

## **Death Inequality During the First Year of Life in Morocco: A Macro Level Analysis**

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### **ABSTRACT**

**Disparities in child mortality are a reality in Morocco. These disparities coexist with inequalities in: (i) the availability of primary health care (PHCs); (ii) the socioeconomic status of the population as reflected by the prevalence of various forms of poverty; as well as (iii) fertility levels (TFRs) and the status of women in literacy and employment rates. Despite its limitations, this research provides a macro-level understanding of the link between infant mortality and a range of aggregates (political, economic, social and demographic). The metadata collected in the 2014 census (RGPH-2014) RGPH-2014 was used to construct a provincial proxy indicator of infant mortality by area of residence. This is considered as a dependent variable that we have tried to explain by the above-mentioned indicators. This is considered as a dependent variable that we have tried to explain by the above-mentioned indicators. The latter indicators reflect the socio-economic conditions prevailing in each of the provinces by area of residence. In addition, they give information on the availability of basic health services and on the woman's status. A key finding is that the level of current fertility as measured by the TFR negatively affects child survival. With a statistically significant regression coefficient of 2.912 ( $P_{\text{value}} = 0.000$ ), it can be argued that high fertility increases the risk of infant mortality. In turn, the prevalence of overall poverty also has a statistically significant effect on infant survival ( $\beta = -0.213$  with a  $p_{\text{value}} = 0.029$ ).**

**Keywords:** infant-mortality, fertility, global poverty, Macro-level, Morocco.

### **INTRODUCTION**

Under-five mortality, which is considered a major indicator of the level of development in general and the physical well-being of children in particular (Shen & Williamson, 1997; Hanmer

et al., 2003), is a concern for nations around the world. In particular, child mortality, one of its main components, is a good indicator of the health status of entire populations (Allotey and Reidpath, 2002) and explains much of the variation in life expectancy between countries (Rodgers, 2002).

Reducing child mortality has long been part of the international community's goals, primarily within the MDGs and SDGs (United Nations, 2000; United Nations, 2015). Indeed, developing countries have made substantial progress toward the fourth Millennium Development Goal, although it varies widely across nations and geographies. United Nations data support the trend of decreasing child mortality since the mid-1950s in almost every part of the world (United Nations, 2019a; 2019b). Thus, the under-5 mortality rate has declined from 213‰ to 40‰ and the infant mortality rate from 140‰ to 29‰. Some differences persist, however, between the countries depending on their development level. For example, to cite only infant mortality, the rate is currently 47‰ in the least developed countries and 32‰ for developing countries versus a mere 4‰ in the developed world.

However, and despite the spectacular improvements in child survival over the past 30 years, the burden of child deaths worldwide remains immense (UNICEF, 2020). An average of 14,000 children died before the age of five years each day in 2019, as compared to 34,000 in 1990 and 27,000 in 2000. Of the estimated 5.2 Million under-5 deaths in 2019, 2.8 Million were boys and 2.4 Million were girls. Approximately 6,700 newborns died each day in 2019. Neonatal death represented a progressively larger share of under-5 deaths over time (In 2019, 47% versus 40% in 1990).

Literature generally classifies factors that influence health outcomes into economic, technological, medical, environmental and societal categories. According to Mosley and Chen (1984), there are two approaches to explain the infant mortality variation. The first one adopted by social science research investigated the association between socioeconomic status and mortality; the second related to epidemiological studies and was concerned by the morbidity and the biological processes of diseases in the environment. The authors argued that a new analytical approach incorporating both social and medical science methodologies was needed and proposed framework based on five proximate determinants. Socioeconomic determinants, which can be grouped at individual, households and community levels, must operate through more the basic proximate determinants that in turn influence the risk of disease and the outcomes of disease processes as mortality (Annex A).

Since, a variety of statistical modeling strategies, based on this framework, have become common (Hill, 2003). Analysis of links between background factors and proximate determinants, between infant mortality and both proximate determinants and background factors and reduced-form models of net associations of background variables and child mortality were thus conducted.

Many cross-national studies tried to identify the background explanatory factors of the child mortality are globally based on five theories (Frey and Field, 2000): modernization/industrialization, economic dependency/world-systems, economic disarticulation, development state and gender stratification. The first four theories fundamentally converge to the idea that an independent and equilibrated development

economy where the State is an important actor increases human well-being and decreases infant mortality by improving education, housing, nutrition, health care, sanitation, and various public services. Gender stratification can be used to argue that societies in which women have a high level of empowerment will generally register low child mortality rate.

Baird and al. (2011) had shown a large negative association between per capita Gross Domestic Product (GDP) and infant mortality. They also found that female infant mortality is more sensitive than male infant mortality to negative economic shocks. Similarly, GDP per capita as a proxy for income and public health expenditure as a percentage of GDP significantly affect infant mortality rate according to Wellington (2014). On the other hand, an aggregate study using data from 16 countries did find a relationship between income inequality and infant mortality with declined association by age at death until aged 65 years from which it became reversed (Rodgers, 2002).

Pison (2010) indicates that the socioeconomic development and health gains could explain the child mortality decline around the world. The Increased agricultural yields and improved transportation have reduced famines and related deaths in most parts of the world. Advances in hygiene and the dissemination of education have also played a key role. Even in the poorest regions, educating women is still associated with better health and reduced child mortality, as it enables them to take better advantage of the availability of care. Health care provision has improved, both to treat disease and to prevent it. Vaccinations, the first preventive tool, have made a significant contribution to reducing infections, the main causes of death in children.

The impact of climate and environmental variables was also tested. Baird and al. (2011) argued that both extreme heat and extreme rainfall affect the likelihood of infant survival. Similarly, Geruso and Spears (2018) provided evidence on the effects of extreme heat and humidity on infant mortality in the developing world.

Also, infant mortality is strongly associated with a number of socioeconomic and demographic variables. The female participation in the labor force and education significantly affect infant mortality (Zakir and al., 1999; Pamuk and al., 2011; Wellington, 2014; Ekholuenetale and al., 2020).

A decrease in the maternal mortality ratio is associated with an increasing probability of under-five child survival (Shen & Williamson, 1997). This result were confirmed by a large international study conducted by Sartorius and al. (2014) who concluded that the maternal mortality were the most prominent attributable risk factor, followed by lack of access to sanitation, water and lower female education.

Particularly, fertility and its components significantly affect infant mortality (Trussel and Peibly, 1984; Zakir and al., 1999; Kapilani, 1992; Rutstein 2000). Recently, using the DHS data about 60 poor countries during the period 1985-2008, Yount and al. (2014) have found that the decline of Total Fertility Rate(TFR) were associated with improvements in child survival. Ekholuenetale and al. (2020) have shown that households with large number of children (3&+) had higher risk of infant mortality, compared to the other. The study of Knodel and al. (1984) had shown that sib ship size is positively related to infant mortality established an association between infant mortality and maternal age. Kaplan and al. (2015) had demonstrated that the

mortality risk decreases by 24% with each additional year of age of the mother at birth. Also, age of first birth has a significant effect on mortality rates, reducing the mortality risk of the earlier-born infant by a quarter for each additional year that a young women delays reproduction, contraceptive prevalence appears to be negatively correlated with infant mortality (Shen and Williamson, 2001).

In a comparative study based on DHS data from 42 countries, Rustein (2000) has established that the risk of child mortality is inversely proportional to the length of births intervals. Also, the risk of death in the childhood period is higher when the mother's age is over 35 years and births intervals are less than 24 months. Knodel et al (1984) confirmed earlier that inter-birth interval is an important factor in infant mortality. Kaplan and al. (2015) noted that a short interval between births increases the mortality risk to the subsequent infant about fourfold.

It's clear that a large number of factors influence the infant mortality improvement but many however are strongly collinear, which makes analysis a complex process (Garenne and Vimard, 1984). In underdeveloped countries, it's more difficult to isolate their effects. In addition, health programs are often most intensive in the least healthy places, which tends to confuse observed relationships even more (Flegg, 1982).

In our context, national statistics confirm that Morocco had already achieved an under-five mortality rate below the Sustainable Development Goal (SDG) target of 25 or fewer deaths per 1000 live births (22.2 per 1000). In general, the mortality in Morocco has fallen considerably as reflected in lower crude mortality rates and increased life birth expectancy. The life birth expectancy has risen from under 50 years in the 1960s to over 75 years in recent years. The infant mortality risk has fallen by 90% during the last six decades from 149 per thousand in 1962 Multiple Purposes Surveys (EOM) to 18 per thousand according to the National Population and Family Health Survey (ENPSF-2018).

In Morocco, efforts have been made to reduce child mortality through child health strategies and programs. A sharp decline has been recorded since 1950 as the rate has dropped from 151‰ to 20‰ today (ENPSF-2018). In addition, the most striking disparities are observed between areas of residence (14.9‰ against 21.5‰ respectively in towns and in rural areas). Similarly, disparities are noted according to the level of household wealth (10.9‰ for the affluent level. against 16.9‰ for middle-income households and 23.5‰ for the poor). However, there are no notable differences between boys and girls (18.3‰ versus 17.7‰ respectively). However, and compared to developed countries, infant mortality today is 5 times higher, indicating that a significant portion of recorded infant deaths are still preventable.

However, despite the considerable and sustained efforts undertaken by Morocco to reduce infant morbidity and mortality, the neonatal mortality rate in Morocco is 14 times higher than in Sweden and in Japan as countries with the least risk of mortality. Therefore, it's possible to reduce more this component of mortality. Moreover, it should be noted that the differences in neonatal chance of survival are widening more between countries during the last decades. In fact, neonatal mortality, which was 12 times higher in Morocco than in Sweden or Japan in 1990, rose to 14 times in 2019 (UNICEF, 2020).

Besides this inter-country disparity, there are also intra-country variations. However, while the first ones can be assigned to the existence of development gaps between the countries, the internal variability, despite sharing some explanatory factors with the former, can never be justified or admitted.

The case of Morocco is not exceptional to the extent that inequality in the number of children who die is observed by place of residence, by region, and by province. This inequality can be attributed to several factors, as outlined in Mosley's conceptual framework. According to Mosley and Chen (1984), the variation in infant mortality can be explained according to two approaches. The first, embraced by social science research, focuses on the relationship between socio-economic background and death, while the second approach, which is epidemiological in nature, concentrates on the biological process of disease and morbidity. These authors, aware of the need for a mixed approach, proposed a framework based on five proximate determinants: (i) maternal factors (age, parity, birth spacing), (ii) environmental contamination; (iii) nutrient deficiency; (iv) injuries (accidental, intentional) (v) and finally personal control of disease. This approach considers that socioeconomic factors, measured at different levels, affect the health and the survival of the children through the intermediate determinants.

The important downtrend of infant mortality was accompanied by a significant decline of fertility. The TFR has decreased from 7 children in 1960s per a woman to 2.2 currently and there is a total convergence both in urban and rural areas and all social strata. This paper attempts to verify at the macro level [2] the impact that fertility can have on the infant mortality level. Additional indicators were selected to control for confounding effects on fertility and child mortality (poverty, basic health care coverage, and women's social status).

## DATA AND METHODS

To verify the eventual links between fertility and infant mortality, we have adopted a macro-level analysis and the province/prefecture was the statistical unit of analysis.

### Data sources

Various data sources were consulted in order to generate macro indicators at the provincial level. Primarily, data from the RGPH-2014 made available by the High Commission for Planning was used to produce a Macro Indicator that measures the probability of dying in the first months of life. These meta-data provide information on a random sample of 10% of all individuals enumerated in the RGPH-2014. This random sample, which is composed of 3,341,426 individuals, is nationally, regionally and provincially representative. It makes it possible to create indicators considering the main demographic and socio-economic characteristics (gender, place of residence, age groups, type of housing, etc.). The database also contains very important information on the survival chances in the infant period that is used to compute a measurement of the risk of death in the first months of life. This information concerns: (i) the number of live births delivered during the 12 months prior to the census reference date; (ii) as well as the number of deaths that occurred among these live deliveries during the reference period.

Furthermore, and for analysis purposes, multidimensional poverty indicators were also used, as developed by the HCP using the OPHI approach. This approach has based the measurement of multidimensional poverty on a wide range of requirements which, if not met, constitute a

factor of poverty prevalence or manifestation, as well as a factor of its social reproduction. These needs concern access to basic social services, water, electricity and sanitation. These indicators were generated at the provincial level and by area of residence using data from the RGP-2014 (HCP, 2014).

Given the link between the occurrence of health events (morbidity and mortality) and healthcare supply, the latter component was included in the model analysis. Therefore, the availability of primary health care derived from a provincial database issued by the Moroccan Ministry of Health is used to develop an indicator of the availability of primary health care. The 1978 Alma Ata (USSR) International Conference Declaration states that primary health care is considered essential care (both curative and preventive/promotional) that is based on scientifically sound methods, techniques, and practices. Primary health care is made universally available to all individuals and families in the community at a cost that the community and the country can afford at all stages of development. It constitutes the primary point at which individuals, families, and the community come into contact with the national health system.

## Methods

### *Dependent variable*

This indicator is the ratio of deaths recorded among births in the last 12 months prior to the 2014 census (RGP-2014) to births in the same period. It is considered to be a proxy for the probability of death between birth and the first anniversary. Of course, the calculation of this probability requires perfect knowledge of the total number of deaths (components D1 and D2 (Figure 1) within a particular generation of births (the 2014 generation in this study). However, only the D1 component is provided by the RGP-2014, which obviously implies an underestimation of the risk of infant mortality. Nevertheless, considering the relatively low level of infant mortality in Morocco, deaths in the first triangle constitute the largest share of infant deaths [0; 1yr [. Guillaume Wunsch and Antonio Canedo (1978) consider three out of four deaths to occur in this the first triangle if infant mortality is not more than 100‰. Thus, taking into account the level of infant mortality in Morocco (18‰ according to ENPSF-2018), a good auxiliary "proxy" indicator of infant mortality by province is this D1 component (proxy=D1/N2014). The child mortality quotient (1q0) is obtained by a simple linear transformation of this indicator ( $1q0=4*Proxy/3$ ).

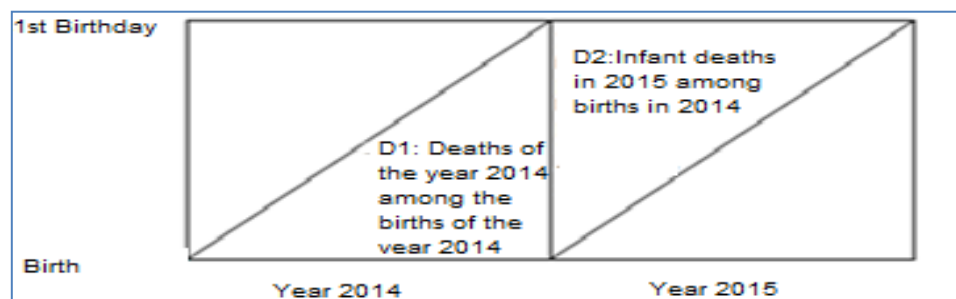


**Figure 1. Diagram of child mortality components**

**Source:** Developed by us

Admittedly, the selected proxy for mortality, as with any measure of mortality calculated from retrospective surveys, has several limits. Firstly, the data used concern only the births of women who were not single and who survived at the moment of the 2014 RGP. Thus, no

information on the survival status of births where the mothers had died prior to the census is provided. Such births are more likely to be at risk of dying compared to births with surviving mothers. Likewise, the exclusion of single mothers introduced another potential bias, whose magnitude remains undetermined. The fact that the questions on births and deaths were asked only of non-single, living women compromises the quality of these data, unless we assume that there is no differential mortality of children according to their mother's matrimonial and survival status, which is unlikely.

In addition, the validity of infant mortality data may be affected by underreporting of births or deaths. In our case, this risk can be considered negligible since the reference period "12 months before the RGPH-2014" can be considered controllable and less affected by the memory effect.

### ***Explanatory variables***

Taking into account our literature review, we selected a series of indicators as reported in abstract. So, from the set of indicators measuring the level of poverty prevailing in the provinces during 2014, the global [3] poverty rate composed by both monetary [4] and multidimensional [5] poverty were chosen. Moreover, and in order to verify the presumed impact of women's status on child survival, the woman literacy rate and their activity rate were retained in our analysis. To examine the impact of healthcare facilities on child survival, we used as indicator the number of PHCs by habitants.

The PHCs are the first component of Morocco's health system and are the primary place to seek health care within a well-organized supply network. They ensure basic preventive health care (family planning, child immunization, prenatal consultations and childbirth assistance, etc.) as well as treatment. They also have an impact on fertility, in particular through family planning, information, education and communication (IEC) services for women. Such services, in conjunction with other reproductive health services, are managed under specific PHC programs.

Furthermore, through the maternal and child health programs, the PHCs are able to influence the health and survival of children by making antenatal monitoring of pregnancy and delivery in a health care setting accessible and available. Following birth, these PHC services provide infant immunization and curative care. All of these services can help saving the children's lives from life-threatening infections (measles, whooping cough, tetanus, diphtheria, pneumonia, etc.). Poverty is a measure of the success of economic, social, and sustainable development policies in eradicating inequality. A high poverty rate inevitably implies that there are several households experiencing financial difficulties or deprivation in the fields of healthcare, schooling and the standard of living. Of course, in those provinces with high overall poverty rates, the risk of malnutrition, disease, and poor living conditions is greater.

The literacy rate and the female labor force participation rate are indicators that provide information on the status of women in a province. Several other indicators relating to women were tested, such as the unemployment rate, the proportion of women with tertiary and secondary education, and the gap between the ages at first marriage of women and men

### ***Statistical methods***

Taking into account the numerical nature of the data, Principal Component Analysis (PCA) is used to describe the data and summarize the information by replacing the most correlated initial variables with a smaller number of "composite" variables (or "factors").

The PCA process is therefore based on the correlation matrix, and for the analysis to be relevant, the initial variables must be correlated with each other. The adequacy of the model is measured by the Kaiser-Meyer-Olkin (KMO) test. This test compares the magnitude of the observed correlation coefficients with the magnitude of the partial correlation coefficients. Low values of the KMO coefficient suggest that factorial analysis is not relevant. Likewise, the Bartlett's Sphericity Test provides the same outcome by testing the null hypothesis that the variables are uncorrelated. A KMO that tends to 1 or a p-value of the Bartlett test that tends to 0 means that the PCA is applicable. In practice, we can fix in advance a threshold of variance that we want to restore and we then retain the number of axes necessary to reach this threshold. A threshold of about 60% is generally acceptable in the social sciences.

Furthermore, given that PCA remains a purely exploratory and descriptive method, we completed our analysis by using the multiple regression method. This latter method allows us to test the strength and direction of the link between infant mortality and all of the explanatory variables selected, including fertility (TFR). The procedure used is the Stepwise method, whose principle of choice of explanatory variables to be included in the model is based on their mathematical contribution to its improvement. SPSS chooses among the explanatory variables submitted to the analysis, the one that has the highest correlation with the dependent variable (proxy indicator of infant mortality). Afterwards, the software assesses whether the inclusion of other variables in the regression model is significant and starts by including the variable with the highest partial correlation with the dependent variable and so on. The calculation is done with the variance of the dependent variable that remains to be explained once the effect of the first variable is removed. Moreover, at each step, the software reassesses the contribution and significance of the other variables in order to eliminate those that are redundant.

## **CHILD MORTALITY AND FERTILITY IN MOROCCO: RECENT TRENDS**

### **Child mortality trends**

In Morocco, infant mortality has fallen dramatically over the past three decades (1987-2018), reduced by three quarters. The two components of infant mortality did not benefit in the same way from this decline: a higher reduction in post-neonatal mortality is observed (86%) compared to neonatal mortality (66%). Moreover, the downward trend was more accelerated between 1992 and 2011 for post-neonatal mortality while the rate of reduction in neonatal mortality increased between 2011 and 2018 (Figure 2).

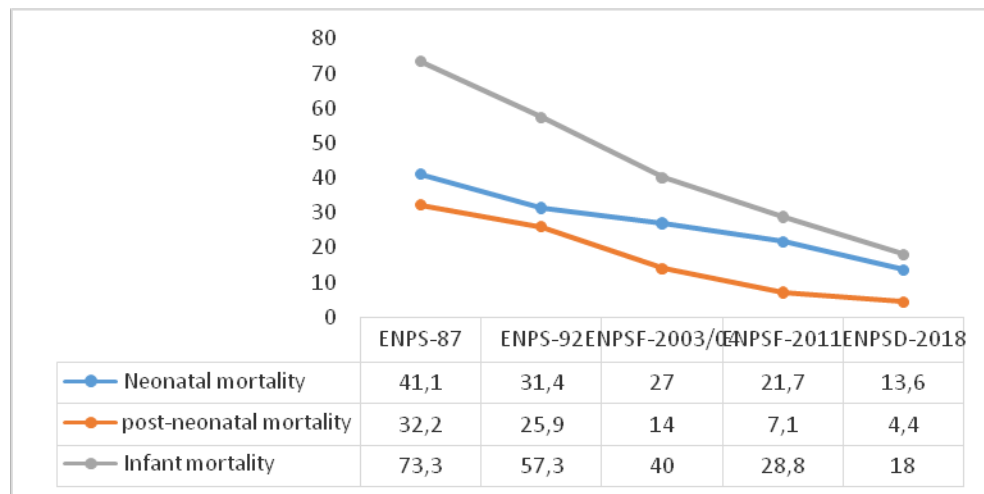


**Figure 2. Trends in neonatal, post-neonatal and infant mortality, Morocco, 1987-2018**  
**Source : Developed by us**

Despite this significant decline, the last population and health survey (ENPSF-2018) reveals that infant mortality differ according to many socio-demographic indicators as the gender of child, the area of residence, the mother's age at birth of the child, the birth rank, the Wealth-index of the house and the level of mother education (table1). This table shows that the boy are more exposed to death in the neonatal period than the female. In the post-neonatal period, the female child mortality is greater than the boy one (the sex ratios are respectively 1.27 and 0,55). If we consider that the neonatal mortality is more likely a result of endogenous cause and that the post-neonatal is due to exogenous one, we can suggested that the male births profite of more interest accorded by their parents if we compare them at the females children.

The same, the infant in the urban area has more chance to survive until his/her first birthday than the rural one. The mortality ratio is about 0,7 for both neonatal and postneonatal mortality. In the table 1, we compare also the child mortality according to the mother age at the birth of his/her child. Hence, except the neonatal mortality, the post-neonatal and the child mortality are more higher if the age of the mother at the childbirth is too young (less than 24 years old) or too old (greath than 35 years old). The risk of neonatal mortality is higher in births of the first order and births of orders over 4. This finding remains true for postneonatal mortality, but only for births of order 4 and above. As expected, the risk of infant mortality is inversely correlated with the level of household wealth and with the level of mother education. Even though, the effect of education is not so strong because of the classification adopted for this indicator (certificate / no certificate).

At the national level, the improvement in child survival is mainly the result of a decrease in the post-neonatal mortality (4.4 per thousand according to the ENPS-2018). The resistance to the decline of the neonatal component [6] (13.6 per thousand according to ENPSF-2018) could be explained by the prevalence of endogenous causes of death, which are more difficult to eradicate, and requires, in particular, a high quality care for pregnant women. It's not the case of the post-neonatal mortality, which is more affected by preventable exogenous causes.

Undoubtedly, many programs and actions had contributed enormously to the decline in infant mortality. It concerns: the Pregnancy and Childbirth Surveillance Programs; the strengthening

of primary health care structures providing preventive and curative care; the Emergency Obstetric and Neonatal Care-SONU; the audits of neonatal deaths; the construction and equipping of delivery rooms and Dar Al Oumouma [7]; Neonatal screening program for congenital hypothyroidism; National Plan of Response against Acute Viral Bronchitis in infants; National Nutrition Program has contributed enormously to the decline in infant mortality.

**Table 1. Neonatal, postneonatal and infant mortality quotient according to some socio-demographic characteristics, Morocco, 2018**

| Indicator                    | Neonatal mortality | Post-neonatal mortality | Infant mortality |
|------------------------------|--------------------|-------------------------|------------------|
| Gender                       |                    |                         |                  |
| Boy                          | 15,1               | 3,2                     | 18,3             |
| Girl                         | 11,9               | 5,8                     | 17,7             |
| Area of residence            |                    |                         |                  |
| Urban                        | 11,2               | 3,7                     | 14,9             |
| Rural                        | 16,3               | 5,3                     | 21,6             |
| Mother's age at birth        |                    |                         |                  |
| <=24 years                   | 14,9               | 5,7                     | 20,6             |
| 25-34 years                  | 14,1               | 2,9                     | 17               |
| 35 years et +                | 12                 | 6,3                     | 18,3             |
| Birth rank                   |                    |                         |                  |
| First                        | 15                 | 3,4                     | 18,4             |
| Second / third               | 11                 | 4,1                     | 15,1             |
| Fourth &+                    | 17,3               | 6,6                     | 23,8             |
| Wealth-index                 |                    |                         |                  |
| The poorest                  | 16,9               | 6,7                     | 23,5             |
| Medium                       | 13,2               | 3,8                     | 16,9             |
| The richest                  | 9,2                | 1,7                     | 10,9             |
| Woman education              |                    |                         |                  |
| Without any certificate      | 13,6               | 4,6                     | 18,2             |
| At least primary certificate | 13,6               | 4,1                     | 17,6             |
| <b>National</b>              | <b>13,56</b>       | <b>4,45</b>             | <b>18</b>        |

**Source:** Health Ministry, 2018

## Fertility trends

There has been a significant decline in fertility in recent decades. Indeed, until the early 1960s, the fertility of Moroccan women was comparable whatever the area of residence (~7 children per woman). Fifteen years later, the fertility level in rural areas remained unchanged, while that in urban areas fell to only 4.4 children. The pace then accelerated, reaching a total fertility rate of 2.8 children per rural woman according to the ENSPF-2018 (~1 child more than urban women) (Figure 2). Fertility in urban areas is currently comparable to that in developed countries. It has even crossed the generational replacement level for some categories of urban women, such as those with secondary education or more (1.64 children/woman). According to the ENSPF-2018, the fertility level shows quite clear variations depending on the woman's educational level and the economic status of the household. When the level of education is higher, the fertility is lower. In fact, the TFR for illiteracies women is about 2.54, on average, 0.6

more children than those who have reached primary level (1.96 children) and 0.9 children more than those who have completed secondary school or above (1.64 children). Similarly, the average number of children per woman decreases with the level of economic well-being of the household. Indeed, the TFR decreased from 2.7 children per woman in the less affluent households to 2 children in the wealthiest households.

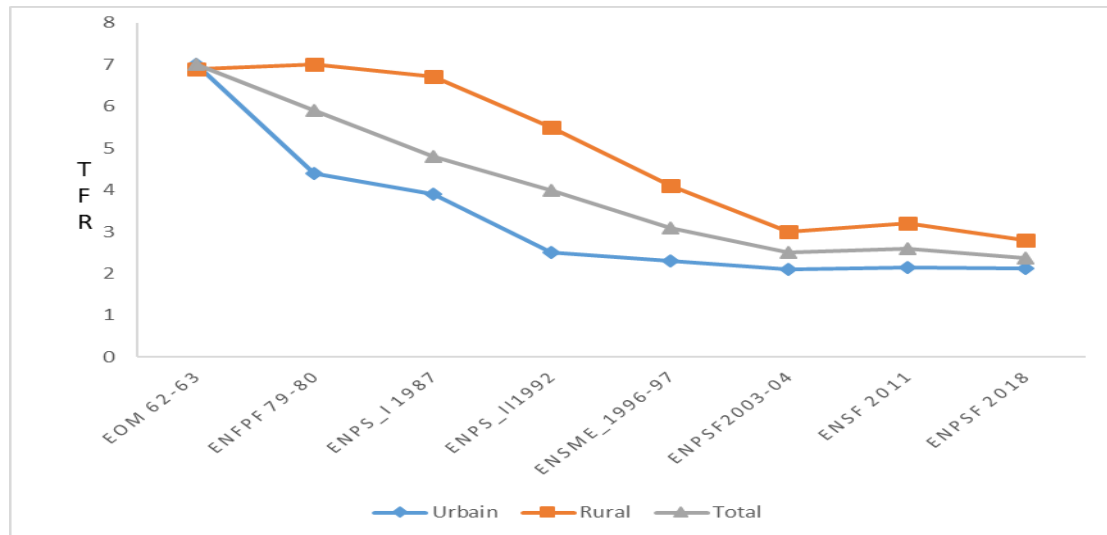


**Figure 2. Total Fertility Rate trends by residence area, Morocco, 1960-2018**

**Source : Developed by us**

Nevertheless, the downward trend observed at the national level and by urban and rural areas hides provincial disparities (Figure 3). These distinctive trends in fertility should reflect the inequality in social and economic development between provinces in terms of global poverty, female status, health care facilities supply, etc. This argument is not supported by the poverty profile by provinces and by their total fertility rates as published recently by the HCP. The figure 3 shows effectively that the poorest provinces are not systematically those with the highest fertility rates. In the other hand, many provinces with the least global poverty rates belonged to the category of area with high fertility. This result remains true for both rural and urban areas of residence.

After this brief overview of the recent trends in infant mortality rates and the total fertility rate in Morocco, the following will focus on the discussion of the possible relationships between these two key components of the demographic transition in our context.

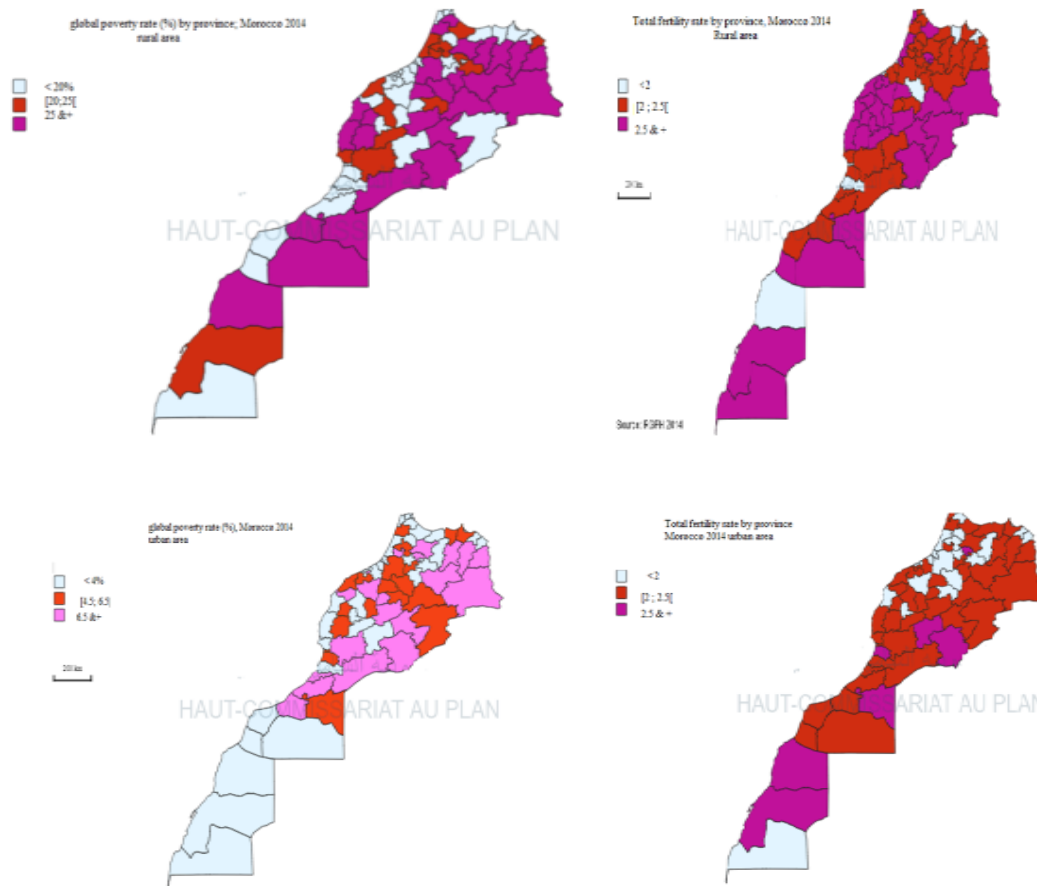


**Figure 3. The global poverty rate and the total fertility rate by province and area of residence, Morocco, 2014**

**Source : HCP**

## RESULTS

### Descriptive analysis

It emerges from the descriptive analysis (Table 2) that the TFR varies by province from a minimum of 1.6 to a maximum of 4.3 children per woman, with little heterogeneity (coefficient of variation of 16.4%). There also appears to be some relative variability across the provinces in terms of literacy among women, for which the coefficient of variation is 24.9%. In contrast, strong provincial disparities emerge with respect to poverty, health care provision and infant mortality. The provinces are very heterogeneous in terms of the overall poverty rate (85.7%) and the number of inhabitants per primary health care facility (56.5%). We also note that the proportion of deaths varies from a minimum of almost 0% to a maximum of 9.7% with a coefficient of variation of 41.3% and an average proportion of 4.1% (Table 2). According to area of residence, the variables are classified in the same order, with a few differences, according to their degree of dispersion. In fact, the provinces in rural areas are more heterogeneous with respect to the variables relating to women's activity, poverty and health care supply. In contrast, in urban areas, with the exception of poverty and health care availability, the provinces seem to be more homogenous with regard to the remaining variables.

Following the analysis and description of the variables, a correlation matrix was also computed for them. This matrix highlighted a positive and significant correlation between the infant mortality and the total fertility rates by area of residence and on a national level (pvalue <1% in rural areas and pvalue <5% in urban areas). That correlation suggests that both infant mortality and fertility rates change at the same direction. This means that high fertility provinces also experience high infant mortality. Women's literacy, in turn, is significantly related to all the other indicators (poverty, women's activity, fertility, health care supply) with the exception of the infant mortality indicator. Out of the total of the five selected indicators included in this study, the only one that appears to be significantly correlated with early childhood mortality is fertility.

**Table 2. Description of variables and the correlation matrix by area of residence, Morocco, 2014**

| indicator             | Description of indicator |         |         |                    |                          | Correlation matrix |                      |                       |                 |                |                |
|-----------------------|--------------------------|---------|---------|--------------------|--------------------------|--------------------|----------------------|-----------------------|-----------------|----------------|----------------|
|                       | Minimum                  | Maximum | Average | standard deviation | Coefficient of variation | Rural area         |                      |                       |                 |                |                |
| Woman activity        | 5,7                      | 48,4    | 12,6    | 6,4                | 50,9                     | woman activity     | total fertility rate | healthcare facilities | child mortality | global poverty | woman literacy |
| Total fertility rate  | 1,7                      | 4,3     | 2,5     | 0,4                | 16,7                     | 1                  |                      |                       |                 |                |                |
| Healthcare facilities | 701                      | 24927   | 11151   | 5087               | 45,6                     | 0,122              | 1                    |                       |                 |                |                |
| Child mortality       | 0,0                      | 9,7     | 4,0     | 1,9                | 48,4                     | -0,014             | -0,134               | 1                     |                 |                |                |
| Global poverty        | 3,8                      | 68,2    | 22,6    | 11,1               | 49,1                     | 0,082              | ,565**               | 0,134                 | 1               |                |                |
| Woman literacy        | 24,7                     | 59,5    | 41,8    | 7,6                | 18,1                     | -0,072             | 0,093                | ,301*                 | 0,026           | 1              |                |
|                       |                          |         |         |                    |                          | ,279               | 0,094                | -0,162                | -0,095          | -,718**        | 1              |
| Urban Area            |                          |         |         |                    |                          |                    |                      |                       |                 |                |                |
| Woman activity        | 9,8                      | 38,8    | 21,4    | 5,5                | 25,9                     | 1                  | -,336**              | -,510**               | 0,040           | -,505**        | ,673**         |
| Total fertility rate  | 1,6                      | 2,9     | 2,2     | 0,3                | 11,9                     |                    | 1                    | 0,102                 | ,281            | ,295           | -0,175         |
| Healthcare facilities | 3717                     | 56720   | 24375   | 9705               | 40                       |                    |                      | 1                     | -0,152          | ,366**         | -0,197         |
| Child mortality       | 1,7                      | 7,9     | 4,1     | 1,4                | 34,1                     |                    |                      |                       | 1               | -0,165         | 0,125          |
| Global poverty        | 1,5                      | 25,2    | 5,5     | 3,7                | 67,6                     |                    |                      |                       |                 | 1              | -,584**        |
| Woman literacy        | 50,0                     | 78,1    | 65,1    | 5,5                | 8,5                      |                    |                      |                       |                 |                | 1              |
| National              |                          |         |         |                    |                          |                    |                      |                       |                 |                |                |
| Woman activity        | 5,7                      | 48,4    | 17,1    | 7,4                | 43,4                     | 1                  | -,201*               | -,647**               | 0,001           | -,446**        | ,605**         |
| Total fertility rate  | 1,6                      | 4,3     | 2,3     | 0,4                | 16,4                     |                    | 1                    | ,310**                | ,508**          | ,375**         | -,340**        |
| Healthcare facilities | 701                      | 56720   | 17992   | 10165              | 56,5                     |                    |                      | 1                     | 0,042           | ,610**         | -,649**        |
| Child mortality       | 0,0                      | 9,7     | 4,1     | 1,7                | 41,3                     |                    |                      |                       | 1               | 0,073          | -0,105         |
| Global poverty        | 1,5                      | 68,2    | 14,0    | 12,0               | 85,7                     |                    |                      |                       |                 | 1              | -,858**        |
| Woman literacy        | 24,7                     | 78,1    | 53,8    | 13,4               | 24,9                     |                    |                      |                       |                 |                | 1              |

\* The correlation is significant at the 0.05 level (two-tailed).

\*\* The correlation is significant at the 0.01 level (two-tailed).

**Source : Developed by us**

Confirmation or denial of the above result prompted further investigation using principal component factor analysis and multiple regression. The application of the principal component factor analysis to the data collected during the RGPH-2014 as described in the previous section, allowed us to retain two factors that explain about 75% of the total variation. Two eigenvalues are greater than 1 and the corresponding components explain 57% and 17.5% respectively. The model is adapted to our data since the KMO Index exceeds 72% and the Bartlett test of sphericity is very significant (p-value tends towards 0.000).

Table 3 and figure 4 present a summary and an illustration of the contribution of the various indicators to the first factorial plane axis. It emerges that the first factorial axis is defined by the indicators relating to global poverty, to healthcare-facilities, to total fertility, to woman-activity and literacy. The second factorial axis is determined only by the child's mortality indicator. The woman's status defined by the woman's activity and literacy contributes negatively to the first axis and are opposed to healthcare-facilities (inhabitant per primary health care facilities), to

global poverty and to the total fertility rate. Furthermore, the child's mortality is positively and strongly correlated with the second factorial axis. The first axis can be named "poverty-fertility-woman status" and the second one "child mortality".

**Table 3. Contributions of the various indicators to the development of the 1<sup>st</sup> Factorial Plan axis, Morocco, 2014**

| Indicators            | Component-1 ( $\lambda_1=3,4$ ; explained variance =56,8%) | Component-2 ( $\lambda_2=1,05$ ; explained variance =17,5%) |
|-----------------------|------------------------------------------------------------|-------------------------------------------------------------|
| Global poverty        | 0,884                                                      | 0,039                                                       |
| Healthcare_facilities | 0,810                                                      | -0,189                                                      |
| Total fertility       | 0,615                                                      | 0,345                                                       |
| Child mortality       | -0,056                                                     | 0,950                                                       |
| Woman_activity        | -0,849                                                     | 0,049                                                       |
| Woman_literacy        | -0,930                                                     | 0,024                                                       |

**Source :** Developed by us

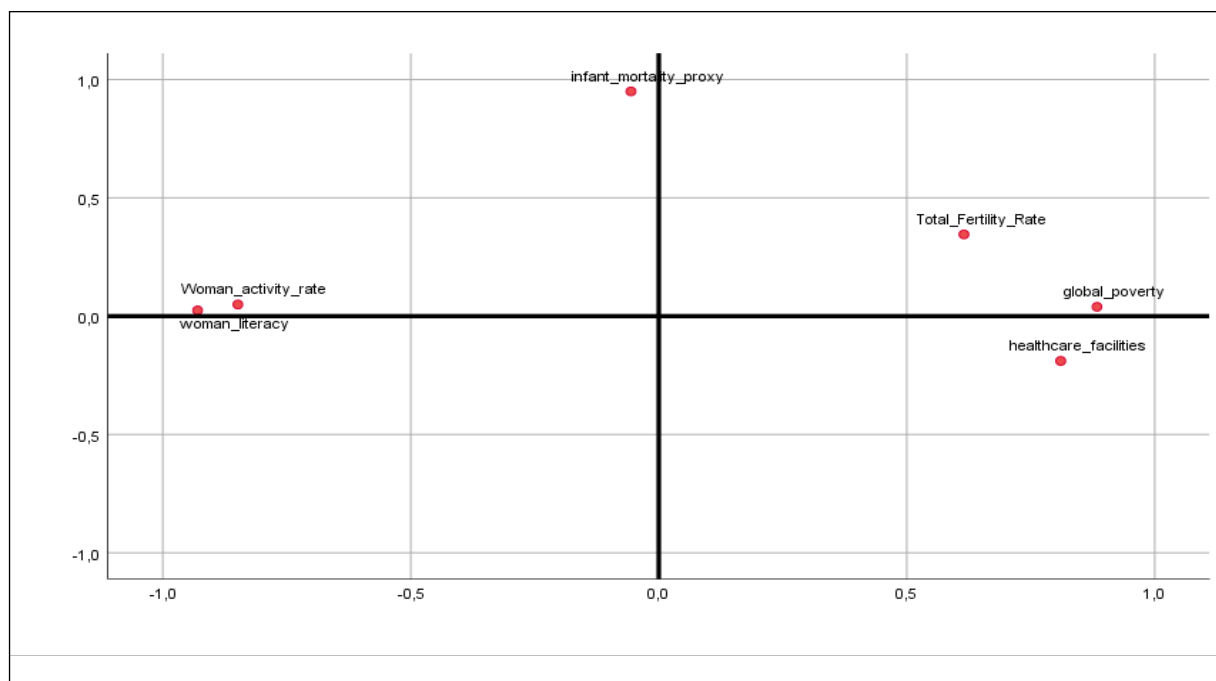


**Figure 4. First factorial design of indicators, Morocco, 2014**

**Source :** Developed by us

The projection of provinces on the first factorial plane suggests that rural area are more characterized by a high level of mortality, fertility and poverty. The woman status in these provinces is not so developed. In fact, the woman literacy and activity rates, in the rural area, are low. In spite of the involvement of the woman in the farm activity and the burden she bears, her work is unpaid, and she is more often declared as inactive. The urban areas, in the other hands, are more characterized by a low level of fertility and of global poverty. These areas are more concentrated in the left of the graphic which is defined by the indicators relating to a

developed status of women (literacy rate and activity). But many urban area have also a high score on the second factorial axis indicating a high level of child mortality (Figure 5). This exploratory analysis confirms that all urban provinces are ranked higher with regard to the status of women, fertility control and the availability of primary health care. Nonetheless, the urban areas are differently classified compared to child mortality. As for rural areas, they are rather characterized by very low scores as regards the status of women. Likewise, these areas have higher fertility compared to urban areas. As was the case in urban areas, rural areas in Moroccan provinces also register heterogeneity in terms of child mortality. The resemblance between the profiles of the two environments could be explained, partially, by the existence of a peri-urban environment classed administratively as urban. Living conditions in these peri-urban areas, in general slums, are unfavorable and sometimes more deteriorated than in rural areas. From the above, we could conclude that the only urban/rural administrative subdivision hides the really differences that exist between the two zones. So, the performance and the specificities of urban areas which, theoretically, advantages the townsfolk children are diluted. Extended this research by taking into account the variable stratum [8] of residence will be more interesting in studies dealing with the survival of children and the factors that could impact it. Unfortunately, this kind of studies requires a specific data which is not available in the accessible data bases.

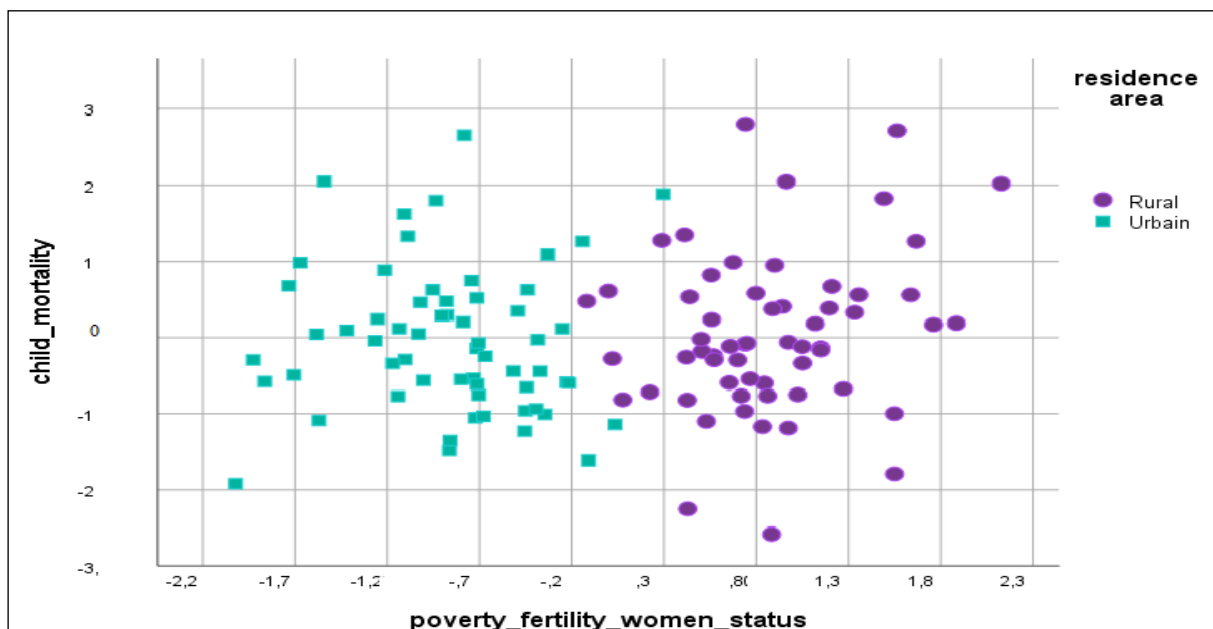


**Figure 5. Provincial projection on the first factorial plane, Morocco, 2014.**

**Source : Developed by us**

The projection of the provinces on the first factorial plane, taking into account the region of affiliation, made it possible to highlight the regions where high fertility and mortality persist. It also made it possible to identify the best performing regions, whether in terms of the development of the status of women or in terms of the other indicators retained in the framework of this study. Indeed, the regions of Casablanca-Settat and Rabat-Salé-Kénitra seem to be the best ranked on the two axes while the Draa-tafilat region has the least performing scores on the two axes (Figure 6).

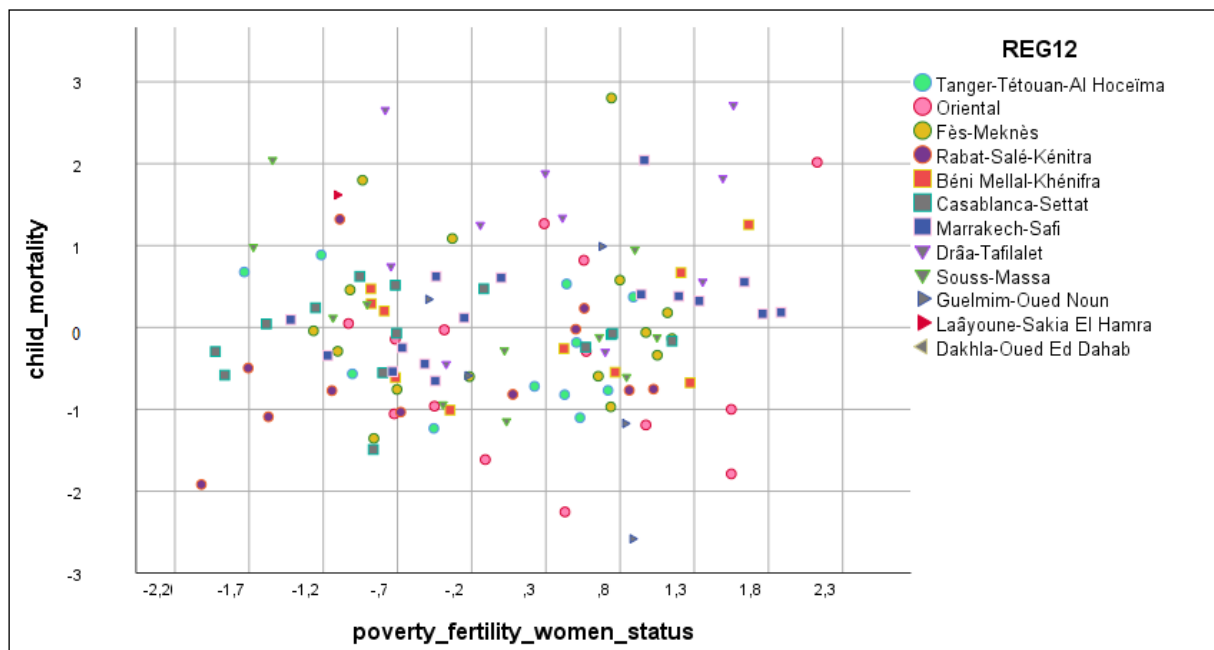


**Figure 6. Projection of the Provinces on the first factorial plane by region, Morocco, 2014**  
**Source : Developed by us**

### Explanatory analysis

Admittedly, the exploratory spatial analysis is very interesting because it has made it possible to highlight the differences that exist between regions and provinces by using relevant indicators (Total Fertility Rate, infant mortality, overall poverty, the number of inhabitants per primary health care establishment, the literacy rate of women and their activity rate). However, its explanatory contribution remains limited and does not make it possible to meet with certainty the objective set for this study namely: the net link between the level of fertility and the proportion of births that died in the same year as they came into this world. The results of the PCA which are so informative are complemented by an explanatory analysis allowing (i) to sort the variables according to their explanatory power of the infant mortality differential observed between the provinces, (ii) and to verify what role is attributed to the demographic changes operated in Morocco in terms of fertility and women's status in this complicated process.

The more adapted explanatory model to the quantitate nature of ours indicators is the multiple regression. The regression coefficients inform us about the degree to which each explanatory variable influence child survival (variable to be explained). The sign of the coefficient indicates the direction of this relationship and its standard error provides information on the variability of the coefficient in the population. This error also makes it possible to calculate the value of "t" whose level of significance makes it possible to decide whether the variable contributes significantly to the model. The value of the standardized Beta ( $\beta$ ) indicates the change in standard deviation of the variable to be explained for each increase of one standard deviation of the explanatory variable when all other values are constant. It thus emerges from table 4 relating to the results of the multiple regression, that the current fertility level measured by the TFR has a negative impact on the child survival. Indeed, with its statistically significant regression coefficient of 2.912, one could support the hypothesis that high fertility increases the risk of mortality in infancy. In other words, a one unit increase in the TFR translates to an

increase of about 3 points in the risk of mortality, all other things being equal. Except fertility, the other indicators have a non-significant statistical effect. We have also tested a simple regression model (infant mortality /total fertility rate) and the result confirms a statistically significant effect of the total fertility rate on the infant mortality (4.885). Of course, our objective is not to build a predictive model ( $R = 42\%$  for multiple regression and  $50\%$  simple regression) but already the variable total fertility rate alone explains half of the variability in the chances of infant survival.

**Table 4. Summary of the results of the multiple regression model**

| Explanatory variables | Regression coefficient | standard error | Beta ( $\beta$ ) | t of Student | P <sub>value</sub> |
|-----------------------|------------------------|----------------|------------------|--------------|--------------------|
| (Constante)           | -2,46                  | 2,25           |                  | -1,09        | 0,28               |
| Healthcare facilities | 0,00                   | 0,00           | 0,10             | 0,79         | 0,43               |
| Total fertility rate  | 2,91                   | 0,59           | 0,50             | 4,94         | 0,00               |
| global poverty rate   | -0,05                  | 0,03           | -                | -1,47        | 0,14               |
| Woman activity rate   | 0,04                   | 0,04           | 0,12             | 0,84         | 0,40               |
| Woman literacy        | 0,01                   | 0,03           | 0,05             | 0,27         | 0,79               |

**Source :** Developed by us

## DISCUSSION

In Morocco, there are regional, provincial and residential disparities in infant mortality. Such disparities co-exist with inequities in: (i) primary health care provision; (ii) socioeconomic conditions measured here by the presence of various forms of poverty; and (iii) fertility levels (TFR) and women's status as measured here by their literacy and labor force participation rates. Admittedly, these indicators have their limits, but they allow one to test at an aggregate level the relationship between infant mortality and fertility by controlling for some of the exogenous factors that seem to be influencing the two aspects of demographic change.

These indicators summarize the situation with respect to the main aggregates presented in the theoretical framework of this thesis. For example, the number of primary health care facilities per capita is very informative about the supply of health care and its accessibility. It is also a mirror of the politics of health care supply model. Similarly, it gives an indication of the commitment of the country to the various international conventions and declarations on equitable health care and health for all. The availability of preventive and curative healthcare has been improved, and immunizations, as the primary means of prevention, have contributed greatly to the reduction of infectious diseases, which are the main cause of death for children.

The poverty rate, for its part, provides information on the success of economic, social and sustainable development policies in eradicating inequality. A high poverty rate necessarily means that there are many households in financial difficulties or in situations of deprivation. Of course, where poverty is high, there is most likely a greater risk of illness and death, particularly among the most vulnerable populations of whom the children is an integral part.

Also, female literacy and labor force participation rates are indicators that provide information on the status of women in a province. Conceptual models suggest that socio-demographic characteristics directly or indirectly influence overall child well-being, of which chances of survival are a core component. According to the literature, infant mortality is strongly related to a number of socioeconomic and demographic variables. Women's labor force participation and education significantly affect infant mortality (Ekholuenetale et al., 2020; Wellington, 2014; Pamuk et al., 2011).

Nonetheless, the introduction of all these indicators into a multiple regression model using the Stepwise procedure showed that only the TFR fertility indicators and the poverty rate were statistically significant. This finding is due partly to the high degree of correlation between the indicators not included in the model and the poverty and fertility rates at the macro level. It is clear that a large number of factors influence child survival, but many are highly collinear, making the analysis complex (Garenne and Vimard, 1984). In developing countries, it is more difficult to isolate their effects. In addition, health programs are often more intensive in less healthy locations, which tends to further confound the observed relationships (Flegg, 1982).

Furthermore, empirically testing the hypothesized relationships between mortality and fertility is not easy, since they are related to phenomena that occur simultaneously in most developing countries (industrialization, urbanization, educational progress, etc.). Thus, although several quantitative studies have found statistical correlations and temporal associations consistent with these theoretical assumptions, other competing explanations cannot be ruled out. In other words, a causal relationship that is valid for one population may not be valid for another (Randall S. and LeGrand T., 2003).

Notwithstanding these limitations, the results found support the conclusions of several previous studies adopting different methodologies and relating to different contexts. Our key finding is that after controlling for poverty, education, female employment, and primary health care provision, fertility levels affect child survival at the provincial level in both urban and rural areas. In other words, as fertility declines, infant mortality declines significantly.

Many case studies suggest that a mother's education is one of the most important predictors of infant and child mortality. But even after controlling for these socioeconomic variables, regional differentials in infant mortality still persist. This leads to believe that there is some significant sociocultural or other region specific factors that need to be investigated (Kalipeni, 1993).

Declining fertility improves the chances of child survival by many mechanisms. Taucher, (1982) had written that the mechanism by which the decline in fertility may influence the level of infant mortality is the modification of the structure of births with respect to at least three variables related to infant mortality: birth order, the mother's age and the length of the previous birth interval.

According to Trussel (1984), who have explored the relation between changes in reproductive behavior and changes in child and maternal mortality, the elimination of fourth and higher order births would reduce infant and child mortality by about 8 per cent. Increases in the percentage of births to mothers under age 18 was associated with higher neonatal mortality and an increase in the percentage of births to women aged 35 years was associated with higher

neonatal and infant mortality rates. Decreases in the occurrence of short birth intervals (<24 months) reduced post-neonatal and infant mortality (Rutstein, 2000).

Many studies relate that reductions in fertility contribute to fall in infant mortality by enabling parents to devote more time and resources to their children (Nanitashvili, 2014). So, when parents have large families they may be less able to invest in their children, whether this be by providing them adequate nutrition, healthcare or schooling (Palloni, 1999). Reher (2011) argued that the decrease of women's parity gave them more time to carry for their children. Lee (2003) had shown that women who have to spent 70% of their adult lives, giving birth and raising young children before the demographic transition spend only 14 per cent today.

At the macro level, the increase of TFR decrease the public expenditure by child especially the health one as argued by Lee and Mason (2010) who have found a negative relationship between the TFR and human capital expenditure per child in a study conducted between 1994 and 2004 in 19 countries. The reduction of the public expenditure by child may affect the availability of the health care facilities and the provision of quality services to all children, which can in turn increase the infant mortality risk.

With regard to births spacing, various mechanisms can be considered to explain the impact on the infant survival like maternal nutritional depletion, suboptimal lactation related to breastfeeding-pregnancy overlap, sibling competition, transmission of infectious diseases among siblings and women's physiological regression (Conde-Agudelo and al., 2012). Birth intervals less than 24 months were associated with increased risk of anaemia (Dairo and Lawoyin, 2004). The mother anaemia during pregnancy increases the prevalence of a low weight at birth which may affect the probability of death (Leno and al., 2017). In fact, Peibly and al. (1991) had found that preceding birth intervals less than 24 months were associated with increased risk of neonatal mortality. The effects of the short birth intervals on infant mortality were stronger when preceding sibling died than when she/he survived (DaVanzo et al., 2008; Blanco Villegas and Fuster, 2009).

Moreover, close births do not allow a woman to recover after childbirth, which weakens her physical and physiological health. All this has a negative impact on the quality of care she provides to her children and on her vigilance regarding the symptoms of serious illness of them. Similarly, the risk of neglecting the vaccination of her children increases. The higher-ranked children were less likely to be vaccinated (Parashar, 2005).

In the other hand, high fertility that is generally associated with early marriage and a low age at first maternity translating a traditional system of norms characterized by unbalanced gender relationship within the household. This imbalance is correlated to a woman's lack of autonomy. They are not systematically involved in decision-making within their household and even decisions regarding the use of maternal and child health care. However, this remedy could save their life and the life of their children through adequate and timely management of complications of pregnancy and childbirth. In the same sense, one of five women does not use health services because of the lack of authorization from their husband (ENPSF-2018).

Indeed and despite the fact, that the woman status seems to be improved and that social investment in a woman's body is no longer so geared towards procreation, numerous women

still suffering in a society characterized by a patriarchal dominance where the change of beliefs and behavior is difficult (Zerari, 2006 ; Mielusel, 2015). The 2019 National Survey on Violence against Women confirmed the persistence of conjugal violence which is more prevalent among women whose husbands decide unilaterally on their contraception use (60.6%) compared to that of women who decide on their own use (55.2%) or with those whose decision is taken jointly with their husbands (50.4%) (HCP, 2019). Moreover, according to the same data source, the mother-in law is also incriminated by married women victims of family violence (more than 25%). Effectively, the mother-in-law constitute a pole of resistance within Moroccan households; particularly those with no-nuclear structure and she gives herself the right to make some decisions regarding even the number of children to be born. In this context, women may have a parity that exceeds the ideal number of children they would prefer and they will be more exposed to physical and psychological illness, which in turns affect health and ultimately the child survival.

This analysis should be improved if we had more observation units to take into account other determinants of infant mortality like nutritional status and infant feeding (breastfeeding, weaning and supplementation) , health care access and the use of health services by mothers and children for family planning, prenatal care and childbirth, child immunization,...), environmental conditions (water, climate pollution; rain and temperature,...), socio-economics (education, age at first union, etc. ). Other limit of our analysis came from the fact that the data used concerns only ever married women who were alive at the time of census. So, it did not provide information on the survival status of births whose mothers died before the census and who were being more exposed to. Similarly, the exclusion of unmarried mothers introduces another bias of undetermined magnitude. Furthermore, the validity of data on child mortality could be affected by the under-reporting of births or deaths. In our case, this risk could be considered negligible given that the reference period "12 months before the 2014 population census" could be considered as controllable and less affected by the memory effect.

Finally, the fact that fertility seems to be a key determinant of child survival must be relativized as the causality also runs in the other direction. The causal relationship between infant mortality and fertility had been a debate for long years but there is no consensus essentially because of the lag in relationship between these two variables as argued by Chowdhury (1988). The author believes that when a woman has multiple pregnancies, the chances of her child's survival are significantly reduced. A woman may thus decide to bear more children in the hope that at least some will stay alive. A dynamic analysis is therefore essential to correctly analyze the mortality-fertility relationship.

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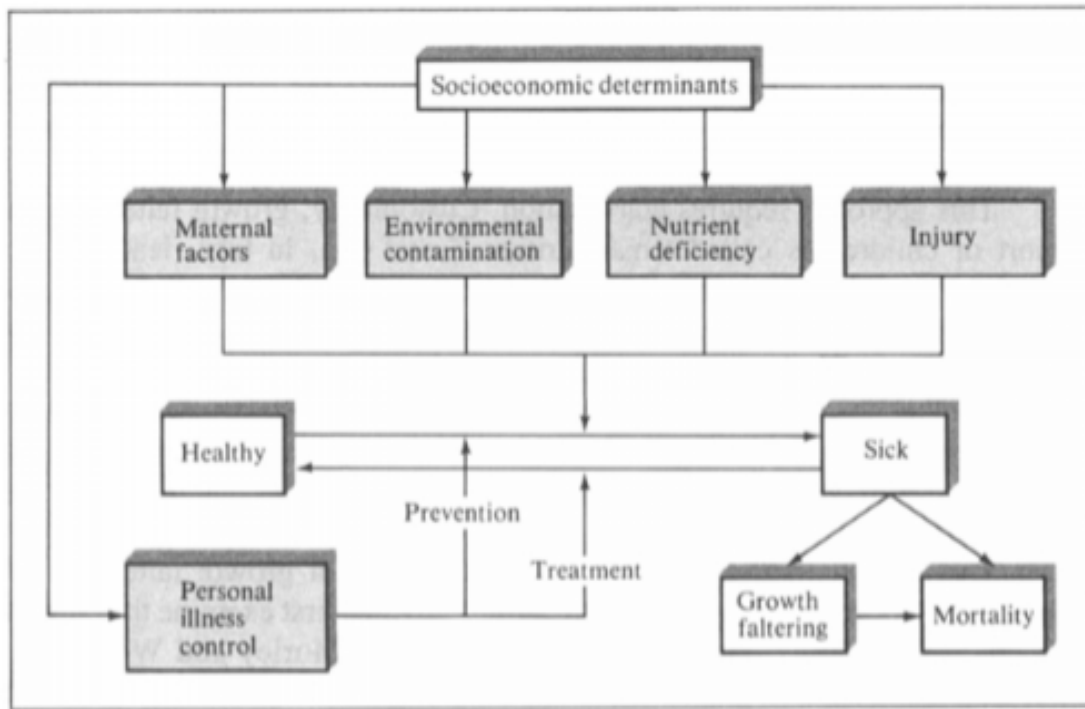
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## ANNEX A. OPERATION OF THE FIVE GROUPS OF PROXIMATE DETERMINANTS ON THE HEALTH DYNAMICS OF A POPULATION



**Source:** Population and Development Review, Vol. 10, Supplement: Child Survival: Strategies for Research (1984), pp. 25-45

**ANNEX B. ADMINISTRATIVE DIVISION OF MOROCCO**

| Region                    | Province/ Prefecture                                                                                   | Population 2014   |            | Total area            |            | Density                        |
|---------------------------|--------------------------------------------------------------------------------------------------------|-------------------|------------|-----------------------|------------|--------------------------------|
|                           |                                                                                                        | Number            | %          | (in km <sup>2</sup> ) | %          | (inhabitants/km <sup>2</sup> ) |
| Tanger-Tétouan-Al Hoceïma | Tanger-Assilah, M'diq-Fnideq, Tétouan, Fahs-Anjra, Larache, Al Hoceima, Chefchaouen and Ouazzane       | 3 540 012         | 10.5       | 17262                 | 2.4        | 205.1                          |
| Oriental                  | Oujda-Angad, Nador, Driouech, Jerada, Berkane, Taourirt, Guercif and Figuig.                           | 2 302 182         | 6.8        | 90127                 | 12.6       | 25.5                           |
| Fès-Meknès                | Fez, Meknes, Hajeb, Ifrane, Moulay Yacoub, Sefrou, Boulmane, Taounate and Taza,                        | 4 216 957         | 12.5       | 40075                 | 5.6        | 105.2                          |
| Rabat-Salé-Kénitra        | Rabat, Salé, Skhirat-Témara, Kénitra, Khémisset, Sidi Kacem and Sidi Slimane.                          | 4 552 585         | 13.5       | 18194                 | 2.6        | 250.2                          |
| Béni Mellal-Khénifra      | Beni Mellal, Azilal, Fqih Bensaleh, Khénifra and Khouribga                                             | 2 512 375         | 7.5        | 41033                 | 5.8        | 61.2                           |
| Casablanca-Settat         | Casablanca, Mohammedia, El Jadida, Nouaceur, Mediouna, Benslimane, Berrechid, Settat and Sidi Bennour. | 6 826 773         | 20.3       | 19448                 | 2.7        | 351.0                          |
| Marrakech-Safi            | Marrakech, Chichaoua, Al Haouz, Kelaa Sraghna, Essaouira, Rhamna, Safi and Youssoufia                  | 4 504 767         | 13.4       | 39167                 | 5.5        | 115.0                          |
| Drâa-Tafilalet            | Ouarzazat, Midelt, Tinghir and Zagora                                                                  | 1 627 269         | 4.8        | 115592                | 18.6       | 14.1                           |
| Souss-Massa               | Agadir Ida-Outanane-Inezgane Aït Melloul, Chtouka Aït Baha, Taroudante, Tiznit and Tata.               | 2 657 906         | 7.9        | 53789                 | 7.6        | 49.4                           |
| Guelmim-Oued Noun         | Guelmim, Assa-Zag, Tan-Tan, Sidi Ifni,                                                                 | 414 489           | 1.2        | 46108                 | 6.5        | 9.0                            |
| Laâyoune-Sakia El Hamra   | Laâyoune, Boujdour, Tarfaya and Smara                                                                  | 340 748           | 1.0        | 140018                | 19.7       | 2.4                            |
| Dakhla-Oued Ed-Dahab      | Oued-Eddahab and Aousserd.                                                                             | 114 021           | 0.3        | 130998                | 18.4       | 0.9                            |
| <b>National</b>           |                                                                                                        | <b>33 610 084</b> | <b>100</b> | <b>710850</b>         | <b>100</b> | <b>47.3</b>                    |

**Source: Ministry of the Interior**

## ANNEX C. DIMENSIONS, COMPONENTS, INDICATORS, THRESHOLDS AND WEIGHTINGS OF THE MULTIDIMENSIONAL POVERTY INDEX

| Dimension         | Component            | Indicator: definition of deprivation                                                                                                                                                              | Weighting |     |
|-------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|
| Education         | Children's education | If one of the children of school age 6-14 does not attend school                                                                                                                                  | 1/6       | 1/3 |
|                   | Adult education      | If no member of the household aged 15 and over has completed five years of schooling                                                                                                              | 1/6       |     |
| Health            | Handicap             | If a member of the household is unable to perform any of the following organic functions: vision, hearing, walking, cognitive ability (remembering or concentrating), body care and communication | 1/6       | 1/3 |
|                   | Infant mortality     | If a child under 12 months died in the household                                                                                                                                                  | 1/6       |     |
| Living conditions | Potable water        | If the household does not have access to clean water within a 30 minute walk from home                                                                                                            | 1/18      | 1/3 |
|                   | Electricity          | If the household does not have electricity                                                                                                                                                        | 1/18      |     |
|                   | Sanitation           | If the household does not have a private toilet or a healthy sanitation system                                                                                                                    | 1/18      |     |
|                   | Flooring             | If the floor of the apartment is dirty, sand or dirt                                                                                                                                              | 1/18      |     |
|                   | Cooking mode         | If the household cooks with wood, charcoal or manure                                                                                                                                              | 1/18      |     |
|                   | Asset holding        | If the household does not own a car or tractor / truck and does not own at least two of the following items: telephone, television, radio, motorcycle, bicycle and refrigerator                   | 1/18      |     |

Source: HCP

[1] Maternal factors (age, parity, birth interval), environmental contamination (air, food/water/fingers, skin/soil/inanimate objects, insect vectors), nutrient deficiency (calories, protein, micronutrients), injury (accidental, intentional) and finally personal illness control (personal preventive measures, medical treatment).

[2] Morocco's geographical and administrative division is reproduced in Annex B.

[3] The demographic weight of the (i) hard core of poverty, represented by the category of households which combine the two forms of the sources of poverty, (ii) category of households which are poor according to the multidimensional approach and not poor according to the monetary approach, (iii) category of poor households according to the monetary approach and non-poor according to the multidimensional approach, determines the global poverty rate.

[4] The monetary poverty rate measures the proportion of the population living below the poverty line, conventionally defined at 60% of the median standard of living. This measurement is therefore relative. It compares incomes within the population and does not take into account the living conditions of low-income households.

[5] The multidimensional poverty rate gives the proportion of poor people, cumulating a number of deprivations greater than the poverty line - at least 30% of the basic deprivations to which households are exposed -. It expresses the ratio of the number of poor to the total number of the population. More information is reproduced in Annex C.

[6] Neonatal Death Quotient measures the probability of dying before reaching the exact age of one month; Post-neonatal mortality quotient measures the probability of dying between the first month and the exact twelfth month; Infant mortality quotient measures the probability of dying between birth and the first birthday;

[7] The DAO approach is intended to be a palliative alternative to the difficulties of geographical, financial and cultural accessibility encountered in rural areas. An approach that is essentially based on social mobilization around maternal and neonatal health and the participation of all components of the local community.

[8] Luxury and modern'; 'Economic and social'; 'slums'; 'Old medina'.