2010;375:1609-23.
8. World health Organization. Global Health Observatory (GHO) data. Maternal Mortality. Available from: http://www.who.int/gho/maternal_health/mortality/maternal_mortality_text/en/
9. Instituto Nacional de Estadísticas y Censos (INEC). Nacimientos y defunciones. Available from: <http://www.ecuadorencifras.gob.ec/nacimientos-defunciones/>
10. Ministerio de Salud Pública del Ecuador. Cartera de Servicios Hospitalarios. Available from: <http://www.salud.gob.ec/datos-de-hospitales/>
11. Pino MA, Reascons N. Mortalidad materna en el Ecuador y aspectos culturales de la atención a la mujer embarazada. *Rev Inst JC García* 1991;1:33-55.
12. United States Agency for International Development. Essential Obstetric and Newborn Care (EONC). Available from: <https://www.k4health.org/sites/default/files/EONC%20Program%20Implementation%20Guide%20v1.1.pdf>
13. Freire WB, Ramirez-Luzuriaga MJ, Belmont P, et al. Tomo II: Encuesta Nacional de Salud y Nutrición de la población ecuatoriana de cero a 59 años. ENSANUT-ECU 2012. 1st ed. Quito: Ministerio de Salud Pública/Instituto Nacional de Estadísticas y Censos; 2014.
14. Ministerio de Salud Pública del Ecuador. GeoSalud 2.0. Available from: <https://aplicaciones.msp.gob.ec/salud/publico/dniscg/geosalud/gui/>
15. University of Washington. GBD Compare. Available from: <http://vizhub.healthdata.org/gbd-compare/> <http://vizhub.healthdata.org/gbd-compare/>
16. Cohen RL, Alfonso YN, Adam T, et al. Country progress towards the Millennium Development Goals: adjusting for socioeconomic factors reveals greater progress and new challenges. *Global Health* 2014;10:67.
17. Jayanna K, Mony P, Thomas A, et al. Assessment of facility readiness and provider preparedness for dealing with postpartum haemorrhage and pre-eclampsia/eclampsia in public and private health facilities of northern Karnataka, India: a cross-sectional study. *BMC Pregnancy Childbirth* 2014;14:304.
18. Kuruvilla S, Schweitzer J, Bishai D, et al. Success factors for reducing maternal and child mortality. *Bull World Health Organ* 2014;92:533-44B.

19. Eichler R, Agarwal K, Askew I, et al. Performance-based incentives to improve health status of mothers and newborns: what does the evidence show? *J Health Popul Nutr* 2013;31:36-47.
20. Gan XL, Hao CL, Dong XJ, et al. Provincial maternal mortality surveillance systems in China. *Biomed Res Int* 2014;2014:187896.
21. Tunçalp Ö, Souza JP, Hindin MJ, et al. Education and severe maternal outcomes in developing countries: a multicountry cross-sectional survey. *BJOG* 2014;121:57-65.
22. Van Lerberghe W, Matthews Z, Achadi E, et al. Country experience with strengthening of health systems and deployment of midwives in countries with high maternal mortality. *Lancet* 2014;384:1215-25.
23. Abalos E, Cuesta C, Carroli G, et al. Pre-eclampsia, eclampsia and adverse maternal and perinatal outcomes: a secondary analysis of the World Health Organization Multicountry Survey on Maternal and Newborn Health. *BJOG* 2014;121:14-24.
24. Jamison DT, Breman JG, Measham AR, et al. *Priorities in Health, Washington (DC): The International Bank for Reconstruction and Development/The World Bank; 2006.*
25. Isaacs RA, Wee MY, Bick DE, et al. A national survey of obstetric early warning systems in the United Kingdom: five years on. *Anaesthesia* 2014;69:687-92.
26. Renfrew MJ, McFadden A, Bastos MH, et al. Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care. *Lancet* 2014;384:1129-45.