



## Analysis of Maternal Deaths in Oaxaca through Bayesian Networks

Araceli Pinacho-Ríos, Guillermo De la Torre-Gea  
Sierra Sur University, Mexico

### ABSTRACT

Maternal mortality has shown a considerable decrease in countries where the rate of development is higher. This is not the case for Mexico where a large number of annual maternal deaths are still perceived, which turns out to be a public health problem in which the World Health Organization (WHO) considers indigenous populations with a higher rate of maternal deaths, as is the case in the state of Oaxaca. The aim of this paper is to carry out an analysis of maternal deaths during the period 2014-2016 in the municipalities of this state in order to identify the main causes that cause it, factors that intervene in it and municipalities with the highest rate of this problem. The analysis has revealed that the National Institute of Social Security (IMSS) is the site where the highest number of deaths occurred, as well as identifying the main causes that lead to maternal mortality, determining that it is not enough to have Public and Private Health institutions, but they must have a better care system and equipment for care, without leaving aside the cultural aspect of the inhabitants of the municipalities of the state of Oaxaca.

**Keywords:** *Maternal mortality, public health, indigenous women, municipalities*

### Introduction

According to the World Health Organization (WHO), maternal mortality can be defined as "the death of a woman during pregnancy, delivery or within 42 days after termination, for any cause related or aggravated. for pregnancy, childbirth or puerperium or its

management, but not for accidental causes ( Briones and Díaz de León, 2013).

Maternal mortality is a subject of vital importance for both the government and the general public. This problem must be of priority attention for the government, due to the diverse precarious conditions in which the health centers are located in marginalized areas of the country; which leads to higher rates of maternal mortality. The WHO asserts that where there are more cases of maternal mortality it is in places that present a lower rate: "maternal mortality is higher in rural areas and in the poorest communities" (WHO, 2016).

In Mexico, according to secondary analyzes of official data, between 1990 and 2013, a total of 29,822 women died due to maternal causes. For 2008, the Maternal Mortality Ratio (MMR) in the country was 57.2, in 2010 it was 51.5, in 2012 it was 42.3 and in 2013, the last year with official statistics validated until May 2015, of 38.2 maternal deaths per 100,000 births. (Schiavon, 2015). In the case of Oaxaca, the female mortality rate according to data presented by INEGI (2015) was 11,225 deaths. These can have various causes, among them medical assistance, the reluctance of women to be treated and the working conditions and equipment in which the health sector is located. That is to say, the maternal mortality does not depend on the conditions of origin of the woman, but rather on the place of destination where it is attended to for childbirth.

It is necessary that governments focus attention on solving this global problem. In the specific case of Mexico, it is committed to "the goal of the

Sustainable Development Goals is to reduce the maternal mortality ratio (MMR) worldwide to less than 70 per 100,000 live births between 2016 and 2030" (WHO, 2016). Therefore, the government must establish the appropriate measures to create public policies aimed at mitigating this global problem.

In view of the previous situation, the objective of this paper is to analyze the causes and effects of maternal mortality in Mexico, especially in women in situations of poverty and marginalization, as well as a minimum level of basic studies, in order to find a solution to the problem.

For the development of the research, open data provided by the INEGI on the maternal mortality rate presented in the years 2012-2014 were considered. The selected variables were determined by the questions included in the survey, of which the following were chosen for analysis: the place where the death occurred, type of medical insurance, the level of schooling, usual occupation, medical assistance, the person who certified, as well as the mortality ratio.

Below is Table 1 showing the variables considered for this analysis.

## Methodology

**Table 1: Study variables**

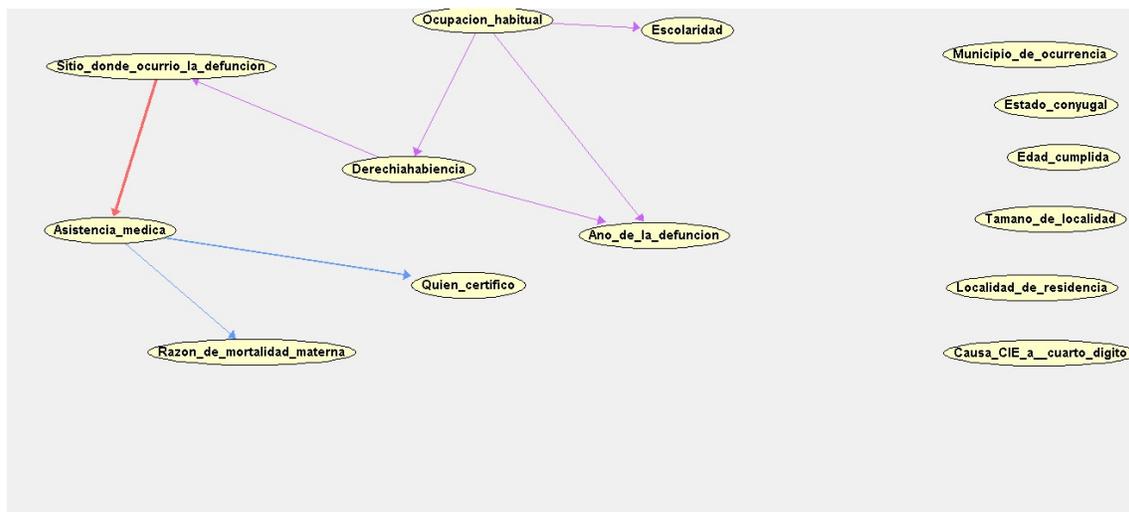
VARIABLE	VALUE	DESCRIPTION
<b>SITIO_OCURRENTO_DEF</b>	1	IMSS
	2	IMSS OPPORTUNITIES
	3	ISSSTE
	4	HEALTH SECRETARY
	5	SECRETARY OF NATIONAL DEFENSE
	6	SECRETARY OF THE MARINA
	7	PRIVATE MEDICAL UNIT
	8	HOME
	9	PUBLIC ROAD
	10	ANOTHER UNIT
	11	ANOTHER PLACE
	12	IT IS IGNORED
<b>DERECHO_HABIENCIA</b>	0	NOT SPECIFIC
	1	ANY
	2	IMSS
	3	ISSSTE
	4	PEMEX
	5	SECRETARY OF NATIONAL DEFENSE
	6	SECRETARY OF THE MARINA
	7	POPULAR INSURANCE
	8	ANOTHER UNIT
	10	IMSS OPPORTUNITIES
<b>ESCOLARIDAD</b>	0	NOT SPECIFIC
	1	ANY
	2	INCOMPLETE PRIMARY
	3	PRIMARY
	4	INCOMPLETE SECONDARY
	5	HIGH SCHOOL
	6	BACCALAUREATE

	7	PROFESSIONAL
<b>QUIEN CERTIFICO LA DEFUNCIÓN</b>		
	1	TREATING MEDICAL
	2	MEDICAL EXAMINER
	3	OTHER DOCTOR
	4	PERSONNEL AUTHORIZED BY S.S.A.
	5	CIVIL AUTHORITY
	8	OTHER
<b>OCUPACIÓN HABITUAL</b>		
	0	NOT SPECIFIC
	2	NOT BUSSY
	4	AGRICULTURE, LIVESTOCK, FISHING
	11	PROFESSIONALS
	12	TECHNICAL
	13	WORKERS OF EDUCATION
	62	SUPPORT TO ACT. ADMITIVES.
	98	DOES NOT APPLY UNDER 12 YEARS OLD
<b>ASISTENCIA MÉDICA</b>	0	NOT SPECIFIC
	1	WITH MEDICAL ASSISTANCE
	2	WITHOUT MEDICAL ASSISTANCE
<b>RAZÓN DE MORTALIDAD</b>		
	1	MATERNAL DEATHS FOR THE REASON OF MATERNAL MORTALITY
	2	MATERNAL DEATHS EXCLUDED FOR THE REASON OF MATERNAL MORTALITY

The treatment of the selected variables was carried out through the use of Elvira software, which is oriented to the edition and evaluation of Bayesian network models and influence diagrams. Bayesian networks have different applications, for classification, prediction, diagnosis and provide relevant information on relationships between variables that can be interpreted as causes and effects (Ramírez-Madrigal, 2018; Rentería-Gaeta, 2018; De la Torre-Gea *et al.*, 2016). In this sense, the relationships between seven groups of variables are analyzed.

### Analysis of results

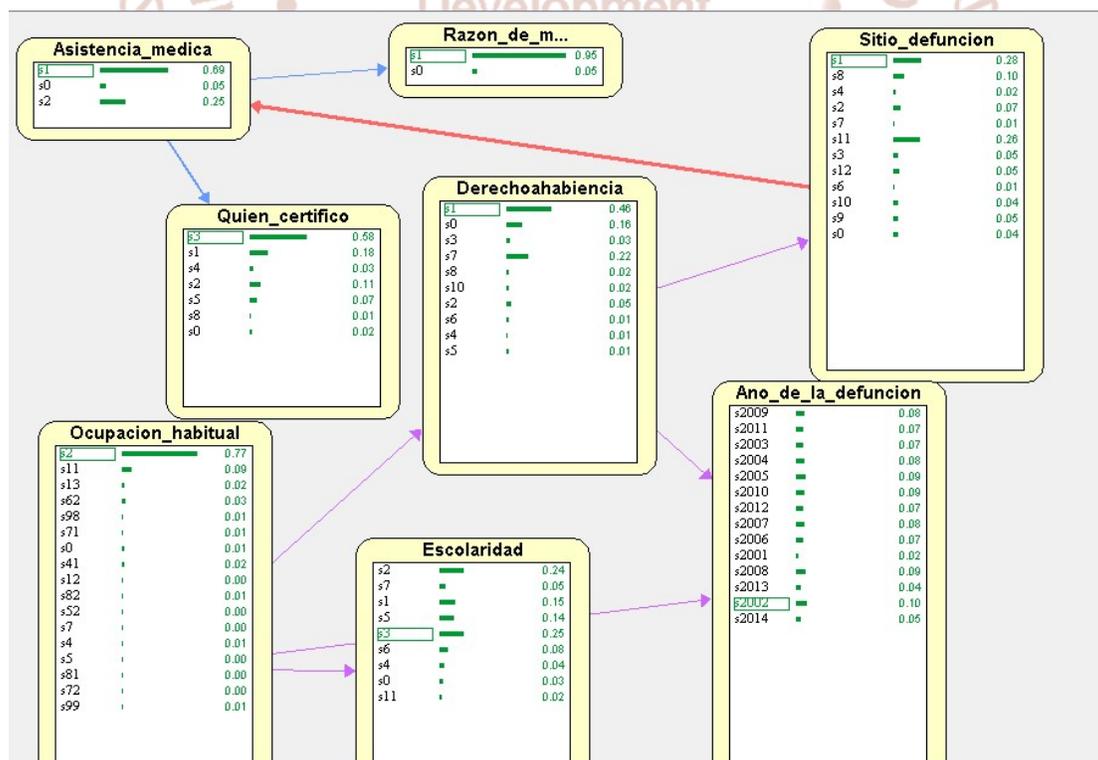
The results obtained from the analysis of the variables related to maternal mortality show that there is a greater relationship between the place where the death occurred, followed by the medical assistance provided. There is also a relationship between the mother's occupation, schooling and the type of Social Security she had. In addition, it is possible to appreciate the existence of independent variables that do not directly influence the developed problem, such as locality of residence, size of the locality, conjugal status, municipality of occurrence, age of the mother and the cause of mortality. As shown in Figure 1.



**Figure 1: Dependent and independent variables of maternal mortality**

An important finding identified in the previous figure, where the data presented by the World Health Organization contradict, which affirm that the highest maternal mortality rate occurs in indigenous populations, considering this as the determinant of the problem. However, the analysis of the variables shows a different result, being, in this case, the place where the death has presented a factor of influence in the proposed topic.

In the same way the study shows an a priori probability where it determines that the maternal deaths were carried out in people who were not currently working, and the schooling they presented was basic representing 25% of the total sample, counting only with Insurance Popular, without having access to the right to know the IMSS, this institution being the place with the highest mortality rate presenting 28% of the total, followed by another place not specified with 26%. These results are shown in Figure 2.



**Figure 2: A priori probabilities of the study variables**

Knowing that they died in the IMSS, it is identified that 77% of the mothers did not find themselves with any occupation, having a primary school level and content at the time of their demise with Seguro Popular in this institution.

These women were treated in this medical institution and 94% of them died for reasons of maternal mortality. The analysis allowed to know that the doctor who had certified the decease was not the same one that attended the prenatal control and delivery. As shown in Figure 3.

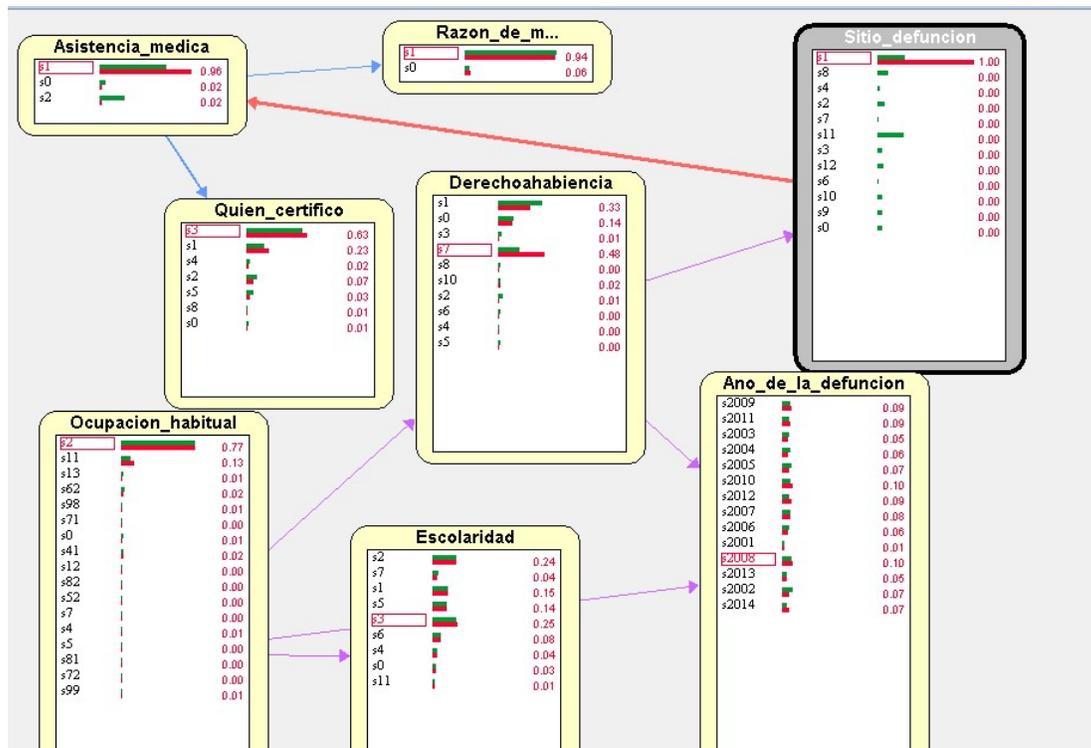


Figure 3: Inference Model where the death site was the IMSS

Despite the previous figure in 2008 and 2010, there is a 10% of deaths from the total analysis, but in 2014 this event decreases to 7%, which may deduce that measures are being taken to control the problem before mentioned.

### Conclusions

To conclude with the analysis of the variables on the subject of maternal mortality, it is determined that the state of Oaxaca still presents problems in the health issue, since the data presented in this study show that the characteristics that the WHO assumes as variables The determinants of maternal mortality (poverty, underdevelopment, marginalization) are not really significant in this global health problem.

In addition, in view of the evident commitment of the countries to end this worldwide problem, it is also concluded that they have really taken no action to counteract this situation. It is opportune to pay attention and carry out an analysis that allows us to really determine which factors influence this problem,

far from the poverty and marginalization of the right holders of health.

The population where the problem was presented lacks education, this is reflected in their level of study being only basic, coupled with the above is the situation where people are not working and this limits them to not have the right of any institution of public health, being their social security the Seguro Popular.

The awareness of the government and citizens about the need to have medical infrastructure is not enough. It is urgent to seek the quality of the institutions in charge of providing this health service to pregnant women, who fit in a population considered to be socially vulnerable. In addition, it requires a total commitment to public servants (doctors and nurses) involved in its implementation. Only by combining labor commitment and political will in this matter will efficiency and effectiveness in its provision in the state of Oaxaca be achieved.

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