THE IMPACT OF CONSANGUINEOUS MARRIAGES ON EARLY AGE MORTALITY IN EGYPT

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A Master's Thesis
Submitted to the
Department of Demography
in Accordance with the Regulation of the Institute of Population Studies

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This is to certify that we have read and examined this thesis and in our opinion it fulfills the requirements in scope and quality of a thesis for the degree of Master of Science in Demography.

Jury Members:

Supervisor.....
Prof. Dr. İsmet KOÇ (Supervisor)
Hacettepe University, Institute of Population Studies

Member.....
Assoc. Prof. Dr. Abdülkerim SÖNMEZ
Hacettepe University, Department of Sociology

Member..... ….
Assoc. Prof. Dr. Mehmet Ali ERYURT
Hacettepe University, Institute of Population Studies

Member.....
Assoc. Prof. Dr. İlknur YÜKSEL-KAPTANOĞLU
Hacettepe University, Institute of Population Studies

Member.....….
Assoc. Prof. Dr. Alanur ÇAVLİN
Hacettepe University, Institute of Population Studies

This thesis has been accepted by the above-signed members of the Jury and has been confirmed by the Administrative Board of the Institute of Population Studies, Hacettepe University.
…/…/2016

Prof. Dr. A. Banu Ergöçmen
Director

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SUMMARY

Consanguineous marriage, one of the most significant and prevalent social phenomena in Egypt, is estimated to constitute some 30% of that country's marriages, according to (EDHS 2014). Many studies have examined consanguineous marriage and its effects on the health of populations, but there is little agreement about the true type and magnitude of those effects. With declining death rates from all causes in communities where consanguinity occurs, the research has been increasingly focused on the effects of consanguineous marriages on children's health and mortality. Unfortunately, the majority of said research concentrates on the medical aspects of childhood mortality, while neglecting the possible social factors and related causes of early age deaths.

This study aims to fill the gap in the research and update the outcomes of consanguinity and early age mortality in Egypt, as well as to examine the association between the two, and explain the relationships between various socio-economic, environmental and demographic factors that accompany early age mortality and consanguinity. It will also congregate environmental aspects and social determinants into a unified model that identifies the causes of early age mortality, as evidenced through a descriptive analysis based on the Mosley and Chen framework. In addition, it estimates the impacts of consanguinity on early age mortality through the use of a logistic regression model by controlling for all the socio-economic, environmental and demographic factors which cause, both directly and indirectly, early age mortality. The data source used for the study is the EDHS-2014.

The findings herein suggest that consanguinity carries a significant impact on post-neonatal mortality and infant mortality, particularly with first and second cousin marriage types - impacts which were not previously on the agenda with regards to neonatal mortality. It is noteworthy that individual level variables, maternal factors, nutritional availability, and personal illness control determinants have profound effects, followed by environmental contamination and tradition /attitude / norms determinants with average effects, with household and community level variable determinants causing low effects at both the micro level and macro level, simultaneously. It should also be noted that consanguinity, particularly first and second cousin marriages, have clear effects on early age mortality, especially on post-neonatal mortality, even after the addition of the various effective determinants into the regression model. In other words, there is a significant risk associated with both first and second cousin marriages on post-neonatal mortality and infant mortality in Egypt according to the data derived from EDHS-2014.

ÖZET

Mısır'da önemli ve yaygın bir olgu olan akraba evliliğinin, ülkedeki evliliklerin %30'unu oluşturduğu tahmin edilmektedir (EDHS 2014). Akraba evliliklerinin nüfus sağlığı üzerindeki etkileri pek çok çalışmada ele alınmış olmasına rağmen, etkilerin gerçek niteliği ve boyutları ile ilgili fikir birliği bulunmamaktadır. Akraba evliliklerinin sık rastlandığı topluluklarda gözlemlenen ölüm oranlarındaki düşüşle birlikte araştırmalar, akraba evliliklerinin çocuk sağlığı ve çocuk ölümleri üzerindeki etkilerine odaklanmaya başlamıştır. Fakat çalışmaların önemli bir bölümü çocuk ölümlerinin tıbbi yönlerine eğilirken, erken yaşta gerçekleşen ölümlerin olası sosyal nedenlerini ihmal etmektedir.

Bu çalışma literatürdeki bahsi geçen boşluğu doldurmayı ve Mısır'daki akraba evlilikleri ve çocuk ölümleri ile ilgili bulguları güncellemeyi amaçlamaktadır. Bu çalışma kapsamında bu iki olgu arasındaki ilişki, ilgili sosyo-ekonomik, çevresel ve demografik etmenler bağlamında incelenmektedir. İlgili çevresel ve sosyal etmenler erken yaş ölümlerinin nedenlerini betimleyen Mosley ve Chen modeli temel alınarak oluşturulan birleşik bir modelle ele alınmaktadır. Ayrıca, akraba evliliğinin erken yaş ölümleri üzerindeki etkisi doğrudan ve dolaylı olarak etkisi olan tüm sosyo-ekonomik, çevresel ve demografik etmenlerin kontrol edildiği lojistik regresyon yöntemi ile incelenmiştir. Analizler, 2014 Mısır Nüfus ve Sağlık Araştırması verileri kullanılarak yapılmıştır.

Çalışmanın bulguları, akraba evlilikleri, özellikle birinci ve ikinci kuzen evlilikleri, yeni doğan sonrası dönemdeki ve bebeklik dönemindeki ölümler üzerinde önemli bir etkiye sahiptir. Bu etki yenidoğan döneminde daha baskındır. Bireysel değişkenler, annenin özellikleri, beslenme ve kişisel hastalık kontrolü önemli ölçüde etkilidir. Çevre kirliliği ve gelenek, tutum ve normlar ortalama etkilere sahipken, hanehalkı ve topluluk düzeyindeki değişkenler hem mikro hem makro düzeyde daha az etkilidir. Akraba evliliğinin, özellikle birinci ve ikinci derece kuzen evliliklerinin, tüm belirtilen değişkenler modele dahil edildikten sonra bile erken yaş ölümleri üzerinde, özellikle de yeni doğan dönemi sonrası ölümler üzerinde, etkili olduğu görülmektedir. Başka bir ifade ile, MNSA-2014 sonuçlarına göre Mısır'da birinci ve ikinci derece kuzen evlilikleri özellikle yeni doğan sonrası dönemindeki bebek ölümleri açısından önemli bir risk faktörüdür.

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AN	Antenatal care
FP	Family Planning
EDHS	Egypt Demographic and Health Survey
GDP	Gross Domestic Product
NFHS	Indian National Family Health Survey
IMR	Infant Mortality Rate
MCH	Maternal and Child Health
MC	Mosley and Chen framework
NN	Neonatal
PDHS	Pakistan Demographic and Health Survey
PNN	Post-neonatal
SPSS	Statistical Package for the Social Sciences
MNSA	Mısır Nüfus ve Sağlık Araştırması
MENA	The Middle East and North Africa region
UNICEF	United Nations Children's Emergency Fund
WHO	World health organization

CHAPTER 1

INTRODUCTION: THE PROBLEMS AND ITS SETTING

Consanguineous marriage has been a constant social phenomenon throughout human history, but with the dawn of the nineteenth century, the consanguinity phenomenon declined in the Western world. Still, the prevalence rate among developing societies is high, and some communities continue to prefer consanguineous marriage, especially first cousin marriages, to other unions due to a multitude of social, cultural and economic reasons (Bittles, 1994).

Usually consanguinity is defined as a marriage between people who are second cousins or closer (Bittles, 1994). First cousin union is thought to be the most prevalent form of unions globally, and consanguineous unions may have a positive impact on the economic, social and cultural aspects of a culture. Yet, it can be demonstrated that there is a direct correlation between the practice and early age mortality rates in those communities, especially in the case of first cousin marriages. Recent studies showed the continued prevalence of consanguineous marriage and there is no expectation that these rates will decrease significantly in the near future, instead, they are predicted to remain prevalent and perhaps increase globally (Bittles, 1994).

Consanguinity was a common practice amongst the ancient Egyptians of the reigning dynasties, as a way to keep the "royal blood" pure (Stern, 1949). Today, consanguineous marriages are closely related to customs and traditions in developing countries, but they have a pronounced impact on early age mortality rate.

Consanguinity in developing countries has been portrayed as the most important cause of genetically associated early age mortality (Guo, 1993). The offspring of couples who are not relatives have the chance to live longer than those whose parents are related (Bittles,1994). In Pakistan for instance, it has been found that child mortality (under five years old) among those children whose parents are first cousins is 1.18 times higher than whose parents are unrelated (Shah, Toney, and Pitcher ,1998). Another study conducted in Turkey found that early age mortality rates are low in non-consanguineous unions in comparison with first cousin marriages, and the study results indicated a strongly significant determinant underlying the high total infant mortality and fertility rates of first cousin unions in Turkey (Tunçbilek & Koc, 1994),(Koç & Eryurt, 2016). In Egypt, close related couples

were also seen to have a significant effect on early age mortality, where the rates of infant and child mortality doubled within closely related parents, compared children whose parents had no relation (Khayat & Saxena, 2007).

In the Arab world, consanguinity is reported at higher rates compared to other countries in the Middle East region. For example, 65% of couples in Sudan are married to a relative (Federal Ministry of Health, 1995), while in Saudi Arabia the percentage is 56.7% (el-Hazmi et al., 1995), followed by Jordan at 51.3% (Khoury & Massad, 1992). The rate also remains high in United Arab Emirates at 50.5% (Al-Gazali et al., 1997), while in Tunisia the rate is 49% (Ministry of Public Health, 1996), in Yemen, 40% (Jurdi & Saxena, 2003) in Egypt 40% (National Population Council, 1996) and in Kuwait the number stands at 36% (Ministry of Health, 1996).

Egypt is the most populous country in the Middle East, and that fact brings with it many social, economic, demographic, environmental and medical phenomena which can affect the population, both directly and indirectly. Proportions of consanguineous marriages in the general population vary between rural and urban areas and also between Lower and Upper Egypt. Notably, child mortality rates in Egypt are considered one of highest among the Middle Eastern countries. One study that converged with the objectives of The Fourth Millennium Development Goal (MDG 4) 1994 was aimed at reducing mortality rates among under-five children by two thirds in the developing world, so it sought out all causes and determinants that are directly and indirectly related to increased rates of death for children in Egypt. Some previous studies had already found that there was likely a relationship between consanguineous marriages and high mortality rates among children in Egypt. Of course, consanguineous marriage in Egypt is not a modern practice; it is perhaps as old as the nation, itself. However, the practice has declined recently due to a number of factors, dropping from 38.9% (Khayat & Saxena, 2007) to about 30% of the total number of marriages, according to the latest demographic survey in Egypt in 2014.

A study in Egypt, based on EDHS 2000 datasets, showed the consanguinity proportion at 30% and a 19% higher risk of infant mortality among close (first and second) and remote consanguineous couples, respectively. Similarly, the risk of child mortality is elevated among closely related couples by more than 50%, in fact, and among remote marriage couples the risk is 27% higher as compared to non-relative unions (Khayat & Saxena, 2007).

Consanguinity is widely practiced in Egypt at (39%), or (30%) according to Egypt Demographic Health Survey 2000 and 2008 data sets, respectively. In 2000, EDHS conducted a survey that consisted of 16,957 households and, included 15,573 ever-married women aged 15-49 from six different regions in Egypt, namely: Urban Lower Egypt, Rural Lower Egypt, Urban Upper Egypt, Upper Egypt Rural, Frontier Governorates and Urban Governorates (Hamamy, 2003).

The impacts of consanguinity on early age mortality in Egypt were examined by Khayat and Saxena (2007), who divided the sample related to women into three different categories; 'close consanguinity', 'remote consanguinity', and 'non-consanguinity' marriages. All known socio-economic variables affecting the dependent variable ('infant mortality' and 'child mortality') had been controlled for by using multivariate logistic regression models for the analysis. The outcomes obtained indicate 19% and 30% infant mortality among the children of remote and close relative couples, respectively. The same higher risks of child mortality were more than 50% for close related unions and 27% for remote related unions, as compared to non-related couples. They further found that consanguinity was still high in Egypt, (38.9%). The proportions according to the regions were: 25.4% in Urban Lower Egypt, 36.7% in Rural Lower Egypt, 37.7% in Urban Upper Egypt, 55.2% in Upper Egypt Rural, 46.3% in Frontier Governorates and 28.7% in Urban Governorates.

First cousin marriages were the most common in all regions, standing at 22.2% of all unions, and rural regions returned the highest ratios, as with those found in Upper Egypt-Rural. The close related couple's category had a significant positive effect on early age mortality, where the rates of infant and child mortality doubled within close related parents compared to parents having no relation.

The bivariate analysis used to examine the non-genetic determinants of early age mortality, (namely; mother's education, size of the child, standard of living, antenatal care, medical assistance during delivery, birth order, residence, birth interval, sex of the child and age of the mother at delivery), and which factors significantly affected it, showed a particularly notable outcome for maternal education. There were two inverse relationships among early age mortality rates with maternal education, where illiterate mothers had high risk for their offspring, while early age mortality rates correlated positively with standard of living (e.g. drinking water, nutrition, health quality, antenatal care, etc.).

Early age mortality rates were higher within close related couples who had a low standard of living, where rates were 40% more than within families of non-related couples, and more than remote couples by 6%. In addition, early age mortality rates according to consanguinity vary by region, and they are significantly higher in Rural Upper Egypt and lowest in Frontier Governorates. There were other strong, non-genetic factors affecting early age mortality such as birth interval, birth order, size of child at birth, and age of the mother at the time of birth.

Three logistic regression models are provided. The goal of using these models is to estimate the effect of consanguineous marriages on early age mortality after controlling for the effects of non-genetic determinants. The outcomes illustrated that, in the case of related unions, the risk of early age mortality was higher than in case of non-related unions, even after controlling for all non-genetic factors of infant and child mortality. The estimates clarified that close related couples had increased risks by 50% and 30% for infant and child mortality rates, respectively; more than those couples who were not related. The same high risk of death persists even with remote related couples, with rates of 30% and 20%, respectively when compared to non-related couples.

1.1. AIMS AND OBJECTIVES

This thesis shares the concerns of the fourth Millennium Development Goal (MDG 4) of 1990, which aims to reduce the mortality rate among under-five children by two thirds in developing countries. Unfortunately, the majority of the current research focuses on the medical aspects while neglecting the social factors and other causes of early age mortality, since the child mortality rate in Egypt is, overall, one of the highest in the Middle East region, while consanguinity is preferred among the Egyptians.

Given this gap in the research, this study will try to broaden the scope of inquiry and update the outcomes for consanguinity proportions and early age mortality rates in Egypt, as well as examine the associations between early age mortality (for neonatal, post-neonatal and infancy periods) and consanguinity, and explain the relationships between socio-economic, environmental and demographic factors and early age mortality, and gather medical and environmental aspects and social determinants together into one model which identifies the causes of early age mortality during the neonatal, post-neonatal and infancy periods.

The main objective of the research is to conduct an optimal analysis of the data to get the best results possible, and to get useful recommendations for future research in the same field. Finally, it will hopefully be a resource for politicians and decision makers in the Egyptian state to aid in the development of policies and treatments which may help in reducing rates of high infant mortality, especially those mortalities caused by the effects of consanguineous marriages in Egypt.

1.2. RESEARCH QUESTIONS

The main research questions in this thesis are as follows:

- What are the impacts of consanguineous marriages on infant age mortality?
- Does consanguinity have a resistant impact on infant death numbers even after controlling for all possible covariates?

Beside these main research questions, the study also aims to answer an important secondary research question:

- What are the factors behind the high infant mortality rate in Egypt?

To answer these questions, the study will focus on the consanguinity phenomenon and early age mortality by preparing the recent ratios according to Egypt demographic and health survey 2014 datasets. Next, the study will configure the social determinants and environmental and medical factors which are believed to influence, directly and indirectly, child mortality in Egypt. Then, the study will examine the statistical relationships between the independent variables and the dependent variable (infant mortality) to measure the impact caused by those elements. For the most part, the study is based on the Mosley and Chen model which works by collecting factors and statistically analyzing them through a multiple logistic regression analysis. Using this approach, the study is expected to show the impact of consanguinity on early age mortality in Egypt.

1.3. CONTRIBUTIONS TO THE LITERATURE

When the impact of consanguineous marriages on early age mortality is considered by researchers in future, this thesis is expected to introduce a new study into the demographic literature, particularly with regard to the countries of the Middle East, but also

for developing countries, in general. It is believed that this thesis would make four main contributions to the literature:

Firstly, the study will contribute by updating the proportions of consanguineous marriages (first cousin couples, second cousin couples and relative couples) and early age mortality rates for neonatal, post-neonatal and infancy periods.

Secondly, the study is expected to provide answers to the questions of the most affected determinants and their relationships with early age mortality; elements which cause overall negative impacts on neonatal, postnatal and infant mortality rate in Egypt.

Thirdly, the study will create a balance between the two main disciplines involved (social and medical sciences) in early age mortality in developing countries. It will use, therefore, both the social factors and medical determinants shown to cause the risk of early age mortality in one particular model, Mosley and Chen (1984). This model presented a useful and important strategy by avoiding biased research approaches in policy and program in each discipline, and by gathering the different concerns and methodologies together to offer a more useful approach to understanding childhood survival by integrating both medical and social science methodologies into a consistent analytical framework. The model consists of a set of proximate determinants that directly cause risk of morbidity and mortality. In order to understand the socio- economic determinants that affect child survival directly, research must operate through proximate determinants, with these variables categorized into groups such as maternal factors, environmental contamination, nutrient deficiency and personal illness control. Furthermore, the model will be the first of its kind to be used in this type of research in Egypt, and hopefully it will obtain accurate outcomes and a picture close to reality about the most important factors affecting child mortality in Egypt. Although the model has been known among researchers for the past three decades, its use in developing countries was limited.

Finally, the study will prepare a comprehensive review benefiting more than those who are interested in child mortality, especially in the countries of the Middle East and in developing countries in general, and it will attempt to contribute to the understanding of the current reality on the ground in Egypt through a truly comprehensive academic inquiry.

1.4. LIMITATIONS OF THE STUDY

The study has its limitations, however, and those are as follows:

Firstly, the demographic survey was conducted in Egypt in 2014 and it excluded the province of the Sinai for the first time. In view of the very complex security situation in Sinai Province today, the survey omitted one of the most active regions for consanguineous marriages and child mortality studies, as the border provinces, especially the Sinai, are considered to have one of the highest rates of consanguinity and, one of the highest rates of child mortality in Egypt.

Secondly, there is a bias arising from this lack of data from Sinai governorates according to EDHS 2014, which leads to biased and unclear results during the data analysis process. Therefore, the recommendations have turned out to be incomplete in some aspects.

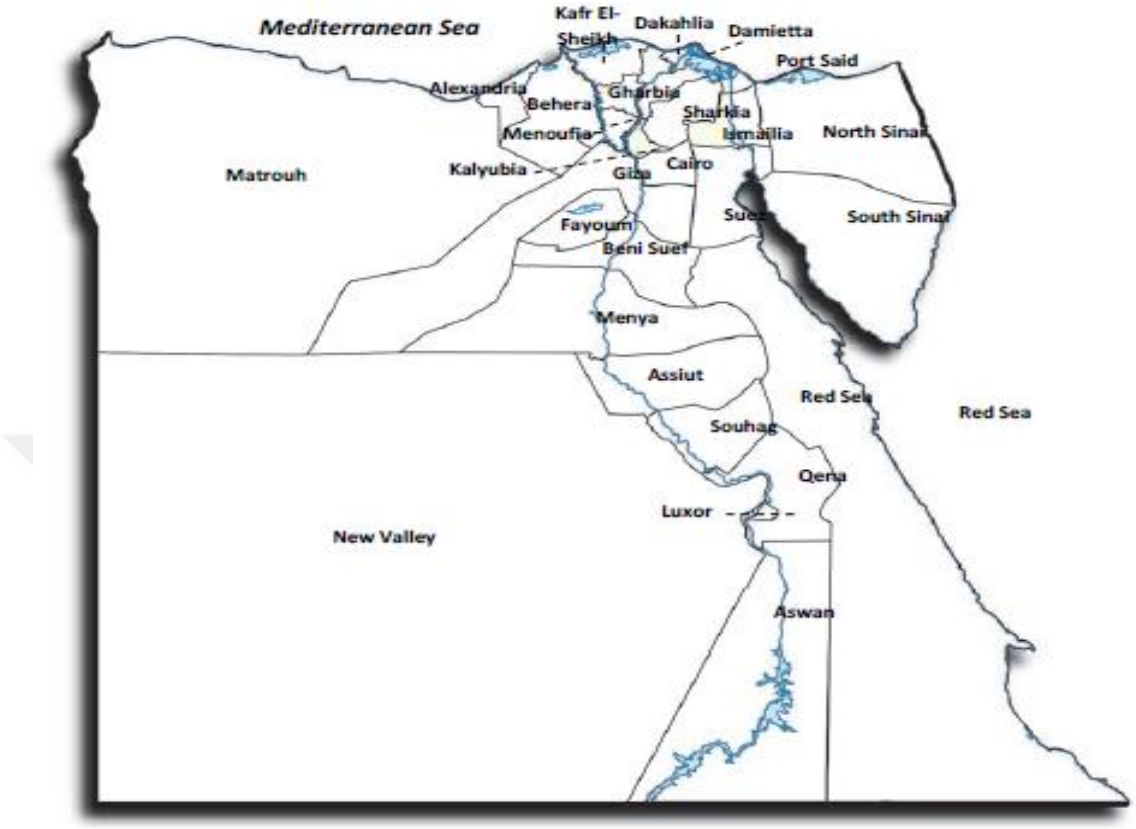
The third limitation stems from the fact that, according to the methodology used in the data analysis, a focus on the last five years of births and deaths for children will show that many who were born during this period were not able to be tracked adequately. Therefore, it is not possible to properly measure childhood mortality and under five years of age mortality rates and the study will instead focus on neonatal mortality, post-neonatal mortality and infant mortality as the early age mortality dependent variables.

1.5. THE SETTINGS

Egypt is located in northern Africa. To the west, it is bordered by Libya, to the south by Sudan, to the east by the Red Sea, and to the north by the Mediterranean Sea. Egypt has the largest population among Arab nations. It covers approximately one million square kilometers, mostly of which are desert; the inhabited regions constitute only 7.7 % of the nation’s total land area. The government, however, has a policy of land reclamation and fostering of new settlements in the desert.

The majority of the population is concentrated in specific areas, with the most density in the Nile Delta located in the north of the country, or in the narrow Nile Valley south of Cairo.

Figure 1.1: Map of Egypt's Provinces



Source: EDHS2014: Ministry of Health and Population, et al., 2015.

Egypt is divided into 27 governorates. There are only four Urban Governorates (Alexandria, Cairo, Suez, and Port Said) and those governorates have no rural population. The other governorates are subdivided into urban and rural areas. Nine of these governorates are located in the Nile Valley, nine are in the Nile Delta, and the remaining five Governorates are on the western and eastern boundaries of Egypt.

1.5.1. Population Size and Structure

The latest population census was carried out in Egypt in November of 2006 and the de facto population is 72 million. Roughly 2.2 million of them were living abroad at the time of the survey. The population has been increasing at a high rate after the census and it was estimated the number stood at nearly 84 million by 2013.

In 2013, 57 % of the Egyptians were living in rural areas. The urban-rural distribution of residence approximately remained the same since the 1990s, as shown in Table 1.1.

Table 1.1: Total population in Egypt and the percentage living in urban and rural areas, 1996-2013.

		Place of residence	
Year	**Total population (thousands)**	**Urban**	**Rural**
1996	58,835	42.6	57.4
1997	60,053	42.6	57.4
1998	61,296	42.6	57.4
1999	62,565	42.5	57.5
2000	63,86	42.5	57.5
2001	65,182	43.1	56.9
2002	66,531	42.9	57.1
2003	67,908	42.9	57.1
2004	69,313	42.8	57.2
2005	70,748	42.7	57.3
2006	72,212	42.5	57.5
2007	73,608	43.1	56.9
2008	75,194	42.9	57.1
2009	76,925	43.0	57.0
2010	78,685	43.0	57.0
2011	80,53	42.8	57.2
2012	82,55	42.9	57.1
2013	83,667	42.8	57.2

Source: CAPMAS 2014, Table 2.3

1.5.2. Recent Rate of Natural Increase

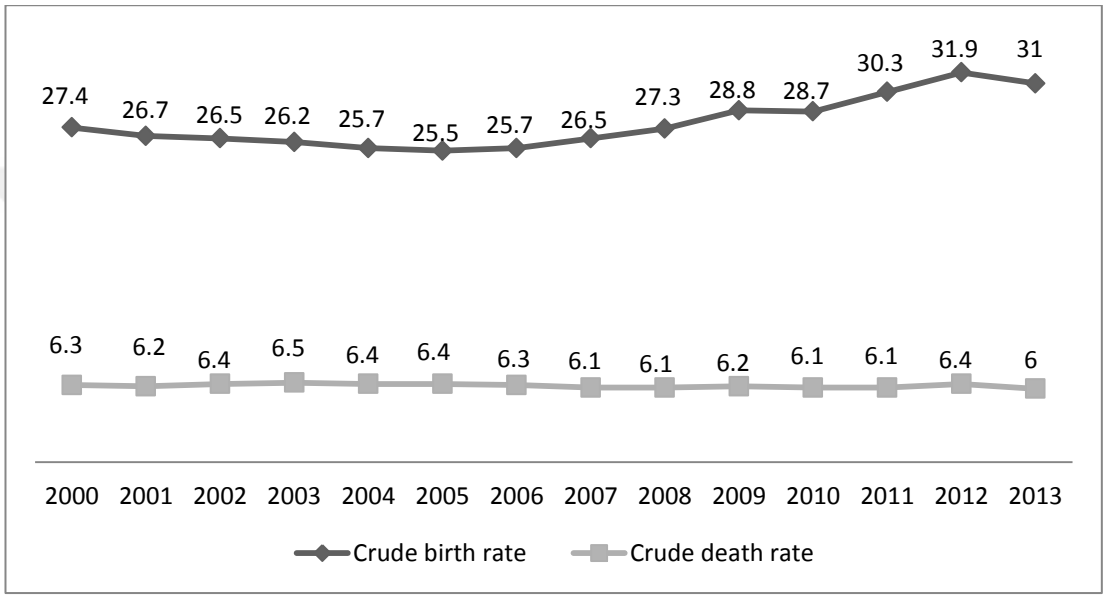
The natural increase rate represents the difference between birth and death rates in population. It refers to the growing rate of a population by comparing crude birth rates (CBR) and crude death rates (CDR), which were decreasing in Egypt from 2000 to 2005. This decreasing trend had reversed in 2006, and the rate of natural increase came to a peak of 25.5 per thousand in 2012, which then declined slightly in 2013. Changes in fertility have been mainly affected the growth in Egypt's population.

The CDR remained approximately stable during the period 2000-2013, fluctuating between 6.0 and 6.5 per thousand in the population. CBR dropped at the beginning of the period, from 27.4 per thousand populations in 2000 to 25.5 per thousand in 2005. Later, in 2012, the trend was reversed and CBR increased by 25 % to 31.9 births per thousand in 2012 before decreasing to 31 births per thousand in 2013, as shown in Figure 1.1.

The life expectancy at birth of the Egyptian population has been affected by the decrease in mortality rates over time. Life expectancy at birth represents the average number

of years a child born in a specific year may be expected to live during his/her lifetime. The life expectancy of the Egyptian population increased from 71.0 years in 2000 to 74.8 in 2009 for females, and from 66.7 years in 2000 to 70.2 years in 2009 for males. Life expectancy decreased for both males and females in 2010 and then rose again, reaching 69.7 years for males and 72.5 years for females by 2014, as shown in Table 1.2.

Figure 1.2 Trends in crude birth and death rates, Egypt 2000-2013



Source: CAPMAS 2014

Table 1.2: Life expectancy at birth by sex, Egypt 1976-2014

Year	Male	Female
2000	66.7	71.0
2001	67.1	71.5
2002	67.5	71.9
2003	67.9	72.3
2004	68.4	72.8
2005	68.8	73.5
2006	69.2	73.6
2007	69.5	74.0
2008	69.9	74.4
2009	70.2	74.8
2010	68.2	70.9
2011	68.6	71.4
2012	69.0	71.7
2013	69.4	72.1
2014	69.7	72.5

Source: CAPMAS 2014

1.5.3. Social and Economic Indicators

According to Human Development Report for 2015, the gross domestic product (GDP) per capita achieved a level of US $13,541 which reflects the steady expansion of the Egyptian economy. This economic growth led to remarkable improvements in a number of human development indicators, including:

- An increasing proportion of households with sustainable access to improved sanitation from 87 % in 1990 to 96.5 % by 2013 (UNDP 2015).
- Literacy levels which have risen as a logical conclusion to increasing levels of school enrolment. For example, in 1990, the enrolment ratio at the primary level was 84 % and adult literacy was 47 %; by 2014, the enrolment ratio at the primary level had increased to 95 % and adult literacy had risen to 73.9 % (UNDP 2015).

There was a noticeable increase in the female education ratio. At the primary level, female enrolment rose from 57 % in 1970 to 98 % in 2013. Female enrolment at the secondary level was more notable and rapid as it increased from 23% in 1970 to 70 % in 2013 (UNDP 2015). Improved indicators over time were not identical when we disaggregated the category into subgroups.

1.5.4. Population Policy and Programs

Demographic problems and their effects on national development objectives were noted by the Egypt government, so they adopted a national population policy that considered both quantitative and qualitative aspects of the population as development determinants.

For a long period, Egyptian government policy was aimed at reducing the population growth rate. In 1973, the government's concerns were clearer when the Supreme Council for Family Planning issued the first National Population Policy. The main objective of the policy was to reduce the CBR from 34 births per thousand populations in 1973, to 24 per thousand in 1982**.**

In the late 1970s, the Supreme Council for Population and Family Planning established high committees to coordinate Information, Education, and Communication (IEC) activities so that family planning activities became more structured, organized and better managed.

A new National Strategic Framework for the Population, Human Resource Development and Family Planning Program was issued in 1980. This strategy set measurable, time-framed indicators to assess the progress toward the achievement of the population and human development goals. In 1984, the national population conference was held. Shortly after that, the national population council (NPC) was established.

The failure of these steps to achieve progress in reducing the population growth rate instigated the NPC to carry out the third national population plan. This plan described and re-confirms the relationship between the population and certain development factors.

As the 1994 International Conference on Population and Development (ICDP) recommended, a modified population strategy was developed in 1995. This strategy brought to light a comprehensive approach to population and development issues and further identified a range of demographic and social goals to be achieved over a 20-year period.

Early in 1996, population activity became one of the responsibilities of the Ministry of Health, which later became the Ministry of Health and Population (MOHP). MOHP started a women's health program that includes family planning, maternal health, and child health services, and also adds more than 500 mobile clinics to increase the level of access to these services. In 2010, the MOHP network included 60 general hospitals with 12,168 beds, and 214 district hospitals with 18,908 beds. The MOHP network also includes 135 specialty hospitals with 12,103 beds and 4,839 primary health care centers (MOHP 2012).

Recently, Egypt developed a Plan of Action for the Prevention, Care and Treatment of Viral Hepatitis (2014- 2018) with several international best practices in place pertaining to prevention, treatment, screening, and surveillance. To our knowledge, the prior strategy on which this was based (2007- 2012) has not yet been formally evaluated and as a result, the potential lessons that could have been learned have not been realized (MOHP 2014).

1.5.5. Health Policies and Programs

The health system in Egypt faces a wide range of diseases within the population, including those which are linked to poverty and ignorance, and those which are linked to a modern, urban lifestyle. Communication and commercial projects raised the people's expectation of the level of health services provided by the government. The Egyptian health system was able to provide a comprehensive health service, with 95% of the population being no more than 5 KM away from a health facility.

MOHP started a national program that focused on diarrhea, acute respiratory infections and expanding the range of its immunization program. Its targets were the eradication of poliomyelitis and elimination of neonatal tetanus before the year 2000, and decreasing neonatal mortality by increasing the quality of postnatal services, both at home and in health facilities. MOHP aimed to increase basic health services coverage to reach to the most vulnerable groups. Efforts focused on both expanding health insurance to cover more beneficiaries and enhancing the quality of health services, so it redistributed health workers who then received more support. Special attention was paid to the information system. Data collection, analysis, and reporting were improved to enhance and lead efforts in areas that have a positive effect on the health of women and children.

Egypt has seen gains in MCH outcomes, as demonstrated by reductions in the last 10 years in the maternal mortality ratio by one-third, from 100.0 to 66.0 maternal deaths per 100,000 live births; and the under-five mortality rate falling by half, from 41.9 to 22.0 infant deaths per 1,000 live births (World Bank 2014a). However, neonatal mortality represents half of the infant mortality and is still disproportionately higher among those living in rural Upper Egypt. Concurrently, Egypt is witnessing an increase in fertility with a decline in the contraceptive prevalence rate. In addition, rates of female genital mutilation/cutting (FGM/C) remain extremely high, with 91% of all women aged 15- 49 circumcised (El-Zanaty and Way 2009). To address this, Egypt has developed a National Acceleration Plan for Child and Maternal Health (2013 -2015) (MOHP 2013) to speed up the progress in further reduction of maternal and child deaths, but it can be better targeted to disadvantaged groups.

1.5.6. Other Reproductive Health and Demographic Indicators

In this sub-section, some of the selected indicators of reproductive health and demographic status in Egypt are presented in order to understand more about their context. According to EDHS-2014 results, TFR is quite high in Egypt, at 3.5 children per woman. Adolescent fertility rates are found to be 56 children per 1,000 women, which indicate a decline in the last three decades from 78 children per 1,000 women. Approximately only 6 out of 10 women are using contraceptive methods in Egypt; however, almost all of the women use modern contraceptive methods. About 60 % of women in Egypt are willing to stop childbearing. Coverage of antenatal care has increased to 90 %, although full vaccination rate is still at around 80 %. Age at marriage among women aged 25-49 is on the rise, from 19.2 to 20.8 during the last 20 years. Although developments in reproductive

health services in Egypt have been achieved, deaths during the first years of life are still significantly high in the country. Infant mortality rates derived from EDHS-2014 for the last five years preceding the survey stand at22 per 1,000 live births, implying that 22 out of 1,000 newborn dies before reaching their first birthdays.

Table 1.3: Status of Reproductive Health and Demographic Indicators

Indicators	Unit	Source	Rate/Percentage
Total Fertility Rate	Per woman	EDHS-2014	3.5
Adolescent fertility rate	Per 1000 15-19 women	EDHS-2014	56
Household Size	Number of persons	EDHS-2014	4.1
Contraceptive Prevalence Rate (Total)	Currently married women	EDHS-2014	58.5
Contraceptive Prevalence Rate (Modern)	Currently married women	EDHS-2014	56.9
Desire no more children	All women Currently married	EDHS-2014	59.1
Coverage of antenatal care	Women with Children born during last 5 years	EDHS-2014	90.3
Age at first marriage	All women aged between 25-49	EDHS-2014	20.8
Infant Mortality Rate	Per 1000 live births	EDHS-2014	22.0
Full vaccination rate	Children aged between 18-29 months	EDHS-2014	78.0

Source: EDHS2014: Ministry of Health and Population et al., 2015.

This study consists of six chapters which are designed as follows:

The first chapter presents an introduction to the impact of consanguineous marriages on early age mortality in Egypt; this chapter consists of four sections. The first section explains the aims and objectives of the study. The second section identifies the research questions, while the third section provides the contribution to the literature. The fourth section explains the limitations of the study and the last section explores basic demographics and social status in Egypt, as presented in the previous chapter.

The second chapter explains the data and methodology used in this study. In the first section, EDHS 2014, which is the data source of this study, is presented and the procedures are explained, including the components and the elements of the survey. The second section clarifies the methodology under five subsections. Firstly, it explains the analytical framework to be used throughout this study. Secondly, the independent variables are identified and interpreted, and thirdly; consanguinity is explained as an independent variable that is the main pillar of this study in unraveling the high infant mortality rates in Egypt.

Lastly, the infant mortality as a dependent variable is defined and explained and, finally; the statistical method that used through this study is identified and elucidated.

In the third chapter, a literature review is presented. Its first section expounds upon the history of consanguineous marriage in the most developed countries. The second section has a review of consanguinity in developing countries under four geographic subsections; Asia, Africa, (MENA), and Egypt.

The fourth chapter discusses the descriptive analysis of the Mosley and Chen framework variables distribution, and its effects on understanding consanguineous marriage and early age mortality. This chapter consists of three sections as follows:

Firstly, it will provide and explain the Mosley and Chen framework variables distribution's effect on consanguinity types under eight separate determinants; individual, maternal, environmental, children's nutrition, personal illness, tradition/ norms/ attitude, household level and community level variables.

Secondly, it will provide and explain the effect of the Mosley and Chen framework's approach to early age mortality types under eight determinants; individual, maternal, environmental, children's nutrition, personal illness, tradition/ norms/ attitude, and household level and community level variables. Thirdly, it will provide and explain the distribution of consanguineous marriage types on the early age mortality.

The fifth chapter will illustrate the estimation results for the logistic regression of consanguineous marriage on early age mortality by controlling for all other risk effect independent variables.

Finally, together with a brief summary of the thesis, a discussion about the use of literature with similar results will be carried out in the last chapter. This chapter also includes several recommendations that were derived from the results of the thesis.

CHAPTER 2
DATA AND METHODOLOGY

2.1. DATA SOURCE

Egypt Demographic and Health Survey (2014) is the latest survey of its kind conducted in Egypt. The EDHS full-scale and interim series were implemented in 1988, 1992, 1995, 1997, 1998, 2000, 2003, 2005 and 2008. El-Zanaty and Associates were implemented EDHS-2014 under the supervision of the Egyptian Ministry of Health and Population.

EDHS-2014 consists of two main components: the ever married women between the ages of 15-49, and the general population. This survey was meant to update the information on the important health problems facing Egypt. EDHS-2014 introduces estimates for contraceptive use, fertility, coverage of antenatal and delivery care, infant and child mortality rates, plus nutrition and immunization levels. It also introduces updated information for some critical indicators such as domestic violence, female circumcision and children's welfare (EDHS, 2014)

Generally, EDHS-2014 consists of two questionnaires; the individual and household questionnaires. The 15-49 age group of ever-married women (individual questionnaire) covered critical issues such as; contraceptive use, respondent's background, pregnancy and breastfeeding, attitudes and fertility preferences of the family planning, child nutrition and female circumcision.

EDHS -2014 covered visitors and usual household members in order to collect all the needed information on anemia levels and nutritional status among children and women, as well as on each household's socioeconomic status. Through the first section of household questionnaire, information on the marital status, sex, age, household head's relationship of each visitor and household member and educational attainment was collected.

The second section of household questionnaire contains questions about the characteristics of housing, such as flooring material, the number of rooms, toilet facilities

and source of water. The household questionnaires also collected information about child labor. Finally, anemia testing and measurements of the weight and height for children and women were recorded.

The health and population indicators were provided in occasion sample design, including mortality and fertility rates across the whole country, as well as for six main regions (Frontier Governorates, urban Upper Egypt, urban Lower Egypt, Urban Governorates, rural Upper Egypt and rural Lower Egypt Governorates). For the 2014 EDHS, 28,175 households were successfully interviewed, while the number of eligible women successfully interviewed in this survey was 21,762, the number of children under 60 months was 15,668, and the number of births recorded for Egypt during this survey was 59,354.

The 2014 Egypt DHS involved a multi-stage sample design. The 2014 EDHS sample was selected in four stages. During the first stage selection, a total of 926 primary sampling units (481 shiakhas/towns and 445 villages) were chosen with probability proportional to size. During the second stage selection, each shiakha or village was divided into equal parts, 5,000 for each part. Three parts were selected in shiakhas/villages with a population of 100,000 or more, and two parts were selected in shiakhas/villages with populations between 20,000 and 100,000. In the remaining smaller shiakhas/villages, only one part was selected. In the third stage selection, the selected parts were then divided into a number of segments of roughly equal size. In large shiakhas/towns and villages where there were two or three parts, one segment was chosen from each. In small shiakhas/towns and villages where only one part had been selected, two segments were chosen. Over the last stage selection, a household listing was obtained for each segment. Using the household lists, a systematic random sample of 29,471 households was chosen for the 2014 EDHS. All ever-married women 15-49 included in that list were eligible for the individual survey interview. Note that, due to security issues, the EDHS 2014 could not be conducted in North and South Sinai.

The 2014 EDHS survey focused on respondent's background, reproduction, fertility preferences, pregnancy, postnatal care and breastfeeding, child health and nutrition, husband's background and woman's work. Sections of the questionnaire pertaining to ever-married status provided such valuable information that consanguinity marriage and early age mortality rates could be calculated, as well as other valuable variables such as timing of first antenatal checkup (in months), number of antenatal visits during pregnancy, birth weight in kilograms and size of child at birth. Although most of the child health related questions were asked of those women who had given birth between the beginning of 2009 and the time of

the survey in 2014, it is also possible to analyze consanguinity marriage and early mortality rate for more than 5 years, and to measure its trends and increasing number of cases in a longer term view.

Within those two main data sources (household and ever-married women) we find the 'children under- five' dataset used in this study; numbers which include all live births after January 2009. The work based on this dataset aims to gather all the pertinent information about health care, environmental determinants, maternal factors, nutrition for children, personal illness, traditions, norms, attitudes, and households and communities, and then to calculate all the variables needed such as wealth index, religion, region, relationship to household head, cohabitation duration, timing of first antenatal check (in months), number of antenatal visits during pregnancy, birth weight in kilograms, size of child at birth, birth order number, birth order categories, preceding birth interval, source of drinking water, education for mother, husband's education, woman's work status, and finally, woman's age categories.

2.2. METHODOLOGY

This section consists of five subsections. Firstly, it will explain the analytical framework that is going to be used throughout this study. Secondly, it will explain the independent variables, thirdly, the consanguinity variable, fourthly, the early age mortality as a dependent variable, and lastly it will explain the statistical method that will be used.

2.2.1. Analytical Framework

The fourth Millennium Development Goal (MDG 4) conducted in Cairo (1994) aimed to reduce the mortality rate among under-five children by two thirds. The largest proportion of child mortality in the world is located in developing countries. In most of these nations, mortality patterns could be observed along a J-shaped curve. The risk of mortality and morbidity is not consistent between different age groups of the population, and it highlights the children under the age of five group, where the death risk probability is more than that of older age groups due to environmental factors. Demography as a discipline attaches great importance to early childhood mortality and, depending on the characteristics of the children in each population study, more detailed approaches have been developed in order to understand the fundamental determinants of early age deaths.

Childhood survival strategies have been shaped by many different disciplines interested in assessing the magnitude of the multiple obstacles and problems which impede the understanding and identification of the causes of death. Early age mortality has usually been studied by sociologists and demographers, but it is, of course, also studied by medical scientists. Due to the importance of the topic, the contributions from various social scientists and medical scientists reflected multi-disciplinary structures that sometimes interfered with one another, and it was difficult for them to design an integrated structure to accommodate a generalized childhood survival strategy. The basic mechanism of interactions among variables was also a concern, but each discipline has a unique theory for its own approach.

The social studies approach is primarily interested in the association between socio-economic factors and patterns of mortality. The correlation between socio-economic variables and mortality usually highlights the determinants of mortality. For example, two main factors affecting childhood mortality, namely income and maternal education, have gained an interest amongst social scientists who probed those issues as they were found in developing countries. Generally, the medical causes of mortality are not included, therefore, the social scientists' approach to infant mortality does not provide a complete picture.

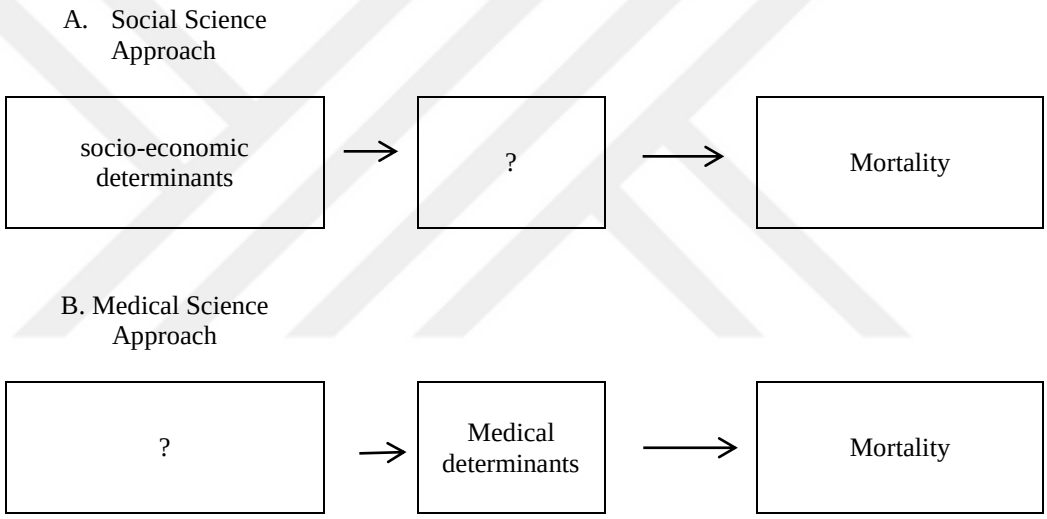
On the other hand, medical scientists have paid close attention to the problems of children's health and they designed a strategy in line with their own approach which depends on specific medical variables. such as the risk of malnutrition, breastfeeding habits, dietary practices and food availability, as they relate to nutritional status, as well as infection and disease transmission through the environment (as with malaria vector control), and injuries due to environmental contamination (polluted drinking water) and disease (cholera). These factors are all associated with diseases that might explain causes of morbidity and mortality, and most of medical studies use only morbidity as the dependent variable by focusing on the incidence and prevalence of disease states in a population. However, the socio-economic factors tend to be neglected in this approach. Recently, medical researchers have begun to modify their research methods by inserting socio-economic factors as common causes of exposure to the risk of mortality (Iyun & Oke, 2000). In this way, major contributions were made by both the medical and social sciences toward an understanding of child mortality in developing countries.

Mosley and Chen (1984) presented a useful and important framework by avoiding biased research approaches in policy and programming in each discipline, and by gathering the differing concerns and methodologies to get a more complete view of the complex issues

involved, and by creating more useful approaches to understanding child survival. They offered an analytical approach which integrates both medical and social science methodologies into a consistent analytical framework of child survival according to their model.

According to this model, mortality is the final indirect outcome of socio-economic factors present in a country, and it operates through (the proximate determinants of) the intermediate variables to affect child survival, while medical factors affect mortality directly, as shown in Figure 3.1.

Figure 2.1: Conceptual Model of Social and Medical Sciences on Mortality



Source: (Mosley and Chen, 1984)

The model presented five premises that guide the development of intermediate variables based on a study of childhood survival:

1- The expectation for newborn infants to exceed the first five years of life is over 97%, in an optimal setting.
2- Social, economic, environmental, and biological forces could conceivably be the main causes of reduction probability of survival.
3- Socio-economic determinants (independent variables) must operate through more basic proximate determinants.
4- Biological indicators of the operations of the proximate determinants might include diseases and issues of nutrient absorption in the surviving population.

5- A child's death is rarely caused by a single disease. Rather, there are cumulative effects of multiple diseases that, in turn, influence health and increase child mortality rates.

The model consists of a set of proximate determinants that directly cause the higher risk of mortality. A further condition of socio-economic determinants is that, in order to affect child survival directly, they must operate through proximate determinants, and these variables can be categorized into five groups:

1- Maternal factors: Age, parity; birth interval (the time between last birth and the previous one).
2- Environmental contamination: Various vectors of diseases and infections (air; food/water/fingers; skin/soil/inanimate objects; insect vectors).
3- Nutrient deficiency: Availability of essential nutrients for infant and pregnant women (calories; protein; micronutrients such as vitamins and minerals).
4- Injury: Accidental or intentional.
5- Personal illness control: Personal preventive measures; medical treatments needed such as timing of first antenatal checkup, number of antenatal visits during pregnancy, quality of antenatal care).

This study mainly uses four categories of proximate determinants; maternal factors, environmental contamination, nutrient deficiency and personal illness control. The four proximate determinates operate in conjunction with socio-economic variables; according to the model, the intermediate variables (independent variables) are grouped into three basic categories in social science studies, in order to achieve maximum analytic value:

1- Individual-level variables: Individual productivity (father's and, mother's; education, employment status, age etc.; traditions/norms/attitudes, relationship to household head, length of cohabitation, literacy, decision maker for contraceptive issues.
2- Household level variables: Income wealth at the household level will affect goods and services such as clothing, drinking, heating, etc.
3- Community-level variables: Categorized into three groups;
    a- Ecological setting including climate, soil, rainfall, temperature, etc.
    b- Politico-economic factors that can operate to influence child survival are as follows;

(i) Organization of production and the availability and stability of food supplies.
(ii) Physical infrastructure such as railroad, roads, electricity, water, etc.
(iii) Political institutions.

c- Health system as epidemic control measures such as vector control programs, quarantine, immunizations.

The conceptual framework is obviously characterized by drawing the attention of researchers from different disciplines to the possibility of using both social and medical determinants to make it easier to obtain satisfactory, logical and expressive conclusions for the survival of children. The model gave researchers and politicians alike the ability to know the underlying causes of death. In developing countries, realistic information about causes of death can be gleaned from the data and used in the development of policies and strategies to confront high infant mortality rates.

The Mosley and Chen framework is also characterized by its option to add or remove variables within the proximate determinants to render the data more suitable for different developing countries and to realize an optimal structural framework capable of operating all related variables for each region perfectly. The framework allows for the modification of main determinants by adding a new one, or excluding others, such as in the case of this study which will exclude the injury determinant.

The model opens horizons to create an extensive novel theoretical framework for maternal demographic status. For example; a case study done in Tanzania by Nathan and Mbago (1999) improved this framework and further placed some household level variables, such as source of water and type of toilet facility, into a third group called ‘intervening variables’ (Tuğ, 2005).

The Mosley and Chen model highlights the importance of a comprehensive knowledge of relevant health issues, and also perfectly determines the factors behind child mortality. During the last quarter of the twentieth century, the model remained the main source for researchers from different disciplines in developing countries, for example Tuğ (2005) and Uçar (2011) from Turkey and Nathan and Mbago (1999) from Tanzania.

This study will be based on Mosley and Chen's conceptual framework and the independent variables will be categorized into two main groups: the proximate variables and the socio-economic variables, as will be explained in the next section.

2.2.2. Independent Variables

This section will review all the proximate variables and socio-economic variables which are thought to play a role in early age mortality in Egypt, based on the Mosley and Chen framework. Individual level consists of five variables; educational level of women, education level of husband, working status of women, coverage by health insurance and age of women, as shown in Table 2.1.

Table 2.1: Explanation and Percentage Distribution of Individual Level Variables

Variable names	Variable labels	Explanation	Categories	%
v106	Educational level of women	Highest educational level that mother attended.	No education	17.9
			Primary	8.6
			Secondary	57.6
			Higher	16.0
v701	Education level of husband	Highest educational level that mother attended.	No education	12.9
			Primary	13.4
			Secondary	56.7
			Higher	17.0
v717_cat	Working status of women	Working status of women at the time of the survey.	Not working	87.0
			Working in agriculture	2.1
			Working in services	3.5
			Working in manufacture	7.4
v481	Coverage by health insurance	Coverage by health insurance of the women from public or private sector.	No	93.3
			Yes	6.7
v013_cat	Age of women	Age of the women at the time of the survey.	<25	25.1
			25-34	59.7
			35 and over	15.3

According to maternal variables for consanguinity in Egypt based on EDHS, 2014 datasets, there are three variables; birth order categories, months passed since preceding birth, succeeding birth interval and mother's age at birth. Each of these variables is distributed across four types of consanguineous marriage; first cousin, second cousin, other relative and non-consanguineous marriage, as shown in Table 2.2.

Table 2.2: Explanation and Percentage Distribution of Maternal Factor Variables

Variable names	Variable labels	Explanation	Categories	%
bord_cat	Birth order	Birth order of the women born in the last 5 years.	First birth order	30.8
			2-3	49.8
			4-5	15.9
			6+	3.4
b11_cat	Months since preceding birth	Number of months passed since preceding birth.	First birth	31.7
			7-23	13.4
			24-47	32.8
			Over 4 years	22.1
b12_cat	Succeeding birth interval	Birth interval for succeeding birth (months).	7-23	10.9
			24-47	13.7
			48-59	1
			Open birth interval	74.4
Ageatbg	Mother's Age at birth	Age of mothers at birth in the last 5 years.	<20	9.4
			20-34	82.1
			>35	8.5

Environmental variables in this study consist of four variables; source of drinking water and if it is an improved or non-improved source, type of toilet facility, time to obtain drinking water, and frequency of someone smoking inside the household. These variables are also distributed over the related marriages types, as shown in Table 2.3.

Table 2.3: Explanation and Percentage Distribution of Environmental Variables

Variable names	Variable labels	Explanation	Categories	%
v113_cat	Source of drinking water	Improved sources include a piped source within the dwelling, a public tap, a tube hole or borehole, a protected well or spring, and bottled water.	Improved	93.2
			Non-Improved	2.4
			Not a dejure resident	4.3
v116_cat	Type of toilet facility	A household is classified as having an improved toilet if the toilet is used only by members of one household (i.e. it is not shared) and if the facility used by the household separates the waste from human contact.	Improved	87.7
			Non-Improved	8.0
			Not a dejure resident	4.3
v115_cat	Time to obtain drinking water	The duration shows the total time to go the source, get water and come back home for only households that the source of the drinking water is not on premises.	Water on premises	88.1
			Less than 30 minutes	6.8
			30 minutes or longer	0.7
			Don't Know	0.1
			Not a dejure resident	4.3
s125h	Frequency of someone smoking inside the household	Frequency of smoking inside the house.	Daily	45.0
			Weekly	1.2
			Monthly	1.2
			Never	48.2
			Not a dejure resident	4.3

Nutritional availability for child consists of two variables; size of child at birth and status of breastfeeding, as shown in Table 2.4.

Table 2.4: Explanation and Percentage Distribution of Nutritional Availability for Child Variables

Variable names	Variable labels	Explanation	Categories	%
m18_cat	Size of child at birth	The size of children at birth for children born in the last five years based on information provided by mothers.	Very small	4.7
			Smaller than average	11.8
			Average or larger	83.1
			Don't know/Missing	0.4
M4_cat	Status of breastfeeding	Breastfeeding status of children at the time of survey.	Never breastfed	5.7
			Ever breastfed	64.9
			Currently breastfeeding	29.1
			Missing	0.2

Personal illness factor consists of the variables of timing of first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider (doctor,

Trained nurse/midwife, *daya* (traditional birth attendant) and others), place of delivery and number of examinations during antenatal care, as shown in Table 2.5.

Table 2.5: Explanation and Percentage Distribution of Personal Illness Factor Variables

Variable names	Variable labels	Explanation	Categories	%
GCACT	Timing of the first antenatal check (months)	The month that mother visits the health staff first for antenatal care during the pregnancy in the last five years.	No antenatal visit	9.8
			1-3	54.5
			4-6	9.4
			7 and +	1.6
			Don't know/Missing	0.2
			Question not asked	24.5
GCACN	Number of antenatal visits during pregnancy	The numbers of antenatal visits of women during their pregnancies in the last five years.	No antenatal care	9.8
			1-2	3.3
			3-4	10.0
			5+	76.2
			Don't know	0.6
providerg	Antenatal care provider	The person who provided the antenatal care to the mothers during their pregnancy in the last five years.	No Antenatal care	9.8
			Doctor	81.8
			Trained nurse/midwife	2.7
			Daya (traditional birth attendant) and others	5.8
m15_cat	Place of delivery	The place where the women give their birth in the last five years.	Home	13.2
			Public sector health facilities	25.6
			Private sector health facilities	60.8
			Other	0.5
examg	Number of examinations during antenatal care	Number of examinations (weight, blood pressure, urine sample and blood sample) of women that conducted by the health staff during their antenatal care.	0	36.0
			1-2	11.8
			3-4	52.2

The traditions/norms/attitudes variables are viewed in duration of marriage (years), literacy, media exposure, ideal number of children, decision maker for using contraception, number of reasons for which wife-beating is justified and number of decisions in which women participate as shown in Table 2.6.

Table 2.6: Explanation and Percentage Distribution of Tradition /Attitude / Norms Variables

Variable names	Variable labels	Explanation	Categories	%
v513	Duration of marriage (years)	The marital duration of women by five-year groups.	<5	30.2
			5-14	58.0
			15-24	10.9
			25 and over	0.9
v155	Literacy	The literacy status of women determined by their ability to read a document in the official language of the country.	Cannot read at all	19.7
			Able to read only parts of sentence	4.2
			Able to read whole sentence	76.1
			Blind/visually impaired	0.0
mexpo	Media exposure	The number of media (newspaper/radio/ TV) that women keen to follow up during their daily life.	0	1.1
			1	70.4
			2	23.2
			3	5.2
v614	Ideal number of children	The ideal number of ideal children that is reported by women.	<2	2.2
			2-3	66.7
			4-5	23.9
			6+	3.5
			Non-numeric response	3.6
v632	Decision maker for using contraception	The person (husband/wife) who mainly makes the decision when using contraception.	Mainly women	13.6
			Mainly husband	1.3
			Joint decision	46.9
			Other	0.2
			Not married/not using contraception	38.0
beatg	Number of reasons for which wife-beating is justified	The number of reasons (if wife goes out without telling husband; if wife neglects the children; if wife argues with husband; if wife refuses to have sex with husband and if wife burns the food) for which wife-beating is justified by women.	0	63.4
			1-2	20.7
			3-4	11.6
			5	4.3
dicisiong	Number of decisions in which women participate	The number of decisions (respondent's health care; large household purchases; visits to family or relatives; what to do with money husband earns) in which women participate partially or completely.	0	11.4
			1-2	20.9
			3	17.1
			4	50.7

This study has one variable for household level; a wealth index divided into five categories of poorest, poorer, middle, richer, and richest. Community level consists of three variables; religion, region and type of residence, as shown in Table 2.7.

Table 2.7: Explanation and Percentage Distribution of Household and Community Level Variables

Variable names	Variable labels	Explanation	Categories	%
V190	Wealth index	The cumulative wealth status of the households that determined by the ownership of the durable goods and other possessions.	Poorest	18.0
			Poorer	19.6
			Middle	24.9
			Richer	20.9
			Richest	16.5
v130	Religion	The religion that the head of the household belongs to.	Muslim	96.6
			Christian	3.3
			Other	0.1
v025	Type of place of residence	The urban and rural breakdown is made based on the administrative status of the settlements. The shiakhas (cities) are classified as "urban"; the villages are classified as "rural" in EDHS-2014.	Urban	30.9
			Rural	69.1
v024	Region	The regional breakdown of the Egypt based on the geographic locations of the regions.	Urban governorates	10.2
			Urban Lower Egypt	9.1
			Rural Lower Egypt	38.3
			Urban Upper Egypt	11.1
			Rural Upper Egypt	30.3
			Frontier governorates	1.0

2.2.3. Independent Variable: Type of Consanguineous Marriage

This section discusses the consanguineous marriage variable; where consanguineous marriage is considered one of the most important of independent variables that affect early age mortality in developing countries. The definitions regarding with the kind of consanguineous marriages are given in Box 2.1 (Bittles, 1994).

Box 2.1. Definitions of Kind of Consanguineous Marriages

Kind of Consanguinity	Definition
Consanguineous marriage	Usually defined as a marriage between people who are related by blood
First cousin's marriage	A marriage between a wife and a husband who are the children of two siblings
Second cousin's marriage	A marriage between a wife and a husband whose parents are first cousins
Remote consanguineous marriage	A marriage between a wife and a husband who are only distantly related by blood.
Non-Consanguineous marriage	A marriage between a wife and a husband who are not related by blood.

The prevalence of consanguineous marriage in the countries of the developing world has cultural roots, as well as social and economic elements, and some of the factors behind it are determined by the special characteristics of each of these individual societies. In general, however, the explanations for consanguineous marriages are common across all those communities.

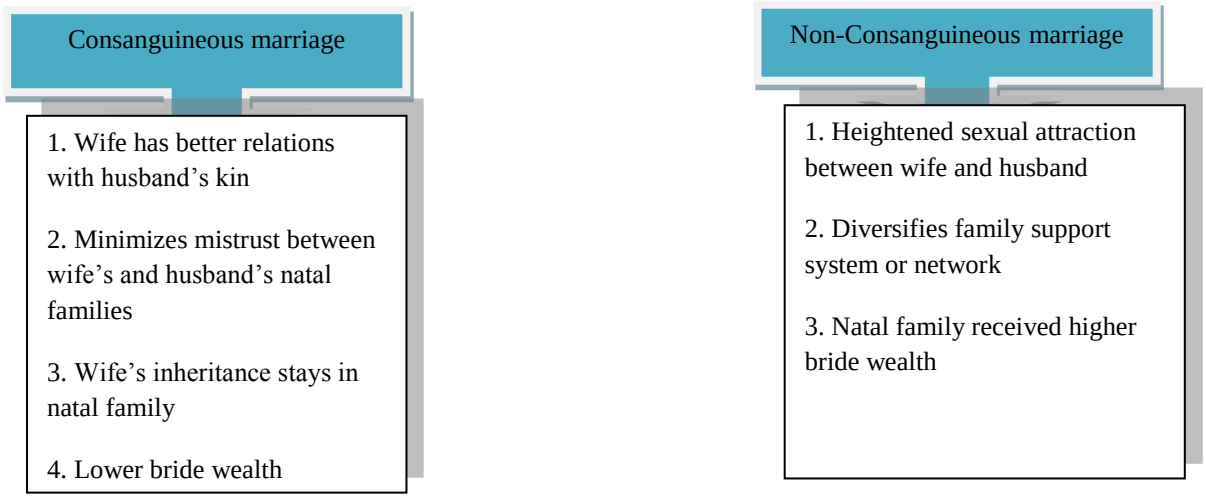
There are many factors that affect the decision to marry a relative or not, some of which are provided by (Weinreb, 2008), as shown in Figure 2.2.

One of the more important factors in the choice for consanguineous marriage in developing societies is that the wife has better (existing) relations with the husband's kin. In developing societies, people often look for marriages that successfully combine two families, rather than a relationship between an unrelated man and a woman, so families prefer to increase the bonds of love and affection by marrying off their sons and daughters to each other in an effort to unite and grow families under a close bond of cordiality and support. These marriages to related partners also minimize mistrust between the wife's and the husband's natal families. Families in these regions encourage the marriages of their offspring based on the principle of trust, so fathers and mothers prefer cousin marriages for their sons and daughters based on their long-term prior knowledge of the suitor, hoping that their familiarity with the family will produce long marriages and descendants who will reinforce parent-family ties. If, on the other hand, they had to look to stranger marriages more often, there would be a lesser confidence in the new partner due to the lack of personal knowledge of each other. By supporting consanguineous marriages, the families involved are trying to take the closest and easiest option to ensuring a good union. For all these reasons and more, the consanguineous marriage phenomenon has become commonplace (Weinreb, 2008).

Inheritance is another one of the most important cornerstones of consanguineous marriage (Weinreb, 2008), as it plays a key role in encouraging the choice of a husband from within the family, especially cousins' son. The wife's father is often keen to preserve the legacy of his family – something that is a mark of honor in his community - and keep any inheritance from being dissipated outside the family, so this factor is considered to be the backbone of consanguineous marriage norms in developing countries. In these regions, fathers are particularly anxious to keep their wealth in hands of their sons and they combat the fear of dissipation of family wealth through successive generations by pushing close relative marriages, as seen in Figure 2.2.

While these are reasons for wealthy families' preferences for consanguineous marriage, there is another factor, especially among poorer families, and that is lower bride wealth. In light of deteriorating living conditions and the deteriorating economic situation in many countries of the Third World, and since marriage is one of the most expensive events in those communities, parents respond to the circumstances by choosing lower cost marriages for their daughters and sons alike. In those cases, consanguineous marriage is an ideal choice for families wanting to control costs, since developing communities' social structures consist mainly of the poor. Overall, it could be said that consanguineous marriage acts as a social bedrock within poor communities (Weinreb, 2008).

Figure 2.2: Effective Factors on Consanguinity.



Source: (Weinreb, 2008).

Nevertheless, there are multiple factors that encourage marriage outside the family. Human instinct is to seek out everything strange and unique, so, heightened sexual attraction between wife and husband is considered one of the all-important factors when

marrying outside the family. This factor contributes to an increase in the frequency of non-kinship marriages, wherein there is opportunity for the husband and wife to choose each other away from traditional social and economic determinants.

Diversifying family support systems or networks also contributes to non-consanguineous marriage numbers, where the marriage depends on pumping new blood into the family, and adding an element that might support the formation of a new social network. Due to economic, political and social events in developing countries, many families tend to favor marriages between people with non-kinship ties. Natal family of the husband receiving higher bride wealth (dowry) is one of the important factors overall, and in cases where the groom's family is rewarded by accession of the wife's wealth to them, it is a factor which increases the proportion of non-relative marriage in the developing communities.

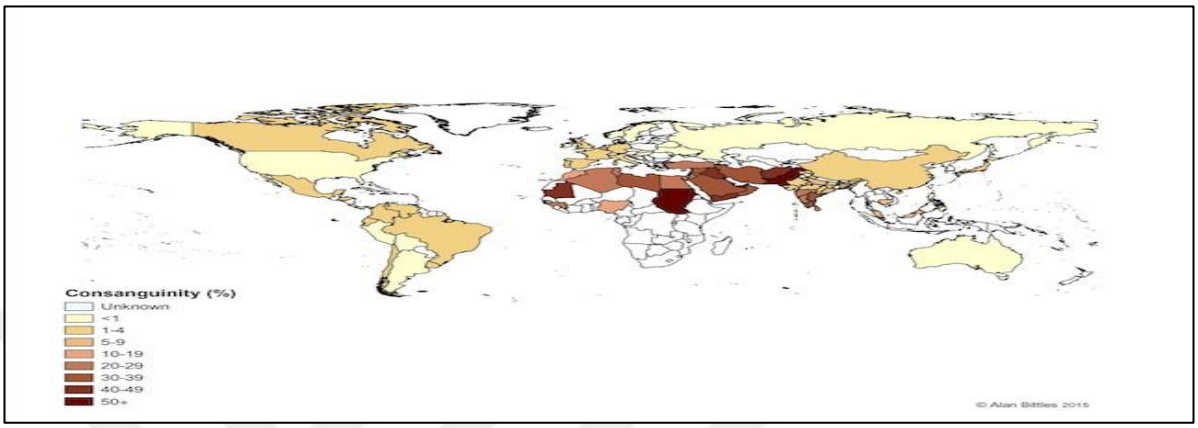
From the above, it is clear that many social and economic factors play important roles in determining the type of marriage practice, and these factors are interwoven with each other to produce the current patterns of consanguineous marriage in developing countries.

While consanguineous marriages are an old idea that persists even today, there has been a significant decline of the practice in developed countries during the past two centuries. This decline was contemporaneous with the Industrial Revolution in Europe and it could be argued that most of developed countries now do not practice consanguineous marriages. The practice is still a popular idea in developing countries, however, and it is not expected to drop significantly in the coming years.

Consanguineous marriage is in practice around the world, but ratios vary by region and by advancement within these communities. We find it in less than 1% of marriages in developed countries such as in North America and European nations, while it is increasingly prevalent, as high as between 20% and 50%, in developing countries such as Egypt, as shown in Figure 2.3.

In general, consanguineous marriage slightly decreased in Egypt from 37.8% in 2000 to 30.4% in 2014, and for first cousin marriages, from 21.8% to reach 16.5% in 2014. This means there was a decrease of around 1% every two years, as shown in Table 2.8.

Figure 2.3: Percentage Distribution of Consanguineous Marriage in all over the World



Source: http://www.consang.net/index.php/Summary.

Although second cousin marriages have low ratios compared with first cousin marriages, they decreased slowly, from 9.9% in 2000 to 6.8% by 2014. It is interesting to note that other relative consanguineous marriages have increased over the last two decades, from 6.1% in 2000 to 7.1% in 2014, thereby exceeding the second cousin ratio.

Throughout the last two decades, the decline of consanguineous marriage is estimated at 7.4%, 5.3% and 3.1% for consanguineous marriages in general, first cousin type, and second cousin type, respectively. It is clear that there is a decline in the phenomenon of consanguineous marriage in Egypt, but it is happening slowly and it is not expected to record a significant decrease in the near future.

Table 2.8: Percentage of Women by Consanguinity Status in Egypt, EDHS-2000-2014

Surveys	Not Related	Consanguineous marriages	First cousin	Second cousin	Other relative
EDHS-2000	62.3	37.8	21.8	9.9	6.1
EDHS-2003	63.8	36.2	20.1	10.4	5.7
EDHS-2008	70.2	29.8	15.6	7.1	7.1
EDHS-2014	69.6	30.4	16.5	6.8	7.1

Consanguineous marriage is practiced in the present day in various areas in Egypt, and the rates there are high. By studying data for the last two decades, one finds that consanguineous marriage in general ranged between 53.5% in Upper Egypt's rural areas in 2000, to 17.9% in Lower Egypt's urban areas by 2008. For first cousin marriages, the

numbers fell between 30.4% % in rural Upper Egypt in 2003 and 9.4% in Lower Egypt's urban in 2014, as shown in Table 2.9.

It is evident that consanguineous marriages are more widespread among Upper Egypt's rural region, but there has been a slight decrease in consanguineous marriages in general, falling from 53.5% in 2000 to 46.6% in 2014, and 30.0% in 2000 to 25.3% in 2014 in the first cousin marriages.

Table 2.9: Percentage distribution of women by consanguinity status and region, EDHS-2000-2014

	Kind of relations					
Region by Year	**Not Related**	**First Cousin**	**Second Cousin**	**Other Relative**	**Total**	**Number of Cases**
2000						
Urban Governorates	71.0	16.5	6.3	6.3	100	2991
Urban Lower Egypt	74.9	14.6	6.5	4.0	100	1946
Rural Lower Egypt	63.4	23.1	8.4	5.1	100	4880
Urban Upper Egypt	64.7	17.9	11.6	5.8	100	1808
Upper Egypt Rural	46.5	30.0	15.2	8.3	100	3739
Frontier Governorates	53.6	23.0	15.8	7.7	100	209
2003						
Urban Governorates	74.4	14.0	7.3	4.2	100	1666
Urban Lower Egypt	76.8	12.7	5.5	4.9	100	1179
Rural Lower Egypt	65.8	19.7	9.3	5.1	100	2922
Urban Upper Egypt	65.8	16.4	11.6	6.2	100	1062
Upper Egypt Rural	46.2	30.4	15.8	7.6	100	2327
Frontier Governorates	*	*	*	*	*	*
2008						
Urban Governorates	76.7	12.6	4.8	5.9	100	2929
Urban Lower Egypt	82.1	9.7	4.5	3.7	100	1937
Rural Lower Egypt	74.7	14.1	5.4	5.8	100	5683
Urban Upper Egypt	71.8	14.7	6.6	6.9	100	1791
Upper Egypt Rural	52.8	23.2	12.5	11.5	100	3957
Frontier Governorates	65.6	18.9	8.8	6.6	100	227
2014						
Urban Governorates	80.4	10.6	5.4	3.6	100	2774
Urban Lower Egypt	82.0	9.4	4.4	4.2	100	2318
Rural Lower Egypt	73.5	13.9	6.6	6.0	100	8346
Urban Upper Egypt	70.8	17.6	5.2	6.3	100	2421
Upper Egypt Rural	53.4	25.3	9.5	11.8	100	5707
Frontier Governorates	65.1	20.5	6.2	8.2	100	195

(*) Given the security situation in Sinai, so it has been unable to collect the data from Frontier governorates

While Lower Egypt's urban region is the lesser percentage, there has been a decrease from 25.1% in 2000 to 18.0% in 2014, and 14.6% in 2000 to 9.4% in 2014 for consanguineous marriage in general and first cousin marriage, respectively. Also, note that consanguineous marriage is not moving at the same pace in all regions. Surveys show a decrease of 6.1% to a total of 7.1%, for Urban Lower Egypt, Urban and Rural Upper Egypt regions, and a decrease of 9.4% to a total of 11.5% for Urban governorates, Rural Lower Egypt and Frontier Governorates regions. The ranking of these regions according to consanguineous marriage prevalence in the last two decades, from the most to the least, shows prevalence as follows; Upper Egypt Rural, Frontier Governorates, Urban Upper Egypt, Rural Lower Egypt, Urban Governorates, and finally Urban Lower Egypt, for all consanguineous marriage types in Egypt based on EDHS 2000 to 2014.

2.2.4 Dependent Variable: Early Age Mortality Rates

In this study, we have three dependent variables; neonatal mortality (NN), post-neonatal (PNN) and infant mortality (IM), based on the Egypt Demographic and Health Survey conducted in 2014. The required information was obtained from their mothers who relayed the age at death (in days) of any of their children who died in the first month of life, and the age (in months) for children who died before their first birthday. The definitions of early age mortality rates are given in the Box 2.2.

Box 2.2. Definitions of Early Age Mortality Rates

Mortality Rates	**Definition**
Neonatal mortality rate (NNMR)	The probability of dying within the first month of life.
Post-neonatal mortality rate (PNNMR)	The probability of dying between the first month and first birthday.
Infant mortality rate (IMR)	The probability of dying during the first year of life.
Child mortality	The probability of dying between the first and fifth birthday
Under-five mortality	The probability of dying before the fifth birthday

Rutstein (1984) presented the method for calculating the probabilities of the different types of early age mortality as follows:

$$nqx = 1 - \sum_{i=x}^{x+n}(1 - q_i),$$

These mortality estimates are not rates, but rather true probabilities calculated according to the conventional life-table approach. Deaths and risk exposure in any period are first tabulated for the age intervals 0, 1-2, 3-5, 6-11, 12-23, 24-35, 36-47, and 48-59 months, then age-interval specific probabilities of survival are calculated.

According to EDHS-2014, the number of deaths in the NN, PNN, infancy, childhood and U-5 periods were calculated for the years preceding the recent survey and the percentages of those number were calculated for the same periods, as shown in Table 2.10, and Table 2.11.

According to the years preceding recent survey, it is found that there is a general downward trend toward in the percentages and numbers of deaths in NN, PNN, infancy, childhood and U-5 years periods over time. The neonatal mortality percentage 30 years ago was 4.8%, with total numbers of 26 out 539, and these values decreased during this time to reach 1.4%, with 216 of total 15,668 over the last four years of the recent survey.

Table 2.10: Number of deaths and births by years preceding the EDHS-2014

Years preceding the survey	Deaths in NN period	Deaths in PNN period	Deaths in Infancy period	Deaths in Childhood period	Deaths in U-5M period	Deaths in later periods	Alive at the time of survey	Total number of births
0-4	216	122	338	37	375	0	15,293	15,668
5-9	263	139	402	62	464	21	13,234	13,719
10-14	213	157	370	58	428	34	11,069	11,531
15-19	229	164	393	72	465	66	8,454	8,985
20-24	170	174	344	79	423	47	5,581	6,051
25-29	118	106	224	53	277	32	2,553	2,862
30 and over	26	30	56	25	81	8	450	539
Total	**1,235**	**892**	**2,127**	**386**	**2,513**	**208**	**56,634**	**59,355**

During the same period, the percentage of children who died in infancy has seen a sharp decline, from 10.4 to 2.2% during last 30 years based on a recent survey.

Before the recent survey, the total in percentages of deaths in NN, PNN, infancy, childhood and U-5 years periods over time were 2.1%, 1.5%, 3.6%, 0.7% and 4.2%, and the numbers of deaths were 1,253, 892, 2,125, 386 and 2,513, respectively.

Table 2.11: Percentage distribution of deaths and births by years preceding the EDHS-2014

Years preceding the survey	NN period	PNN period	Infancy period	Childhood period	U-5M period	Deaths in later periods	Alive at the time of survey	Total number of births
0-4	1.4	0.8	2.2	0.2	2.4	0.0	97.6	100.0
5-9	1.9	1.0	2.9	0.5	3.4	0.2	96.5	100.0
10-14	1.8	1.4	3.2	0.5	3.7	0.3	96.0	100.0
15-19	2.5	1.8	4.4	0.8	5.2	0.7	94.1	100.0
20-24	2.8	2.9	5.7	1.3	7.0	0.8	92.2	100.0
25-29	4.1	3.7	7.8	1.9	9.7	1.1	89.2	100.0
30 and over	4.8	5.6	10.4	4.6	15.0	1.5	83.5	100.0
Total	**2.1**	**1.5**	**3.6**	**0.7**	**4.2**	**0.4**	**95.4**	**100.0**

2.2.5. Statistical Method

After a series of descriptive analyses conducted on the links between consanguineous marriages and early age mortality in Egypt, logistic regression models will also be used by employing the "early age mortality indicators", namely NNM, PNNM and IM as dependent variables that work under the control of selected variables which are determined on the basis of the MC framework in order to obtain the net impact of consanguineous marriages on early age mortalities.

During the logistic regression analyses, the complex design of the sample of EDHS-2014 is taken into account by using the complex samples modules in PASW Statistics 18.0. We used the "*FSTEP (LR) approach*" in the logistic regression analysis; a consanguinity variable followed by a determinant's variables non-forcibly entered into the model, consecutively; tables and illustrations are produced through chapter five, extensively.

Logistic regression was used to model the impact of a set of covariates on the probability of infants dying during the period under examination. The duration will be one month for the probability of dying in NN period; 11 months for the PNN period and 12

months for the infancy period. Estimated regression coefficients from the fitted models were used to compute odds ratios and their levels of statistical significance. All three dependent variables will be coded as 1 if the child was not alive at the time of the survey; and as 0 if the child was alive at the time of survey. For the dependent variables, the model-fitting process involves eight stages of estimation.

The first model, called the basic model, includes only consanguineous marriage as an independent variable. In the second model, the variables related to individual level (education level of women, education level of husband, working status of women, coverage by health insurance and age of women) are introduced into the regression equation. In the third model, the variables related to maternal factors (birth order, months since preceding birth, succeeding birth interval and mother's Age at birth) are introduced into the regression equation. In the fourth model, the variables related to environmental contaminants (source of drinking water, type of toilet facility, time to obtain drinking water and frequency of someone smoking inside the household) are introduced.

The fifth model covers the variables related with nutritional availability (size of child at birth and status of breastfeeding), while the sixth model includes the variables related with personal illness control (timing of the first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider, place of delivery and number of examinations during antenatal care are all introduced into the regression equation.

In the seventh model, the variables related with tradition /attitude / norms (cohabitation duration (grouped), literacy, media exposure, ideal number of children (grouped), decision maker for using contraception, number of reasons for which wife-beating is justified and number of decisions in which women participate) are introduced into the regression equation. In the eighth model, the household level includes just the wealth index variable, and covers the variables related with community level (religion, type of place of residence and region).

The variables contained in each determinant are added to each model in order to estimate the "additive effects" of the micro level and macro level variables simultaneously. All the models and variables within the models that were used in the logistic regression

analysis are given in Table 3.12. The decision about which variables will be entered into the regression models was made by using correlation coefficients between the independent variables and their dependent variables. In this case, the variable with a high correlation coefficient with independent variables was selected and used in the regression equation.

To understand multiple regressions in multivariate analyses, first the term 'regression' should be defined. It is characterized in this context as "…a *statistical measure that attempts to determine the strength of the relationship between one dependent variable and a series of other changing variables known as independent variables…*" Steel and, Torrie (1960).

Regression has two basic types; straight line (linear) regression and multiple regressions. Linear regression uses one independent variable to explain and/or predict the outcome of the dependent variable, while multiple regressions use two or more independent variables to predict the outcome. The general form of each type of regression is given as:

$$\text{Linear Regression: } y = \beta_0 + \beta_1 x + \epsilon$$

$$\text{Multiple Regressions: } y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

Where;

y= the variable that we are trying to predict

x_i= the variable that we are using to predict Y

β_0= the intercept

β_i= the slope

ϵ= the regression residual.

In other words, (β_0) is the intercept term which demonstrates the mean effect on the dependent variable in the model. For the variables that were excluded through the regression analysis, the correlation coefficient (βi) can take a value from minus one to plus one. A -1 indicates a perfect negative correlation, while a +1 indicates a perfect positive correlation. A correlation of 0 means there is no relationship between the two variables; the independent variable and the dependent variable in the multi regression model.

Table 2.12: The Models and Variables Used in the Logistic Regression Analyses

Model 1: Basic model	**Model 2:** Basic model + Individual level	**Model 3:** Basic model + Individual level+ Maternal factor	**Model 4:** Basic model + Individual level+ Maternal factor+ Environmental contamination	**Model 5:** Basic model + Individual level+ Maternal factor+ Environmental contamination+ Nutritional availability	**Model 6:** Basic model + Individual level+ Maternal factor+ Environmental contamination+ Nutritional availability+ Personal illness control	**Model 7:** Basic model + Individual level+ Maternal factor+ Environmental contamination+ Nutritional availability+ Personal illness control+ Tradition /attitude / norms+	**Model 8:** Basic model + Individual level+ Maternal factor+ Environmental contamination+ Nutritional availability+ Personal illness control+ Tradition /attitude / norms+ Household level and Community level
Consanguinity	Educational level of women	Birth order	Source of drinking water	Size of child at birth	Number of antenatal visits during pregnancy	Media exposure	Wealth index
	Education level of husband	Months since preceding birth	Type of toilet facility	Status of breastfeeding	Place of delivery	Number of reasons for which wife-beating is justified	Type of place of residence
	Working status of women	Succeeding birth interval	Frequency of someone smoking inside the household		Number of examinations during antenatal care	Number of decisions in which women participate	Region
	Coverage by health insurance	Mother's Age at birth					
	Age of women						

When there is a negative correlation between two variables, as the value of one variable increases, the value of the other variable decreases and vice versa. In other words, for a negative correlation, the variables work opposite to one another. When there is a positive correlation between two variables as the value of one variable increases, the value of the other variable also increases. Thus, the variables move together.

Furthermore, regression has innumerable norms such as:

- Logistic Regression
- Elastic-Net Regression
- Stepwise Regression
- Lasso Regression
- Polynomial Regression
- Ridge Regression

These kinds of regression are based primarily on three factors:

1- Independent variables numbers; these depend on how many independent variables are used in the model and, according to that number, the regression type will be chosen. For example, if the model has only one independent variable, the linear regression will be used.

2- Dependent variables type; continuity is an important determinant in choosing suitable regression forms. If the model has a continuous dependent variable, then linear regression is used. If the model has a binary variable, logistic regression is used.

3- Regression line shape; the optimal fit line is not a straight line, but the focus is on making the curve correct, such as under-fitting, just right, or over-fitting, as suited to the nature of the problem. If this causes an interesting shape in theregression line, the polynomial regression will be a good choice.

This study will use the logistic regression model because, firstly, more than one independent variable is involved. In fact, around forty-four variables already exist and it is likely safe to assume that there is a relationship to early age mortality, given those complexities.

Secondly, early age mortality (dependent variable) has binary values in this case (not alive / alive).

Finally, independent variables can be binary or not, and it's reasonable to think that that the value of the dependent variable depends on the explanatory variables.

The logistic regression function was derived as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

$$f\big(E(y)\big) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

$$E(y) = P$$

$$f(P) = \log\left(\frac{P}{1-P}\right)$$

$$\log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

$$E(y) = P = \frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p}}{1 + e^{\beta_0 + \beta_1 x_1}}$$

The logistic function has the following form:

$$f(z) = \frac{1}{1 + e^{-z}}$$

And: $$, \; z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

Where z is a linear combination of variables, the value of $f(z)$ ranges from 0 to 1 as z take values from -∞ to +∞, then if the value of z = -∞, then $f(z)$= -1 and if z = +∞, then $f(z)$= +1.

On the other hand, the two main evaluation tools used in multiple regression differ

from multiple logistic regression in the case of regular multiple regression; the first statistics measure is the F test that is used to measure the significance of parameters inside the used model, and the second is the R^2 estimation for the proportion of variance explained by the model, while the multiple logistic regression formula has equivalent measures; the first statistical measure is the likelihood ratio chi-square statistic which is used as an equivalent to F test. The likelihood ratio measure is computed as follows:

$$c = -2\log(L_0/L_1) = (-2\log L_0) - (-2\log L_1) = -2(\log L_0 - \log L_1)$$

Where the L_0 is the value of the intercept-only model, and L_1 is the likelihood value of the fitted model, $-2\log L_0$ is almost similar to the total sum of squares in the regular linear regression, and $-2\log L_1$ is similar to the error sum of squares, therefore $-2\log(L_0/L_1)$ can be seen as the model sum of squares.

While there is no direct statistical measure of multiple logistic regressions which is equivalent to R^2, various options have been presented:

- A popular measure is Hosmer and Lemeshow's R_L^2 and their equation is as follows:

$$R_L^2 = 100\,(L_0 - L_1)/L_0$$

- Aldrich and Nelson's pseudo R^2 is presented as follows:

$$\text{pseudo } R^2 = c/(n + c)$$

Where the chi-square model is c, and the total sample size is *n*,

- Cox and Snell R^2 estimated as follows:

$$R^2 = 1 - \{L_0/L_1\}^{\frac{2}{n}}$$

Where the L_0 is the value of the intercept-only model, and L_1 is the likelihood value of the fitted model, and the sample size is *n,*

- The (max-rescaled R^2) proposed by Nagelkerk

$$\widetilde{R^2} = R^2/R^2_{max}$$

The logistic regression models will be used by employing the "early age mortality indicators" namely; NNM, PNNM and IM as dependent variables under the control of selected variables which are determined on the basis of MC Framework in order to obtain the net impact of consanguineous marriages on early age mortalities by using Statistical Package for the Social Sciences (SPSS).

The next chapter will review the studies that focused on consanguinity and its impact on early age mortality around the world, including for developed countries and still developing countries according to their regions (Asia, Africa, MENA and Egypt).

CHAPTER 3

LITERATURE REVIEW

Consanguineous marriage has faced some obstacles in terms of legitimacy over its long history. The first son of uncle marriage type was forbidden at times in some countries, as it was in England and in some Indian beliefs. But at the beginning of the 20th century, social and medical research studies began to converge upon the practice. The biggest motivation for these researchers was to know the impacts of consanguineous marriages on mortality, and especially on early age mortality.

This chapter will review the studies that focused on consanguineous marriages and its impact on early age mortality around the world, divided into two main sections; the first part will review developed countries and the second will review still developing countries according to their regions (Asia, Africa, MENA and Egypt).

3.1. MOST DEVELOPED COUNTRIES

Western societies in Europe including Great Britain witnessed the spread of consanguineous marriage at varying rates until the mid-nineteenth century. The rates were once generally high, but there was a significant decline due to the displacement of many indigenous peoples in that period - a demographic shift which accompanied industrial development - until it reached 1% or lower levels (Bittles & Black, 2010). In North America, the consanguineous cousin marriage rates among the general population was less than 0.6 % (Coleman, 1980; Lebel & Opitz, 1983), and for Japan the rate of first cousin marriages dropped from an estimated 5.9-8.0 % in the early 1950s to 3.9 % in the 1980s (Imaizumi, 1986; Imaizumi, Shinozaki, & Aoki, 1975).

Research interests in the consanguineous marriage phenomenon in Western societies has diminished due to the low rates for these populations, but many other parts of the world are still interested in studying consanguineous marriage practice and its impact on child mortality. It is

worth noting that some studies singled out consanguineous marriage in Western societies within migratory communities coming from areas where the practice was widespread, such as the Middle East, Africa, Central Asia, South Asia and Turkey. In this context Bittles and Black (2010) produced a list that discusses the advantages and disadvantages of consanguineous marriage in relation to immigrant communities in Western countries, and its impacts on population health.

In this section, we will discuss the studies concerned about consanguineous marriages in developed Western societies and their impact on the early age mortality.

In the late nineteenth century, several books and articles were published related to cousin marriage and they dealt with the phenomenon from the sixteenth century to the early nineteenth century, with a limited discussion of consanguinity in general. During the early eighteenth century, attention in England was concentrated on affinal marriage (i.e., unions between individuals related through marriage and not through genetic relationships) rather than consanguineous marriage. The study by Darwin (1875) discussed cousin marriage and its adverse effects and it explained that the adverse implications of married cousins were exaggerated. He added that, according to developed countries, higher incomes could provide health education on the individual, family and community level, with a genetic medical advice, diagnosis before marriage, and prenatal diagnosis for potential genetic diseases. He also explained that there is no need to ban cousin marriage as it has existed for more than 450 years (15-20 generation), so taking preventive action toward maintaining and improving health would be a more useful approach.

Between 1720 and 1899, the State Lutheran Church in Sweden collected data on births, deaths, and marriages of the Skelleftea region. In Sweden, first cousin marriage was prohibited until 1680. From that date until 1844, a royal exemption was issued that permitted the practice. Of the 14,639 marriages initially studied, 20.8 % were consanguineous, with a significant increase in first cousin marriages post-1844. (Egerbladh & Bittles, 2008) provided a study that examined the fertility and mortality of two subsets of marriages for the data of the period from 1780 to 1899, using logistic regression. First cousin marriages were strongly favored by

freeholders and peasant land owning families; and in some families they had been preferentially contracted across successive generations. Fertility appeared to have not been effected by consanguinity; however, first cousin marriages had higher rates of early age mortality. This excess mortality was probably associated with both genetic and non-genetic factors. There was evidence of the clustering of multiple deaths within first cousin families. Overall, the data confirm the significance of close consanguinity as an important demographic variable in this western community.

In the Basque region of Spain (1800–1990) population data was listed in parish records. Alfonso-Sanchez and Peña (2005) used those records to analyze the effects of parental consanguinity on child mortality from an epidemiological viewpoint. They examined the relations between consanguinity and infant/pre-reproductive deaths statistically, and the data were statistically tested by means of the likelihood ratio test (G-test) for contingency tables. This method was used in order to estimate interactions between demographic variables and consanguinity factor on early age mortality over time (by cohorts). The number of families in the study was 1,527, which represented 50% of the total marriages (3,060). The number of children resulting from consanguineous marriage families was 1,245 - around (19.6%) of the total number of 6,336 -whereas 5,091 (80.4%) were of non-consanguineous marriages, as shown in Table 3.1.

Table 3.1: Effect of the Parental Genetic Relatedness on Infant (less than 1 Year) and Pre-Reproductive (less than 16 Years) Deaths in a Basque Rural Population (Period 1800–1990)

Variables	**Marital Type**					
	1C	2C	3C	CM	NC	Total
Families	48	76	169	293	1,234	1,527
Offspring	195	353	697	1,245	5,091	6,336
Consanguinity rates %	3,14	4,98	11,07	19,2	-	-
Before one year	23,6	14,4	15,6	16,6	13,1	873
(1 – 15) years	14,9	10,2	12,9	12,5	9,7	649
Before 16 years	38,5	24,6	28,5	29,1	22,8	1522

Source: (Sanchez and Peña, 2005)

In all, 1,522 individuals, or about 24.0% of offspring of the total sample died before their 16th birthday, and pre-reproductive mortality was recorded at a high rate (more than 50%) in period among (1860–1919). The infant mortality rate was especially affected by close consanguinity (see Table 3.1). The first cousin 1C unions were recorded the highest rates of the infant mortality. Where 23.6% of first cousin's offspring died before their first birthday, compared to 13.1% of unrelated couple's offspring, there were 10.5% represents absolute increase as well as represents a relative increase about 80% ($P < 0.001$, df = 1,G = 14.37). Also infant deaths of 1C were more prevalent than observed for 2C couples at 14.4% ($P < 0.05$, df = 1,G = 6.41), while infant mortality of 3C was (15.6%) with (ns, df = 1,G = 2.57). Although close relative unions (1C, first cousins or closer relatives) are not very prevalent, the study clarified through the data analysis that the practice had significant effects on child age mortality causes by first cousins or closer relative marriages.

There is a hypothesis that states; in the population with low consanguinity and mortality rates, the mortality differentials are larger because non-genetic causes of death are not eclipsed by the effects of consanguinity. This hypothesis offered by Jorde (2001) is an examination of the impacts of consanguinity on children.

In Utah, the largely Mormon state in America, data from the time period between 1847 and 1945 provided consanguinity coefficient estimates for 303,675 members. Although in this population, consanguinity has been slightly rare among them, there was a large sample size of consanguinity children of around 3,500 children. Within the non-consanguinity children, 13.2% died before the age of sixteen. By contrast, the first cousin marriages and children of closer unions in pre-reproductive mortality were (22%) and (32%), and the relative risks were 1.70 and 2.41, respectively. Other categories of related marriages did not give significant effects on early age mortality. When controlling for the socioeconomic impacts, they get close results. Similar to estimates with many other studies of low consanguinity rates populations; this population had a relatively high increase in the early age mortality among the children of first-cousin unions (9%).

In La Cabrera, Spain, for the period of 1880–1959, the dataset contained 44,510 members as follows; 23,427 births, 16,112 deaths and 4,971 weddings. Families constituted (53.71%) of the dataset and some 2,196 individual correspond to unrelated couples, with 474 being categorized as consanguineous marriages up to third degree.

Villegas and Fuster (2006) provided a study aimed to evaluate the possible factors determining the differences between consanguineous and non-consanguineous families on early age mortality. The study concluded that there were significant effects of consanguineous marriages on mean number of neonatal deaths rate (0.36), more than the mean number of neonatal deaths for non-consanguineous marriages (0.27). But for the postnatal period, these differences vanish; standing at (0.24) and (0.23), respectively. In the La Cabrera population, related marriages appear as a social and cultural process that affects fertility. A related marriage modifies the marital structure, which results in a greater number of offspring. Lower infertility rates and the possible compensatory effect for infant mortality may be a reflection of the biological factors that make the wife's reproductive period more prolific.

Bittles (2003) presented an annotation to briefly review the current universal diffusion of related marriage and to estimate the adverse results expressed in the infancy period. From the mid-nineteenth century onwards, in the UK and the USA, the subject of consanguineous marriage has been a source of major scientific and public interest. The majority of concerns focused on the adverse results of consanguinity, although there were also scientists who denied any deleterious outcomes and instead argued that related marriages offered major biological advantages. Most research showed that early age mortality was increased by consanguineous marriages when compared with children of non-consanguinity parents. However, most of these studies failed to control for the potential effects of socio-demographic variables. Where such control was attempted, as in the extensive post-World War II surveys conducted in Japan, research indicated that, during the period between 1929 and 1962, the mean cumulative mortality for offspring who were born to the first cousin marriages was (99 per 1000 live births), higher than in the children of non-related parents (64 per 1000 live births) until the sixth child, but in the latest time period (1961 to 1962) mortality rates were decreased and first cousin level

rates were the same as non-related offspring (48 per 1000 births). Consanguinity could be subdivided into several major groupings:

- The first subdivision: Communities wherein less than 1% of marriages are consanguineous, as in North America, Australasia, Russia, and Western Europe.
- The second subdivision: Communities wherein 1 to 10% of marriages are consanguineous, such as Japan, South America and the Iberian Peninsula.
- The third subdivision: Communities wherein between 20% to 50% or more of marriages are consanguineous, such as sub-Saharan Africa, West, Central and South Asia, and North Africa as Egypt, 30%, (Bittles, 2003).

In most countries, the positive or negative attitudes towards consanguineous marriage reflect long-standing religious or cultural beliefs. The most common kind of consanguineous unions are first cousin marriages and they are generally sanctioned within Buddhism, Confucianism, Judaism, and Islam. Traditional beliefs and religion and can also determine the specific types of consanguinity that are allowed. First cousin marriages are more desirable in Arab Muslim communities, as opposed to the Hindu communities of South India.

Another study was conducted by Schull and Neel, 1972 in Hirado, which is located in Nagasaki Prefecture, Japan. In the summer of 1964, there was a sample of 10,530 marriages represented by one or more spouses alive and residing on Hirado. Consanguineous marriages represented 15.7% of the sample size, and 16.3% of the parents were themselves a product of a consanguineous marriage. In these datasets, stillborn infants had no significant link to consanguineous marriages; however, there were significant increases in non-accidental deaths of live born children between the age of infant and twenty-first birthday seen with consanguinity. Cumulative mortality records showed approximately 0.75% were children of consanguineous marriages (actually, 0.77 + 0.16). They also obtained composite results of this data around the implications of consanguinity and parents who were product of consanguineous marriage in Japan. By analyzing the morbidity, mortality, frequency of childless marriages, and mean number of children, the study showed that fetal/child loss and death prior to the age of

reproduction are both estimated at approximately 4.0% higher in the children of a first-cousin marriage compared to children resulting from the marriage of non-consanguinity.

Norway has been the subject of research with two valuable articles that will be reviewed in this section. The studies were completed in almost the same period (1967-1993, 1967- 1994), each with a different approach for the same field of inquiry; consanguinity and its impacts on early age mortality in Norway.

These researchers were primarily interested in the children who had two parents of ethnic Pakistani origin, and who were born in Norway between 1967 and 1993. Stoltenberg et al., 1998 prepared a study based on data consisting of 7,494 children that met these criteria and compared the data with 1,448,766 children who had two parents of ethnic Norwegian origin, and who were born in Norway between 1967 and 1993. The infant mortality risk of both populations for first cousin parents was 2.4% (95 percent CI 2.0-3.0). The two communities displayed patterns similar to each other, and although a significantly elevated relative risk of infant mortality for first cousin parents did not exist, the risk was deemed to be higher for Pakistanis than Norwegians. In addition, there was an association between increasing of infant mortality and other consanguineous relations. Maternal education, maternal age, parity, and year of birth were independent of consanguinity effects.

The most prominent findings were:

1) Consanguineous marriage affected the risk of early mortality independently of maternal education.
2) Consanguineous marriage is closely associated with early mortality in the two communities, despite different frequencies and histories of consanguineous marriage.
3) Mortality rates were the same for children with non-consanguineous parents in both populations, even though the Pakistani parents originated from a country with high mortality rates and have lower socioeconomic status in Norway.
4) In a population with low mortality rates, the risks associated with consanguinity had a large impact on public health.

5) In agreement with other studies, the risk of infant death increased significantly in both populations, while consanguinity influenced stillbirth rates only slightly.

The study showed that the effect size of consanguinity on stillbirth and on all early deaths was the same in the two groups, but slightly higher for infant death in the Norwegian first-cousin group compared with either of the Pakistani consanguineous groups, and the differences were not statistically significant.

Stoltenberg, Magnus, Skrondal, and Lie, 1999 presented the second study based on a dataset which consisted of 7,466 births related to first cousins and 629,888 births related to non-consanguinity. The study's population consisted of all single births with a previous sibling born in Norway between 1967 and 1994. The recurrence risk of stillbirth and infant death among subsequent siblings who have either first cousin parents or unrelated parents was estimated. In this study, they conducted their analysis by adjusting for parental educational levels effects and other factors that had impacts on the risk of stillbirth and infant mortality. Consanguineous marriages lead to a higher risk of recurrence, and the effect of consanguineous marriages is higher when the previous sibling was stillborn or had died as an infant. For non-consanguinity, the risk of early death (stillbirth plus infant death) for the subsequent sibling was 17 of 1000 if the previous child survived, compared to 67 of 1000 if the previous child died before 1 year of age for children whose parents were first cousins. The risk of recurrence of stillbirth and infant death is higher for offspring of first cousin parents compared with offspring of unrelated parents.

Birmingham city in the West Midlands, England, had a cohort of babies born in a multiracial community. Bundey, Alam, Kaur, Mir, and Lancashire, 1990 provided a study from birth to five years for those babies. Their dataset consisted of 625 Indian mothers, 956 Pakistani mothers, 509 Afro-Caribbean mothers, 216 Bangladeshi mothers, and 2,432 European mothers. The study discussed various social features and consanguinity in Birmingham babies and the goal was to measure the effects of consanguineous marriages on the health of children of this region, where it was found that the highest rates of consanguineous marriages was in the Pakistani Muslim community (69.0%), whereas in Muslims from other countries the rate was 23.0%, and it was less than 1.0% in non-Muslims. First cousin consanguinity was the most

prevalent in consanguineous Muslim pedigrees. The presence of several consanguineous marriages in many Muslim pedigrees brings the inbreeding coefficient above that level due to a single first cousin marriage. It is notable that consanguinity of Pakistani Muslims was the higher percentage (69.0%) among Muslims communities in Birmingham compared to other countries. It was also observed that the consanguinity rate in Britain amongst Pakistanis was more than the consanguinity rate in Pakistan, and the closer consanguineous marriages occurring between younger Pakistanis was higher than between older couples. The overall mean coefficients of inbreeding for the non-Muslim groups were 0.00022 for Europeans, 0.00016 for Afro-Caribbean, less than 0.00001 for Sikhs and 0.00046 for Hindus. The overall mean for all Muslim babies was 0.0384. Because of the high level of consanguinity in Muslims of different races, they had been enumerated and subdivided by race and consanguinity. Of the total of 734 consanguineous Muslim couples, 553 (75.0%) were first cousins, but in 408 of these (74.0%) their parents were also consanguineous, which raised the inbreeding coefficients for their children above 0.625. Of those 553 families where the parents of the baby were first cousins, the most common situation was that the two grandfathers were brothers. This accounted for 37.0% of first cousin relationship. The mean inbreeding coefficient for the babies of these consanguineous mating was 0.0674; however, the true mean was likely to be higher than this, since 183 of the 279 mothers (66.0%) who could not precisely describe the other consanguineous marriages in their families were married to their first cousins. If 0.0674 was to be considered the mean inbreeding coefficient for the Muslim babies born to consanguineous parents, then the overall mean for all Muslim babies had been 0.0384. Altogether, 471 Muslims had more than one consanguineous marriage in their pedigree.

3.2. DEVELOPING COUNTRIES

Consanguineous marriage in developing countries is widespread across both the continents of Africa and Asia, especially in the countries of the Middle East and North Africa. In addition, both Turkey and Egypt are countries with high percentages of consanguinity, thus many researchers had focused their best efforts in those areas to estimate the impacts of consanguineous marriage on early age mortality in the developing countries, as will be shown in the next subsections.

3.2.1. Asia

Social scientists and medical geneticists share an interest in subject of the relationship between population health and consanguinity, both around the world and in developed communities such as Hiroshima, Fukuoka, Hirado and Nagasaki,in Japan. In developing countries such as Egypt, Kuwait, Sudan, Iran, the southern Republics of the former USSR and Hindu peoples of south India, researchers had a particular interest in the relationship between consanguineous marriages and prenatal and postnatal mortality in that communities.

Shami, Schmitt, and Bittles, 1989 presented a study which focused on Muslim Pakistani communities of Punjab, aimed at clarifying the impacts of consanguineous marriages on prenatal and postnatal mortality in that province. The populations were subdivided by consanguinity class into double first cousin, first cousin, first cousin once removed, second cousin, and non-consanguineous marriages. According to the data, consanguineous marriages in these cities ranged from 37.8% in Mian Channu to 48.9% in Sheikhupura. Multiple weighted regressions were used as statistical tools for analysis to estimate consanguinity impacts on early age mortality in Muslim Pakistani communities of Punjab.

Their estimations showed that consanguinity was commonly preferred in those communities, while the coefficients of inbreeding (F) for that generation in each locality ranged from 0.0236 to 0.0286; Mian Channu 0.0236, Muridke 0.0240, Gujarat 0.0257, Jhelum 0.0262, Sheikhupura 0.0271, Lahore 0.0269, and Rawalpindi 0.0286. There was a highly significant relationship between mortality and consanguinity degree, and they found that there were close relationships between consanguinity and neonatal, infant, and child mortality rates. The outcomes suggest a link between the high rates of postnatal mortality in the United Kingdom for the Pakistani communities and a probability that consanguinity may play a major role in this issue.

Consanguinity in Pakistan was the subject of research done by (Grant & Bittles, 1997) who presented an investigation about the categories of early age mortality rates based on (Pakistan Demographic and Health Survey data, 1990/1991) that involved 26,408 births to

6,611 women. They analyzed the comparative impacts of consanguinity and a number of socio-economic and demographic determinants, such as the maternal age, maternal education, sex of child, birth order and birth interval and their individual effects on early age mortality by using bivariate and multivariate logistic regression analyses.

The outcomes of the analysis refer to the adverse effects of consanguineous marriage on four of five categories of early age mortality; neonatal, post-neonatal, infant and under 5 years. The study employed three statistical tools; bivariate, odds ratios (OR) and multivariate logistic regression to estimate the impacts of independent variables; first cousins, second cousins, other cousin consanguinity, and non-consanguinity, with other possible variables on the dependent variables; neonatal, post-neonatal, infant, child and under 5 years. The results of the analysis referred to impacts of high significance upon the consanguineous marriage variables which were determining post-neonatal, infant and under-5-year mortality in Pakistan.

Another study included two neighboring countries at the same time; both located in South Asia. By using data collected from the Pakistan Demographic and Health Survey (PDHS, 1990/91) and from the Indian National Family Health Survey (NFHS, 1992/93), (Hussain, Bittles, & Sullivan, 2001) measured the impacts of first cousin consanguinity on the early age mortality. The focus was on determinants of mortality in live-born children up to the age of 5 years.

The goal of this study was to measure the determinants of early age mortality in the Muslim communities of Pakistan and India during the previous two generations. It focused on the role of the consanguineous marriages factor on early age mortality, with other impacts of socio-demographic and biological factors being simultaneously measured.

There was a highly significant risk among the children of first cousin consanguinity unions during the neonatal and post-neonatal, total infant and under-5 year periods in both countries, according to the bivariate analysis. Through multivariate regression analysis, the demographic and biological factors were controlled for and the outcomes were confirmed.

Table 3.2: Distributions of Offspring Mortality in the Muslim Populations in India and Pakistan.

Period of Death	Pakistan (PDHS)		India (NFHS)			
	No. of Women	No. of Women	No. of Births	Deaths (%)	No. of Births	Deaths (%)
Neonatal	4.959	6.283	24.429	4.5	19.356	5.2
Past-neonatal	4.717	6.546	22.112	3.2	17.244	4.9
Infant	4.749	6.593	23.170	7.7	18.205	9.0
Child	4.064	5.646	17.457	3.1	13.540	2.7
Total under 5	3.993	5.447	17.531	11.3	14.050	11.8

Source: (Hussain et al., 2001)

There was similarity evident in the proportions of neonatal, post-neonatal, infant, and child under 5 years in Pakistan and India. In Pakistan, the study showed 9.0% and 11.8% of infant mortality and under-5 deaths, respectively, whereas for India, the numbers were 7.7% and 11.3% of infant mortality and under-5 deaths, as per (Table 3.2).

The study also discussed the impact of consanguineous marriages on fertility in Asian communities. The outcomes in both samples referred to the relations between consanguineous marriages and fertility (direct and indirect) determinants, including lower maternal marriage age, lower use of contraceptives, rural residence and lower maternal education. In the multivariate analysis, which was based on PDHS, 1990/91 datasets, they found fertility to be lower among women in first cousin consanguinity, while for the Indian cases based on NFHS, 1992/93, they found that fertility levels were similar to the first cousin and non-consanguineous marriages. They further examined the impacts of consanguineous marriages on early age mortality in South Asian communities. In both countries, multivariate regression outcomes indicated that early age mortality was significantly increased in the child of first cousin consanguinity, even when all demographic and biological factors were controlled.

3.2.2. Africa

An important comparative study in consanguinity in 24 African and Asian Countries was provided by Saadat, 2007. Through this study, he tried to answer a key question: Does consanguinity lead to increased child mortality rates in countries with high levels of consanguineous marriages? Studies into the health impacts of consanguinity on child and adult mortality were conducted, and interdependence among gender child and adult mortality rates and coefficient of inbreeding mean(α) in 24 countries from Africa and Asia was estimated (Table 3.3). This included Asian and African countries because of the high incidence of consanguinity

in these regions. Countries included in the study were; the African countries of Algeria, Egypt, Guinea, Nigeria, Sudan, Tanzania and Tunisia; and the Asian countries of Bahrain, Bangladesh, Indonesia, Iran, Iraq, Jordan, Kuwait, Lebanon, Malaysia, Oman, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Turkey, and UEA. Table 3.3 shows the countries including in the study and their sex specific mortality rates of childhood and adulthood, as well as the inbreeding coefficient mean (α) and GDP per capita. Pearson's correlation coefficient parameter analysis was used to measure the correlations between the determined variables.

Table 3.3: Mean of Inbreeding Coefficients α, GDP per Capita and Sex Specific Mortality Rates of Childhood and Adulthood of the Study Countries.

			Mortality rates			
			Childhood		Adulthood	
Country	**α**	**GDP**	**Female**	**Male**	**Female**	**Male**
Algeria	0.0152	3960	44	55	129	164
Bahrain	0.0165	15609	7	9	89	123
Bangladesh	0.0045	1239	84	82	258	251
Egypt	0.0122	3604	44	46	160	230
Guinea	0.0131	1675	153	172	327	407
Indonesia	0.0095	3121	40	50	213	246
Iran	0.0185	6120	39	45	137	209
Iraq	0.0225	2809	111	122	180	258
Jordan	0.0235	4012	24	27	122	193
Kuwait	0.0210	18350	10	12	66	87
Lebanon	0.0091	5884	28	34	140	204
Malaysia	0.0038	9315	11	13	108	194
Nigeria	0.0242	884	152	159	360	419
Oman	0.0169	15808	22	24	106	182
Pakistan	0.0282	1834	115	105	203	229
Philippine	0.0003	4966	33	46	141	272
Saudi Arabia	0.0218	13019	27	30	115	193
Singapore	0.0020	25840	4	4	54	92
Sri Lanka	0.0092	3303	18	22	123	247
Sudan	0.0237	1072	117	124	291	378
Tanzania	0.0236	457	152	163	502	552
Tunisia	0.0213	6717	27	33	117	174
Turkey	0.0073	6455	40	46	118	206
UEA	0.0223	25853	11	13	124	171

Source: (Saadat, 2007).

The study showed a correlation among the variables by using Pearson's correlation coefficient analysis. The method used showed significant negative correlations among child or adult mortality rates and GDP per capita. Contrastingly, there were significant positive correlations among child or adult mortality rates and the inbreeding coefficient mean (α). Countries with relatively higher rates of consanguineous marriages had higher mortality rates than those with lower consanguinity rates. In addition, countries with relatively higher GDP per capita had lower mortality rates. See Table (3.4).

Table 3.4: Pearson's Correlation Coefficients between the Study Variables

		α	GDP	Adult female mortality rate	Adult male mortality rate	Child female mortality rate
GDP	r	-0.093				
	P	0.665				
Adult female mortality rate	r	0.292	-0.611			
	P	0.167	0.002			
Adult male mortality rate	r	0.227	-0.656	0.956		
	P	0.286	0.001	0.000		
Child female mortality rate	r	0.391	-0.648	0.898	0.862	
	P	0.059	0.001	0.000	0.000	
Child male mortality rate	r	0.361	-0.658	0.902	0.880	0.995
	P	0.083	0.000	0.000	0.000	0.000

Source: (Saadat, 2007).

The study concluded that consanguineous marriages impacts early age mortality independently of GDP per capita, and it further showed that the high rates of early age mortality could be attributed to high rates of consanguinity in several countries.

3.2.3. Middle East and North Africa

Bekaa Valley, Lebanon, was the subject of research on the impacts of first cousin union on early age mortality among reproductively isolated Bedouin agro-pastoralists. Selected demographic and socio-economic determinants were controlled during the study, and there was a negative impact of first cousin unions on infant mortality rates, but not on child mortality rates. (Joseph, 2007) presented an integrated perspective of related marriages to answer a question usually asked in demographic research: Which are the most important determinants that affect early age mortality, social or biological factors? They considered consanguinity to be one of the

key biological factors, and further considered it to have negative impacts and recognized it as a known determinant of early childhood mortality, even after demographic and socioeconomic factors were controlled.

The study was based on a survey conducted in 2000 of Bedouin women living in the Bekaa Valley. The proportion of first cousin marriage was 47%, and infant and child rates were 5.6% and 2.3%, respectively, as compared with infant and child rates for non-related marriages which stood at 4.1% and 0.8%, respectively. First cousin marriages on father's side was the most common was the most common type of union to result in a negative effect on early age mortality rates. In the Bedouin villages of the Bekaa Valley, there were statistically significant rates of consanguinity affecting infant and child mortality, and the most important determinant of early offspring mortality was short birth intervals, which are primarily linked to early cessation of lactational amenorrhea and lack of use of effective methods of contraception.

This study added other social determinants relevant to understanding marital behavior. Marital unions remain a central organizing principle of social life in many developing communities. Consanguinity was found to be a complex bio-cultural point with multiple levels of causality, especially when researchers focused solely on its demographic consequences which sometimes lead to a distorted view of marriage between relatives.

Around 20-25% of the relative unions in the study were in Turkey. According to this proportion, Turkey has one of the higher consanguinity rates in the Middle East. Types and rates of consanguinity and their associations with early age mortality were discussed in a study of Acipayam, a rural area of Denizli, Turkey.

Keskin, et al., 2011, was a surveying study of types and rates of related unions and their effects on offspring mortality based on information about the high prevalence of consanguinity in Acipayam. The dataset consisted of 795 families who were interviewed and the results point to a consanguinity proportion in mean total of 17.5% in Acipayam. The study also found that first cousin related couples amounted to (10.6%) and second cousin related couples stood at (6.9%). The infant mortality rate was found to be higher among offspring of related couples than

non-related couples (infant mortality of 19.4% and 3.5%, respectively) (Table3.5). There was a positive association among infant deaths related to consanguineous marriages (OR: 1.67; 95% CI: 1.12-2.49).

The conclusions of the study meant there were additional risks of infant mortality which affected the children of first and second cousin related couples. Woman's age at marriage and women's education as non-genetic determinants on offspring mortality were not considered to be predictors of offspring mortality because they had no statistically significant difference in related unions and non-related unions ($p > 0.05$).

Table 3.5: Infant Mortality Rates in Consanguineous and Non- Consanguineous Marriage in Acipayam.

Parameters	No. of families	Consanguineous	Non- consanguineous marriages (%)
Infant mortality			
None	745	112 (80. 6)	633 (96.5)
1	29	12 (8. 6)	17 (2.6)
2+	21	15(10.8)	6 (0.9)
Total	795	139(100.0)	656(100.0)
Chi-Square			56.9
Df			2
Sig.			P<0.001

Source: (Keskin, et al., 2011).

The study concluded they were not regarded as a predictor of offspring mortality in consanguinity. Of all the logistic regression analysis variables used to estimate the independent variables, just two of them (number of living children, women's education) were found to affect infant mortality independently. (Table 3.6)

Table 3.6: Logistic Regression Analysis Results to Detect Effective Factors on Infant Mortality/ Abortions in Acipayam

Dependent variable	Independent Variables	(R-value)	Exp(B)	95 % CI
Infant mortality/Abortions	Consanguineous marriages	0.011	1.67	1.12-2.49
	Number of living children	0.000	1.24	1.13-1.36

Source: (Keskin, et al., 2011).

The study clarified that consanguineous marriages are highly prevalent in Acipayam, a rural area of Denizli, Turkey. Also, it found infant mortality risks are higher in that area, along with a higher number of living children.

In the majority of the US States, cousin marriages are illegal under statutes passed in the nineteenth and twentieth centuries. In European communities, related unions generally account for less than 1.0% of marriages, while in southern and western Asia and North Africa communities the rates vary from 20.0- 60.0 %. In Saudi Arabia, for instance, over 55% of all unions are between relatives.

El-Hazmi, et al., 1995 presented and discussed the possible consequences of increased consanguinity. This study was conducted on 3,212 Saudi families to estimate prevalence of related marriages in that county. In looking at the types of unions between husband and wife, Saudi Arabia's consanguinity rate was 57.7%, one of the highest not only in the region, but around the world. In this region, more half the population preferred consanguinity. First cousin related (28.4%) was the most frequent marriage type, followed by remote relative (15.2%) and second cousin related (14.6%).

Table 3.7: The Prevalence of Consanguinity in the Middle East

	Consanguinity (%)			
Country	**First Cousin**	**Second Cousin**	**Others**	**Total**
Saudi Arabia				
CP	29.80	13.40	17.60	60.80
NP	17.9	17.4	17.4	52.1
NWP	27.3	2.8	19.6	67.7
SWP	26	12.4	12.4	54.2
EP	40.9	9.1	9.1	59.1
Egypt	14.1	5.4	9.46	28.96
Jordan	35.38	3.47	11.38	50.23
Kuwait	32.2	0.8	21.3	54.3
Iraq	30	-	-	57.9
Bahrain	21	7.8	10.6	39.4
Lebanon				
Muslims	17.3	-	-	29.6
Christians	7.9	-	-	16.5
UAE	31.5	-	30.1	61.6

Source: El-Hazmi, et al., 1995.

Consanguinity proportions showed a varying prevalence within Saudi Arabia from one region to another, as seen in Table 3.7. In most of areas, first cousin related marriages were most common, but in some remote places, second cousin marriages occurred at high percentages. The overall inbreeding coefficient (F) was estimated (0.024), which is considered one of the high values of inbreeding in the world. The major negative effects of related unions on early age mortality of their offspring were also observed.

Jordan was another country in the Middle East region to demonstrate high consanguinity proportions amongst its population. Khoury and Massad, 2000 studied the risk of related unions on infant mortality, reproductive wastage, and the eventual fertility of their offspring. They showed that consanguinity did not affect fertility as measured by pregnancies number, even after taking into consideration marriage duration. Furthermore, there were no significant differences between related and non-related marriages on abortion proportions and twin pregnancies. Related marriages, however, did correlate with a high significance of risk on infant mortality and still births. Among non-related marriages groups, gender mortality had a high significance, as infant mortality rates for female were higher than male. Congenital malformations related to maternal consanguineous marriages were significantly higher than those related to maternal unrelated unions. The study showed that consanguinity has an adverse effect on many aspects of reproductive health as shown in Table 3.8.

Table 3.8: Infant Death by Consanguinity in the Total Sample in Jordan

Relationship	Number	Rate/1000 LB
Related couples	186	65.1*
Non- Related couples	134	48.8**
Total	320	57.1

Significant difference (P<.01)
* Rate is from 1000 consanguineous live births (LB) (n=2857)
** Rate is from 1000 non-consanguineous live births (LB) (n=2746)
Source: Khoury & Massad2000

Table 3.8 shows the rates and numbers of infant deaths by consanguinity, the differences here being statistically significant (P<.01). Related marriages had a higher significance rate, more than non-related marriages, on offspring infant mortality. First cousin unions did not show any significant difference in rates of mortality based on gender, nor in the sample as a whole for other kinds of consanguineous marriages. However, there was a significant difference within

offspring of non-related marriages. Results indicated that consanguinity increases female infant mortality to a point where there is no significant difference in infant mortality between genders.

In conclusion, the study showed that 51% of marriages in Jordan were between related partners. The health effects of consanguinity shed light on a significant accession of related marriages with infant mortality and stillbirths in general, and female infant mortality in particular.

Table 3.9: Infant Mortality Rates in the Arab World

Arab countries	IMR 1990	IMR 2009	Dropping in IMR
Algeria	52.00	36.00	30.70
Bahrain	14.00	10.00	28.60
Comoros	90.00	75.00	16.70
Djibouti	95.00	67.00	29.50
Egypt	66.00	20.00	66.70
Eritrea	92.00	41.00	55.40
IRA	42.00	36.00	14.30
Jordan	31.00	17.00	45.20
Kuwait	13.00	9.00	30.80
Lebanon	33.00	12.00	33.30
Libya	33.00	15.00	54.50
Mauritania	81.00	75.00	7.40
Morocco	68.00	32.00	53.00
Oman	23.00	10.00	56.50
Palestine	33.00	20.00	39.40
Qatar	17.00	9.00	47.00
Saudi Arabia	35.00	18.00	48.60
Somalia	133.0	109.0	18.00
Sudan	78.00	70.00	10.20
Syria	30.00	14.00	53.30
Tunisia	40.00	18.00	55.00
UAE	15.00	7.00	53.30
Yemen	90.00	53.00	41.00

Source: Abuqamar, et al., 2011

Abuqamar, et al., 2011, presented a comprehensive study encompassing all Arab countries. They prepared an estimation of infant mortality in the context of socio-economic determinants (unemployment, poverty, literacy rate, early marriage, Gross Domestic Product (GDP) and consanguinity) for the period of two decades between 1990 and 2009. The study was based on a statistical analysis performed on data provided by the United Nations Children's Emergency Fund (UNICEF) and the World Health Organization (WHO). Consanguinity and early marriage were both considered as intermediate determinants which affect infant mortality

and socio-economic factors. Consanguinity, particularly first cousin marriages, had higher rates of stillbirths and infant mortality.

Table 3.9 shows infant mortality rates in Arab communities between 1990 and 2009, and the changes that occurred during these twenty years. In 2009, various rates of infant mortality within Arab regions ranged from 7/1000 to 109/1000 live birth, while in 1990, it ranged from 13/1000 to 133/1000 live births. Clearly, there was a drop in infant mortality rates across all countries, ranging from 7.4% to 66.7% during that period. Egypt had the most accelerated decrease of IMR, while the slowest decrease was found in Mauritania.

In 2009, according to infant mortality rates, the Arab countries were divided into the following four categories;

1. The first category consisted of IMRs lower than 16/1000 live births: United Arab Emirates (7/100), Qatar (9/1000), Kuwait (9/1000), Oman (10/1000), Bahrain (10/1000), Lebanon (12/1000), Syria (14/1000), and Libya (15/1000).
2. The second category consists of IMRs of 16 to 30/1000 live births: Jordan (17/1000), Tunisia (18/1000), Saudi Arabia (18/1000), Egypt (20/1000) and Palestine (20/1000).
3. The third category consists of high infant mortality rates of 31 to 50/1000 live births: Morocco (32/1000), Algeria (36/1000), Iraq (36/1000) and Eritrea (41/1000).
4. The fourth category consists of even higher infant mortality rates of over 50/1000 live births: Yemen (53/1000), Djibouti (67/1000), Sudan (70/1000), Mauritania (75/1000), Comoros (75/1000), and Somalia (109).

In (Table 3.10), it is apparent that related marriages and early marriage were common in Arab regions, the prevalence ranging from 15.0-65.0%, and 1.0-48.5%, respectively. There was a statistically significant and good correlation between consanguinity and infant mortality in 1990 and 2009, and the significance associated was (R= 0.46, P-value= 0.047). Also, a statistically significant and high correlation between consanguinity and infant mortality (R= 0.752, P-value = 0.000) was found for the same period.

Table 3.10: Consanguinity and Early Marriage 2009 in the Arab World

Countries	Consanguineous marriage %	Early marriage %
Arab countries		
Algeria	34.00	4.00
Bahrain	29.90	7.00
Comoros	N/A	N/A
Djibouti	N/A	43.00
Egypt	40.00	15.00
Eritrea	N/A	47.00
Iraq	46.00	21.00
Jordan	25.60	8.00
Kuwait	42.10	5.00
Lebanon	25.00	4.00
Libya	46.50	1.00
Mauritania	60.10	28.00
Morocco	15.25	13.00
Oman	33.00	16.00
Palestine	44.30	24.00
Qatar	54.00	4.00
Saudi Arabia	52.00	7.00
Somalia	N/A	N/A
Sudan	65.00	40.00
Syria	32.00	25.00
Tunisia	24.81	1.00
UAE	50.50	8.00
Yemen	44.70	48.40

Source: Abuqamar, et al., 2011.

There was consistent fact within the previous studies (Hammami, Chalbi, Ben Abdallah, & Elgazzeh, 2005; Khayat & Saxena, 2007) which proved that infant mortality rates are affected by consanguinity and early marriage and that this was a product of culture and social behavior; those parents who experienced the death of infants more often came from areas where the cultural practice of related marriage was increasing. Many research studies clarified the impacts of consanguinity on early age mortality (Shami, et al., 1991; Hussain, 1999; Jurdi & Saxena 2003; Weinreb, 2008). In this study, their findings were consistent with previous studies regarding their estimations of the significant relationship between consanguineous marriage and infant mortality.

In Lebanon, a medical study was presented by Charafeddine, et al. (2012) with the goal of describing the role of consanguinity as an influencing factor on infant mortality in Lebanese hospitals. The birth data of 26 hospitals from six Lebanese governorates, representing approximately 25.0% of the total national deliveries in Lebanon during the period from beginning of 2004 to the end of 2008, was collected. The outcomes showed that the proportion of first cousin marriages was 9.9% and mortality was 6.7 per 1000 live births (439/65,402) in total. The inbreeding coefficient (F) was higher among first cousin offspring (F = 0.0625), while second-cousin offspring (F = 0.0156) are closer to non-related (F = 0).

Related unions were significantly associated with in-hospital mortality (odds ratio 2.4; 95% confidence interval (CI): 1.8, 3.1) and consanguinity was a significant determinant of mortality (odds ratio 1.8 [95% CI: 1.2, 2.9]) after controlling for crowding index, maternal age and education, prenatal care, mode of delivery, history of abortion, gender, and birth weight. The study clarified that consanguinity was associated with mortality, which points to potential genetic factors leading to this increased risk.

Tunisia is one of the Arab countries in North Africa with a high rate of consanguinity. Jemai, Messaoudi, Chaouch, and Kerkeni, 2007 presented a study to estimate the relationship between various social factors and consanguinity, as well as the impacts of related marriages on mortality and reproductive behavior in Tunisia. The study included all live-births recorded from November 1989 to October 1990 in Monastir. There were three categories of marriages recorded as follows: Marriages among first cousins couples, other degrees of cousins, and non-related couples. They estimated the mean coefficient of inbreeding to be 8.76 in the Northwest regions and 21.34 in the central regions of the country. In particular, they focused on the prevalence of related marriages in the Tunisian region of Monastir and its impact on the fertility and offspring of related couples.

Their dataset consisted of 1,741 live-births, of which 24.81% were related couples' offspring. First cousin marriages were recorded at 17.40% of all unions and 70.13% of all related couples, and a positive correlation existed among consanguinity and early age mortality (neonatal, post-neonatal and children under 5 years). The results also showed that there was a

positive correlation between first cousin marriages and rates of neonatal and post-neonatal mortality. In addition, under five years' mortality was 39.12 %, 34.23 %, and 18.34 %, respectively, in comparison with 20.54 5%, 23.69 %, and 6.42 5%, respectively, in non-related couples. In other words, mortality, especially in neonatal age, was positively associated with consanguinity.

Another study was conducted on the population of Beirut, Lebanon by (Khlat, 1988) to examine the impacts of consanguinity on reproductive performance, in terms of both fertility and offspring mortality. The study used data from a survey carried out in 1984, one which was based on Mosley and Chen's (1984) analytical framework to examine child survival in developing countries, which was relevant to the aim of their analysis. Observations from the Beirut study included; firstly, consanguinity was related to Muslim religion practices and low socio-economic status. Secondly, the consanguinity rate slightly declines through time, and mortality rates show a similar slight decrease over time. Consanguinity correlated with a higher fertility and mortality among their offspring for socio-economic reasons (lower social classes) and demographic reasons (longer marriage duration, on average). During the study's investigations of the effects of inbreeding, the date of marriage, religion and occupation of husband or education of wife were controlled.

The outcomes clarified that a high consanguinity rate existed during the study period in Beirut (25%), and there was a high prevalence within Muslim communities, more so than amongst Christian groups. First cousin couples are a majority for Muslims (59.0% of all related couples), while marriages between remote-related couples were slightly common amongst Christians (52.0% of all consanguineous marriages). Patrilateral parallel-cousin marriage was the most prevalent type of first cousin marriage in both religious groups (37.0% of all first-cousin marriages among Muslims, 38% among Christians). The related marriages group (all degrees of relatedness) showed higher significant values than the non-related marriages on mortality rates. In particular, the offspring of first cousin couples rate was 1.33 higher risk ($P = 0.05$) compared to others at 1.22 higher risk of mortality.

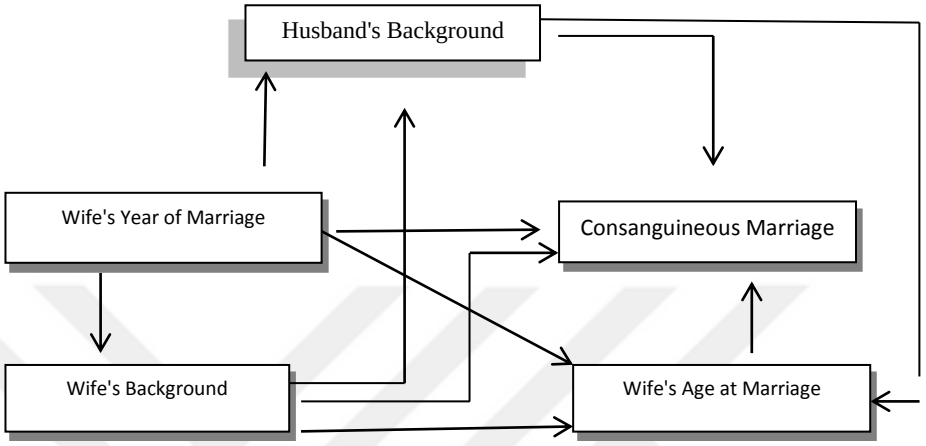
The results showed that consanguinity had a positive association with fertility and mortality. When the relevant socio-religious factors are controlled for, fertility no longer presents a significant pattern in relation to consanguineous marriage, and the difference in mortality is marginally significant, while the socio-economic and demographic factors explain a substantial proportion of the total variance.

There were two assumptions presented by Givens and Hirschman, 1994, who presumed a negative association among related marriages with measures of social status and decreasing practice of consanguinity over time in Iran, based on William Goode's theory of modernization. They used data from the (1976-77) Iran Fertility Survey, which included 4,667 women. When the social associations and trends of related marriages in Iran were examined in Iran for the time period of the 1940s to the 1970s, there was a slight increase of cousins related marriages rates.

Multivariate logistic regressions were used as a suitable statistical tool to get optimal results; however, they referred to an expected negative association between consanguinity and measures of individual social status. Overall, the outcomes referred to the possibility that the impacts of modernization are slowly eroding the social bases of consanguinity, while the increase expected in marriages of cousins may lead to an increase in consanguinity in the near term. The outcomes for related marriages ranged from 25.1% in Tehran to 32.8% in some rural areas.

Goode (1963) presented a comprehensive theory of the impact of modernization and industrialization on family structure and unions relationships. The basic idea was that the traditional family and its set of associated attributes were less adapted to manage the high levels of geographic and social mobility of industrial society. Goode's theory of family change in the industrial world was the only alternative, although it had faced frequent challenges. One of the lesser discussed aspects of Goode's theory was about consanguinity marriages between cousins or other close relatives. As with other aspects of traditional marriage patterns, Goode assumed a decline in related marriages would accompany modernization as shown in Figure 3.1.

Figure 3.1: Hypothesized Model of Time and Social Background on Consanguinity



Source : Goode, 1963.

All of these variables are hypothesized to affect consanguinity, either directly or indirectly, through subsequent variables. Goode (1963) interpreted the hypotheses in Figure 3.1 as follows:

1. Women marrying in later decades will have a lower prevalence of consanguinity than women marrying in earlier decades.
2. Women with an urban origin will have a lower incidence of consanguinity than women with a rural origin.
3. Women whose husbands have an urban origin will have a lower incidence of consanguinity than those married to men with a rural origin.
4. Women with more education will have a lower incidence of consanguinity than women with little or no education.
5. Women married to men with more education will have a lower incidence of consanguinity than women whose husbands have little or no education
6. Women who worked before marriage will have a lower incidence of consanguinity than women who did not work.
7. Women married to men who work in high-status occupations will have a lower incidence of consanguinity than those married to men who work in low-status occupations.
8. Women who marry at later ages will have a lower incidence of consanguinity than women who marry at younger ages.

The patterns of consanguinity shown by these characteristics of women generally support Goode's thesis that the adoption of modern social roles leads to a decrease in consanguinity.

Table 3.11: Frequency of Double First Cousin, First Cousin and Clan Marriage by Location

Type of marriage	Lebanon	Jordan	Jordan1	West Bank	Gaza	Syria
Double first cousin						
FZS and MBS	1.80	1.80	2.70	NA	NA	1.90
FBS and MZS	1.10	0.7	1.10	NA	NA	1.20
First cousin						
FBS, Ibn amm	9.40	13.0	12.50	13.40	17.40	6.80
MBS, Ibn Khal	2.70	2.30	2.30	3.80	4.20	2.0
FZS, Ibn amma	2.60	4.10	4.00	4.80	5.0	2.80
MZS, Ibn Khala	2.20	4.10	4.0	4.80	5.0	3.60
Same clan, father	8.80	15.60	16.30	20.20	20.20	8.40
Same clan , mother	3.70	4.70	4.60	18.70	11.70	3.90
Unrelated	67.7	53.8	52.9	33.7	36.5	69.5
Total Women interviewees	3.972	2.888	4.95	10.409	5.778	4.195

Source : Pedersen, 2002.

In a community with a high proportion of consanguinity, both first cousin related marriages and other related marriage types were an added risk for early age mortality. Pedersen, 2002 explored the properties of the differences in mortality that went along with related marriages amongst Palestinians who migrated to neighboring countries. The data was obtained from five surveys of Palestinians who were living in the West Bank and Gaza, Syria, Jordan and Lebanon, during the period 1995– 2000. Early age mortality (infant and child) was estimated for the offspring of both related and non-related parents. The outcomes referred to an increase in infant mortality with additional deaths among the offspring of first cousins and remote related marriages at a rate of 15.0 deaths per 1,000 births and 6.1 deaths per 1,000 births, respectively, compared to infant mortality among the offspring of non-related marriage.

Palestinians in the Middle East (Table 3.11), preferred related marriages and estimates there ranged from 15.2% for first cousin couples in Syria, to 31.6% first cousin marriage in Gaza. Related cousin couples on the father's side accounted for approximately half of all cousin couples. In addition, marriage within the patrilineal clan was favored, especially in Gaza

(42.6%) and the West Bank (38.4%). As a result, the non-related couples were between 33.7% of marriages (in the West Bank) and 69.5% (in Syria).

Table 3.12: Absolute and Relative Mortality Differences between the Progeny of First Cousins, Member of the Same Patrilineal Clan and Unrelated Couples

Type of marriage	Absolute difference, deaths per 1,000 births			Relative difference1, %		
	Neonatal	Infant	< 5 Years	Neonatal	Infant	< 5 Years
First cousin						
Robust mean	6.8	15	17.4	46.1	51.7	51.8
Mean	7.7	13.7	16.7	44.8	47.1	49.6
SEM	2.1	2.2	2.5	10.7	7.7	7.4
Robust mean	2.5	6.1	8.8	18.6	13.3	19.7
Mean	4.7	7.1	9.3	29.2	28.8	33.3
SEM	2.1	2.9	3.6	12.1	11.3	12.4

Source : (Pedersen, 2002).

The locations in which different Palestinian communities lived impacted infant mortality rates. Child's gender and time period ranged from a low of 20 deaths per 1,000 (Lebanon, females) to 37 deaths per 1,000 (Lebanon, males).

Additionally, death rates of 15.0 per 1,000 births among infants, and 17.4 deaths per 1,000 births among child under five years existed among offspring of first cousin couples and were demonstrated to be higher than the rates of non-related couples (Table 3.12). Consanguinity had a negative effect on early age mortality and increased these rates, which showed 6.1 deaths per 1,000 for infant mortality and 8.8 deaths per 1,000 for child mortality. There were roughly similar effects of related marriages on neonatal, infant and under five phases.

In conclusion, first cousin, second cousin, remote related, and other relative marriages carried an added risk of neonatal, post-neonatal, infant and child mortality of Palestinians living in the West Bank and Gaza, Lebanon, Jordan and Syria.

3.2.4. Egypt

Egypt has the largest population among 22 members of the League of Arab States. The prevalence of consanguinity varies between 20-50% in the region (Hamamy, 2003). The practice is widespread in Egypt (39.0%), or (30.0%) according to Egypt Demographic Health Survey of 2000 and 2008, respectively. Where EDHS, 2000 consisted of 16,957 households; this included 15,573 ever-married women aged 15-49 from six administrative divisions of Egypt, namely: Urban Lower Egypt, Rural Lower Egypt, Urban Upper Egypt, Upper Egypt Rural, Frontier Governorates and Urban Governorates.

The impacts of consanguinity on early age mortality in Egypt were examined by Khayat and Saxena (2007), who divided the sample related to the women into three different categories, namely; 'close consanguinity', 'remote consanguinity', and 'non- consanguinity' marriages. All known socio-economic variables which affected the dependent variable ('infant mortality' and 'child mortality') had been controlled for by using multivariate logistic regression models for the analysis. The outcomes showed 30.0% and 19.0% of infant mortality among close and remote consanguineous couples, respectively. The same high risk of child mortality stood at more than 50.0% for close related unions and 27.0% for remote related unions, as compared to non-related couples. It was also found that consanguinity was still high in Egypt at the time of the study, (38.9%). The recorded rates in each region were: 25.4% in Urban Lower Egypt, 36.7% in Rural Lower Egypt, 37.7% in Urban Upper Egypt, 55.2% in Upper Egypt Rural, 46.3% in Frontier Governorates and 28.7% in Urban Governorates, as shown in Table 3.13.

Table 3.13: Distribution of Consanguinity in Egypt, 2000.

Region	Non-Consanguinity	Consanguinity	Number of cases
Urban Governorates	71.3	28.7	3102
Lower Egypt -Urban	74.7	25.3	1831
Lower Egypt -Rural	63.3	36.7	4277
Upper Egypt -Urban	62.3	37.7	1670
Upper Egypt -Rural	44.8	55.2	3743
Frontier Governorates	53.6	46.4	949
Egypt -Total	61.1	38.9	15572

Source : Khayat & Saxena, 2007

First cousin marriages were the most common in all regions, accounting for 22.2% of all unions, and the rural regions showed the highest ratios, as in those found in Upper Egypt-Rural. Close related couples were a significant positive effect on early age mortality, where the rates of infant and child mortality doubled within close related parents compared to parents having no relation.

The bivariate analysis used to examine the non-genetic determinants, (namely; mother's education, standard of living, antenatal care, medical assistance during delivery, region/residence, birth order, birth interval, size of the child, sex of the child and age of the mother at delivery), of early age mortality showed that this rate was significantly affected, particularly by maternal education. There were two inverse relationships among early age mortality rates with maternal education, where illiterate mothers had high risk between their offspring, and early age mortality rates correlated with a low standard of living. Early age mortality drops as both education and living standard increase.

Early age mortality rates were higher within closely related couples who had a low standard of living, some 40.0% higher than non-related couples, and more than remotely related couples by 6.0%. In addition, early age mortality rates according to consanguinity varied by region, showing significantly higher rates in Rural Upper Egypt and the lowest rates in Frontier Governorates. In addition, there were several strong, non-genetic factors affecting early age mortality such as birth interval, birth order, size of child at birth and age of the mother at the time of birth.

Two logistic regression models were used to examine infant or the child mortality as a dependent variable. The goal fusing the separate models was to find the effect of consanguineous marriages on early age mortality after controlling for the effects of non-genetic determinants. The outcomes illustrated that, in the case of related unions, the risk of early age mortality was higher than in case of non-related unions, even after controlling for all non-genetic factors of infant and child mortality. The estimates were that closely related couples had 50.0% and 30.0% higher risk for infant and child mortality rates, respectively, more than those couples who were not related by blood. The same high risk of death remained, even with remotely

related parents, for their infant and child, where the ratios were 30.0% and 20.0%, respectively when compared to non-related couples.

Another study aimed to clarify the role of consanguinity and advanced maternal age on reproductive losses in the city of Alexandria (Mokhtar & Abdel-Fattah, 2001). Here, they relied on data from a case-control study of 730 couples with a history of reproductive losses and 2,081of normal couples. The study was conducted, between October, 1998 and August, 2000. Consanguineous marriages were highly common within the group of the 730 couples with reproductive losses; the ratio was 68.8% for all, with 56.2% being first cousin marriages.

The study concluded that infant deaths and perinatal losses occurred at high frequencies among consanguineous marriages ($p < 0:0001$). A multivariate logistic regression analysis was used to measure the relative risk of repeated abortion between related couples, a rate which increased (OR: 3.85; 95% CI: 3.14–5.13). It also looked at stillbirths (OR: 11.6; 95% CI: 6.17–17.04), neonatal deaths (OR: 17.4; 95% CI: 10.3–26.13), post-neonatal death (OR: 14.15; 95% CI: 10.16–19.88) and total reproductive losses for consanguineous unions (OR: 8.13; 95% CI: 6.19–10.21), (OR: 3.29; 95% CI: 2.08–4.96), as well as total reproductive losses for the overall population (OR: 2.47; 95% CI: 1.84– 3.42).

The study suggested that related unions could be the cause of the high rates of prenatal and infant mortality, while advanced maternal age has a significant effect on repeated abortion rates, and the study gave clear indicators for prevention.

The next chapter will explain the descriptive analyses of the Mosley and Chen framework based on the variables of each determinant that are assumed to cause early age mortality. The framework variables distribution for consanguinity types (not related marriage, first cousin marriage, second cousin marriage and other relative marriage) will be presented on one side, while early age mortality, neonatal mortality, post-neonatal mortality and infant mortality will be provided on the other side, based on EDHS (2014) datasets.

CHAPTER 4

A DESCRIPTIVE ANALYSES OF CONSANGUINIEOUS MARRIAGES AND EARLY AGE MORTALITY IN EGYPT

This chapter will discuss the descriptive analyses of the Mosley and Chen framework, which consists of a set of proximate determinants that cause mortality risk. It will provide the model variables distribution for the consanguinity types of; not related marriage, first cousin marriage, second cousin marriage, and other relative marriage from a side. It will also cover early age mortality, neonatal mortality, post-neonatal mortality and infant mortality, based on EDHS (2014) datasets.

The chapter consists of three sections addressing the model variables distributions as follows:

Firstly, it will provide and explain the Mosley and Chen framework variables distribution for consanguinity types under seven determinants; individual, maternal, environmental, children nutrition's, personal illness, tradition/ norms/ attitude, household level and community level.

Secondly, it will provide and explain the Mosley and Chen framework variables distribution on early age mortality types under seven determinants; individual, maternal, environmental, children's nutrition, personal illness, tradition/ norms/ attitude, household level and community level.

Finally, it will provide and explain the distribution of consanguinity types on infant mortality.

4.1. CONSANGUINEOUS MARRIGES

Individual level consists of five variables; educational level of women, education level of husband, working status of women, coverage by health insurance and age of women, as shown in (Table 4.1).

This section will explain how the determinants of the Mosley and Chen framework distribute across consanguinity, while observing and explaining the differences and similarities between the different variables categories which are distributed against not related marriage type, first cousin marriage type, second cousin marriage type, and other relative marriage type.

According to the education level of women variable, most of the not related marriages couples have secondary school education, (57.2%), while primary education accounts for less at 8.1%. There is also a similarity between no education level and higher education level, which stand at 16.1% and 18.6%, respectively. The secondary education level for the first cousin marriage type is similar to the not related couples with 58.0%, while higher education level declines among them to 10.0% and these differences go to 22.1% for those who have no education level, the latter number being the higher percentage among consanguinity categories. Primary education amongst the first cousin marriage type has a similar profile to those not related, with 9.9%.

The second cousin marriages couples are close to the first cousin marriages couples with 60.7%, 19.8%, 10.6% and 9.0% for secondary, no education, higher and primary education level, respectively. Other relative consanguinity is similar to the first and second cousin marriage types for all levels of education. Clearly, there is an association between non-educated women and consanguinity, while the most educated women are found in not related couples.

For the education level of husband variable, similar to the education level of women, it is found that most of the not related marriages partners have secondary education level, with 54.8%, while no education level and primary education level account for 12.8% and 13.5%, respectively. The higher education level stands at 18.9% for this group. Secondary education level for first cousin marriages are the most common here and have similar outcomes with second cousin and other relative groups, at around 60%. No education, primary and higher education level have close percentages to each other for the consanguinity groups. Again, there is a clear association between non-educated women and consanguinity, while the most educated women are in the not related couples category. The higher education level increases amongst those not related with 18.9%, while most not educated partners are first cousin marriages partners at 13.7%. Generally, husband's highest education level is recorded as more than highest education level of women across all groups.

According to the respondent's occupation variable, most are not working at any kind of job for all consanguinity types. These ratios increase for those who have consanguinity with 91.0%, 90.7% and 88.3% for first cousin, second cousin and other relative type, respectively. It is less for those who are in not related marriages, with 85.4%, while there is a slight difference between not related marriages and the other types of consanguineous marriage according to work in the manufacturing sector, with 8.7% for not related couples compared to 4.1%, 4.0% and 6.6% for first cousin, second cousin and other relative type, respectively. Working in agriculture and working in services shows quite similar numbers for all four types of consanguinity, at around 3%.

In terms of health care, unfortunately more than 95% of women in Egypt are not covered by health insurance. This high percentage is similar amongst all consanguinity types with a slight decrease in the proportion for not related couples, at 92.1%. The largest group found to not have health insurance was the second cousin marriage type, with 97.2%.

According to the age of women variable, women in the 25-34 age group were similar to consanguinity types with around 60%, except for second cousin consanguinity type where the number was 51.5%. The youngest women, under 25 years old, make up a quarter of all women, with decreasing numbers in this group of those who are in related marriages, particularly the second cousin type with 31.3%. The not related marriage category shows fewer, with 23.9% of women in this age group. The over 35 group is the lowest recorded group, with around 15%. There is no significant difference among marriage type groups with 15.6%, 14.5%, 17.2% and 11.7% for not related, first cousin, second cousin and other relative marriage type, respectively.

Overall, for the individual variables, it is apparent that the not related marriage type has slight differences in percentages compared to other consanguinity types. Level of education for women and their partner is slightly higher and for respondent's occupation the numbers show employed respondents more than in other groups and higher proportions of health insurance coverage, although there is a serious deficiency of health insurance in general. Finally, their age groups are slightly older than those in consanguinity groups, with a mean age 1.94 higher compared to first cousin, second cousin and other relative marriage type, which are recorded at 1.89, 1.88 and 1.87, respectively.

According to maternal variables for consanguinity in Egypt based on (EDHS) 2014 datasets, birth order categories, months since preceding birth, succeeding birth interval and mother's age at birth distribute across the types of consanguineous marriage; first cousin, second cousin, other relative and not related marriage, as seen in (Table 4. 2).

Around half of the births order group is part of the second and the third child in birth order, with a total 10,659 births. Not related couples have birth orders within the first to the third child at a higher proportion than related couples. First in order of birth is recorded as similar for first cousin and other relative, with 26.8% and 26.4%, respectively, while second cousins are slightly elevated in number with 28.0%. Not related couples account for the highest numbers of first in birth order, with 32.6%, but the second or third in birth order varies here. The not related and first cousin types are similar with 50.1% and 50.7%, respectively, and the second cousin and other relative types are lower and similar with 46.3% and 48.5%, respectively.

Related marriage types are similar for fourth and fifth in birth order, while they differ from the not related couples in this category. Past sixth in birth order is recorded as the least percentage among birth order categories, and not related are the lowest here with 2.6%, while the second cousin couples are higher with 5.1%. First cousin and other relative groups show similar numbers, with 5.7% and 5.4%, respectively.

According to months since preceding birth variable, not related type differs from other consanguinity types, wherein first in birth order is the highest at 33.5% while the related union types are lower and similar to each other at around 28%. For 7-23 months since preceding birth, the not related couples and other relative are similar with 13.0% for each as well, while first and second cousin types are slightly higher with 14.9% 14.2%, respectively. The consanguinity types for 24-47 months since preceding birth are similar and range from 31.8% to 35.6% for the not related type and other relative type, respectively. Over 4 years since preceding birth shows consanguinity types are close to each other, ranging from 21.7% to 24.5%. Generally, first in birth order and 24-47 months since preceding birth are the most common among all women, with around 30% for each.

Table 4.1: Percentage Distribution of Individual-Level Variables by Consanguinity

Individual variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Educational level of women	No education	16.1	22.1	19.8	22.2
	Primary	8.1	9.9	9.0	8.7
	Secondary	57.2	58.0	60.7	57.3
	Higher	18.6	10.0	10.6	11.8
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,731	1,088	1,188
Education level of husband	No education	12.8	13.7	12.4	13.2
	Primary	13.5	13.6	13.3	11.3
	Secondary	54.8	60.3	60.5	62.3
	Higher	18.9	12.3	13.7	13.2
	Total	100.0	100.0	100.0	100.0
	n	10,658	2,731	1,087	1,189
Working status of women	Not working	85.4	91.0	90.7	88.3
	Working in agricultural	2.0	2.1	2.1	2.4
	Working in services	3.9	2.7	3.1	2.8
	Working in manufacture	8.7	4.1	4.0	6.6
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,730	1,088	1,188
Coverage by health insurance	No	92.1	95.7	97.2	95.0
	Yes	7.9	4.3	2.8	5.0
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,731	1,088	1,189
Age of women	less than 25 years old	23.9	26.2	31.3	27.3
	25-34	60.5	59.3	51.5	61.0
	Over 35 years old	15.6	14.5	17.2	11.7
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,731	1,088	1,188
Mean age of women		1.94	1.89	1.88	1.87

There are differences between consanguinity types according to succeeding birth interval. There are also differences between the variable categories, where the 7-23 months category has ratios of less than 24-47 months, while the 48-59 months category has the lowest ratio with less than 1.5% for each union type. For the open birth interval category, all union types are similar with around 73% for each. Generally, 7-23 months and 24-47 months are close

to 20% only of total with differences according to consanguinity types while the more than 70% for the open birth interval category.

Table 4.2: Percentage Distribution of Maternal Variables by Consanguinity

Maternal variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Birth order	First birth order	32.6	26.8	28.0	26.4
	2-3	50.1	50.7	46.3	48.5
	4-5	14.7	17.5	19.9	19.7
	6+	2.6	5.1	5.7	5.4
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,731	1,088	1,188
Months since preceding birth	First birth	33.5	27.5	28.5	27.7
	7-23	13.0	14.9	14.2	13.0
	24-47	31.8	35.2	32.9	35.6
	over 4 years	21.7	22.4	24.4	23.7
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,089	1,189
Succeeding birth interval	7-23	9.6	9.9	10.8	9.8
	24-47	14.4	16.4	14.7	14.5
	48-59	1.0	1.1	0.6	1.4
	Open birth interval	74.9	72.6	73.9	74.3
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,731	1,088	1,188
Mother's age at birth	<20	8.4	10.8	13.2	11.1
	20-34	82.9	81.2	77.1	81.6
	>35	8.6	8.0	9.6	7.3
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,732	1,089	1,189

For mother's age at birth, it found that second cousin category is the greatest among others with 13.2% of total 1,089 women, followed by other relative and first cousin categories with 11.1% and 10.8%, respectively. Not related marriages category comes in last, with 8.4% according to mother's below than 20 years old at birth. For mothers between 20 and 35 years old at birth, it found that not related marriages category is the greatest with 82.9%, while second cousin was the lowest with 77.1%. Finally, for those over 35 years old at time of giving birth, it

found that there were similarities between consanguineous marriages types and not related marriages.

There are four environmental variables in this study; source of drinking water, if it is an improved or non-improved source, type of toilet facility, time to obtain drinking water, and frequency of someone smoking inside the household. Each of these variables is distributed across consanguinity types, as seen in (Table 4. 3).

The majority of the population in Egypt has improved sources of drinking water, with about more than 90% of total households, and with slight remarkable differences among consanguinity types. The not related marriage type has similar percentage as first cousin marriage, at around 93.5%. Second cousin marriage is the lowest in this group with 91.7%, while other relative type is similar to first cousin with 93.2%. From this data, it is apparent that there is no significant difference between marriage types.

According to type of toilet facility variable, most households have improved sources, at more than 86.8%, with a close similarity among consanguinity types, at 86.6% , 89.7%, 89.8%, and 89.1% for not related, first cousin, second cousin and other relative consanguinity types, respectively.

Around 88.0% of all households have water on premises, with almost no differences between consanguinity types, wherein not related marriage couples have 88.0%, and first cousin and second cousin marriage couples have the same percentage 88.2%, while other relative marriage couples are slightly higher with 88.8%. Less than 30 minutes to water stands at about 6.0% for second cousin type and 6.2% for other relative, while it's slightly higher for the not related group with 8.8%, and 6.0% for first cousin group. Thirty minutes or longer and don't know categories have less than 1% for all consanguinity groups. Notably, there is a similarity among consanguinity types regarding the time needed to obtain drinking water.

According to the variable of someone smoking inside house, about half of the houses have someone smoking inside, wherein the daily smoking category is the most common, while weekly, monthly and less than monthly categories are rarely found. When comparing someone

smoking inside house daily with never smoking, the first cousin marriage type for both are the same at 46.1%. Second cousin marriage type is most similar with 46.3% and 44.9% and 42.3% for both not related marriage type and other relative marriage type, respectively. Obviously, first cousin and second cousin are similar in most categories, but they differ from other relative marriage type and not related marriage type.

Table 4.3: Percentage Distribution of Environmental Variables by Consanguinity

Environmental variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Source of drinking water	Improved	93.5	93.1	91.7	93.2
	Non-improved	2.1	2.5	3.4	3.6
	Not a dejure resident	4.4	4.4	4.9	3.2
	Total	100.0	100.0	100.0	100.0
	n	10,654	2,730	1,088	1,188
Type of toilet facility	Improved	86.8	89.7	89.8	89.1
	Non-improved	8.8	6.0	5.3	7.7
	Not a dejure resident	4.4	4.4	4.9	3.2
	Total	100.0	100.0	100.0	100.0
	n	10,655	2,730	1,089	1,188
Time to obtain drinking water	Water on premises	88.0	88.2	88.2	88.8
	Less than 30 minutes	6.9	6.7	6.0	6.2
	30 minutes or longer	0.6	0.8	0.8	1.8
	Don’t Know	0.1	0.0	0.1	0.0
	Not a dejure resident	4.4	4.4	4.9	3.2
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,088	1,187
Frequency of someone smoking inside the household	Daily	44.9	46.1	46.3	42.3
	Weekly	1.3	1.0	1.5	1.4
	Monthly	0.8	2.5	1.2	1.3
	Never	48.6	46.1	46.1	51.7
	Not dejure resident	4.4	4.4	4.9	3.2
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,729	1,088	1,186

Nutritional availability for child consists of two variables; size of child at birth and duration of breastfeeding, as seen in (Table 4.4).

With the size of child at birth variable, it is apparent that there are differences between marriage types, wherein incidence of very small children for those in not related marriage type is decreasing in percentage to 4.4%, less than first cousin type at 5.6%, second cousin type at 5.1%, and other relative at 5.5%. Contrastingly, children over average or larger have the largest percentage at 83.6%, while first cousin, second cousin and other relative marriage type are still below 83%.

According to status of breastfeeding variable, the number of children currently breastfeeding shows slight differences between consanguinity types and not related marriage type, at 29.4% for not related marriage type and declining to 28.9% and 29.2% for first cousin and other relative marriage types, respectively. This number drops to 28.0% for second cousin marriage type, but for children ever breastfeeding, the not related marriage type is close to first cousin marriage type, at around 64.7%, while second cousin increases to 67.2% and 65.9% for other relative marriage type. Never breastfeeding is around 5% for all types. Generally, there are similarities for the breastfeeding variable across consanguinity types with only slight differences in these ratios.

Table 4.4: Percentage Distribution of Nutritional Availability Variables by Consanguineous Marriage

Nutritional Availability variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Size of child at birth	Very small	4.4	5.6	5.1	5.5
	Smaller than average	11.7	12.2	11.4	12.1
	Average or larger	83.6	81.6	83.0	82.2
	Don't know/missing	0.3	0.7	0.5	0.2
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,732	1,089	1,188
Status of breastfeeding	Never breastfed	5.9	6.1	4.8	4.9
	Ever breastfed	64.7	65.0	67.2	65.9
	Currently breastfeeding	29.4	28.9	28.0	29.2
	Total	100.0	100.0	100.0	100.0
	n	10,639	2,717	1,088	1,189

The personal illness factor consists of five variables; timing of the first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider, place of delivery and number of examinations during antenatal care, as seen in (Table 4. 5).

According to the timing of first antenatal check variable, no antenatal visit category is different throughout consanguinity types, wherein not related marriage type is the least at 8.9%, while there is an increase amongst women who have some kind of consanguinity. First cousin marriage type stands at 12.8%, second cousin marriage type at 11.5%, and other relative marriage type is at 9.3%. Women having a medical visit in the first three months of their pregnancy are the category that varies throughout the consanguinity types, wherein the ratio is 55.8% for not related marriage type, followed by second cousin marriage type at 54.0%. There is decreasing similarity for first cousin and other relative marriage types with 51.1% and 51.3%, respectively. From this data, it is clear that women in Egypt prefer to have checkups in this time period. From the fourth month until the end of their pregnancy, about 10% of women are checked for the first time, whereas the not related marriage type slightly increases to 10.7%, while first cousin marriage type is close to 11.2%, second cousin is 10%, and other relative marriage type stands at 13.7%. “Don’t know” category is less than 1% of total. Notably, around a quarter of all women haven’t had any medical checkup throughout their pregnancy, or the question is not asked of them, and while two thirds of women do attend a medical check during their pregnancy, its timing varies.

According to the number of antenatal visits during pregnancy variable, the majority of women, about 80%, make more than four visits for medical checks during their pregnancy. The number of antenatal visits varies according to consanguinity types, wherein 1-2 antenatal visits show slight differences between not related and related marriage types, not related marriage being the lesser among them at 3.2%. First cousin and second cousin groups exceed this percentage by 0.1% to 0.6%, but other relative is close with 4.3%. The category of 3-4 antenatal visits varies for consanguinity types, but it is less than 11.5%, with the same mode of five visits or more percentage distribution across consanguinity types. According to types of marriage, not related marriage is the largest group with 77.6%, followed by other relative marriage type, while consanguineous marriage is dropping to the lowest percentage for the first cousin marriage type with 72.0%. Generally, most women had checkups fewer than four times during their pregnancy, while about 10% of total women are not checked at all.

According to antenatal care variables, there are differences in the ratios between consanguinity types related to the place (or person) at which they prefer to have their antenatal care provided. The majority of women prefer to have their antenatal care provided by a private doctor, and about more than three fourths of total women fall into this category. Women in the not related union type prefer private doctors at a proportion of 84.0%, while second cousin and other related union types are slightly lower with 79.7% and 75.6%, respectively. First cousin union type shows slightly lower numbers preferring private doctors, with 76.5%, while antenatal care through a nurse or *daya* are less preferred among them, at 10.0% or lower. Generally, women in the not related union type have slightly lower ratios than consanguinity types.

For number of examinations during antenatal care, around half of women were weighed, had blood pressure taken, urine samples taken and blood samples taken, with more than 60.0% of the total receiving these services. Here, there are slight differences between consanguinity types according to the number of examinations during antenatal care variables category. One or two examinations during antenatal care variable shows more than 10% of total, with increasing ratios among other relative union type, at 14.9%. Other related union types show decreasing ratios are close to this percentage, with 13.3% for first cousin and 12.9% for second cousin union. The majority of women have taken 3-4 examinations during antenatal care with around 50% of total, but with slight differences among consanguinity types where not related union type has 54.1%, and first cousin union type has 47.3%, while second cousin and other relative unions have similar percentages. Medical number of examinations during antenatal care variable within not related unions has the highest ratios compared to related unions types.

The location of delivery varies according to marital union types, where home as a place of delivery is less used by the not related union type, at 11.5%, while this ratio increases for first cousin union type to 16.5%. Second cousin union type stands at 16.0%, and other relative union type is the highest with 18.7%. The not related union type has an increasing preference for using public and private sector health facilities, more than any other union types. Public sector health facilities are used at a proportion of 26.3% for not related union type, dropping to 24.6% for first cousin type, followed by second cousin and other related union types at 23.8% and 22.8%, respectively. Private sector health facilities are the most used by women overall, with about two thirds of them preferring this location for delivery. This ratio varies according to marital union

type, wherein not related unions are the highest among them with 61.8%, and related union types drop to less than 60% of total.

Table 4.5: Percentage Distribution of Personal Illness Variables by Consanguinity

Personal Illness variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Timing of the first antenatal check	No Antenatal visit	8.9	12.8	11.5	9.3
	1-3	55.8	51.1	54.0	51.3
	4-6	9.2	9.7	7.6	11.6
	7+	1.5	1.4	2.4	2.1
	Don't know/Missing	0.2	0.0	0.2	0.2
	Question not asked	24.4	24.9	24.3	25.4
	Total	100.0	100.0	100.0	100.0
	n	10,658	2,731	1,088	1,188
Number of antenatal visits during pregnancy	None	8.9	12.8	11.5	9.3
	1-2	3.2	3.3	3.8	4.3
	3-4	9.7	11.5	9.1	10.8
	5+	77.6	72.0	75.2	74.8
	Don't know	0.7	0.4	0.5	0.8
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,088	1,189
Antenatal care provider	No Antenatal care	8.9	12.8	11.5	9.3
	Doctor	84.0	76.5	79.7	75.6
	Nurse/Midwife	2.4	2.9	2.6	5.3
	Daya and others	4.8	7.8	6.2	9.8
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,089	1,188
Place of delivery	Home	11.5	16.5	16.0	18.7
	Public sector health facilities	26.3	24.6	23.8	22.8
	Private sector health facilities	61.8	58.4	59.7	58.2
	Other	0.5	0.5	0.6	0.3
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,730	1,088	1,188
Number of examinations during antenatal care	0	34.9	39.4	37.7	36.4
	1-2	11.0	13.3	12.9	14.9
	3-4	54.1	47.3	49.3	48.7
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,731	1,089	1,188

Tradition/norms/attitude variables consists of seven variables; cohabitation duration (grouped), literacy, media exposure, ideal number of children (grouped), decision maker for using contraception, number of reasons for which wife-beating is justified and number of decisions in which women participate. These complex and extensive variables will help in understanding women's characters, and how these tradition/norms/attitude variables are distributed across consanguinity in Egypt, (see Table 4. 6).

According to the marriage duration variable it is apparent that most of marriage duration is located inside the 5-14 years group, followed by less than 5 years, then 15-24 years group and 24 tears and over. Marriage duration ratios also vary in distribution according to consanguinity types, wherein the not related type for less than 5 years group is the highest at 32.3%, while first cousin union type declines to 25.2%, second cousin union type is 27.8% and other relative is the lowest ratio among them with 24.6%. For the between 5-14 years of marriage duration, first cousin and other relative union types exceed 60%, while second cousin union type is 55.6% and not related union type is 57.0%. In the 15-24 years group, the not related union type is the lowest ratio among them with 9.9%, while second cousin union type records the highest ratio with 14.8%, followed by other relative and first cousin union types with 12.8% and 12.5%, respectively. The 25 years and over category shows less 2% for all, with only slight differences between union types.

The literacy variable is an interesting one. It reveals significant differences between union types according to the ability of reading, wherein 78.2% of the not related union type is able to read whole sentence, while this ratio declines amongst those who have relative unions. There is a decline in literacy to 70.6% for the first cousin union type, 70.8% for other relative union type, and slight increase with the 73.7% for second cousin union type. The next ratios reflect the can't read at all category, wherein not related unions is the lowest with 17.6%, while first cousin marriages are the highest with exactly one quarter of the total, followed by other relative union type with 24.4%. However, literacy in second cousin union type declines to 21.3%. The able to read only parts of sentence category has no significant differences in ratios amongst types of consanguinity, and this category is below 5% of total for all groups.

Table 4.6: Percentage Distribution of Tradition/Norms/Attitude Variables by Consanguinity

Tradition/Norms/Attitude variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Cohabitation duration (grouped)	Less than 5 years	32.3	25.2	27.8	24.6
	5-14	57.0	61.1	55.6	61.6
	15-24	9.9	12.5	14.8	12.8
	25 and over	0.8	1.1	1.7	0.9
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,730	1,088	1,189
Literacy	Cannot read at all	17.6	25.0	21.3	24.4
	Able to read only parts of sentence	4.1	4.3	4.8	4.6
	Able to read whole sentence	78.2	70.6	73.7	70.8
	Blind/visually impaired	0.0	0.1	0.2	0.2
	Total	100.0	100.0	100.0	100.0
	n	10,655	2,731	1,088	1,188
Media exposure	0-1	70.1	74.2	71.5	78.3
	2	24.1	21.8	24.4	18.3
	3	5.8	4.0	4.1	3.4
	Total	100.0	100.0	100.0	100.0
	n	10,652	2,731	1,088	1,188
Ideal number of children (grouped)	less than 2	2.3	1.5	2.4	2.8
	2-3	70.6	58.0	59.7	58.0
	4-5	20.6	30.6	29.8	33.6
	6+	3.0	5.2	4.3	3.2
	Non-numeric response	3.5	4.7	3.8	2.4
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,088	1,189
Decision maker for using contraception	Mainly woman	13.7	13.8	12.1	13.9
	Mainly husband	1.4	1.4	0.8	0.6
	Joint decision	49.1	41.1	42.2	45
	Other	0.2	0.1	0.1	0.3
	Not married/not using contraception	35.7	43.6	44.8	40.3
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,732	1,088	1,189
Number of reasons for which wife-beating is justified	0	66.9	55.8	58.3	54.2
	1-2	19.7	22.3	21.7	25.0
	3-4	10.1	15.3	13.2	15.2
	5	3.4	6.6	6.8	5.6
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,088	1,188
Number of decisions in which women participate	0	10.3	13.5	15.9	11.5
	1-2	20.2	22.8	20.3	23.2
	3	16.5	18.5	17.6	18.4
	4	53.0	45.2	46.2	46.9
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,087	1,188

For the women not reading newspapers or magazines, not watching television, nor listening to radio (media exposure) variable, their distributions vary according to consanguinity types, and not related union type is the lowest for this category with 70.1%. Relative unions have higher ratios compared to other relative union type at 78.3%. Women who are in not related unions and show interest in up to three media make up 29.9% of the total, while that ratio declines for first cousin, second cousin and other relative union types, at 25.8%, 28.5% and 21.7%, respectively.

According to the ideal number of children variable, most women prefer to have 2-3 of children, followed by 4-5 children of total being less than 10% of the rest. The distribution of the ideal number of children is different from one consanguinity type to another, particularly for the not related union type, wherein 2-3 children is preferred 70.6% of the time, with an observable decline in this ratio for first cousin, second cousin and other relative union type at less than 60.0% of total. This is in contrast to the 4-5 children category where there is a decline in not related type to 20.6%, while related union types are at about 30% or more. Clearly, there is a significant difference between not related union type and related union type when it comes to the ideal number of children.

For the number of decisions in which women participate, the majority are participants with four decisions; not related unions are the highest among them with 53.0%, while first, second and other relative unions come after with 45.2%, 46.2% and 46.9%, respectively.

Household level has one variable in this study; the wealth index. Community level variables consist of three components; religion, type of place of residence and region, as shown in Table 4.7.

Through the wealth index variable, it's observable that there is a continuous increase from the poorest at 14.8% to the highest ratio for middle class, standing at 24.9%, and a decline again along the curve to 19.8% being from the richest category and part of the not related union type. The same distribution happens with other relative union, but not with the first and the second cousin union types. In particular, related union types are poorest compared to not related union type, with at least 10%, while the not related are richest, with at least 10% for each type. The four types of consanguinity are similar at the middle of the curve. Obviously, there are

associations between wealth index and consanguinity. In other words, the women who have related union type usually have a lower wealth index.

There are no significant differences according to religion. The ratios are almost the same with a little variance, where all types for Muslims centered around 96.0%, and 4.0% for Christians, the significant different between Muslims and Christians being due to the total populations for each of those groups.

Table 4.7: Percentage Distribution of Household and Community-Level Variables by Consanguinity

Household and Community-Level variables	Categories	Consanguinity			
		Not Related	First Cousin	Second Cousin	Other Relative
Wealth index	Poorest	14.8	24.2	27.7	23.8
	Poorer	17.9	22.8	22.7	24.6
	Middle	24.9	24.9	23.7	26.8
	Richer	22.6	18.5	16.1	16.1
	Richest	19.8	9.6	9.8	8.8
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,088	1,188
Religion	Muslim	96.9	96.0	96.7	95.9
	Christian	3.0	4.0	3.0	3.8
	Other	0.1	0.1	0.3	0.3
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,732	1,087	1,188
Type of place of residence	Urban	35.0	24.0	20.8	19.9
	Rural	65.0	76.0	79.2	80.1
	Total	100.0	100.0	100.0	100.0
	n	10,660	2,731	1,088	1,188
Region	Urban governorates	12.1	6.5	6.7	5.3
	Urban Lower Egypt	11.1	5.2	5.6	4.1
	Rural Lower Egypt	41.6	29.7	35.3	30.9
	Urban Upper Egypt	11.3	11.8	8.1	9.9
	Upper Egypt Rural	23.0	45.7	43.5	48.9
	Frontier governorates	1.0	1.1	0.8	0.8
	Total	100.0	100.0	100.0	100.0
	n	10,659	2,732	1,088	1,188

According to type of place of residence variable, there are observable differences between urban and rural locations due to the geographical distribution of the population. There are also significant differences between union types, where not related union is increasing in urban places with 35.0%, while first cousin is 24.0%, second cousin is 20.8% and other relative is 19.9%. Relative unions, by contrast, are increasing in rural places, with 76.0% for first cousin

union type, 79.2% for the second cousin union type and 80.1% for other relative union type, while the ratios are decreasing to 65.0% for non-related union type. In other words, consanguinity is increasing in rural areas and declining in urban zones.

The region variable shows a significant difference among consanguinity types, where not related union type is increasing in the urban governorates at 12.1%, more than double the ratio for each types of related unions. It is the same case in Urban Lower Egypt and Rural Lower Egypt. The four marital types have close ratios in Urban Upper Egypt, but Rural Upper Egypt related union types are doubled compared to not related union type, with 45.7% for first cousin union type, 43.5% for second cousin union type and 48.9% of other related union type, while not related type stands at 23.0%. Frontier governorates have about 1% of total for each type. Clearly, there is an association between regions and consanguinity.

Up to now, the study has discussed the percentage of covariates by consanguinity as column percentages. The distribution of consanguinity by different levels of variables as row percentages is given in APPENDIX 1.

4.2. EARLY AGE MORTALITY

4.2.1. Early age Mortality in Egypt

Trends in early age mortality in Egypt have shown high values for nearly half a century. In the period between 1965- 1969 according to EFS-80; neonatal mortality rates and infant mortality rates were 63 and 141 per thousand, respectively. Those high rates declined over time t 14 and 22 by 2010-2014 according to 2014 EDHS, as shown in Table 4.8.

Early childhood mortality rates by socioeconomic characteristics for the 10-year period preceding the survey are reviewed in Table 4.9.

Urban region has a clear fall in its rates at 13, 7, and 20 comparing to rural region at 18, 11, and 29 for NNMR, PNNMR and IMR, respectively. Particularly, Urban Lower Egypt rates at 10, 9 and 19 comparing to Rural Upper Egypt at 21, 14 and 35 for NNMR, PNNMR and IMR, respectively.

Table 4.8: Trends in early childhood mortality from various selected surveys, Egypt 1965-2014

Reference period	Approximate midpoint	Survey	NN Mortality	Infant mortality	Under-five mortality
2010-2014	2012	2014 EDHS	14	22	27
2005-2009	2007	2014 EDHS	19	30	33
2004-2008	2006	EDHS-08	16	25	28
2001-2005	2003	EDHS-05	20	33	41
2000-2004	2002	2014 EDHS	19	33	39
1999-2003	2001	EDHS-08	19	33	39
1996-2000	1998	EDHS-05	26	48	59
1996-2000	1998	EDHS-00	24	44	54
1994-1998	1996	EDHS-08	21	41	54
1991-1995	1993	EDHS-05	32	60	81
1991-1995	1993	EDHS-00	34	66	84
1991-1995	1993	EDHS-95	30	63	81
1988-1992	1990	EDHS-92	33	62	85
1986-1990	1988	EDHS-00	37	74	103
1986-1990	1988	EDHS-95	44	82	110
1984-1988	1986	EDHS-88	39	73	102
1983-1987	1985	EDHS-92	51	97	130
1981-1985	1983	EDHS-95	45	97	139
1979-1983	1981	EDHS-88	58	120	167
1978-1982	1980	EDHS-92	48	108	157
1975-1979	1977	EFS-80	59	132	191
1974-1978	1976	EDHS-88	53	124	203
1970-1974	1972	EFS-80	67	146	238
1965-1969	1967	EFS-80	63	141	243

Source: EDHS2014: Ministry of Health and Population et al., 2015

Moving to other characteristics, we find that higher educated mothers have the lowest rates of infant mortality at 14, 8 and 21 when compared to non-educational mothers at 21, 13 and 34 for their NNMR, PNNMR and IMR, respectively.

The last background characteristic is the wealth quintile, and it shows that the highest wealth groups have the lowest rates at 11, 6 and 18 compared to the lowest wealth group at 23, 13 and 36 for their NNMR, PNNMR and IMR, respectively.

According to EDHS-2014, NNMR, PNNR, IMR, CMR and U5MR decreased though the last 15 years from 19, 13, 33, 7 and 39, to reach 14, 8, 22, 5 and 27 during the last four years, respectively, as shown in Table 4.10.

Table 4.9: Early childhood mortality rates by socioeconomic characteristics for the 10-year period preceding the survey, by background characteristics, Egypt 2014

Background characteristic	Neonatal mortality (NN)	Post-neonatal mortality (PNN)	Infant mortality (1q0)	Child mortality (4q1)	Under-five mortality (5q0)
Urban-rural residence					
Urban	13	7	20	3	23
Rural	18	11	29	5	34
Place of residence					
Urban Governorates	14	4	17	2	20
Lower Egypt	14	9	23	3	26
Urban	10	9	19	2	21
Rural	16	8	24	4	28
Upper Egypt	19	13	32	6	38
Urban	14	8	23	5	27
Rural	21	14	35	7	42
Frontier Governorates	12	7	19	6	25
Mother's education					
No education	21	13	34	7	41
Some primary	21	17	38	4	42
Primary complete/some secondary	17	9	27	4	31
Secondary complete/higher	14	8	21	3	25
Wealth quintile					
Lowest	23	13	36	6	42
Second	16	12	28	6	34
Middle	16	10	25	4	29
Fourth	15	7	22	4	26
Highest	11	6	18	2	19

Source: Source: EDHS2014: Ministry of Health and Population et al., 2015

Table 4.10: Early childhood mortality rates by years preceding the EDHS-2014

Years preceding the survey	NNMR	PNNR	IMR	CMR	U5MR
0-4	14	8	22	5	27
5-9	19	11	30	3	33
10-14	19	13	33	7	39

Source: EDHS2014: Ministry of Health and Population et al., 2015

4.2.2. Level of Early Age Mortality Based on All Covariates

This section will explain how the determinants of the Mosley and Chen framework distribute on early age mortality, while observing and explaining the differences and similarities between the variables categories which are also distributed against neonatal mortality, post-neonatal mortality and infant mortality. The analyses carried out in this section, at the same time, serve to determine the reference category out of all variables used in the multivariate analyses.

Starting with individual determinant variables, the highest ratios of infant mortality are 2.7% for those parents who haven't received any education, while those who have higher education levels score the lowest infant mortality proportion, at 1.6%. Primary and secondary education levels have the same ratios of 2.25. It's noticeable that neonatal mortality ratios are higher than post-neonatal mortality ratios according to education levels, whereas education level categories of neonatal mortality ratios are higher, at 1.2%, while the same categories for post-neonatal mortality ratios are less than 1.1%. The differences between neonatal and post-neonatal mortality ratios for each education level categories are obvious in light of these statistics. There are also inverse associations between highest education level and early age mortality ratios apparent when the education level is increasing at the same time that early age mortality appears to be decreasing in the dataset, and vice versa; for neonatal mortality, the no education level category has the highest ratio at 1.6%, while the higher education category is the lowest at 1.2%. The same holds true for post-neonatal and infant mortality ratios. Primary and secondary education levels are close to each other with 1.3% and 1.4% for neonatal mortality and 1.1% and 0.8% for post-neonatal mortality, respectively, see (Table 4.11).

According to the husband's education level variable, there are significant differences between the husband's education level categories and early age mortality types. Husband has no education level has the highest ratio for each early mortality type, wherein neonatal mortality is 1.9%, post-neonatal mortality is .09%, and 2.8% for infant mortality. Husband with higher education level has the lowest ratios, at 1.2%, 0.5% and 1.7% for neonatal, post-neonatal and infant mortality, respectively. Also, it's noteworthy that neonatal mortality ratios are higher than post-neonatal ratios for the same categories, wherein for the no education category it's 1.9% for neonatal mortality, while it is 0.9% for post-neonatal mortality. For the primary education

category, the ratios are doubled for neonatal mortality compared to post-neonatal mortality, with 1.2%, and the same holds true for secondary and higher education level categories.

Almost a majority of women haven't worked outside the home according to respondent's occupation variable. It shows no similarity between respondent's occupation categories for early age mortality types, where infant mortality ratios are 2.2%, 1.8%, 1.3% and 2.1% for not working. Working in agriculture, working in services and working in manufacturing, respectively, also gave neonatal and post-neonatal mortality ratios that are different for respondent's occupation categories. It is apparent that neonatal ratios are higher than post-neonatal mortality ratios when compared the same categories of respondent's occupation. It's also noticeable that women working in agricultural sectors have the lowest ratios for early age mortality types, followed by women working in service industries. Those not working or working in manufacturing have the highest ratios among this group, but it might be due to the lesser total number of workers in the population of those categories.

A key difference is found between women having health insurance and those not having insurance, wherein infant mortality proportions are 2.2% and 1.0% for not covered and covered by health insurance, respectively. A difference is apparent here between neonatal and post-neonatal mortality ratios. For those not covered by health insurance, the ratios are 1.4% and 0.8%, respectively, but this gap does not exist for women who have health insurance, where the ratios are 0.5% and 0.4% for neonatal and post-neonatal mortality, respectively.

According to the age group variable, there is an association between age groups and infant mortality. Higher age for women correlates to lower early age mortality proportions and vice versa, with early age mortality standing at 2.9%,2.0% and 1.6% of women less than 25, 25-34 and 35 years and over, respectively. When women's age increases, the gap between neonatal and post-neonatal mortality also increases, to 1.6% and 1.3% for less than 25 years old category, while it is 1.2% and 0.5% for the 35 years old and over category. In general, neonatal mortality ratios are higher than post-neonatal mortality ratios and there are declining ratios of early age mortality as women's ages increase.

Table 4.11: Percentage of Deceased Children in Infancy Period by Individual-Level Variables

Individual variables	Categories	NN	PNN	IM	n
Educational level of women	No education	1.6	1.1	2.7	2798
	Primary	1.3	1.0	2.2	1341
	Secondary	1.4	0.8	2.2	9024
	Higher	1.2	0.4	1.6	2506
Education level of husband	No education	1.9	0.9	2.8	2026
	Primary	1.2	0.6	1.8	2095
	Secondary	1.4	0.9	2.2	8886
	Higher	1.2	0.5	1.7	2660
Working status of women	Not working	1.4	0.8	2.2	13628
	Working in agricultural	1.2	0.6	1.8	328
	Working in services	1.3	0.0	1.3	554
	Working in manufacture	1.6	0.5	2.1	1159
Coverage by health insurance	No	1.4	0.8	2.2	14624
	Yes	0.5	0.4	1.0	1044
Age of women	less than 25 years old	1.6	1.3	2.9	3929
	25-34	1.3	0.7	2.0	9349
	over 35 years old	1.2	0.5	1.6	2390

According to maternal determinant variables, the birth order variable shows an increase in early age mortality among births whose birth order are amongst the first in the family. This is higher than other orders, where the ratio decreases continuously throughout the top-orders, except the seventh in birth order and over category, where infant mortality proportions are 2.6%, 2.0% and 1.6% for first birth order, 2-3, and 4-6 birth order, respectively. Neonatal mortality ratios are higher than post-neonatal mortality ratios for all categories except the seventh plus category, and the ratios are similar; neonatal mortality ratios compared to post-neonatal mortality are 1.6%, 1.3% and 1.0% compared to 1.0%, 0.7%, and 0.6% for first birth order, 2-3, and 4-6 birth order, respectively, (Table 4.12)

According to the months since preceding birth variable, there is a marked increase of early age mortality for the category of less than two years since preceding birth category. For the same category, neonatal mortality tracks 2.3% higher than post-neonatal mortality, with 1.3%, while there is almost no difference amongst the 24-47 months since preceding birth category with 0.8% for neonatal mortality and 0.6% for post-neonatal mortality. From these ratios it could

be said that the risk of early age mortality proportion increases sharply during the first 24 months since preceding birth.

The risk of death increases sharply through the 24 months succeeding birth interval for both the neonatal mortality with a 5.7% ratio, and 2.7% for post-neonatal mortality according to the succeeding birth interval variable. Neonatal mortality ratios are more than double that of post-neonatal mortality ratios through all months succeeding birth interval categories. It is noteworthy that 8.4% of infant mortality at 7-23 months succeeding birth interval is the highest ratio recorded in this study.

Table 4.12: Percentage of Deceased Children in Infancy Period by Maternal Variables

Maternal variables	Categories	NN	PNN	IM	n
Birth order	First birth order	1.6	1.0	2.6	4828
	2-3	1.3	0.7	2.0	7806
	4-5	1.0	0.6	1.6	2496
	6+	1.5	0.7	2.4	538
Months since preceding birth	First birth	1.9	1.0	2.8	4962
	7-23	2.3	1.3	3.6	2101
	24-47	0.8	0.6	1.4	5135
	over 4 years	1.1	0.3	1.4	3470
Succeeding birth interval	7-23	5.7	2.7	8.4	1532
	24-47	1.5	0.8	2.3	2320
	48-59	1.9	0.6	2.5	161
	Open birth interval	0.8	0.5	1.3	11655
Mother's age at birth	<20	2.0	1.8	3.7	1469
	20-34	1.3	0.7	2.0	12867
	>35	1.7	0.4	2.1	1332

For mother's age at birth, it found that infant mortality for those less than 20 years old is the highest, while for those aged between 20 to 34 years old at birth is the lowest with 2.0%, generally neonatal percentages for all categories are highest comparing to post-neonatal at the same ages.

According to environmental determinant variables, the source of drinking water has reduced early age mortality for those who use improved sources when compared to those who

have a non-improved source. The infant mortality ratio is 2.1% for those have improved source and 3.2% for those with only a non-improved source. Neonatal mortality also has higher ratios than post-neonatal, where neonatal mortality ratios are 1.3% and 1.9% compared to post-neonatal mortality ratios, which are 0.7% and 1.3% for improved and non-improved source of drinking water, respectively. See Table 4.13.

Type of toilet facility shows a decline in early age mortality for those who have improved sources, with a high ratio of neonatal mortality of 1.3%, more than post-neonatal mortality with 0.7% for those have improved sources.

Table 4.13: Percentage of Deceased Children in Infancy Period by Environmental Variables

Environmental variables	Categories	NN	PNN	IM	n
Source of drinking water	Improved	1.3	0.7	2.1	14609
	Non-improved	1.3	1.3	2.9	374
	Not a dejure resident	1.9	1.3	3.2	679
Type of toilet facility	Improved	1.3	0.8	2.1	13736
	Non-improved	2.0	0.5	2.5	1248
	Not a dejure resident	1.9	1.3	3.2	679
Time to obtain drinking water	Water on premises	1.3	0.7	2.0	13807
	Less than 30 minutes	1.9	1.1	3.0	1061
	30 minutes or longer	0.0	0.9	0.9	113
	Don’t Know	*	*	*	8
	Not a dejure resident	1.9	1.3	3.2	679
Frequency of someone smoking inside the household	Daily	1.5	0.7	2.2	7057
	Weekly	2.1	1.5	3.6	194
	Monthly	1.6	1.1	3.2	185
	Never	1.2	0.8	2.0	7548
	Not dejure resident	1.9	1.3	3.2	679

According to the time to obtain drinking water variable, there are differences between early age mortality among the variable categories, where the water on premises category has less effect on early age mortality types than those needing less than 30 minutes to obtain drinking water. Those who have water on premises show ratios of 2.0%, with less than 1.0% for those who do not.

For the number smoking inside the house weekly or monthly, while the majority are daily or never smoking inside the house, there are differences between the variable categories and neonatal mortality have higher ratios than post-neonatal mortality. Never smoking inside the house category has lowest effect on early age mortality types, 1.5%, 0.7% and 2.2% for neonatal, post-neonatal and infant mortality, while smoking inside the house carries risks for early age mortality, for example; 2.1%, 1.5% and 3.6% for neonatal, post-neonatal and infant mortality when someone smokes inside the house weekly.

According to the nutritional availability determinant variables, births average or larger have the lowest risk of early age mortality, and, post-neonatal mortality ratios are less than neonatal mortality ratios. Very small and smaller births have greatest effects on early age mortality; infant mortality for births which are very small have an 8.3% ratio compared to those that are smaller in size which have 3.6%. Also, there is a noticeable a gap between very small and average for neonatal mortality, at 7.5% and 0.8%, respectively, see (Table 4.14).

According to the breastfeeding variable, there are clear differences among breastfeeding categories when it comes to early age mortality. For never breastfed, the risk of death is quite high for births than ever breastfeeding, with neonatal mortality ratios of 15.7% and 0.7%, respectively. Generally, the breastfeeding variable has effects on neonatal mortality higher than on postnatal mortality.

Table 4.14: Percentage of Deceased Children in Infancy Period by Nutritional Availability Variables

Nutritional Availability	Categories	NN	PNN	IM	n
Size of child at birth	Very small	7.5	0.7	8.3	743
	Smaller than average	2.9	0.8	3.6	1844
	Average or larger	0.8	0.8	1.5	13026
	Don't know/missing	14.5	3.6	16.4	55
Duration of breastfeeding	Never breastfed*	15.4	2.6	17.8	899
	Ever breastfed	0.7	1.0	1.7	10169
	Currently breastfeeding	0.0	0.0	0.0	4565

According to personal illness determinant variables, the timing of first antenatal check has a marked effect early age mortality risks when compared to those who conduct an antenatal check and those who don’t. Infant mortality for those who don’t conduct antenatal checks is

2.0%, while for those who do attend their first antenatal check at any month of pregnancy shows an infant mortality proportion of less than 1.6%. Practically all women who conduct a first and 2-3 month visit are at 1.1% according to infant mortality, and neonatal mortality ratios are higher than post-neonatal mortality in general in these women, except for the 4+ category. For those who conduct their first antenatal check through 4+ months, post-neonatal mortality ratio is more than double than for those who conduct their first antenatal check in the first three months, in contrast to neonatal mortality ratios (see Table 4.15).

Table 4.15: Percentage of Deceased Children in Infancy Period by Personal Illness Variables

Personal illness	Categories	NN	PNN	IM	n
Timing of the first antenatal check(months)	No Antenatal visit	1.3	0.7	2.0	1534
	1-3	0.7	0.4	1.1	8546
	4-6	0.5	0.8	1.4	1471
	7+	0.0	1.6	1.6	245
	Don't know/Missing	0.0	0.0	0.0	29
	Question not asked	3.4	1.5	4.9	3843
Number of antenatal visits during pregnancy	None	1.3	0.7	2.0	1534
	1-2	1.0	1.0	1.9	519
	3-4	1.3	0.7	2.0	1573
	5+	1.4	0.8	2.2	11947
	Don't know	2.1	4.2	6.3	96
Antenatal care provider	No Antenatal care	1.3	0.7	2.0	1534
	Doctor	1.4	0.8	2.1	12809
	Nurse/Midwife	0.9	0.5	1.4	422
	Daya and others	2.1	0.9	3.0	903
Place of delivery	home	1.7	0.6	2.3	2068
	Public sector health facilities	2.0	0.9	3.0	4007
	Private sector health facilities	1.0	0.8	1.8	9519
	Other	1.4	2.7	4.1	74
Number of examinations during antenatal care	0	2.7	1.3	4.0	5638
	1-2	0.6	0.4	1.0	1854
	3-4	0.6	0.5	1.1	8175

The majority of women had an antenatal care visit at least 4 times during their pregnancy with a resulting 2.0% ratio infant mortality ratio. Examining the number of antenatal

visits during pregnancy shows there are differences between its categories, where 1-2 times for antenatal visits has the lowest ratio for early age mortality types, while 0 times and 3-4 times have similar ratios at 1.3% and 0.7% for neonatal and post-neonatal mortality. The don't know category is the highest among them, at 6.3% for infant mortality. Generally, neonatal mortality ratios are higher than post-neonatal mortality ratios for all numbers of antenatal visits during pregnancy. As for the antenatal care provider variable, it found that infant mortality has the lowest risk with 1.4% for those have provider by nurse, while *daya* recorded a higher percentage with 3.0% for infant mortality. Generally, neonatal mortality recorded high risk for this variable more than post-neonatal mortality.

Other place of delivery has the highest risk of infant mortality with 4.1%, but it might be due to the low number of women choosing this option, while private sector health facilities has the lowest risk on infant mortality with 1.8%, and home and public sector health facilities have slightly higher effects on infant mortality with 2.3% and 3.0%, respectively. In general, neonatal mortality ratios are high than post-neonatal mortality.

According to the number of examinations during antenatal care, those have more than 3 examinations during their antenatal time have the lowest risk for early age mortality, with 1.1% for infant mortality compared to the haven't had any type of examinations which carries a 4.0% death risk for infant mortality.

According to traditions/ norms/ attitude determinant variables, in respect to cohabitation duration, it found that for 15-24, and 25 years and over of marriage duration, these categories have the same lowest effect on infant mortality with 1.4%, while less than five years and 5-14 years of marriage duration have high ratios with 2.3% and 2.2%, respectively. Also, neonatal mortality ratios are higher than post-neonatal mortality ratios for all marriage duration categories, except the 25 and over category which has the same ratio with 0.7% for both. Post-neonatal mortality for less than five years and 5-14 years of marriage duration has same risk with 0.8% for both.

Table 4.16: Percentage of Deceased Children in Infancy Period by Tradition/Norms/Attitude Variables

Tradition/Norms/Attitude	Categories	NN	PNN	IM	n
Cohabitation duration (grouped)	Less than 5 years	1.5	0.8	2.3	4730
	5-14	1.4	0.8	2.2	9086
	15-24	1.0	0.4	1.3	1705
	25 and over	0.7	0.7	1.4	147
Literacy	Cannot read at all	1.5	1.1	2.6	3085
	Able to read only parts of sentence	2.1	0.9	3.0	666
	Able to read whole sentence	1.3	0.7	2.0	11904
	Blind/visually impaired	*	*	*	7
Media exposure	0-1	1.4	0.7	2.1	11210
	2	1.5	0.9	2.3	3642
	3	1.0	0.9	1.7	809
Ideal number of children (grouped)	less than 2	2.0	0.6	2.6	348
	2-3	1.3	0.8	2.1	10456
	4-5	1.5	0.7	2.2	3749
	6+	1.3	1.1	2.4	545
	Non-numeric response	1.4	0.4	1.8	570
Decision maker for using contraception	Mainly woman	0.9	0.4	1.4	2130
	Mainly husband	1.0	0.0	1.0	206
	Joint decision	0.9	0.4	1.3	7349
	Other	0.0	0.0	0.0	26
	Not married/not using contraception	2.1	1.4	3.5	5957
Number of reasons for which wife-beating is justified	0	1.2	0.7	1.9	9928
	1-2	1.5	0.8	2.2	3246
	3-4	1.5	0.9	2.4	1815
	5	2.8	1.6	4.4	678
Number of decisions in which women participate	0	1.6	1.6	3.2	1782
	1-2	1.3	0.8	2.1	3274
	3	1.9	0.4	2.4	2672
	4	1.2	0.7	1.9	7940

Able to read whole sentences category has the lowest effect on early age mortality with 2.0% for infant mortality, while those can't read at all is 2.6%. Those able to read only parts of sentences have the highest risk on early age mortality with 3.0% of infant mortality, but notably this category has a lower population in the group, about 666 women of total. Generally, neonatal mortality ratios are higher than post-neonatal mortality ratios according to literacy.

According to the media exposure variable, infant mortality for those interested in two types of media is the highest between other categories with 2.3%, while three media types category is the lowest risk with 1.7% for infant mortality.

According to the ideal number of children variable, neonatal mortality ratios are higher than post-neonatal mortality, while within neonatal mortality ratios there are similarities between 2-3, and 6+ categories with 1.3% each. Within infant mortality ratios, the 2-3 and 4-5 categories are close to each other, with 2.1% and 2.2%, respectively. The highest ratios are 2.6% of infant mortality for less than 2 children as an ideal number of children.

For neonatal mortality there are similarities between mainly respondent and joint decision categories, with 0.9% for both and the same for them within the post-neonatal mortality at 0.4%. Mainly husband category has the lowest risk on early age mortality with 1.0% of infant mortality proportion, but has fewer total numbers in the group. Generally, except the mainly husband category, there is a similarity among decision maker for contraception categories on early age mortality.

Number of reasons for which wife-beating is justified variable also has a difference among its categories; the risk increases for infant mortality when the number of reasons for which wife-beating is justified increases, and it is 1.9%, 2.2%,2.4%and 4.4% for 0, 1-2, 3-4 and 5 reasons for which wife-beating is justified.

According to the number of decisions in which women participate variable, zero-decisions in which women participate has the highest risk for infant mortality with 3.2%, while four decisions in which women participate is the lowest among them with 1.9%.

The wealth index demonstrates a continuous declining effect for increased wealth when it comes to early age mortality, where the poorest group records a 2.7% infant mortality proportion compared to richest, at 1.3%. Wealth index has more of an effect on neonatal mortality than post-neonatal mortality for all categories. For example, neonatal mortality is 1.8% while post-neonatal mortality is 0.9%, exactly half for the poorest according the wealth index. It is also notable that poorest, poorer and middle wealth classes on the index have the same effect on post-neonatal mortality, with 0.9% for poorer and 1.4% for middle wealth.

Generally, wealth index has an association with early age mortality, increasing with the poorest groups and decreasing for the richest, (see Table 4.17).

Table 4.17: Percentage of Deceased Children in Infancy Period by Household and Community Level Variables

Household and community level	Categories	NN	PNN	IM	n
Wealth index	Poorest	1.8	0.9	2.7	2820
	Poorer	1.4	0.9	2.3	3074
	Middle	1.4	0.9	2.4	3906
	Richer	1.3	0.6	2.0	3280
	Richest	0.9	0.4	1.3	2588
Religion	Muslim	1.4	0.8	2.1	15139
	Christian	1.2	1.6	2.7	511
	Other	*	*	*	18
Type of place of residence	Urban	1.2	0.5	1.7	4845
	Rural	1.5	0.9	2.4	10822
Region	Urban governorates	1.2	0.4	1.6	1599
	Urban Lower Egypt	0.8	0.6	1.4	1431
	Rural Lower Egypt	1.2	0.7	1.9	6000
	Urban Upper Egypt	1.5	0.6	2.0	1733
	Upper Egypt Rural	1.8	1.2	2.9	4752
	Frontier governorates	0.6	0.6	1.3	154

According to the religion variable, the Muslim category has slightly more risk effects at 1.4% compared to Christians at 1.2% for neonatal mortality. Contrastingly, post-neonatal mortality for the Christian group at 1.6% is double that of the Muslim group for postnatal mortality. Generally, infant mortality of Christians is higher than with Muslims.

Urban place of residence has low risk ratios when compared to rural places of residence, where infant mortality ratios are 2.1% and 2.7%, respectively. Neonatal mortality is still higher than post-neonatal mortality, at 1.2% and 1.5% of neonatal compared to 0.5% and 0.9% of post-neonatal mortality for urban and rural, respectively.

An examination of region types reveals differences between regions and among early age mortality types, where Frontier Governorates and Urban Lower Egypt are the lowest, at 1.3% and 1.4% respectively, while Rural Upper Egypt is the highest among all regions with

2.9% for infant mortality. Notice here that urban governorates and Rural Lower Egypt have the same effect on neonatal mortality with 1.2%, and Urban Lower Egypt and Urban Upper Egypt have the same effect on post-neonatal mortality, with 0.6%. In particular Rural Upper Egypt has the highest ratios ever amongst regions, with 1.8%, 1.2% and 2.9% for neonatal, post-neonatal and infant mortality respectively.

4.3. THE LINK BETWEEN CONSANGUINITY AND EARLY AGE MORTALITY

As presented in Table 4.18, all rates relating to early age mortality are distinctly higher among children born to women with first and second cousin marriages. Infant mortality rates are found to be 29 per 1000 and 43 per 1000 among children to women with first and second cousin marriages respectively, compared with 19 per 1000 among children to women without consanguineous marriage. In line with these results, percentage distribution of deceased children is also higher for children of women in the first and the second cousin marriages (Table 4.19).

Table 4.18: Early age Mortality Rates by Type of Consanguineous Marriage

Kind of relationship	Early age mortality rates				
	NNMR	PNNMR	IMR	CMR	U-5MR
Not related	13	6	19	3	22
First cousin	17	12	29	8	36
Second cousin	19	23	43	6	49
Other relative	11	8	19	8	28
Egypt	14	9	22	5	27

Table 4.19: Percentage Distribution of Deceased Children in Infancy Period by Kind of Relationship

Kind of relationship	Early age mortality			
	NN	PNN	IM	Number of Cases
Not related	1.3	0.6	1.9	10660
First cousin	1.7	1.1	2.8	2731
Second cousin	1.9	2.1	4.0	1088
Other relative	1.1	0.7	1.8	1189

This chapter has provided eight different determinants of the Mosley and Chen framework in separate tables for each determinant which also encompasses a set of homogenous variables. The distribution of several variables on consanguinity types and early age mortality types have shown risk effects for each variable category and provided the framework for understanding the risks of consanguinity types on early age mortality, where there are significant increases in the percentages of neonatal mortality, post-neonatal mortality and infant mortality among children whose parents have a some form of consanguinity. These increased risks are demonstrably higher than who are in not related marriages.

The next chapter will discuss the logistic regression analysis of consanguinity types on neonatal mortality, post-neonatal mortality and infant mortality, after controlling for the Mosley and Chen framework variables, in order to show how are types of consanguinity have affected early age mortality in Egypt over the last five years, using EDHS 2014 datasets.

CHAPTER 5

LOGISTIC REGRESSION ANALYSIS

5.1. LOGISTIC REGRESSION MODELS FOR PREDICTING THE RISK OF NEONATAL MORTALITY

The first model is called the basic model and it includes consanguineous marriage as an independent variable on NN mortality. The consanguinity variable is almost significant, standing at 0.052%, while other relative marriage type and second cousin marriage type are not significant factors; first cousin marriage type is the only category among the consanguinity variable's categories which does qualify as significant, at 0.012%. This starting point gives us certain predictions that the following models might be non-significant for the consanguinity variable. Although second cousin marriage type is not significant, it has a 1.32 times higher risk on NN mortality compared to not related marriage type. Further, first cousin has a risk on NN mortality 1.487 times higher than not related marriage type. The model's R-square is 0.003 and the constant is 0.013, as shown in Table 5.1.

Table 5.1: Logistic Regression Model for Predicting the NN Mortality, Basic Model

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.052	-
	Not related	-	1.000
	First cousin	0.012	1.487
	Second cousin	0.249	1.320
	Other relative	0.601	0.863
	Constant	0.000	0.013
	R^2-Negelkerte	-	0.003

In the second model, the variables related to individual level (education level of women, education level of husband, working status of women, coverage by health insurance and age of women) were introduced into the NN mortality regression equation, as shown in Table 5. 2.

Consanguineous marriage is not a significant variable at this stage. Only the coverage by health insurance variable is in the equation in this model, and the variable is significant at 0.023%, while those who have no coverage by health insurance have a 2.167 times higher risk on NN mortality compared to those covered by health insurance. The model's R-square is 0.003 and the constant is 0.007, as shown in Table 5.2.

Table 5.2: Logistic Regression Model for Predicting the NN Mortality, Model for Individual Level Variables Added

Variable name	Categories	Sig.	Exp(B)
Coverage by health insurance	No	0.023	2.167
	Yes	-	1.000
	Constant	0.000	0.007
	R^2-Negelkerte	-	0.003

In the third model, the variables related to maternal factors (birth order, months since preceding birth, succeeding birth interval and mother's Age at birth) were introduced into the NN mortality regression equation, as shown in Table 5. 3.

The coverage by health insurance variable is significant here; it increases to 0.035% on the third model, and for those who have no coverage there is a 2.064 times higher risk on NN mortality compared to those covered by health insurance, with a slight decreasing in this model compared to the previous one.

Birth order variable in this model is absolutely significant. The first in birth order category is statistically significant, as it carried less than one fifth of the risk for NN mortality compared to fourth and fifth in birth order. By contrast, second and third in birth order category is not significant, but has a risk effect lower by 0.994times compared to fourth and fifth in birth order in birth order. Only sixth and above in birth order category has a risk effect higher by 1.426 times compared to fourth and fifth in birth order in birth order, but it is not significant.

Months since preceding birth variable are also absolutely significant in the third model, and its categories are significant as well, except the 24-47 months since preceding birth category. It's noticeable that the first birth category has an extremely high risk of 6.432 times more than

over 4 years category when the latter is used as a reference on NN mortality. The 7-23 months category has relatively high risk 1.818 times more than over 4 years category, while 24-47 months category is the lowest among them with 0.719 times higher than reference category.

Succeeding birth interval variable is the last variable in the third model. It is also statistically significant and its categories are significant as well, except the 48-59 months succeeding birth interval category. It's noticeable that the 7-23 months succeeding birth interval category has an extremely high risk of 7.339 times more than open birth interval category when the latter is used as a reference on NN mortality. The 48-59 months category has relatively high risk 2.088 times more than open birth category, while 24-47 months category is the lowest among them with 1.828 times higher than reference category. The model's R-square is 0.090 and the constant is 0.004, as shown in Table 5.3.

Table 5.3: Logistic Regression Model for Predicting the NN Mortality, Model for Maternal Factors Added

Variable name	Categories	Sig.	Exp(B)
Coverage by health insurance	No	0.035	2.064
	Yes	-	1.000
Birth order		0.000	-
	First birth order	0.000	0.127
	2-3	0.979	0.994
	4-5	-	1.000
	6+	0.342	1.426
Months since preceding birth		0.000	-
	First birth	0.000	6.432
	7-23	0.006	1.818
	24-47	0.139	0.719
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	7.339
	24-47	0.003	1.828
	48-59	0.215	2.088
	Open birth interval	-	1.000
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.090

In the fourth model, the variables related to environmental contaminants (source of drinking water, type of toilet facility, time to obtain drinking water and frequency of someone smoking inside the household) were introduced into the NN mortality regression equation, as shown in Table 5. 4.

Table 5.4: Logistic Regression Model for Predicting the NN Mortality, Model for Environmental Variables Added

Variable name	Categories	Sig.	Exp(B)
Coverage by health insurance	No	0.035	2.065
	Yes	-	1.000
Birth order		0.000	-
	First birth order	0.000	0.127
	2-3	0.974	0.993
	4-5	-	1.000
	6+	0.343	1.425
Months since preceding birth		0.000	-
	First birth	0.000	6.433
	7-23	0.006	1.819
	24-47	0.140	0.719
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	7.337
	24-47	0.003	1.829
	48-59	0.216	2.086
	Open birth interval	-	1.000
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.090

In the fourth model, there are no noticeable differences observed by introducing the variables related to environmental contaminants into the model. Almost all the variables at this model have the same values comparing to the previous one with no exceptions. Even the model's R-square remains at 0.090 and the constant remains at 0.004, as shown in Table 5.4.

In the fifth model, the variables related with nutritional availability (size of child at birth and status of breastfeeding) were introduced into the NN mortality regression equation, as shown in Table 5.5.

Months since preceding birth variable is significant in the fifth model, but its categories are not significant. It's noticeable that 7-23 months category is the lone category of this variable that has relatively high risk at 1.544 times more than the over 4 years category, while first birth and 24-47 months categories have the lowest risks, with 0.835 and 0.852 times than reference category.

Succeeding birth interval variable is also statistically significant, but its categories are not significant, with the exception of the 7-23 months succeeding birth interval category. It's noticeable that 7-23 months succeeding birth interval category has an extremely high risk of 4.058 times more than open birth interval category when the latter is used as a reference on NN mortality. The 48-59 months category has relatively high risk 2.617 times more than open birth category, while the 24-47 months category is the lowest among them with 1.262 times higher than reference category.

Size of child at birth variable is absolutely significant in the fifth model, and its categories are absolutely significant, as well. Here, it is found that the very small category has an extremely high risk of 4.575 times more than the average or larger category when the latter is used as a reference on NN mortality. Also, smaller than average category has relatively high risk 2.139 times more than average or larger category.

Status of breastfeeding variable is the last variable in the fifth model. It is also statistically significant and its categories are significant, as well. It's noticeable that never breastfed category has an extremely high risk of 18.524 times more than ever breastfed category when the latter is used as a reference on NN mortality. The model's R-square is 0.347 and the constant is 0.004, as shown in Table 5.5.

Table 5.5: Logistic Regression Model for Predicting the NN Mortality, Model for Nutritional Availability Variables Added

Variable name	Categories	Sig.	Exp(B)
Months since preceding birth		0.013	-
	First birth	0.405	0.835
	7-23	0.069	1.544
	24-47	0.497	0.852
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	4.058
	24-47	0.276	1.262
	48-59	0.118	2.617
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	4.575
	Smaller than average	0.000	2.139
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed*	0.000	18.524
	Ever breastfed	-	1.000
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.347

* The high percentage of death among never breastfed children should be evaluated with caution due to the fact that the majority of the deaths in the first days of the life are mainly among the children deceased just before the initiation of the first breastfeeding.

In the sixth model, the variables related with personal illness control (timing of the first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider, place of delivery and number of examinations during antenatal care) were introduced into the NN mortality regression equation, as shown in Table 5.6.

Months since preceding birth variable is significant in the sixth model, but its categories are not significant. Through this model, we find that the 7-23 months' category remains the lone category of this variable that has relatively high risk at 1.537 times more than over 4 years' category, while first birth and 24-47 months categories remain have lowest risks with 0.894 and 0.848 times than reference category.

Succeeding birth interval variable is also statistically significant, but its categories are not significant, except the 7-23 months succeeding birth interval category. It's noticeable that 7-23 months succeeding birth interval category has an extremely high risk of 3.876 times more than open birth interval category when the latter is used as a reference on NN mortality. Also, the 48-59 months category has relatively high risk at 2.431 times more than the open birth category, while the 24-47 months category is the lowest among them with 1.198 times higher than reference category.

Size of child at birth variable is absolutely significant in the sixth model, and its categories are absolutely significant, as well. Here, it is found that the very small category has an extremely high risk of 4.504 times more than average or larger category when the latter is used as a reference on NN mortality. Also, smaller than average category has relatively high risk 2.147 times more than average or larger category.

Status of breastfeeding variable is statistically significant and its categories are significant, as well. It's noticeable that never breastfed category has an extremely high risk of 18.853 times more than ever breastfed category when the latter is used as a reference on NN mortality.

Place of delivery variable is the last variable in the sixth model. It is also statistically significant, but its categories are not significant, except for the home category. Here it is found that home category has a relative high risk of 1.820 times more than private sector health facilities category when the latter is used as a reference on NN mortality. Other health facilities category has relatively high risk 1.724 times more than private sector health facilities category, while public sector health facilities category is the lowest among them with 1.322 times higher than reference category. The model's R-square is 0.350 and the constant is 0.004, as shown in Table 5.6.

Table 5.6: Logistic Regression Model for Predicting the NN Mortality, Model for Personal Illness Variables Added

Variable name	Categories	Sig.	Exp(B)
Months since preceding birth		0.026	-
	First birth	0.610	0.895
	7-23	0.072	1.537
	24-47	0.485	0.848
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	3.876
	24-47	0.401	1.198
	48-59	0.152	2.431
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	4.504
	Smaller than average	0.000	2.147
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed	0.000	18.853
	Ever breastfed	-	1.000
Place of delivery		0.037	-
	Home	0.006	1.820
	Public sector health facilities	0.088	1.322
	Private sector health facilities	-	1.000
	Other	0.496	1.724
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.350

In the seventh model, the variables related with tradition /attitude / norms (cohabitation duration (grouped), literacy, media exposure, ideal number of children (grouped), decision maker for using contraception, number of reasons for which wife-beating is justified and number of decisions in which women participate) were introduced into the NN mortality regression equation, as shown in Table 5. 7.

In the seventh model, there are some limited noticeable differences observed by introducing the variables related with tradition /attitude / norms. Almost all the variables at this

model have similar values compared to the previous model with no exceptions, and even the model's R-square remains at 0.351 and the constant remains at 0.004, as shown in Table 5.7.

Table 5.7: Logistic Regression Model for Predicting the NN Mortality, Model for Tradition /Attitude / Norms Variables Added

Variable name	Categories	Sig.	Exp(B)
Months since preceding birth		0.026	-
	First birth	0.588	0.888
	7-23	0.077	1.527
	24-47	0.470	0.843
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	3.881
	24-47	0.380	1.208
	48-59	0.151	2.433
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	4.501
	Smaller than average	0.000	2.158
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed	0.000	18.879
	Ever breastfed	-	1.000
Place of delivery		0.036	-
	Home	0.006	1.819
	Public sector health facilities	0.086	1.325
	Private sector health facilities	-	1.000
	Other	0.496	1.724
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.351

In the eighth model, the household level includes the wealth index variable and the variables related with community level (religion, type of place of residence and region) were introduced into the NN mortality regression equation, as shown in Table 5.8.

Throughout the last model, there are also some limited noticeable differences observed by introducing the variables related with household level and community level. Almost all the variables in this model have similar values compared to the previous model with no exceptions, and even the model's R-square remains at 0.351 and the constant remains at 0.004, as shown in Table 5.8.

Table 5.8: Logistic Regression Model for Predicting the NN Mortality, Model for Household-Level and Community-Level Variables Added

Variable name	Categories	Sig.	Exp(B)
Months since preceding birth		0.026	-
	First birth	0.588	0.888
	7-23	0.077	1.527
	24-47	0.470	0.843
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	3.881
	24-47	0.380	1.208
	48-59	0.151	2.433
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	4.501
	Smaller than average	0.000	2.158
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed	0.000	18.879
	Ever breastfed	-	1.000
Place of delivery		0.036	
	Home	0.006	1.819
	Public sector health facilities	0.086	1.325
	Private sector health facilities	-	1.000
	Other	0.496	1.724
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.351

5.2. LOGISTIC REGRESSION MODELS FOR PREDICTING THE RISK OF POST-NEONATAL MORTALITY

The first model, called the basic model, includes consanguineous marriage as an independent variable on PNN mortality. The consanguinity variable is absolutely significant. First cousin marriage and second cousin marriage types have absolute significance with 0.002% and 0.00%, respectively, while other relative marriage type is the only category amongst the consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on PNN mortality, standing at some 3.497 times higher compared to not related marriage type, followed by first cousin which has a risk effect on PNN mortality 2.020 times higher than not related marriage type, while other relative has the lowest risk effect of 1.081 times higher than not related marriage type. Overall, the model's R-square is 0.019 and the constant is 0.005, as shown in Table 5.9.

Table 5.9: Logistic Regression Model for Predicting the PNN Mortality, Basic Model

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.002	2.020
	Second cousin	0.000	3.497
	Other relative	0.846	1.081
	Constant	0.000	0.005
	R^2-Negelkerte	-	0.019

In the second model, the variables related to individual level (education level of women, education level of husband, working status of women, coverage by health insurance and age of women) were introduced into the PNN mortality regression equation, as shown in Table 5.10.

Through this model, the consanguinity variable is absolutely significant. First cousin marriage and second cousin marriage types have absolute significance with 0.008% and 0.00%, respectively, while other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the

greatest risk on PNN mortality, some 3.225 times higher compared to not related marriage type, followed by first cousin which has a risk effect on PNN mortality 1.824 times higher than not related marriage type, while other relative has the lowest risk effect of 0.998 times higher than not related marriage type.

For the first variable of individual level, it is shown that the education level of women variable is significant, but its categories are not significant except no-education level category. The no education level has a slightly high risk amongst other education level categories compared to higher educated level risks on PNN mortality with 2.164 times the risk, followed by primary education level category with 2.045 times the risk, while the secondary education level has lower numbers with 1.246 times the risk.

Table 5.10: Logistic Regression Model for Predicting the PNN Mortality, Model for Individual Level Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.008	1.824
	Second cousin	0.000	3.225
	Other relative	0.996	0.998
Educational level of women		0.033	-
	No education	0.032	2.164
	Primary	0.080	2.045
	Secondary	0.509	1.246
	Higher	-	1.000
Age of women		0.004	
	<25	0.004	2.599
	25-34	0.183	1.530
	35 and over	-	1.000
	Constant	0.000	0.002
	R^2-Negelkerte	-	0.032

The last variable in the second model is a significant variable. The 25-34 years old category is not significant and has a low risk on PNN mortality of 1.530 times of the risk, higher

than 35 years old and over category. In contrast, less than 25 years old category is significant and has 2.599 times higher risk than 35 years old and over category.

There is a relative change happening through this model by entering the individual level determinant into PNN mortality logistic regression. The additive effects of individual level are relatively perceptible through the second model within the variables as illustrated above, and on the whole model. Overall, the model's R-square is increasing to 0,032 and the constant is 0.002, as shown in Table 5. 10.

In the third model, the variables related to maternal factors (birth order, months since preceding birth, succeeding birth interval and mother's age at birth) were introduced into the PNN mortality regression equation, as shown in Table 5. 11.

Through the third model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types have absolute significance with 0.002% and 0.00%, respectively, while other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on PNN mortality, some 3.508 times higher compared to not related marriage type, followed by first cousin which has a risk effect on PNN mortality 1.994 times higher than not related marriage type, while other relative has the lowest risk effect of 1.090 times higher than not related marriage type.

The months since preceding birth variable is significant in the third model, but its categories are not significant, except the 7-23 months since preceding birth category. It's noticeable that 7-23 months category has relatively high risk of 2.330 times more than the over 4 years category, while first birth and the 24-47 months category are 1.425 and 1.1197 times higher than reference category, respectively.

Succeeding birth interval variable is the last variable in the third model. It is also statistically significant, but its categories are not significant with the exception of the 7-23 months succeeding birth interval category. It's noticeable that 7-23 months succeeding birth interval category has an extremely high risk of 5.405 times more than open birth interval category when the latter is used as a reference on PNN mortality. The 24-47 months category has a relatively high risk of 1.353 times more than open birth category, while 47-59 months

category is the lowest among them with 1.143 times higher than reference category. The model's R-square is 0.072 and the constant is 0.003, as shown in Table 5.11.

Table 5.11: Logistic Regression Model for Predicting the PNN Mortality, Model for Maternal Factors Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.002	1.994
	Second cousin	0.000	3.508
	Other relative	0.831	1.090
Months since preceding birth		0.034	-
	First birth	0.258	1.425
	7-23	0.010	2.330
	24-47	0.578	1.197
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	5.405
	24-47	0.297	1.355
	48-59	0.895	1.143
	Open birth interval	-	1.000
	Constant	0.000	0.003
	R^2-Negelkerte	-	0.072

In the fourth model, the variables related to environmental contaminants (source of drinking water, type of toilet facility, time to obtain drinking water and frequency of someone smoking inside the household) were introduced into the PNN mortality regression equation, as shown in Table 5.12.

There are no noticeable differences in the fourth model observed by introducing the variables related to environmental contaminants into the model. Almost all the variables at this model have the same values comparing to the previous model with no exceptions, even the model's R-square remains at 0.072 and the constant remains at 0.003, as shown in Table 5.12.

Table 5.12: Logistic Regression Model for Predicting the PNN Mortality, Model for Environmental Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.002	1.994
	Second cousin	0.000	3.506
	Other relative	0.827	1.092
Months since preceding birth		0.034	-
	First birth	0.257	1.425
	7-23	0.010	2.331
	24-47	0.576	1.198
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	5.404
	24-47	0.296	1.356
	48-59	0.896	1.142
	Open birth interval	-	1.000
	Constant	0.000	0.003
	R^2-Negelkerte	-	0.072

In the fifth model, the variables related with nutritional availability (size of child at birth and status of breastfeeding) were introduced into the PNN mortality regression equation, as shown in Table 5.13.

Through the fifth model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types have absolute significance with 0.026% and 0.00%, respectively, while other relative marriage type is the only category amongst the consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on PNN mortality, some 3.215 times higher compared to not related marriage type, followed by first cousin which has a risk effect on PNN mortality 1.683 times higher than not related marriage type, while other relative has the lowest risk effect of 1.004 times higher than not related marriage type.

In the fifth model, it is shown that the education level of women variable is significant but its categories are not significant, except no-education level category. The no education level

has a slightly high risk amongst other education level categories compared to higher educated level risks on PNN mortality with 2.097 times the risk, followed by primary education level category with 1.930 times the risk, while the secondary education level has lower numbers at 1.168 times the risk.

Age of women is a significant variable. The 25-34 years old category is not significant and has a low risk on PNN mortality of 1.480 times of the risk, higher than 35 years old and over category. In contrast, less than 25 years old category is significant and has 2.472 times higher risk than 35 years old and over category.

Succeeding birth interval variable is also statistically significant, but its categories are not significant, except the 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 2.871 times more than open birth interval category when the latter is used as a reference on PNN mortality. While 24-47 months category and 47-59 months category have lowest risks with 0.823 and0.807 times comparing to reference category.

Status of breastfeeding variable is the last variable in the fifth model. It is also statistically significant and its categories are significant, as well. It's noticeable that never breastfed category has a relative high risk of 2.105 times more than ever breastfed category when the latter is used as a reference on PNN mortality. The model's R-square is 0.123 and the constant is 0.003, as shown in Table 5.13.

Table 5.13: Logistic Regression Model for Predicting the PNN Mortality, Model for Nutritional Availability Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.026	1.683
	Second cousin	0.000	3.215
	Other relative	0.991	1.004
Educational level of women		0.034	-
	No education	0.043	2.079
	Primary	0.111	1.930
	Secondary	0.644	1.168
	Higher	-	1.000
Age of women		0.01	-
	<25	0.008	2.472
	25-34	0.224	1.480
	35 and over	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.871
	24-47	0.498	0.823
	48-59	0.833	0.807
	Open birth interval	-	1.000
Status of breastfeeding		0.015	-
	Never breastfed*	0.004	2.105
	Ever breastfed	-	1.000
	Constant	0.000	0.003
	R^2-Negelkerte	-	0.123

* The high percentage of death among never breastfed children should be evaluated with caution due to the fact that the majority of the deaths in the first days of the life are mainly among the children deceased just before the initiation of the first breastfeeding.

In the sixth model, the variables related with personal illness control (timing of the first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider, place of delivery and number of examinations during antenatal care) were introduced into the PNN mortality regression equation, as shown in Table 5.14.

In the sixth model, there are no noticeable differences observed through this model by introducing the variables related with personal illness control into the model. Almost all the variables at this model have the same values comparing to the previous model with no exceptions, and even the model's R-square remains at 0.123 and the constant remains at 0.003, as shown in Table 5.14.

Table 5.14: Logistic Regression Model for Predicting the PNN Mortality, Model for Personal Illness Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.026	1.683
	Second cousin	0.000	3.215
	Other relative	0.991	1.004
Educational level of women		0.034	-
	No education	0.043	2.079
	Primary	0.111	1.93
	Secondary	0.644	1.168
	Higher	-	1.000
Age of women		0.010	-
	<25	0.008	2.472
	25-34	0.224	1.480
	35 and over	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.871
	24-47	0.498	0.823
	48-59	0.833	0.807
	Open birth interval	-	1.000
Status of breastfeeding		0.015	-
	Never breastfed	0.004	2.105
	Ever breastfed	-	1.000
	Constant	0.000	0.003
	R^2-Negelkerte	-	0.123

In the seventh model, the variables related with tradition, attitude and norms (cohabitation duration (grouped), literacy, media exposure, ideal number of children (grouped),

decision maker for using contraception, number of reasons for which wife-beating is justified and number of decisions in which women participate) were introduced into the PNN mortality regression equation, as shown in Table 5. 15.

Through the seventh model consanguinity variable is remaining has absolutely significant. First cousin marriage and second cousin marriage types have absolute significance with 0.012% and 0.00%, respectively, while other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on PNN mortality, some 3.193 times higher compared to not related marriage type, followed by first cousin which has a risk effect on PNN mortality 1.794 times higher than not related marriage type, while other relative has the lowest risk effect of 1.105 times higher than not related marriage type.

Age of women is a significant variable. The 25-34 years old category is not significant and has a low risk on PNN mortality of 1.368 times of the risk, higher than 35 years old and over category. In contrast, less than 25 years old category is significant and has 2.215 times higher risk than 35 years old and over category.

Succeeding birth interval variable is also statistically significant, but its categories are not significant except 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 2.835 times more than open birth interval category when the latter is used as a reference on PNN mortality, while 24-47 months category and 47-59 months category have lowest risks with 0.773 and0.831 times comparing to reference category.

Status of breastfeeding variable is also statistically significant and its categories are significant, as well. It's notable that the never breastfed category has a relative high risk of 1.963 times more than ever breastfed category when the latter is used as a reference on PNN mortality.

Number of decisions in which women participate variable is also statistically significant, but its categories are not significant, except zero-decisions in which woman participate category, which has a relatively high risk of 1.983 times more than four decisions in which woman participate category when the latter is used as a reference on PNN mortality. The 1-2 and 3 as a number of decisions in which woman participate categories have lowest risks with 0.976 and

0.494 times comparing to reference category. The model's R-square is 0.129 and the constant is 0.004, as shown in Table 5.15.

Table 5.15: Logistic Regression Model for Predicting the PNN Mortality, Model for Tradition /Attitude / Norms Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.012	1.794
	Second cousin	0.000	3.193
	Other relative	0.805	1.105
Age of women		0.020	-
	<25	0.018	2.215
	25-34	0.33	1.368
	35 and over	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.835
	24-47	0.382	0.773
	48-59	0.855	0.831
	Open birth interval	-	1.000
Status of breastfeeding		0.038	-
	Never breastfed	0.010	1.963
	Ever breastfed	-	1.000
Number of decisions in which women participate		0.002	-
	0	0.005	1.983
	1-2	0.922	0.976
	3	0.052	0.494
	4	-	1.000
	Constant	0.000	0.004
	R^2-Negelkerte	-	0.129

In the eighth model, the household level includes the wealth index variable and the variables related with community level (religion, type of place of residence and region) were introduced into the PNN mortality regression equation, as shown in Table 5.16.

In the eighth model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types have absolute significance with 0.024% and 0.00%, respectively, while other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on PNN mortality, some 2.935 times higher compared to not related marriage type, followed by first cousin which has a risk effect on PNN mortality 1.697 times higher than not related marriage type, while other relative has the lowest risk effect of 1.023 times higher than not related marriage type.

Age of women is a significant variable. The 25-34 years old category is not significant and has a low risk on PNN mortality of 1.324 times of the risk, higher than 35 years old and over category. In contrast, less than 25 years old category is significant and has 2.053 times higher risk than 35 years old and over category.

Succeeding birth interval variable is also statistically significant, but its categories are not significant, with the exception of the 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 2.737 times more than open birth interval category when the latter is used as a reference on PNN mortality. While 24-47 months category and 47-59 months category have lowest risks with 0.750 and 0.807 times comparing to reference category.

Status of breastfeeding variable is also statistically significant and its categories are significant, as well. It's notable that never breastfed category has a relative high risk of 2.011 times more than ever breastfed category when the latter is used as a reference on PNN mortality.

Number of decisions in which women participate variable is also statistically significant, but its categories are not significant, except zero-decisions in which woman participate category which has a relatively high risk of 1.844 times more than 4 decisions in which woman participate category when the latter is used as a reference on PNN mortality. The 1-2 and 3 as a number of decisions in which woman participate categories have the lowest risks, with 0.942 and 0.483 times comparing to reference category.

Type of place of residence variable is the last variable in the eighth model. It is also statistically significant and its categories are significant, as well. It's notable that rural areas category has a relative high risk of dying is 1.894 times more than urban areas category when the latter is used as a reference on PNN mortality. The model's R-square is 0.136 and the constant is 0.003, as shown in Table 5.16.

Table 5.16: Logistic Regression Model for Predicting the PNN Mortality, Model for Household-Level and Community-Level Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.024	1.697
	Second cousin	0.000	2.935
	Other relative	0.955	1.023
Age of women		0.041	-
	<25	0.034	2.053
	25-34	0.384	1.324
	35 and over	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.737
	24-47	0.330	0.750
	48-59	0.833	0.807
	Open birth interval	-	1.000
Status of breastfeeding		0.030	-
	Never breastfed	0.008	2.011
	Ever breastfed	-	1.000
Number of decisions in which women participate		0.003	-
	0	0.013	1.844
	1-2	0.812	0.942
	3	0.045	0.483
	4	-	1.000
Type of place of residence	Urban	-	1.000
	Rural	0.005	1.894
	Constant	0.000	0.003
	R^2-Negelkerte	-	0.136

5.3. LOGISTIC REGRESSION MODELS FOR PREDICTING THE RISK OF INFANT MORTALITY

The first model, called the basic model, includes consanguineous marriage as an independent variable on IM. The consanguinity variable is absolutely significant, wherein first cousin marriage and second cousin marriage types have absolute significance, while other relative marriage type is the only category among the consanguinity variable's category that is not significant. It is notable that second cousin marriage type has relatively high risk on IM, some 1.960 times higher compared to not related marriage type, followed by first cousin which has risk effect on IM 1.649 times higher than not related marriage type, and other relative has the lowest risk effect with under one times that of not related marriage type risks. Overall, the model's R-square is 0.008 and the constant is 0. 019, as shown in Table 5.17.

Table 5.17: Logistic Regression Model for Predicting the IM Mortality, Basic Model

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.000	1.649
	Second cousin	0.000	1.960
	Other relative	0.737	0.925
	Constant	0.000	0.019
	R^2-Negelkerte	-	0.008

In the second model, the variables related to individual level (education level of women, education level of husband, working status of women, coverage by health insurance and age of women) were introduced into the IM mortality regression equation, as shown in Table 5.18.

Through the second model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types have absolute significance at 0.000% for both, as well. Other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on IM, some 1.904 times higher compared to not related marriage type, followed by first

cousin which has a risk effect on IM 1.610 times higher than not related marriage type, while other relative has the lowest risk effect of 0.909 times lower than not related marriage type.

Coverage by health insurance variable is significant here; it is 0.016% on this model, and for those who have no coverage by health insurance, there is a 1.945 times higher risk on IM compared to those covered by health insurance, with a slight decreasing at this model compared to the previous one. Overall, the model's R-square is 0.010 and constant is 0.010, as shown in Table 5. 18.

Table 5.18: Logistic Regression Model for Predicting the IM Mortality, Model for Individual Level Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.000	1.610
	Second cousin	0.000	1.904
	Other relative	0.681	0.909
Coverage by health insurance	No	0.016	1.945
	Yes	-	1.000
	Constant	0.000	0.010
	R^2-Negelkerte	-	0.010

In the third model, the variables related to maternal factors (birth order, months since preceding birth, succeeding birth interval and mother's age at birth) were introduced into the IM regression equation, as shown in Table 5.19.

Through this model, the consanguinity variable remains absolutely significant, wherein first cousin marriage and second cousin marriage types have absolute significance, while other relative marriage type is the only category among the consanguinity variable's category that is not significant. It is notable that second cousin marriage type has relatively high risk on IM, some 1.903 times higher compared to not related marriage type, followed by first cousin which has risk effect on IM 1.590 times higher than not related marriage type, and other relative has the lowest risk effect with under one times that of not related marriage type risks.

Coverage by health insurance variable is significant at 0.029% in this model, and for those have no coverage by health insurance, there is a 1.832 times higher risk on IM compared to those covered by health insurance, with a slight decreasing at this model comparing to the previous one.

Birth order variable in this model is absolutely significant. The first in birth order category is statistically significant, as it carried less than one fifth of the risk for IM compared to fourth and fifth in birth order. By contrast, second and third in birth order category is not significant, but it has a risk effect 0.997 times lower compared to fourth and fifth in birth order in birth order. Only sixth and above in birth order category has a risk effect higher by 1.260 times compared to fourth and fifth in birth order in birth order, but is not significant.

Months since preceding birth variable is significant in the third model. Also, its categories are significant, except 24-47 months since preceding birth category. It's notable that first birth category has extremely high risk 6.719 times more than over 4 years category, while 7-23 and 24-47 months category have 1.979 and 0.845 times higher than reference category.

Succeeding birth interval variable is statistically significant and its categories are significant, as well, except the 48-59 months succeeding birth interval category. It's notable that the 7-23 months succeeding birth interval category has an extremely high risk of 6.900 times more than open birth interval category when the latter is used as a reference on IM. The 24-47 months category has relatively high risk 1.647 times more than open birth category, while 47-59 months category is the lowest among them with 1.709 times higher than reference category. The model's R-square is 0.099 and the constant is 0.006, as shown in Table 5.19.

Table 5.19: Logistic Regression Model for Predicting the IM Mortality, Model for Maternal Factors Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.001	1.590
	Second cousin	0.000	1.903
	Other relative	0.647	0.898
Coverage by health insurance	No	0.029	1.832
	Yes	-	1.000
Birth order		0.000	-
	First birth order	0.000	0.143
	2-3	0.986	0.997
	4-5	-	1.000
	6+	0.462	1.260
Months since preceding birth		0.000	-
	First birth	0.000	6.719
	7-23	0.000	1.979
	24-47	0.361	0.845
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	6.900
	24-47	0.003	1.647
	48-59	0.299	1.709
	Open birth interval	-	1.000
	Constant	0.000	0.006
	R^2-Negelkerte	-	0.099

In the fourth model, the variables related to environmental contaminants (source of drinking water, type of toilet facility, time to obtain drinking water and frequency of someone smoking inside the household) were introduced into the IM mortality regression equation, as shown in Table 5. 20.

In the fourth model, there are no noticeable differences observed by introducing the variables related to personal illness control. Almost all the variables at this model have the same

values when compared to the previous model with no exceptions, and even the model's R-square remains at 0.099 and the constant remains at 0.006, as shown in Table 5.20.

Table 5.20: Logistic Regression Model for Predicting the IM Mortality, Model for Environmental Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.001	1.589
	Second cousin	0.000	1.901
	Other relative	0.654	0.900
Coverage by health insurance	No	0.029	1.833
	Yes	-	1.000
Birth order		0.000	-
	First birth order	0.000	0.143
	2-3	0.982	0.996
	4-5	-	1.000
	6+	0.463	1.260
Months since preceding birth		0.000	-
	First birth	0.000	6.719
	7-23	0.000	1.980
	24-47	0.363	0.846
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	6.898
	24-47	0.003	1.647
	48-59	0.300	1.708
	Open birth interval	-	1.000
	Constant	0.000	0.006
	R^2-Negelkerte	-	0.099

In the fifth model, the variables related to nutritional availability (size of child at birth and status of breastfeeding) were introduced into the IM mortality regression equation, as shown in Table 5. 21.

Through this model, the consanguinity variable remains absolutely significant, wherein first cousin marriage and second cousin marriage types have absolute significance, while other relative marriage type is the only category among the consanguinity variable's category that is not significant. It is notable that second cousin marriage type has relatively high risk on IM, some 2.106 times higher compared to not related marriage type, followed by first cousin which has risk effect on IM 1.538 times higher than not related marriage type, and other relative has the lowest risk effect with under one times that of not related marriage type risks.

Months since preceding birth variable is significant in this model, but its categories are not significant, except 7-23 months since preceding birth category. The first birth and 7-23 categories have relatively high risk 1.023 and 1.817 times more than over 4 years category, while 24-47 months category have 0.965 times lower than reference category.

Succeeding birth interval variable is statistically significant but its categories are not significant, except 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 3.832 times more than open birth interval category when the latter is used as a reference on IM. Also 24-47 months category has relatively high risk 1.066 times more than open birth category, while 47-59 months category is the lowest among them with 1.698 times higher than reference category.

Size of child at birth variable is absolutely significant in the fifth model, and its categories are absolutely significant, as well. Here it is found that very small category has an extremely high risk of 3.350 times more than average or larger category when the latter is used as a reference on IM. Smaller than average category also has relatively high risk 1.672 times more than average or larger category.

Status of breastfeeding variable is also statistically significant and its categories are significant, as well. It's notable that never breastfed category has an extremely high risk of 10.428 times more than ever breastfed category when the latter is used as a reference on IM. The model's R-square is 0.281 and the constant is 0.008, as shown in Table 5.21.

Table 5.21: Logistic Regression Model for Predicting the IM Mortality, Model for Nutritional Availability Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.003	1.538
	Second cousin	0.000	2.106
	Other relative	0.886	0.966
Months since preceding birth		0.001	-
	First birth	0.901	1.023
	7-23	0.002	1.817
	24-47	0.850	0.965
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	3.832
	24-47	0.714	1.066
	48-59	0.311	1.698
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	3.350
	Smaller than average	0.001	1.672
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed*	0.000	10.428
	Ever breastfed	-	1.000
	Constant	0.000	0.008
	R^2-Negelkerte	-	0.281

* The high percentage of death among never breastfed children should be evaluated with caution due to the fact that the majority of the deaths in the first days of the life are mainly among the children deceased just before the initiation of the first breastfeeding.

In the sixth model, the variables related with personal illness control (timing of the first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider, place of delivery and number of examinations during antenatal care) were introduced into the IM mortality regression equation, as shown in Table 5.22.

Through this model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types have absolute significance, while other relative marriage type is the only category among the consanguinity variable's category that is not significant. It is notable that second cousin marriage type has relatively high risk on IM, some 2.108 times higher compared to not related marriage type, followed by first cousin which has risk effect on IM 1.535 times higher than not related marriage type, and other relative has the lowest risk effect with under one times that of not related marriage type risks.

Months since preceding birth variable is significant in this model, but its categories are not significant, with the exception of 7-23 months since preceding birth category. The first birth and 7-23 categories have relatively high risks of 1.036 and 1.828 times more than over 4 years category, while 24-47 months category have 0.972 times lower than reference category.

Succeeding birth interval variable is statistically significant, but its categories are not significant except 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 2.588 times more than open birth interval category when the latter is used as a reference on IM. Also, 24-47 months category has relatively high risk 0.720 times less than open birth category, while 47-59 months category is the lowest among them with 1.146 times higher than reference category.

Size of child at birth variable is absolutely significant in the fifth model, and its categories are absolutely significant, as well. Here, it is found that very small category has an extremely high risk of 3.284 times more than average or larger category when the latter is used as a reference on IM. Smaller than average category also has a relatively high risk 1.630 times more than average or larger category.

Status of breastfeeding variable is statistically significant and its categories are significant, as well. It's notable that never breastfed category has an extremely high risk of 10.340 times more than ever breastfed category when the latter is used as a reference on IM.

Number of examinations during antenatal care variable is statistically significant and its categories are significant as well, except the 1-2 category. Only the women who haven't done examinations during antenatal care category has a high risk of 1.571 times more than the 3-4

category when the latter is used as a reference on IM. The model's R-square is 0.283 and the constant is 0.008, as shown in Table 5.22.

Table 5.22: Logistic Regression Model for Predicting the IM Mortality, Model for Personal Illness Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.003	1.535
	Second cousin	0.000	2.108
	Other relative	0.874	0.962
Months since preceding birth		0.001	-
	First birth	0.845	1.036
	7-23	0.002	1.828
	24-47	0.881	0.972
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.588
	24-47	0.154	0.720
	48-59	0.803	1.146
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	3.284
	Smaller than average	0.002	1.630
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed	0.000	10.340
	Ever breastfed	-	1.000
Number of examinations during antenatal care		0.031	-
	0	0.025	1.571
	1-2	0.392	0.800
	3-4	-	1.000
	Constant	0.000	0.008
	R^2-Negelkerte	-	0.283

In the seventh model, the variables related with tradition, attitude and norms (cohabitation duration (grouped), literacy, media exposure, ideal number of children (grouped),

decision maker for using contraception, number of reasons for which wife-beating is justified and number of decisions in which women participate) were introduced into the IM mortality regression equation, as shown in Table 5.23.

Through the seventh model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types have absolute significance at 0.003% and 0.000% respectively, while other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on IM, some 2.120 times higher compared to not related marriage type, followed by first cousin which has a risk effect on IM 1.543 times higher than not related marriage type, while other relative has the lowest risk effect of 0.967 times lower than not related marriage type.

Months since preceding birth variable is significant in this model, but its categories are not significant, except the 7-23 months since preceding birth category. The first birth and 7-23 categories have relatively high risk 1.062 and 1.869 times more than over 4 years category, while 24-47 months category have 0.992 times lower than reference category.

Succeeding birth interval variable is statistically significant, but its categories are not significant except 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 2.571 times more than open birth interval category when the latter is used as a reference on IM. Also 24-47 months category has relatively high risk 0.702 times less than open birth category, while 47-59 months category is the lowest among them with 1.138 times higher than reference category.

Size of child at birth variable is absolutely significant in the fifth model, and its categories are absolutely significant, as well. Here, it is found that very small category has an extremely high risk of 3.287 times more than average or larger category when the latter is used as a reference on IM. Smaller than average category has relatively high risk 1.601 times more than average or larger category.

Status of breastfeeding variable is also statistically significant and its categories are significant, as well. It's notable that never breastfed category has an extremely high risk of 10.270 times more than ever breastfed category when the latter is used as a reference on IM.

Number of examinations during antenatal care variable is statistically significant and its categories are significant as well, except 1-2 category. Only the women who haven't done examinations during antenatal care category has a high risk of 1.573 times more than 3-4 category when the latter is used as a reference on IM. The model's R-square is 0.282 and the constant is 0.008, as shown in Table 5.23.

In the eighth model, the household level includes the wealth index variable and the variables related with community level (religion, type of place of residence and region) were introduced into the IM mortality regression equation, as shown in Table 5.24.

Through the last model, the consanguinity variable remains absolutely significant. First cousin marriage and second cousin marriage types also have absolute significance at 0.007% and 0.000% respectively, while other relative marriage type is the only category amongst consanguinity variable's categories that is not significant. It is notable that second cousin marriage type has the greatest risk on IM, some 1.994 times higher compared to not related marriage type, followed by first cousin which has a risk effect on IM 1.481 times higher than not related marriage type, while other relative has the lowest risk effect of 0.919 times lower than not related marriage type.

Months since preceding birth variable is significant in this model, but its categories are not significant, except the 7-23 months since preceding birth category. The first birth and 7-23 categories have relatively high risk 1.044 and 1.821 times more than over 4 years category, while 24-47 months category have 0.972 times lower than reference category.

Succeeding birth interval variable is statistically significant, but its categories are not significant, except the 7-23 months succeeding birth interval category. It's notable that 7-23 months succeeding birth interval category has a relatively high risk of 2.563 times more than open birth interval category when the latter is used as a reference on IM. Also 24-47 months category has relatively high risk 0.707 times less than open birth category, while 47-59 months category is the lowest among them with 1.125 times higher than reference category.

Table 5.23: Logistic Regression Model for Predicting the IM Mortality, Model for Tradition /Attitude / Norms Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.003	1.543
	Second cousin	0.000	2.120
	Other relative	0.889	0.967
Months since preceding birth		0.001	-
	First birth	0.741	1.062
	7-23	0.002	1.869
	24-47	0.966	0.992
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.571
	24-47	0.126	0.702
	48-59	0.812	1.138
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	3.287
	Smaller than average	0.004	1.601
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed	0.000	10.270
	Ever breastfed	-	1.000
Number of examinations during antenatal care		0.030	-
	0	0.024	1.573
	1-2	0.390	0.799
	3-4	-	1.000
	Constant	0.000	0.008
	R^2-Negelkerte	-	0.282

Size of child at birth variable is absolutely significant in the fifth model, and its categories are absolutely significant, as well. Here it found that very small category has an extremely high risk of 3.257 times more than average or larger category when the latter is used as a reference on IM. Smaller than average category also has relatively high risk of 1.572 times more than average or larger category.

Table 5.24: Logistic Regression Model for Predicting the IM Mortality, Model for Household-Level and Community-Level Variables Added

Variable name	Categories	Sig.	Exp(B)
Consanguinity		0.000	-
	Not related	-	1.000
	First cousin	0.007	1.481
	Second cousin	0.000	1.994
	Other relative	0.730	0.919
Months since preceding birth		0.001	-
	First birth	0.813	1.044
	7-23	0.002	1.821
	24-47	0.883	0.972
	Over 4 years	-	1.000
Succeeding birth interval		0.000	-
	7-23	0.000	2.563
	24-47	0.132	0.707
	48-59	0.829	1.125
	Open birth interval	-	1.000
Size of child at birth		0.000	-
	Very small	0.000	3.275
	Smaller than average	0.005	1.572
	Average or larger	-	1.000
Status of breastfeeding		0.000	-
	Never breastfed	0.000	10.570
	Ever breastfed	-	1.000
Number of examinations during antenatal care		0.039	-
	0	0.040	1.513
	1-2	0.309	0.767
	3-4	-	1.000
Type of place of residence	Urban	-	1.000
	Rural	0.004	1.450
	Constant	0.000	0.006
	R^2-Negelkerte	-	0.285

Status of breastfeeding variable is statistically significant and its categories are significant, as well. It's notable that never breastfed category has an extremely high risk of 10.570 times more than ever breastfed category when the latter is used as a reference on IM.

Number of examinations during antenatal care variable is statistically significant and its categories are significant, as well, except the 1-2 category. Only the women who haven't done examinations during antenatal care category has a high risk of 1.513 times more than 3-4 category when the latter is used as a reference on IM.

Type of place of residence variable is the last variable in the eighth model. It is also statistically significant and its categories are significant, as well. It's notable that rural areas category has a relative high risk of 1.450 times more than urban areas category when the latter is used as a reference on PNN mortality. The model's R-square is 0.285 and the constant is 0.006, as shown in Table 5.24.

5.4. SUMARY OF THE LOGISTIC REGRISION ANALYSES

Table 5.25 provides a summary for the impact of the consanguinity on the deaths in infancy periods in all models constructed in the study. In NNM models, consanguinity has an impact on the NN mortality in the first model only. After that, with the suppressive impacts of the other variables, consanguinity is no longer apparent in the models. In PNNM models, although the risk of dying among children in first and second cousin marriages decreases, even in the last model which controls all covariates, consanguinity keeps its significance on PNN mortality. Among all models of the PNNM, those regarding individual level variables have a greatest additive effect on PNN mortality.

In the IM models, we again observe that consanguinity maintains its negative impact on deaths in the infancy period over the course of all models, even after controlling for all possible variables. The individual factors, when compared with other factors, have a significant additive impact on deaths during infancy period.

The next chapter will discuss and summarize the outputs result of the logistic regression models from this study, and it will make suggestions and recommendations for future research.

Table 5.25. Summary Table for the Impact of the Consanguineous Unions in All Models

Models	Not related	First-cousin	Second cousin	Other	R^2
Neonatal Mortality					
Basic Model	1.000	1.487	1.320	0.863	0.003
Individual level	NIM	NIM	NIM	NIM	0.003
Maternal factor	NIM	NIM	NIM	NIM	0.090
Environmental contamination	NIM	NIM	NIM	NIM	0.090
Nutritional availability	NIM	NIM	NIM	NIM	0.347
Personal illness control	NIM	NIM	NIM	NIM	0.350
Tradition /attitude / norms	NIM	NIM	NIM	NIM	0.351
Household and community level	NIM	NIM	NIM	NIM	0.351
Post-neonatal Mortality					
Basic Model	1.000	2.020	3.497	1.081	0.019
Individual level	1.000	1.824	3.225	0.998	0.032
Maternal factor	1.000	1.994	3.508	1.090	0.072
Environmental contamination	1.000	1.994	3.506	1.092	0.072
Nutritional availability	1.000	1.994	3.215	1.004	0.123
Personal illness control	1.000	1683	3.215	1.004	0.123
Tradition /attitude / norms	1.000	1.794	3.193	1.105	0.129
Household and community level	1.000	1.697	2.935	1.023	0.136
Infant Mortality					
Basic Model	1.000	1.649	1.960	0.925	0.008
Individual level	1.000	1.610	1.904	0.909	0.010
Maternal factor	1.000	1.590	1.903	0.898	0.099
Environmental contamination	1.000	1.589	1.901	0.900	0.099
Nutritional availability	1.000	1.538	2.106	0.966	0.281
Personal illness control	1.000	1.535	2.108	0.962	0.283
Tradition /attitude / norms	1.000	1.543	2.120	0.967	0.282
Household and community level	1.000	1.481	1.994	0.919	0.285

*NIM: Not in the Model

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

As illustrated in this study, consanguineous marriage is a widespread social phenomenon in Egyptian society and it is still estimated at a rate of 30%, according to EDHS 2014.

Many studies have examined consanguineous marriage and its effects on the health of populations. Research has increased on the topic as it relates to early age mortality, since consanguineous marriage is an important risk to children's health, but the majority of research focuses on the medical aspects of early age mortality, while neglecting the social causes behind it.

In Egypt, there are a few studies which have estimated consanguineous marriage's impacts on early age mortality, such as Mokhtar and Abdel-Fattah (2001) and Khayat and Saxena, 2007. Though they have made an effort to prove the connection, they have based their studies somewhere between two main avenues of inquiry; the medical or the demographic.

Although Egypt has one of the highest rates of early age mortality in the Middle East (Hamamy, 2003), with a 22 per 1000 infant mortality rate according to (EDHS 2014), consanguinity remains a preferred type of marital union amongst Egyptians.

For the reasons listed above, this study concludes that there is a need to fill the gap between the medical and social science approaches to consanguineous marriage and its effects on childhood mortality. Where this study differs is that it was based on an optimal framework which gathered the environmental aspects, plus the social and demographic determinants that have direct and non-direct impacts on early age mortality, all under the umbrella of one analytical method, namely the Mosley and Chen framework.

The goal of this study is also to update information about the outcomes of consanguinity's impacts on early age mortality in Egypt, since the last study on this topic was based on EDHS-2000.

It is supported by providing an illustration of the Mosley and Chen framework variables distribution on consanguinity's different types and early age mortality, placed under eight determinants; individual, maternal, environmental, children's nutrition, personal illness, tradition/ norms/ attitudes, household level and community level.

The primary goal of this study was to conduct an estimation of consanguinity's impacts on early age mortality by using the logistic regression model, after controlling for all other risk effect independent variables.

Given this goal, the impact of consanguinity on early age mortality, neonatal, post-neonatal and infant mortality is estimated by using the data of the Egyptian demographic and health survey which was conducted in 2014. The descriptive and multivariate results were provided in Chapter 4 and Chapter 5, respectively.

Chapter 4 discussed the results of the descriptive analyses based on Mosley and Chen model, which consists of a set of proximate determinants that cause mortality risk. Chapter 4 also provided the distribution of various consanguinity types according to other independent variables; not related marriage, first cousin marriage, second cousin marriage and other relative marriage. It then provided the percentage distribution of deaths in early age periods, namely neonatal, post-neonatal and infancy periods again by all covariates, based on EDHS-2014 datasets.

The descriptive analyses chapter consists of three sections addressing the model variables distribution, and the results are as follows:

Firstly: The findings came from the Mosley and Chen framework variables distributions on consanguineous marriage types, under eight determinants; individual, maternal, environmental, children nutrition's, personal illness, tradition/ norms/ attitude, household level and community level. The findings were as follows:

According to the individual variables determinants, it was found that there are notable differences between not related marriage type and related marriages type. Particularly; first and second cousin marriage type were considered more positive than not related marriages. Women in not related marriages had higher education levels than women in related marriage types (i.e.

the higher education level for women in non- related marriage type was 18.6%, while for first cousin marriage type, it was close to 10.0%). The respondent's occupation category also showed them working more than others, and having health insurance more often, although there are seriously deficiencies for health insurance in general. Finally, it was found that their age groups are slightly older.

For maternal variables determinants, it was found that there are non-similarities between not related marriage type and related marriages type, where the 2-3 in order birth category for the birth order variable, 24-47 months since preceding birth, and the open birth interval category for succeeding birth interval variable were all higher amongst those in not related marriages compared to those in the consanguinity types. The most common categories among the variables were; 2-3 birth order, 24-47 months since preceding birth, 24-47 months succeeding birth interval, and 24-35 years old category in mother's age at birth variable.

There are no noticeable differences between consanguinity types according to environmental variables determinants and nutritional availability determinants.

According to personal illness factor determinants, it found that there are notable differences between the not related marriage type and related marriages types, particularly within timing of first antenatal check (in months), number of antenatal visits during pregnancy, antenatal care provider variables and number of examinations during antenatal care which were considered more positive for those in not related marriages.

According to tradition/norms/attitude variables determinants, it was found that there are relative differences between not related marriage type and related marriage types; particularly for literacy, ideal number of children, decision maker for using contraception and number of reasons for which wife-beating is justified categories, where those in not related marriages are more literate, prefer a lesser number of children (2-3 children number category is the most common among them) and have a positive percentage for beating justified variables more often than women in the related marriages type.

Finally, women in related union type are the poorest and the majority live in rural areas in Upper Egypt.

Secondly: The findings of Mosley and Chen framework variables distributions on early age mortality types, under eight determinants; individual, maternal, environmental, children nutrition's, personal illness, tradition/norms/ attitude, household level and community level, indicate that there are notable differences between neonatal and post-neonatal mortality. Neonatal mortality has higher percentages than post-neonatal mortality percentages, based on EDHS (2014).

Generally, there are relative differences among neonatal and post-neonatal mortality values ranging between 0-1.0 percent for neonatal mortality, but in some cases this gap widened as follows:

For the 7-23 months category of succeeding birth interval variable, it was 5.7% for neonatal, while it dropped to nearly half of that for post-neonatal mortality, down to 2.7%. Also, for the very small category of size of child at birth variable, it was 7.5% for neonatal, while it dropped to nearly a one-tenth of that for post-neonatal mortality, down to 0.7%. For the never breastfed category of the duration of breastfeeding variable, it was 15.4% for neonatal, while it dropped to less than a one-sixth of that for post-neonatal mortality, with 2.6%. For 0-1 as an ideal number of children, it was 2.0% for neonatal, while it dropped to less than a one third of that for post-neonatal mortality with 0.6%.

In other cases, there were post-neonatal mortality percentages higher than neonatal mortality as follows; for 30 minutes or longer category of time to obtain drinking water variable, it was 0.9% for post-neonatal, while it was devoid of deaths for neonatal mortality. Also, for those checking their pregnancy for the first time after the seventh month, it was 1.6% for post-neonatal, while it was devoid of deaths for neonatal mortality.

Thirdly: The findings of the distribution of consanguinity types on the early age mortality were as follows:

Neonatal mortality ratios are higher than post-neonatal mortality ratios, except second cousin marriage type, where the post-neonatal mortality ratio of 2.1% is higher than neonatal mortality ratio which stands at 1.9%.

According to neonatal mortality, there is some similarity between not related marriage type and other relative marriage type, and also between first and second cousin marriage types.

In brief, according to early age mortality, it is notable that not related marriage type and other relative marriage type have lower risks on early age mortality, while first and second cousin marriage types are considered to have great risks effect on early age mortality, according to (EDHS 2014).

Chapter 5 covers the logistic regression which was conducted with FSTEP (LR) method to get estimations for the impact of consanguinity on early age mortality, after controlling for all other risk effect independent variables in an additive way.

The logistic regression analysis chapter (Chapter 5), which consists of three sections addressing the logistic regression models for NN, PNN and IM, had results based on enter method as follows:

Firstly: There were the findings for the impact of consanguinity on neonatal mortality logistic regression model after controlling the eight affected determinants gradually; individual, maternal, environmental, children's nutrition, personal illness, tradition/ norms/ attitude, household level and community level. Here, it was found that:

According to the basic model, the consanguinity variable is almost significant with 0.052%. The first cousin marriage type was the only category among the consanguinity variable's categories which was significant, at 0.012%. It was strongly predicted that the following models might be non-significant for the consanguinity variable. The first and second cousin marriage type have higher effects than not related marriage type on NN mortality, with a slight increase for first cousin marriage type, while other relative marriage type has low risk effect.

In the second model, the variables related to the individual level determinant that was introduced into the NN mortality regression equation found that the additive effects of individual level were perceptible through the second model, where consanguinity variable is not existing through this model, but the model's R-square has the same value at 0.003 compared to the previous model.

In the third model, the variables related with the maternal factor determinant that was introduced into the NN mortality regression equation found that there are noticeable additive effects due to maternal factor through the third model, both within the variables and on the whole model, where the model's R-square is greatly increasing about thirty times to become 0.090.

In the fourth model, the variables related to the environmental contaminants determinant that was introduced into the NN mortality regression equation showed that there was limited additive effect of environmental contaminants within the variables and on the whole model, where the model's R-square has the same value at 0.090.

In the fifth model, the variables related to the nutritional availability determinant that was introduced into the NN mortality regression equation showed that there were remarkable additive effects due to the nutritional availability determinant within the variables and on the whole model, where the model's R-square is also greatly increased to be 0.347.

In the sixth model, the variables related to the personal illness control determinant that was introduced into the NN mortality regression equation showed that there were slight additive effects due to the personal illness control determinant within the variables and on the whole model, where the model's R-square is also slightly increased to 0.350.

In the seventh model, the variables related with the tradition /attitude / norms determinant that was introduced into the NN mortality regression equation showed that there were slight additive effects due to the tradition /attitude / norms determinant within the variables and on the whole model, where the model's R-square is slightly increased to 0.351.

In the eighth model, the household level includes only the wealth index variable and community level which were introduced into the NN mortality regression equation. It showed a slight additive effect of household level and community level on the whole model, where the model's R-square has the same value at 0.351.

Secondly: The findings for the impact of consanguinity on post-neonatal mortality logistic regression model after controlling the eight effected determinants gradually; individual, maternal, environmental, children nutrition's, personal illness, tradition/ norms/ attitude,

household level and community level. According to the basic model, the consanguinity variable is absolutely significant, where first cousin marriage and second cousin marriage types have absolute significance at 0.002% and 0.00%, respectively, and other relative marriage type was not significant. It was noticeable that second cousin marriage type has the greatest risk on PNN mortality higher, some 3.497 times higher compared to not related marriage type, followed by first cousin which is 2.020 times higher, while other relative has the lowest risk effect with 1.081 times higher.

In the second model, the variables related with the individual level determinant that was introduced into the PNN mortality regression equation found that there were slight additive effects due to individual level within the variables and on the whole model, where the model's R-square is increasing 0.032, compared to the previous model that was; model's R-square was found to be 0.019.

In the third model, the variables related with the maternal factor determinant that was introduced into the PNN mortality regression equation found that there were noticeable additive effects of maternal factor within the variables and on the whole model, where the model's R-square is increasing to become 0.072.

In the fourth model, the variables related to the environmental contaminants determinant that were introduced into the PNN mortality regression equation found that there were a limited additive effects of environmental contaminants within the variables and on the whole model. The model's R-square has the same value at 0.072.

In the fifth model, the variables related to the nutritional availability determinant that was introduced into the PNN mortality regression equation found that there were remarkable additive effects of nutritional availability determinant within the variables and on the whole model. The model's R-square increased to the level of 0.123.

In the sixth model, the variables related to the personal illness control determinant that was introduced into the PNN mortality regression equation found that there were slight additive effects due to the personal illness control determinant within the variables and on the whole model. R-square has the same value at 0.123 in this model.

In the seventh model, the variables related to the tradition/attitude/norms that were introduced into the PNN mortality regression equation have strong additive effects: In this model, R-square was slightly increased to 0.129.

In the eighth model, community level variables were introduced into the PNN mortality regression equation. This showed a slight additive effect of variables on household and community levels. R-square again increased slightly to the level of 0.136.

Thirdly: The findings for the impact of consanguineous marriages on infancy mortality logistic regression model after controlling for the eight effected determinants gradually; individual, maternal, environmental, children's nutrition, personal illness, tradition/ norms/ attitude, household level and community level. It is found that there are similarities between the results derived from models for PNN and for IM in general. Regression models for IM follow the same approach of PNN mortality in terms of the impacts that occurred due to the gradual introduction of the eight effected determinants.

Briefly, this thesis has reached some important conclusions that are as follows:

- Individual level variables, maternal factors and nutritional availability determinants showed the highest risk effects on deaths in infancy periods in the logistic regression equations for all early age mortality types.
- Variables regarding personal illness control, tradition/attitude/norms, community level and household level determinants have relatively high risk effects, while factors related to environmental contaminants have a limited risk effect on NN, PNN and IM in the logistic regression equations.
- Children of couples with first and second cousin marriages have higher mortality risk in infancy periods compared to the offspring of not related couples in Egypt.
- The risk of dying among children of women with remote consanguineous marriages is very close to the risk of dying among children of women without consanguinity.

This study confirms an association between consanguinity and infant mortality in Egypt. The association was statistically significant, not only for first cousin marriages, but also for second cousin marriages based on the logistic regression models. More specifically, first-cousin

marriage and second marriages were significant risk factors for post-neonatal mortality and infant mortality, while they were non-significant for neonatal mortality.

The wide prevalence of consanguineous marriages may play a role in explaining the reported high incidence of infant mortality in the Egyptian population (30%), as Khayat & Saxena, (2007) pointed out. The results of the present study are consistent with previous literature that has identified consanguinity as a risk factor for infant mortality in most developing countries. The study conducted by (Shami, Schmitt, and Bittles, 1989) in Pakistan under the control of demographic and socio-economic determinants, such as birth interval, sex of child, maternal age, birth order and maternal education, found a highly significant relationship between consanguineous marriages and early age mortality. Hussain, et al (2001) also measured the relationship between first cousin marriage s and early age mortality in Pakistan and India at the same time. They indicated a highly significant risk among the children of first cousin consanguinity unions during the neonatal, post-neonatal and infancy period with both bivariate and multivariate analyses. The study carried out by Joseph (2007) found that in Bekaa Valley/ Lebanon there was a negative impact of first cousin marriages on infant mortality rates, but not on child mortality rates under the control of a number of socio-economic and demographic determinants. Charafeddine, et al (2012) also found that in Lebanon, a close relationship between consanguinity, particularly with first and second cousin marriage types, and infant mortality after controlling for maternal education, maternal age, prenatal care, mode of delivery, crowding index, birth weight and sex of children. El-Hazmi, et al (1995) in Saudi Arabia showed an increasing impact of first cousin marriage and early age mortality. Another study introduced by Khoury and Massad (2000) in Jordon postulated that first and second cousin consanguinity was a significant determinant of mortality in early age period. A further recent study presented by Abuqamar ,et al, (2011) covered selected Arab countries and also showed a highly significant risk among consanguinity marriage types, particularly regarding first degree relatives and infant mortality.

On the other hand, Jemai et al, (2007) found that in Tunisia there was a positive correlation between first cousin and second cousin unions and rates of neonatal and post-neonatal mortality. Recently, Hosseini-Chavoshi, et al (2014) presented a descriptive study on Iran that indicated the percentage of deaths was greater among first-cousin than among second-cousin offspring and the mean postnatal mortality was higher in the progeny of consanguineous

parents. The studies conducted by Mokhtar and Abdel-Fattah (2001), Hammami et al (2005) and Khayat and Saxena (2007) in Egypt also found similar results by presenting the ties between first degree consanguinity and early age mortality rates. The findings from these and other studies in different geographic contexts (Tunçbilek and Koç, 1994; Koç and Eryurt, 2016; Hussain, 1999; Jurdi and Saxena 2003; Pedersen, 2002; Weinreb, 2008) are consistent with our findings regarding their estimations of the significant relationship between first degree consanguineous marriage and infant mortality.

Considering what has been inferred through this thesis, there will be some recommendations as follows:

There are genetic tests in Egypt before marriage, but they are lacking in control, and authorities should be concerned enough to take resolute moves to make sure that these pre-marriage tests have been conducted, particularly for consanguineous marriages. It is hoped that the authorities in Egypt will organize awareness-raising campaigns for mothers on how to care for themselves and their children, particularly in the early stages of life. In general, it is also hoped that the authorities in Egypt raise attention to the critical aspects of human development in Egypt. In addition, for researchers in the field of medical and social-demography, it is hoped that they concentrate their prospective research on consanguinity and its impacts on early age mortality, particularly on second cousin marriage type and post-neonatal mortality.

Any attempts to discourage consanguinity at the population level appear to be inappropriate and undesirable, especially when consanguineous unions remain an integral part of Egypt's cultural and social life. Nevertheless, the WHO-recommended approach to minimizing the negative effects of consanguinity on child health should be followed. This approach is based on the identification of families with a high risk of a genetic disease and the provision of prospective genetic counseling (WHO, 2006).

Finally, there is a plan for prospective studies as an extension of this thesis which will, firstly, give more attention to first and second cousin marriages and their impact on post-neonatal mortality, followed by a comparative study covering Egypt and Turkey in order to estimate the impacts of consanguinity on early age mortality and on fertility in both communities. In the prospective study, if data allows, we will group the variables under four

categories: Medical factors, social factors, medical factors by mediating social factors and social factors mediating by medical factors.

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APPENDIX 1

Table A.1: Percentage Distribution of Individual-Level Variables by Consanguinity (Row percentages)

Individual variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
Educational level of women	No education	61.3	21.6	7.7	9.4	100.0	2,797
	Primary	64.8	20.2	7.3	7.7	100.0	1,340
	Secondary	67.6	17.6	7.3	7.5	100.0	9,024
	Higher	79.0	10.9	4.6	5.6	100.0	2,505
Education level of husband	No education	67.1	18.5	6.7	7.7	100.0	2,026
	Primary	69.0	17.7	6.9	6.4	100.0	2,094
	Secondary	65.7	18.5	7.4	8.3	100.0	8,885
	Higher	75.8	12.7	5.6	5.9	100.0	2,660
Working status of women	Not working	66.8	18.2	7.2	7.7	100.0	13,627
	Working in agricultural	66.7	17.7	7.0	8.6	100.0	327
	Working in services	74.4	13.5	6.1	6.0	100.0	554
	Working in manufacture	79.7	9.8	3.8	6.7	100.0	1,158
Coverage by health insurance	No	67.2	17.9	7.2	7.7	100.0	14,623
	Yes	80.2	11.2	2.9	5.7	100.0	1,044
Age of women	less than 25 years old	64.9	18.2	8.7	8.2	100.0	3,929
	25-34	68.9	17.3	6.0	7.8	100.0	9,349
	Over 35 years old	69.8	16.6	7.8	5.8	100.0	2,388

Table A.2: Percentage Distribution of Maternal Variables by Consanguinity

(Row percentages)

Maternal variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
birth order	First birth order	72.0	15.1	6.3	6.5	100.0	4,827
	2-3	68.4	17.7	6.5	7.4	100.0	7,806
	4-5	62.8	19.1	8.7	9.4	100.0	2,495
	6+	50.9	25.7	11.5	11.9	100.0	538
Months since preceding birth	First birth	72.0	15.1	6.2	6.6	100.0	4,962
	7-23	65.8	19.4	7.4	7.4	100.0	2,101
	24-47	66.1	18.7	7.0	8.2	100.0	5,135
	over 4 years	66.6	17.6	7.7	8.1	100.0	3,471
Succeeding birth interval	7-23	67.0	17.7	7.7	7.6	100.0	1,532
	24-47	66.4	19.3	6.9	7.4	100.0	2,320
	48-59	66.9	18.8	3.8	10.6	100.0	160
	Open birth interval	68.5	17.0	6.9	7.6	100.0	11,654
Mother's age at birth	<20	61.2	20.0	9.8	9.0	100.0	1,469
	20-34	68.7	17.2	6.5	7.5	100.0	12,868
	>35	69.2	16.4	7.9	6.5	100.0	1,333

Table A.3: Percentage Distribution of Environmental Variables by Consanguinity (Row percentages)

Environmental variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
Source of drinking water	Improved	68.2	17.4	6.8	7.6	100.0	14,607
	Non-improved	60.2	18.4	9.9	11.5	100.0	374
	Not a dejure resident	69.1	17.5	7.8	5.6	100.0	679
Type of toilet facility	Improved	67.4	17.8	7.1	7.7	100.0	13,735
	Non-improved	74.9	13.1	4.6	7.4	100.0	1,248
	Not a dejure resident	69.1	17.5	7.8	5.6	100.0	679
Time to obtain drinking water	Water on premises	68.0	17.4	7.0	7.6	100.0	13,805
	Less than 30 minutes	69.7	17.2	6.1	7.0	100.0	1,061
	30 minutes or longer	54.0	19.5	8.0	18.6	100.0	113
	Don’t Know	87.5	0.0	12.5	0.0	100.0	8
	Not a dejure resident	69.1	17.5	7.8	5.6	100.0	679
Frequency of someone smoking inside the household	Daily	67.9	17.8	7.1	7.1	100.0	7,056
	Weekly	69.6	13.4	8.2	8.8	100.0	194
	Monthly	47.8	36.4	7.1	8.7	100.0	184
	Never	68.6	16.7	6.6	8.1	100.0	7,549
	Not dejure resident	69.1	17.5	7.8	5.6	100.0	679

Table A.4: Percentage Distribution of Nutritional Availability Variables by Consanguineous Marriage (Row percentages)

Nutritional Availability variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
Size of child at birth	Very small	63.3	20.5	7.5	8.7	100.0	743
	Smaller than average	67.5	18.0	6.7	7.8	100.0	1,844
	Average or larger	68.4	17.1	6.9	7.5	100.0	13,025
	Don't know/missing	55.4	32.1	8.9	3.6	100.0	56
Status of breastfeeding	Never breastfed	69.4	18.4	5.8	6.5	100.0	899
	Ever breastfed	67.7	17.4	7.2	7.7	100.0	10,168
	Currently breastfeeding	68.5	17.2	6.7	7.6	100.0	4,566

Table A.5: Percentage Distribution of Personal Illness Variables by Consanguinity (Row percentages)

Personal Illness variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
Timing of the first antenatal check	No Antenatal visit	61.8	22.8	8.1	7.2	100.0	1,534
	1-3	69.7	16.3	6.9	7.1	100.0	8,545
	4-6	66.9	18.1	5.6	9.4	100.0	1,471
	7+	63.3	15.9	10.6	10.2	100.0	245
	Don't know/Missing	82.1	3.6	7.1	7.1	100.0	28
	Question not asked	67.6	17.7	6.9	7.9	100.0	3,842
Number of antenatal visits during pregnancy	None	61.8	22.8	8.1	7.2	100.0	1,534
	1-2	64.7	17.5	7.9	9.8	100.0	519
	3-4	65.5	20.0	6.3	8.2	100.0	1,572
	5+	69.3	16.5	6.8	7.4	100.0	11,947
	Don't know	75.0	10.4	5.2	9.4	100.0	96
Antenatal care provider	No Antenatal care	61.8	22.8	8.1	7.2	100.0	1,534
	Doctor	69.9	16.3	6.8	7.0	100.0	12,808
	Nurse/Midwife	59.6	18.9	6.6	14.9	100.0	423
	Daya and others	56.1	23.5	7.5	12.8	100.0	903
Place of delivery	Home	59.1	21.8	8.4	10.7	100.0	2,067
	Public sector health facilities	70.0	16.8	6.5	6.8	100.0	4,006
	Private sector health facilities	69.2	16.7	6.8	7.3	100.0	9,519
	Other	67.1	19.2	8.2	5.5	100.0	73
Number of examinations during antenatal care	0	65.9	19.1	7.3	7.7	100.0	5,638
	1-2	63.3	19.5	7.6	9.5	100.0	1,854
	3-4	70.5	15.8	6.6	7.1	100.0	8,175

Table A.6: Percentage Distribution of Tradition/Norms/Attitude Variables by Consanguinity (row percentages)

Tradition/Norms/Attitude variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
Cohabitation duration (grouped)	Less than 5 years	72.8	14.6	6.4	6.2	100.0	4,730
	5-14	66.9	18.4	6.7	8.1	100.0	9,085
	15-24	61.6	20.0	9.4	8.9	100.0	1,705
	25 and over	58.2	21.2	13.0	7.5	100.0	146
Literacy	Cannot read at all	60.9	22.2	7.5	9.4	100.0	3,085
	Able to read only parts of sentence	66.4	17.6	7.8	8.3	100.0	666
	Able to read whole sentence	70.0	16.2	6.7	7.1	100.0	11,903
	Blind/visually impaired	25.0	25.0	25.0	25.0	100.0	8
Media exposure	0-1	66.7	18.1	6.9	8.3	100.0	11,207
	2	70.4	16.4	7.3	6.0	100.0	3,643
	3	75.9	13.6	5.6	4.9	100.0	809
Ideal number of children (grouped)	less than 2	71.3	11.8	7.5	9.5	100.0	348
	2-3	72.0	15.2	6.2	6.6	100.0	10,455
	4-5	58.4	22.3	8.6	10.6	100.0	3,750
	6+	58.3	26.1	8.6	7.0	100.0	544
	Non-numeric response	65.3	22.4	7.2	5.1	100.0	571
Decision maker for using contraception	Mainly woman	68.4	17.7	6.2	7.7	100.0	2,130
	Mainly husband	74.3	18.0	4.4	3.4	100.0	206
	Joint decision	71.2	15.3	6.2	7.3	100.0	7,349
	Other	70.4	14.8	3.7	11.1	100.0	27
Number of reasons for which wife-beating is justified	0	71.8	15.3	6.4	6.5	100.0	9,928
	1-2	64.8	18.8	7.3	9.2	100.0	3,245
	3-4	59.1	23.1	7.9	9.9	100.0	1,816
	5	52.8	26.4	10.9	9.9	100.0	678
Number of decisions in which women participate	0	61.9	20.7	9.7	7.7	100.0	1,781
	1-2	65.8	19.0	6.8	8.4	100.0	3,274
	3	65.7	18.9	7.2	8.2	100.0	2,671
	4	71.1	15.5	6.3	7.0	100.0	7,940

Table A.7: Percentage Distribution of Household and Community-Level Variables by Consanguinity (row percentages)

Household and Community-Level variables	Categories	Consanguinity				Total	n
		Not Related	First Cousin	Second Cousin	Other Relative		
Wealth index	Poorest	55.8	23.5	10.7	10.0	100.0	2,819
	Poorer	62.2	20.2	8.0	9.5	100.0	3,074
	Middle	67.9	17.4	6.6	8.1	100.0	3,907
	Richer	73.5	15.4	5.3	5.8	100.0	3,279
	Richest	81.7	10.2	4.1	4.0	100.0	2,588
Religion	Muslim	68.2	17.3	6.9	7.5	100.0	15,138
	Christian	63.6	21.1	6.5	8.8	100.0	511
	Other	50.0	11.1	16.7	22.2	100.0	18
Type of place of residence	Urban	76.9	13.5	4.7	4.9	100.0	4,845
	Rural	64.1	19.2	8.0	8.8	100.0	10,822
Region	Urban governorates	80.4	11.1	4.6	3.9	100.0	1,599
	Urban Lower Egypt	82.4	9.9	4.3	3.4	100.0	1,431
	Rural Lower Egypt	74.0	13.5	6.4	6.1	100.0	6,001
	Urban Upper Egypt	69.5	18.6	5.1	6.8	100.0	1,733
	Upper Egypt Rural	51.5	26.3	10.0	12.2	100.0	4,750
	Frontier governorates	67.3	20.3	5.9	6.5	100.0	153

APPENDIX 2

HACETTEPE UNIVERSITY
INSTITUTE OF POPULATION STUDIES
THESIS/DISSERTATION ORIGINALITY REPORT

HACETTEPE UNIVERSITY
INSTITUTE OF POPULATION STUDIES
TO THE DEPARTMENT OF DEMOGRAPHY

Date: 24/7/2016

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Hamed Hamed Mohamed HAWAL

Name Surname:	Hamed Hamed Mohamed Hawal
Student No:	N12124275
Department:	Demography
Program:	M.A.
Status:	X☐ Masters ☐ Ph.D. ☐ Integrated Ph.D.

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