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ASSESSMENT OF THE COMPLETENESS AND TIMELINESS OF DEATH REGISTRATION IN TURKEY: 2009-2015

ZEHRA YAYLA

Hacettepe University
Institute of Population Studies

Supervisor
Assoc. Prof. Dr. Alanur ÇAVLİN

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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:

Member (Chair) ....
Assist. Prof. Şeref HOŞGÖR
Başkent University, Department of Insurance and Risk Management

Member...
Assoc. Prof. Alanur ÇAVLİN (Supervisor)
Hacettepe University, Institute of Population Studies

Member..
Prof. Dr. İsmet KOÇ
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

This thesis aims to evaluate the quality of death registration system in terms of completeness and timeliness for the years 2009-2015. Completeness is evaluated by Hybrid (GGBSEG) Method and by 2013-TURKSTAT life table. Completeness of 2009-2013 and 2013-2015 periods, and each year from 2009 to 2015 are assessed by Hybrid Method. Additionally, 2013-TURKSTAT life table is used to estimate the number of deaths for the years of 2013, 2014, and 2015. Timeliness is assessed by sex, age groups, and 81 provinces according to death registration in 10 days, 11-30 days, 31-90 days, 91-180 days, 181-365 days, and after 1 year.

Analyses of Hybrid method show that coverage of Address Based Population Registration System population has not been stable in the 2009-2015 period especially for women. The coverage of ABRS has been improved significantly every single year, however these improvements of any single year could not be transfered to the previous years' age and sex distribution. Therefore, hybrid method is not sufficient to estimate completeness.On the other hand, results of completeness analyses which were calculated using 2013-TURKSTAT life table, show that majority of unregistered deaths are in the age group of 75+. Especially, females in this age group are more exposed to unregistration than males within this age group. In addition to this, unregistered deaths are determined mostly in the infant deaths apart from in 75+ age group. According to death data that was taken from TURKSTAT by individual application, number of unmatched deaths, (unregistered in MERNIS, but captured by cause of death database) are mostly seen in infants who died before birth registration. Analyzes on timeliness show that death registration in 10 days increases over the years for both sexes. Additionally, it is seen that despite some deficiencies in the functioning of the system, Death Notification System (DNS) provides better death data in terms of coverage and timeliness compared to other systems that were used before 2013 in Turkey.

ÖZET

Bu tezde, ölüm kayıt sisteminin kalitesi 2009-2015 yılları için tamlık ve zamanındalık kriterleri bakımından değerlendirilmeye çalışılmıştır. Tamlık kriteri, Hibrit yöntemi ve 2013 TÜİK hayat tabloları kullanılarak değerlendirilmiştir.Hibrit yöntemiyle 2009-2013 ve 2013-2015 dönemleri ile 2009-2015 arasındaki tüm yıllar için tamlık değeri hesaplanmıştır. Ayrıca, 2013,2014 ve 2015 yıllarındaki ölüm sayısı 2013-TÜİK hayat tablosu kullanılarak tahmin edilmiştir. Zamanındalık kriteri cinsiyet, yaş grubu ve 81 il bazında değerlendirilmiş ve ilk 10 , 11-30, 31-90, 91-180 ve 181-365 gündeki ve 1 yıldan sonraki kayıtlılık oranlarına bakılmıştır.

Hibrit yöntemiyle yapılan analizlere göre Adrese Dayalı Nüfus Kayıt Sisteminin nüfus kapsamı 2009-2015 dönemi için, özellikle kadın nüfunda sabit bir durum göstermemektedir. ADNKS'nin kapsamı her yıl iyileşmesine karşın, bu iyileşme önceki yılın yaş ve cinsiyet yapısına yansımamaktadır. Bu yüzden, Hibrit Metot tamlık oranını tahmin etmede yeterli olmamıştır. Diğer taraftan, 2013-TÜİK hayat tablosuyla hesaplanan tamlık sonuçları ölüm kaydı olmayan kişilerin büyük çoğunluğunun 75+ yaş grubunda olduğunu göstermiştir. Özellikle bu yaş grubundaki kayıtsız kadın ölümleri, erkek ölümlerine göre daha fazladır. Buna ek olarak, 75+ grubunun dışında, en çok kayıtsızlığın bebek ölümlerinde olduğu belirlenmiştir. TÜİK'ten bireysel başvuru ile alınmış olan ölüm verisine göre, eşleşmeyen ölüm sayısının (MERNİS'te kayıtlı olmayıp, ölüm nedeni verisinde olan ölümler) en çok doğum kaydı olmadan ölmüş bebeklerde olduğu gözlenmiştir. Ölüm kayıtlarının zamanındalığı ile ilgili yapılan analizlere göre ilk 10 gün içindeki kayıtlılıkta yıllar içinde artış olduğu görülmüştür. Buna ilaveten, sistemin işleyişindeki bazı eksikliklere rağmen, Ölüm Bildirim Sistemi (ÖBS) kapsam ve zamanındalık bakımından önceki sistemlerden daha iyi ölüm verisi sağlamaktadır.

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ABPRS	Address Based Population Registration System
ASDR	Age Specific Death Rate
CR	Civil Registration
CRVS	Civil Registration and Vital Statistics
DNS	Death Notification System
GBD	Global Burden of Disease
GGB	General Growth Balance
HMN	Health Metrics Network
ICD	International Statistical Classification of Diseases and Related Health Problems
ICT	Information and Communication Technologies
MERNIS	Central Civil Registration System
SEG	Synthetic Extinct Generations
SPO	State Planning Organization
TDHS	Turkey Demographic Health Survey
TURKSTAT	Turkish Statistical Institute
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNSD	United Nations Statistics Division
VS	Vital Statistics
VSPI	Vital Statistics Performance Index
WHO	World Health Organization

1.INTRODUCTION

1.1.BACKGROUND

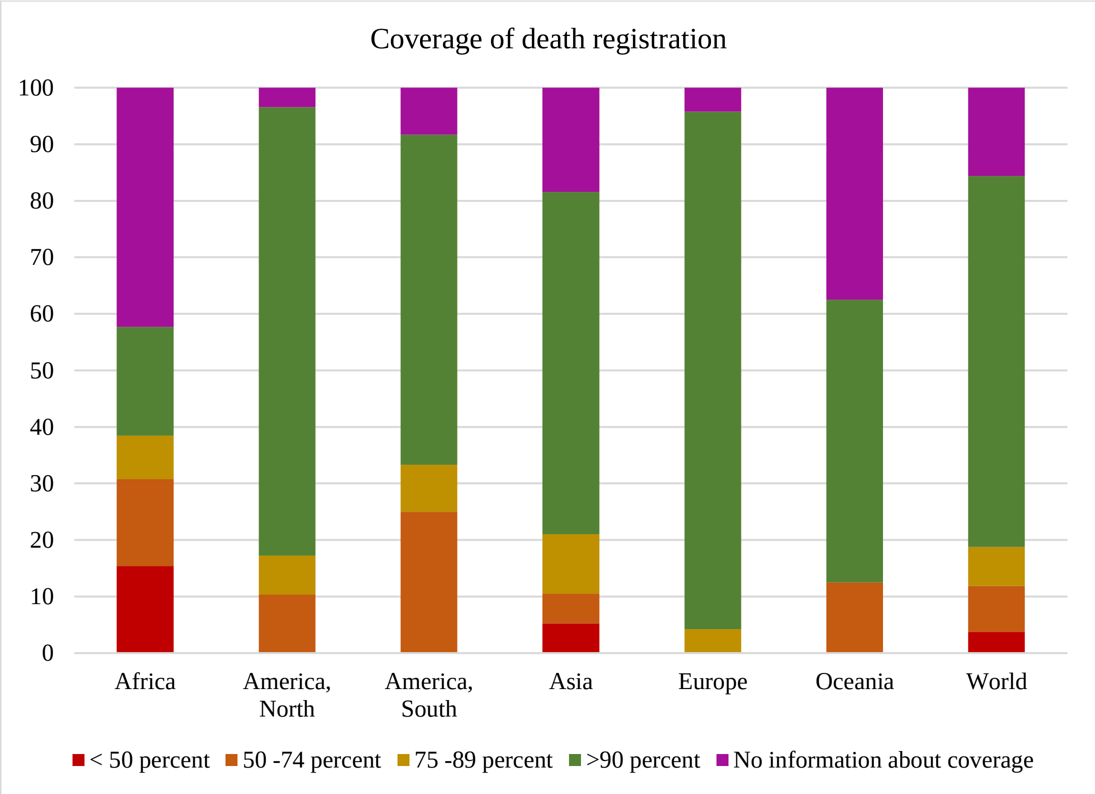
Development is an indicator of quality of life. Accessing the public or private services and benefiting from them are important to see how developed a country is. At this point, having a well-developed civil registration and vital statistics (CRVS) system is essential to examine the development level of a country. In United Nations 2014 Revision, hereafter UN 2014 revision, the importance of civil registration system regarding individual and public authorities is mentioned (UN, 2014). For individual authorities, the rights of identity, citizenship, and property are protected by UN 2014. Additionally, for public authorities, national and regional planning for health care programs, family planning programs, and other social services are ensured. In the year 2000, Millennium Development Goals (UN, 2015) were signed by 189 UN member states to be achieved by the year 2015. These goals are:

- Eradicate extreme poverty and hunger,
- Achieve universal primary education,
- Promote gender equality,
- Reduce child mortality,
- Improve maternal health,
- Combat HIV/AIDS, malaria and other diseases,
- Ensure environmental sustainability and
- Develop a global partnership for development.

Most of these goals require a qualified data for fertility, mortality and causes of deaths (Setel et al., 2007). For example, to measure the level of primary education, a country should have a good birth registration system, to reduce the child mortality, good death and cause of death registration system is necessary. After millennium development goals, on 25 September 2015 post- 2015 development agenda has been established (UN, 2016) and 17 sustainable development goals and 169 targets has been accepted to be achieved by the year 2030. These goals include several targets that require an efficient CRVS system. Targets 16.9, and 17.18 of post-2015 development agenda aim to achieve legal identity for everyone, and to increase the availability of high quality, timely, and reliable data in accordance with several demographic features, respectively. Lessons learned from millennium development goals have shown that efficient data production is essential for policy making and it is seen as an important means for development (Szreter, 2006; UN, 2015).

Although there has been improvement in the registration system, most of the developing countries don't have a qualified data especially for mortality and causes of deaths. Mathers, Ma Fat, Inoue, Rao, and Lopez (2005) made a study for assessing the coverage and quality of global mortality data based on the data for World Health Organization (WHO) member states (Mathers, Ma Fat, Inoue, Rao, & Lopez, 2005). According to results, while in European countries the coverage of death registration is almost 100 percent, in African countries this ratio declines up to 10 percent. When we look at the situation of Turkey, coverage of cause of death data is seen as under 50 percent for the period of years 1987 to 1998 and coverage of death registration is 89 percent (but data is available only for urban areas) for the years 1967- 2000 (Mathers et al. 2005). UN published a data on the situation of death registration coverage for most of the countries (UNSD, 2014). Based on this data, status of death registration coverage of these countries are grouped and presented in figure 1. It is seen that while most of the European countries are leading for highly adequate death registration system, other countries, especially African countries, have deficiencies in their registration systems. According to this data, coverage of death registration in Turkey is 71 percent for the year 2007, and "90 or more" for the year 2013. Undoubtedly, many changes have been made to improve death registration system by the year 2009, however, there are limited number of studies to assess the effect of these changes. The subject of this thesis is to evaluate the effect of these changes in death registration system on the completeness and timeliness of death registration system.

Figure 1.1.1 Coverage of death registration in the world



Source: http://unstats.un.org/unsd/demographic/CRVS/CR_coverage.htm

1.2. REGISTRATION SYSTEM IN DEVELOPMENT PLANS IN TURKEY

Importance of a well-functioning CRVS system has been emphasized in five-year development plans of Turkey. In the sixth Five Year Development Plan (1990-1994) it is emphasized that necessary measures will be taken to improve the CRVS system (article 761) (State Planning Organization [SPO], 1989). In the seventh Five Year Development Plan (1996-2000) (SPO, 1995), due to the lack of organization and infrastructure, existing civil registration system have been found lacking with respect to coverage and necessity of improvement in civil registration system is stated.

In the eighth five year development plan (2001-2005) (SPO, 2000) state of existing registration system has been tackled in detail. Requirement for a central population administration system, strengthening the flow of information and cooperation between relevant institutions have been stated (article 635). It was considered that it is necessary to have local administrative units responsible for gathering timely and reliable data on birth and death events at local level (article 636). In the light of these requirements, it was targeted to expand the civil registration system across the country, so that it can be used by all sectors in the country. In addition to this, it was targeted to provide cooperation and coordination among related institutions (article 644).

In the tenth five- year development plan (2014-2018) (Ministry of Development, 2013), government has given weight to strengthening the statistical system for reliable, timely, and true data. It has been targeted to improve the data infrastructure of all organizations involved in the production of statistics, especially TURKSTAT. Under the statistical information infrastructure development program it is aimed to strengthen the cooperation of related institutions in the production of statistics, to produce statistical data on international standards, and to determine the priorities of the statistical data production.

1.3.DEATH REGISTRATION IN TURKEY

Legal framework and practice surrounding death

Process of death registration, procedures for burying the dead, and responsible institutions in the death registration processes are determined by several legal regulations in Turkey. Depending on the changes in the death registration systems, these regulations took its present state. Legal framework for death and burial processes is located on (Özdemir, 2012):

- *Public Health Law (1930),*
- *Municipal Law (1930),*
- *Regulation on cemeteries (1931),*
- *Metropolitan municipality law (2004),*
- *Population services law (2006),*
- *Regulations on family practice (2010),* and

- *Regulations on transport funeral and burial with the construction of cemetery (2013).*

According to Public Health Law (Umumi Hıfzısıhha Kanunu [UHK], 1930), it is forbidden to bury a dead without the certificate of death (article 215). Certificate of death is given by municipality physicians, if no municipality physician is available the certificate is given by government physicians (community health center physician or family physician)[1]. Unless a certificate is confirmed by an official physician[2], the certificate is invalid. (Article 216). Certifications of death are given by managers or chief physicians for deaths in hospitals (article 218). In the event of unavailability of doctor or any health officer certificates are given by authorized person for certifying the death document, gendarmerie station command, or village headman respectively (article 219). It is obligatory to register all deaths by certifier of death. In these records, name, address, date of death, name of certifier, and cause of death (if known) are present. These records are send to government doctor and health department before the 15th of next month by certifier of death certificate (article 220).

In *Municipal Law* (1930, article 15/5) and *Metropolitan municipality law* (2004, article 7/s), municipalities are held responsible for carrying out burial processes and establishing cemeteries. According to *Regulation on cemeteries* (1931), a dead cannot be buried without a certificate of death which is given by appointed person determined in *Public Health Law* (article 29). Additionally, according to *Population Services Law* (2006) deaths are reported to registration offices at their places of occurrence. In the event of the place of death is not known, it is reported to registration offices where the dead body is found (article 31/3).

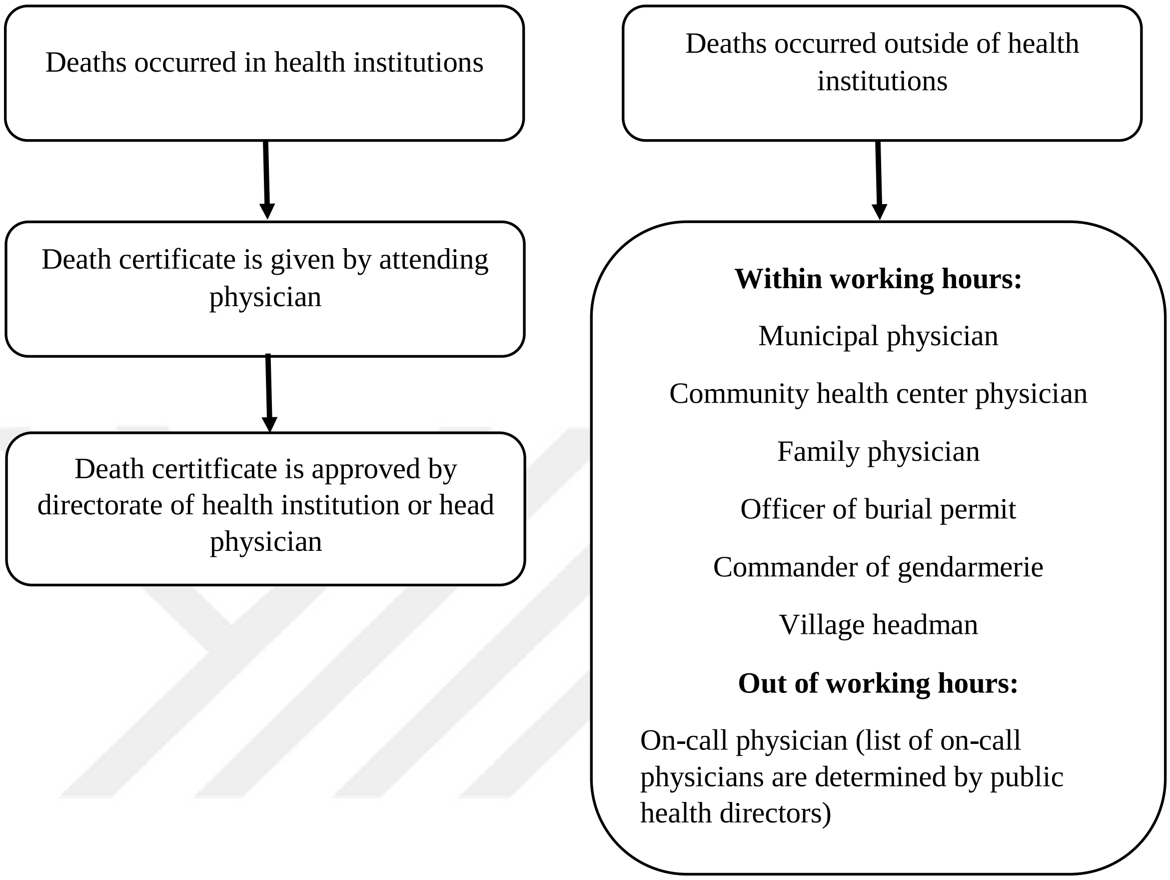
According to *Regulations on Family Practice* (2010), registries of certified deaths should be reported to health department and relevant family physician should be informed. Examination of deceased is executed and certification of death is prepared by municipality physicians at the place of death, if no municipality physician

[1] Regulations on transport funeral and burial with the construction of cemetery, Date of official gazette: 19 January 2013, No: 28533.
[2] Official physicians refer to government physicians, municipality physicians, or health clinics physicians.

is available, community health physicians, if no community health physician is available family physicians are responsible for following the procedures (article 24/5).

In *Regulations on Transport Funeral and Burial with The Construction of Cemetery* (19 January 2013), burial processes are expressed in detail. According to these regulations, when a death is occurred at governmental health institutions, a death certificate is given by the corresponding institution after being approved by a manager or a head physician. For deaths occurring at private health institutions, death certificate is prepared by attending physicians and death certificates are valid only after being approved by a municipality physician, or a public health center physician, or a family physician. For deaths occurring outside health institutions, death certificates are given by either municipality physicians, public health center physicians, family physicians or people authorized to certify death certificates. In the event of unavailability of these authorities, certificates are given by gendarmerie station commanders, or by village headmen. For deaths occurring out of working hours, death certificates are given through a watch list which includes a municipality physician, a public health center physician, and a family physician. Watch lists are prepared by public health centers and approved by local administrative chiefs. Public health directorate supplies needed services for this watch system. Death certificates are filled electronically, but when a certificate is filled on paper due to the technical problems, it is computerized in five workdays (Article 16). In addition to these, in places where municipal or governmental physicians are unavailable, civilian authority provides training for either medical personnel, other public officials gendarmerie station commanders, or village headmen about death certificates. After training, a document is given to the person to be appointed (article 17). Public health directorates notify deaths electronically to civil registries within ten days of occurrence, and also send identity cards of the deceased to civil registries (article 22).

Figure 1.3.1 Institutions responsible for issuing the death certificate



Death Registration Processes before 2009

To understand the death registration processes, it is necessary to know the mechanism of this system before the year 2009 which the death registration system has changed. Death is recorded by two organizations in Turkey: General Directorate of Civil Registration and Nationality through Central Civil Registration System (MERNIS) and Ministry of Health. MERNIS, which was put into practice in the year of 2000 is an electronic record system of family registries[3]. In this system, every citizens of Republic of Turkey has a unique 11 digit ID- number. All changes about civil status are recorded by MERNIS. Before the year 2009, death registration was recorded based on two death documents: Death statistics forms (old death certificate, Appendix A) and MERNIS Death Reporting Forms (Appendix A). Death statistics

[3] http://www.nvi.gov.tr/English/Mernis_EN,Mernis_En.html

forms were issued by health institutions for only deaths in provincial and district centers. MERNIS Death Reporting Forms were prepared for all deaths in Turkey for official records.

Until the year of 2008, Turkish Statistical Institute (TURKSTAT) published death statistics for only provincial and district centers[4]. These statistics were based on the Death statistics forms send by provincial directorates of health in provinces and health clinics in districts. Health clinics and other health institutions collected Death statistics forms for a month, and then sent these forms to Provincial Directorate of Health which later sent them to Regional Directorate of TURKSTAT. Input data of these forms were carried out in Regional Directorate of TURKSTAT. A death statistics form (old death certificate) consists of 3 parts: one part was used for burying dead, one part was kept in issuing health institution, and the last part was sent to TURKSTAT by health departments for statistical purposes. This form contained information on place, date, and main cause of death, information of ID card, and institution which have determined the cause of death.

MERNIS Death Reporting Forms were used only for administrative purposes. These forms were issued by attending physicians for deaths occurred in hospitals. For deaths occurred outside hospitals, forms were issued by municipal physicians or government doctors [5] if available, if not, MERNIS forms were issued by either officers of burial permit, village headmen or commanders of gendarmerie (Ministry of Health 2013). Deaths due to external causes (injuries) were notified by coroner. A MERNIS Death Reporting Form contained information on ID card, residence address, and cause of death. Cause of death consisted of only a row where cause of death was written with a code, was not detailed. Furthermore, there were no information on mother and infant deaths. This form was prepared in 3 copies. First copy was kept in issued institution, and the last two copies were sent to directorates of district civil registration with the

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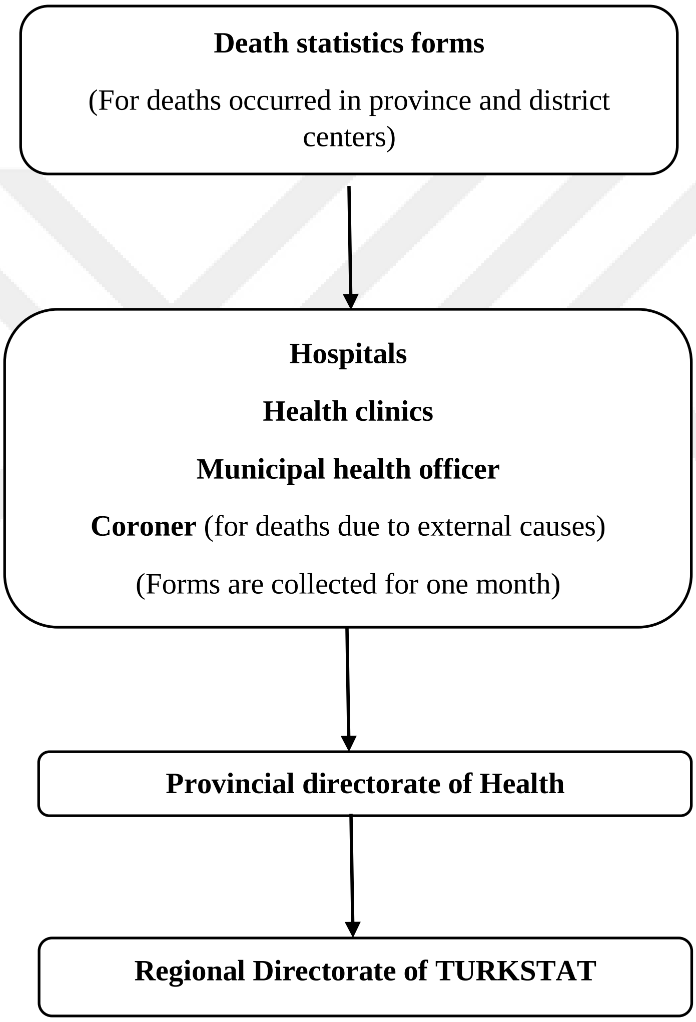
[4] http://www.tuik.gov.tr/PreTablo.do?alt_id=1060

[5] According to *Regulations on transport funeral and burial with the construction of cemetery (2013)*, Government doctor refers to community health center physician or family physician .

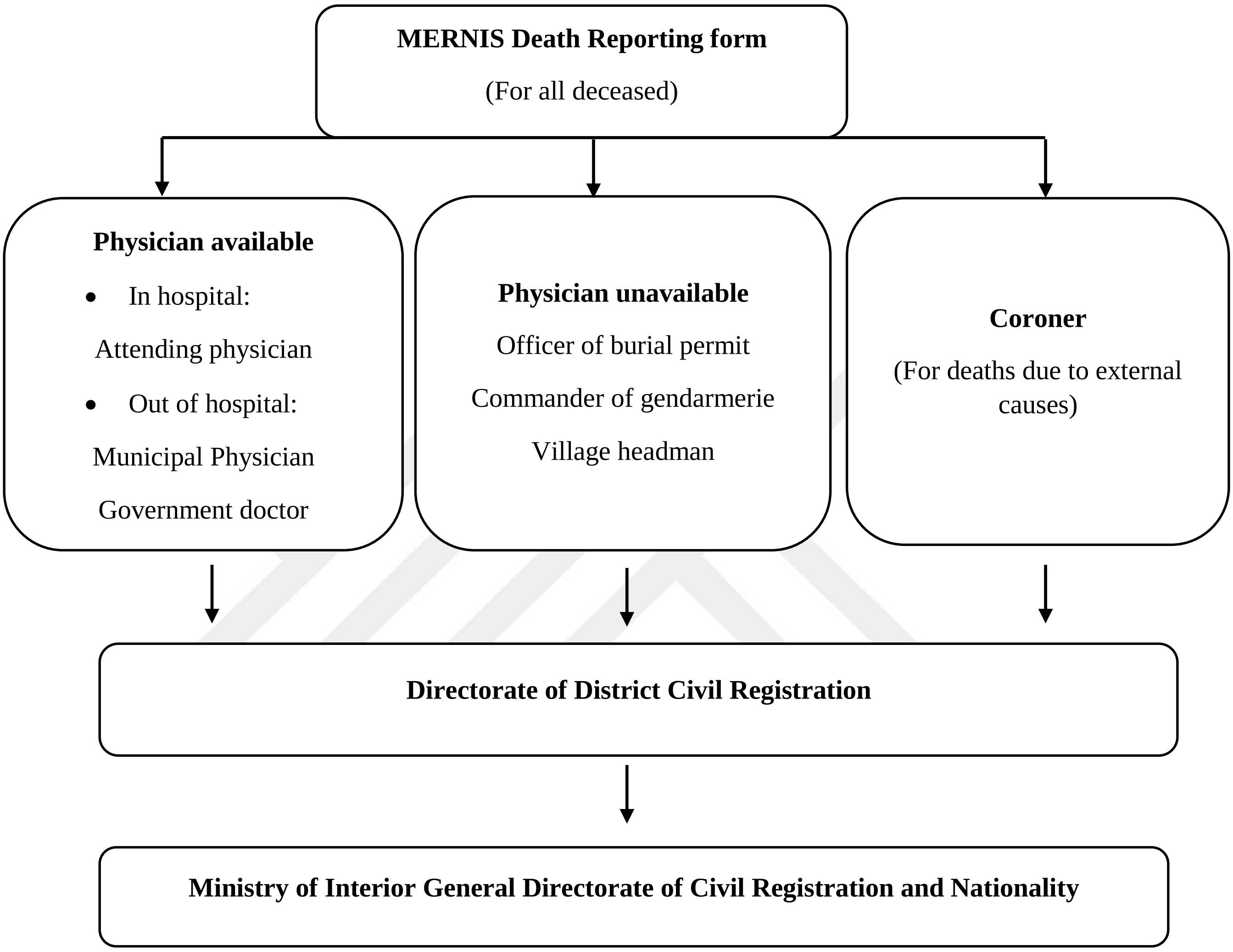
identity card of the deceased within ten days. Then all data from MERNIS forms were collected into national data by the Ministry of Internal affairs.

Figure 1.3.2. The compilation stages of cause of death data in TURKSTAT (Before 2009)



Source: The source of this process is gathered from TURKSTAT by individual application.

Figure 1.3.3. Death registration process of MERNIS (before 2009)



Source: Özdemir, 2012; Özdemir, Rao, Öcek, and Horasan, 2015; Özdemir and Öcek, 2015, interview with authorized persons from TURKSTAT and MERNIS

Death Registration Processes in 2009-2012

Until the year of 2009, death data of TURKSTAT and MERNIS were compiled independently from each other. In 2009, some reforms were made in the process of death registration. Firstly, it was decided to match death records of TURKSTAT and MERNIS. This means that, death certificates which are sent to TURKSTAT by Provincial Health Directorates and MERNIS death reports have been added to TURKSTAT death registration system for deaths occurring earliest in 2009[6] (Özdemir, 2015). Second reform is that TURKSTAT death certificates are made much more detailed in terms of information on cause of death (Appendix A). Current forms contain information on identity, date of death, and cause of death. In addition, maternal mortality, infant and perinatal mortality are recorded. Coding the cause of death is made in accordance with ICD (International Statistical Classification of Diseases and Related Health Problems) coding. Until 2008 Turkey used the ICD-8 version. In 2008 ICD-10 was put into practice.[7]

Death Registration Processes after 2013

Before the year 2013, death registration and vital statistics on deaths were based on two different forms. Death registration was made according to MERNIS Death Reporting Forms and burying procedures and vital statistics were made according to TURKSTAT death certificate. Using of two different forms increased inconsistencies in death registration. In 2013, General Directorate of Population and Citizenship Affairs sent an official letter[8] to 81 provincial governors. According to this letter, a death certificate from electronic death notification system (DNS) is put into practice by Turkey Public Health Institution, and MERNIS Death Certificate is abolished. TURKSTAT has gathered death records from electronic death notification system ever since. For burial processes, one printout of death certificates are given to relatives of the deceased[9]. Two printouts of this certificate are send to related public health directorate. Public health directorates transmit these death certificates to MERNIS periodically[13] (Özdemir, 2015).

[6] http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=21522
[7] http://www.saglik.gov.tr/EN/belge/2-96/icd-10-turkish-version-of-10th-revision-of-diseases-and-.html
[8] Ministry of Interior General Directorate of Population and Citizenship affairs letter 09 January 2013 dated and 3267 numbered.
[9]Ministry of Health, Turkey Directorate of Public Health Institutions circular no: 2012/05

Figure 1.3.4. Death registration processes in Turkey 2009-2012

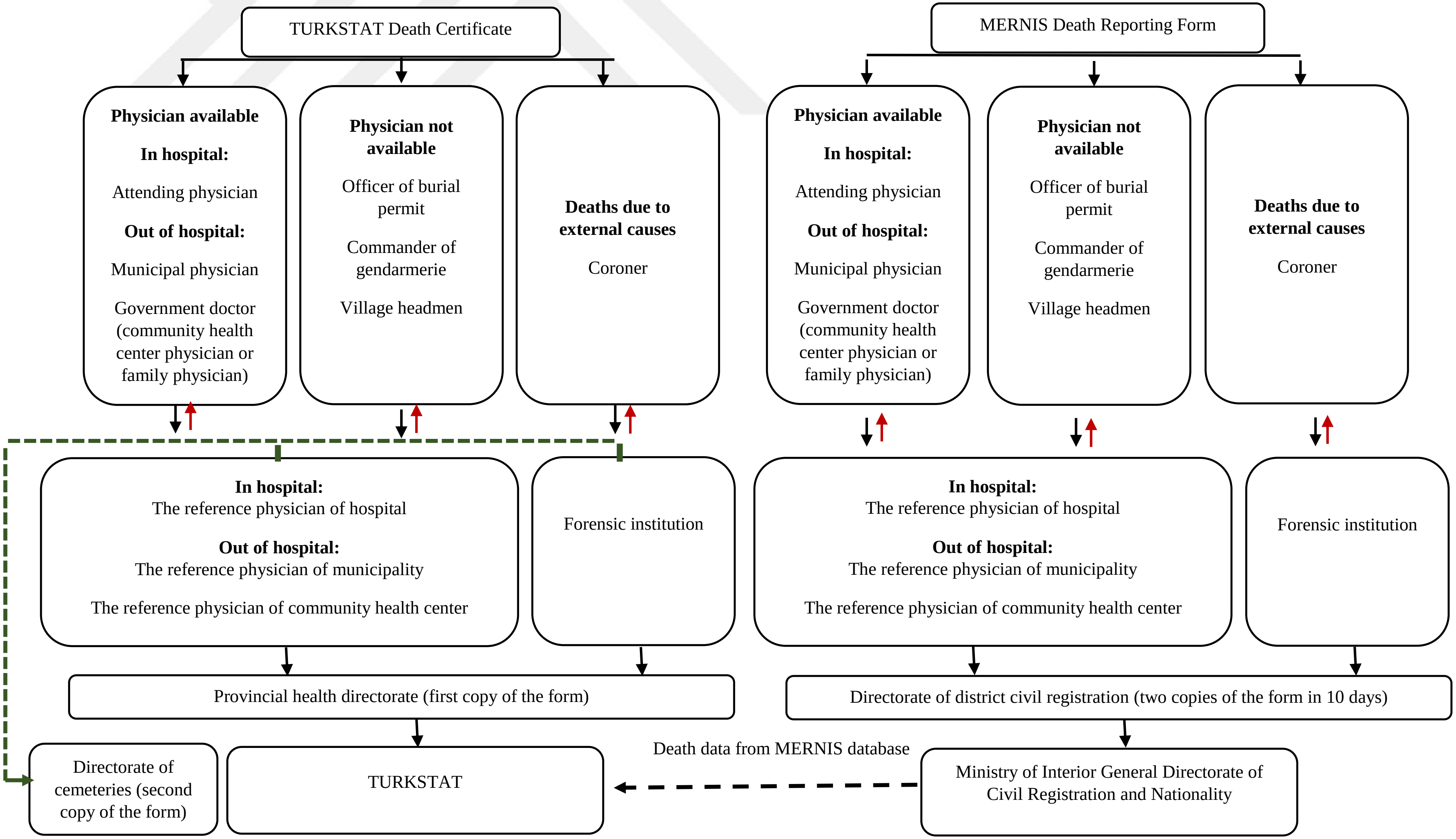
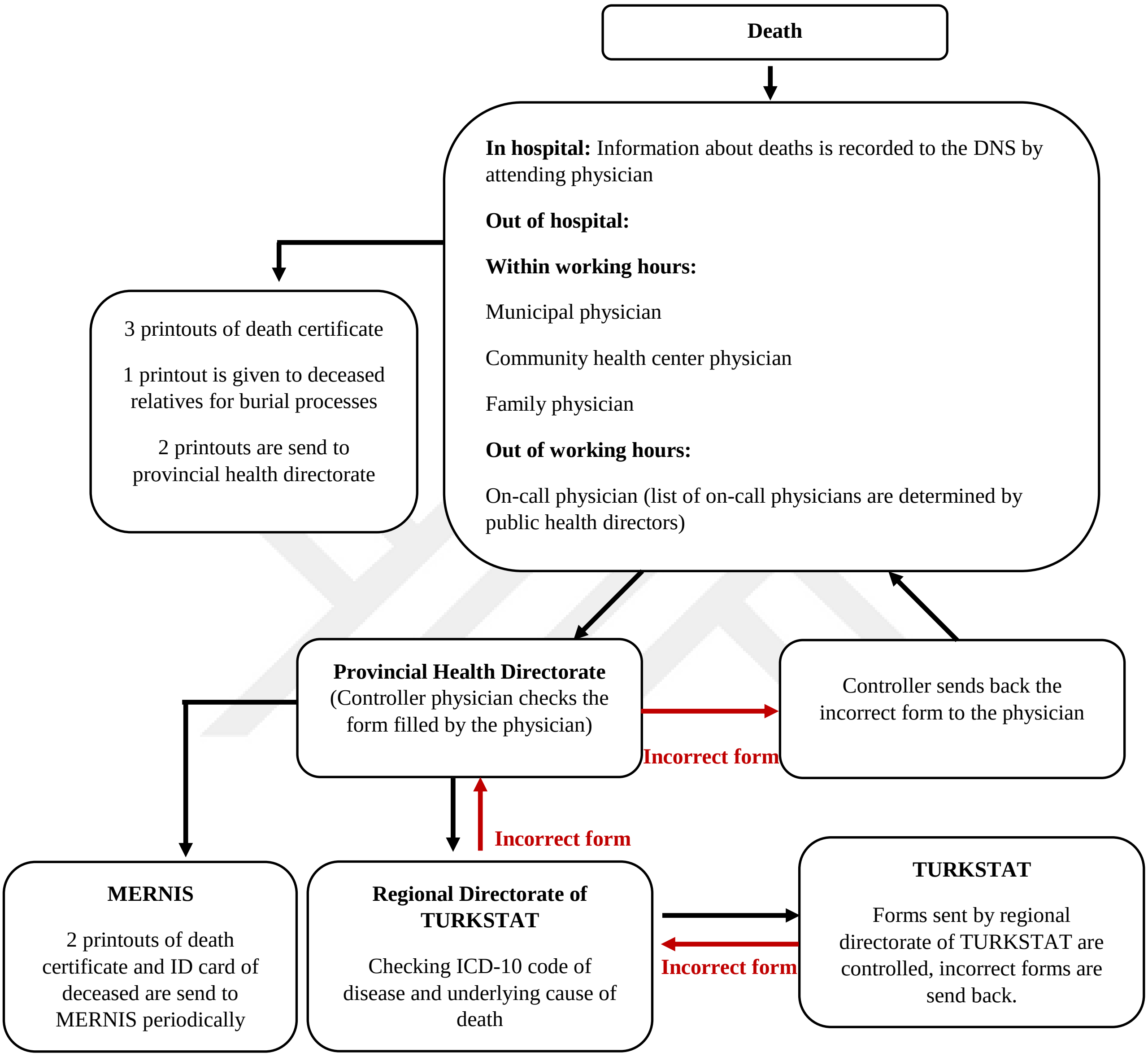


Figure 1.3.5. Death registration processes in Turkey after 2013



Source: TURKSTAT, Turkey Directorate of Public Health Institutions circular no: 2012/05, Ministry of Interior General Directorate of Population and Citizenship affairs article no: 08/03/2013.

1.4. OBJECTIVES AND RESEARCH QUESTIONS

The main objective of this thesis is to assess data quality of death registration in Turkey. Data quality is evaluated according to two criteria:

- **Completeness:** means level of registration of death. The perfect completeness means that each death occurred in Turkey is reported to MERNIS. We assess completeness with this criterion by age and sex for every year from 2009 to 2015.

- **Timeliness:** This is the time elapsed between death occurred and death registrated. Legal period for death registration is 10 days in Turkey. We assess timeliness for within 10 days, 11-30 days, 31-90 days, 91-180 days, 181- 365 days, and 1 year after death by age, sex, and 81 provinces for the period 2009-2015.

Research questions of the thesis are:

- Does completeness of death registration in adult mortality differ from 2009 to 2015 according to age and sex?
- Does completeness of death registration in infant mortality show improvement by sex from 2009 to 2015?
- Does timeliness (registering in 10 days) of death registration improve from 2009 to 2015?
- Does timeliness differ by age, sex, and place of death registered?
- What is the estimated number of unregistered deaths for the years 2013, 2014, and 2015?

This thesis consists of four further chapters. In the next chapter, chapter 2, basic features of civil registration and vital statics, importance of information and communication technologies at civil registration systems, basic information on death and cause of death registration systems are explained. This chapter continues with conducted studies in the World and Turkey to evaluate completeness of death registration system. The third chapter is allocated for data and methodology section. In this chapter, it is mentioned about methods used to assess completeness of death registration systems in the literature. In addition to this, data sources, limitations of data, and the method used in this thesis is explained in detail. In the fourth chapter, results of analysis are presented. Firstly, descriptive results are explained. Secondly, results for completeness of death registration system and then timeliness of death registration are presented. The fifth chapter is allocated for conclusion and discussion section. This section provides a summary of entire content, overall assessment of the results, and suggestions for better death registration system.

2. LITERATURE REVIEW

This chapter consists of six main parts. The first part mentions on definition of civil registration, importance of well-functioned civil registration system, reasons for poor state of a civil registration system and actions to be taken for poor civil registration systems. The second part deals with vital statistics systems. In this part, functions and basic features of vital statistics systems are presented. The third part is related to completeness of registration system. This section mentions about definition of a complete registration system and reasons for incomplete registration system. Importance of death and cause of death registration is presented in the fourth section. The fifth and sixth section are allocated for studies that assess the completeness of death registration in the world and Turkey, respectively.

2.1. CIVIL REGISTRATION

Civil registration *"is continuous, permanent, compulsory and universal recording of the occurrence and characteristics of vital events pertaining to the population, as provided through decree or regulation in accordance with the legal requirements in each country"* (United Nations Statistics Division [UNSD], 2014).

Functioning Civil Registration Vital Statistics (CRVS) systems have two outputs (World Health Organization [WHO], 2014). The first one is that it provides accurate data for national and subnational analysis. It enables statistics for planning and development. These statistics inform on the basis of national/subnational levels about population dynamics, health, and inequities in service delivery, education level, and poverty. The second output is that civil registration provides legal certification for individuals to prove national identification, access services, and protect them against exploitation (especially vulnerable groups women, children). There are three elements of CRVS systems (WHO, 2013)

- Registration of events (births, deaths, marriages etc.)

- Certification: issues birth and death certificate

- Vital statistics: produces statistics from registration and certification.

These elements are closely related with each other. Any deficiency in one of them causes an inefficient CRVS system (WHO, 2013). A civil registration system which produces complete vital events records and includes medically certified cause of death is regarded as “gold standard” (WHO, 2008). Philips et.al (2015) have shown that there is close link between efficient CRVS and health outcomes. They used vital statistic performance index (VSPI) to evaluate the performance of CRVS. This index explains quality, completeness, and timeliness of CRVS. After calculating the index, they compared these results with national estimates of healthy life expectancy, maternal mortality ratio, and child mortality risk for 144 countries from 1980 to 2012. Regression analysis showed that, efficient CRVS contributes to better health outcomes. This study also proves that effective CRVS systems are not only a result of development, but also a driver of it.

2.1.1. Causes for deficiencies in a civil registration

Causes for deficiencies in a CRVS can be divided into two parts: demand side problems and supply side problems (Harbitz &Boekle, 2009; WHO, 2014).

Demand side problems (WHO, 2014):

- Having been unaware of the importance of the registration and advantages of accessing public services: Authorities should tell the importance and benefits of registration and should promote people for registration to access services (AbouZahr, 2015a).

- Encountering difficulties when filling out the registration forms

- Financial barriers such as official fees, fines for late registration, transportation costs (AbouZahr, 2015a)

- Discriminatory laws barrier to registration (head of household is responsible to register child or, being member of disadvantage group such as unmarried women and minority groups)

Supply side problems (WHO 2014):

- Legal framework: Government should ensure that
  - ❖ registries are compiled according to certain rules and individuals should access their personal information to correct any mistakes,
  - ❖ individual privacy rights are protected against any threatening factors.

- Complex structure of CRVS systems

- Lack of necessary skills and inadequate training of physicians

- Information and Communication Technology (ICT):
  - ❖ Government should invest in new technological innovations for registration processes and for sustainable, reliable, and timely vital statistics (AbouZahr, 2015a; AbouZahr, 2015b).

Egypt, Albania, and Thailand are seen as the exemplary countries of ICT users among developing countries with regard to transfer data from civil registrations to vital statistics (WHO, 2013c).

In Egypt, the central agency for public mobilization and statistics (CAPMAS) ensures population and economic censuses and also provides statistics for different sectorial to respond the needs of relevant sectors (El Gendy, 2010). Since multiple data sources are compiled by this system, it has a data ware house to provide storage and analyze data (WHO, 2013c). The ware house is connected to CAPMAS Network which enables high level analysis (WHO, 2013c). Furthermore, CAPMAS has strong coordination with other institutions and governments which collect similar data. For example, vital statistics are collected both by CAPMAS and by Ministry of Health and Population. To ensure data consistency between these institutions, coordination is strengthened.

With the 2001 population census, modernization in CR system is considered necessary in Albania (Skiri, Kumbaro & Abelsaeth, 2012). The Statistics Norway supported legal and technical assistance for pilot study. This modernization is comprised of 4 phases (Skiri et al., 2012). In the first phase, central administrative unit was founded under civil registration. Civil status law was reviewed and renewed. In the second phase, computerization of pilot civil register offices and connection them to central administrative unit takes place. In the third phase, modernization of civil register system was extended to all regions in Albania. Nordic model of CR was modified to Albanian population. In addition to this, all manual register books were digitalized by scanning. Lastly, to produce more relevant statistics, data transfer from national civil registration to institute of statistics was enabled.

Thailand has a computer based civil registration system that generates vital statistics (Kijsanayotin, Ingun & Sunputtanon 2013). In this system each individual has an ID number and vital statistics are produced by this ID number (WHO, 2013c). Thailand Civil registration is more open system to other governments departments than in Albania (WHO, 2013c).

- Lack of Political priority (WHO, 2014):
    - ❖ (Inadequate policies, underfunded CRVS systems, deficient in full-time professional staff) Governments should set budget for civil registration. CR offices should be equipped, staffed and trained (Harbitz and Boekle, 2009).

- Lack of integration and coordination:

- Civil registration systems are under the responsibility of many ministries (health, interior, justice ministries and statistical office). For timely and qualified data it is necessary to provide cooperation between these organizations (AbouZahr, 2015a). Since birth registration provides more direct and immediate benefits to individuals, death registration is generally less coverage than birth registration in most countries. Coverage of death registration can be improved by cooperating persons or institutions responsible for burial permits (AbouZahr, 2015a).

Ghana can be shown as an example for solving above problems. Civil registration system in Ghana had many of the problems mentioned above. It was targeted to improve civil registration for meeting the needs of health sector and was taken action in certain areas to increase the vital registration (Adams, 2011). Costs for birth and death registration were removed. Public awareness campaigns were launched and health nurses and volunteers were trained for recording processes. Verbal autopsy was made when deaths occurred at home or when doctors weren’t available. Additionally, Ghana enhanced a registration system for rural regions called Millennium Villages Project (MVP) (Ohemeng-Dapaah, Pronyk, Akosa,Nemser & Kanter, 2009). This project combined vital registration and verbal autopsies in electronic system, Millennium Global Vital Registration- Net (MGV-Net). Although the results aren’t satisfactory, thanks to steps taken at civil registration, Ghana has achieved to decrease the rate of under-five mortality, maternal mortality and determine the causes of deaths.

2.2. VITAL STATISTICS SYSTEM

Vital statistics are product of civil registration, enumeration and other sources of vital events data and indicate the frequency of occurrence and characteristics of vital events (UNSD, 2014; WHO, 2013b,). A vital statistics system should have 4 principles (UNSD, 2014):

- **Universal coverage:** In a country, all vital events should be covered by a vital statistics system.

- **Continuity:** To monitor the short-term and long- term fluctuations of vital events, continuity is needed for compilation and collection of vital statistics.

- **Confidentiality:** Personal information should be protected and vital statistics should be used for only administrative and statistical purposes.

- **Regular dissemination:** According to *Principles and Recommendations for a Vital Statistics Systems* (UNSD, 2014), vital statistics should provide monthly or quarterly summary counts of vital events to enable health interventions, administrative uses, and other needs. Additionally, vital statistics should product tabulations of vital events on a time schedule by its demographic and socioeconomic characteristics.

2.3. COMPLETENESS OF REGISTRATION SYSTEM

In UN principles and recommendations for a vital statistics system (2014) **complete registration** is defined as "*when every vital event that has occurred to the members of the population of a particular country (or area), within a specified time period, has been registered in the system, i.e., has a vital event registration record. This means that the system has attained 100 per cent coverage*".

In many countries, since civil registration and vital statistics are produced from different government agencies, it is seen that there are inconsistencies between registration records and vital statistic reports (WHO, 2013b). These inconsistencies or errors (incomplete registration) can be arisen from two reasons: over-reporting and under-reporting (WHO, 2013b). Over-reporting occurs when registered a vital event without checking whether it is registered previously or not, in other words re-

registration (WHO, 2013b). This kind of incompleteness occurs in countries where there isn't central collection of vital registration or that have archiving problems. The most common inconsistency is under-reporting. Under-reporting can arise from (WHO, 2013b):

- the problem occurred during transfer vital events from civil registration agencies to vital statistics system,
- not transferring the delayed registration to vital statistics system, and
- not transferring the coronial cases that were resolved and returned to civil registration system.

2.4. DEATH AND CAUSE OF DEATH REGISTRATION

Compared with birth registration, under registration is seen much more at death registration. According to World Health Statistics-2012 report (WHO, 2012), two thirds of deaths aren't counted globally. When analyzed according to income level of countries; in low income countries one percent of deaths, in lower middle income countries 9 percent of deaths, in upper middle income countries 80 percent of deaths, and in high income countries 96 percent of deaths are reported.

Health sector has a major role at death registration processes. Physicians fill the death certificates with cause of death. Cause of death statistics are key elements for public health decision making, planning and monitoring and provide information about mortality pattern of infant, child and adult mortality and about burden of disease of population (WHO, 2014). Cause of deaths are compiled through medical certificate of cause of death with standardized coding. Cause of death information is gathered from two ways:

- Medical certification of cause of death from health facilities: This form is given by a medically trained person who codes the cause of death according to ICD certification standards (WHO, 2013).

- Verbal autopsy by sampled collections methods: This provides to see the burden of disease and monitor the effectiveness of policies in public health.

To improve reporting of deaths and determining cause of death (WHO, 2014);

- automated death certificates should be used,

- physicians should be trained for the International Classification of Diseases (ICD) forms, and

- disincentives such as fees for morticians and burial services should be removed.

In UN principles and recommendations for vital statistics (UNSD, 2014), required information for death registration is shown in table 2.3.1:

Table 2.3.1. Required information for death registration systems

Characteristics of the event	**Characteristics of the deceased**
• Date of occurrence	• Date of birth and age
• Date of registration	• Sex
• Place of occurrence	• Marital status
• Place of registration	• Place of usual residence
• Locality of occurrence	• Locality of residence
• Urban and rural occurrence	• Urban or rural residence
• Cause(s) of death	
• Certifier and type of certification	

Source: UNSD-2014 and Strengthening CRVS for births, deaths and cause of death. (WHO, 2013)

2.5. STUDIES THAT ASSESS THE COMPLETENESS OF DEATH REGISTRATION SYSTEM IN THE WORLD

Mortality data with cause of death is essential for assessing population health status. It is basis for policy makers and epidemiological studies. When we look into literature, it is seen that there are lots of studies that assess the completeness of death registration. These studies differ from each other in terms of used data for assessing the registration system and in terms of the method they use. In this section studies that evaluate death registration in some countries are presented. Since death registration processes and available data differ from country to country, used methods and sources to assess completeness are also different. Firstly, it is mentioned about studies that assess completeness of death registration from censuses. Secondly, studies that use data from surveys, studies that use both censuses and surveys, studies that use verbal autopsy, and finally technical studies are presented.

2.5.1. Studies that assess the completeness of death registration from censuses

Lima and Queiroz (2014) examined the quality of death registration system by calculating the completeness of death registration system and determining the ill defined cause of deaths in the death registration system in Brazil (Lima & Queiroz, 2014). They made use of the Brazilian Health Informatics Department mortality database and population censuses from 1980 to 2010. The data were collected by age, sex and cause of death at the municipality level. Information on deaths and ill-defined causes of death were determined according to the ninth and tenth revision of the International Classification of Diseases (ICD-10) coding. Completeness is evaluated by Death Distribution Methods (DDM). The assumption of closing to migration was important to Brazilian regions, since the country was marked by significant migration flows between its regions. They used the combined method of general growth balance method and synthetic extinct generation that was suggested by Hill, You, and Choi (2009). The main finding of this study was that there has been an improvement in the collection of mortality data in Brazil. The completeness of death registration increased from 80% in 1980-1991 to over 95% in 2000-2010, while ill-defined causes of deaths was found about 53% in the country. In addition to this, it was determined that data quality didn’t show the same ratio for all regions in Brazil.

Another study in Brazil conducted by França, Abreu, Rao, and Lopez (2008). They assessed the quality of cause of death data in Brazil for the years 2002– 2004 at national and regional levels (França, Abreu, Rao, & Lopez ,2008). Data for mortality were gathered from Mortality Information System (MIS) which is under the auspices of Ministry of Health. Cause of death data wasevaluated according to 4 criteria, these were : generalizability, validity, reliability, and policy relevance. Generalizability was evaluated by calculating the coverage and completeness. Generalized growth balance method and extinct generation method were used to assess completeness. Validity was assessed by determining the ill-defined and non-specific codes of cause of deaths. For reliability, two criteria were determined: general level of mortality and consistency of cause of death patterns. Consistency was measured through comparing the mortality patterns by sex and region. To assess policy relevance, timeliness and geographical disaggregation of cause of deaths were observed. According to results, completeness differed by sex and region. Especially Northern and Northeast regions had the lowest level of completeness and highest level of ill-defined codes. These regions also had lower socio-economic level than South, Southeast, and Center-West regions. França et al. suggested innovative and sustained efforts for these regions.

In India, Mahapatra (2007) assessed the completeness of Sample Registration System (SRS) for the years from 1990 to 2007 for four selected states (Mahapatra, 2007). Before analyzes, he drawn attention that there were studies for assessing the completeness of SRS in 1970s and 1980s. Results of these studies showed high level of completeness (> 90 percent) and after that it wasn’t needed to control completeness of SRS. For this reason, he started a study for the period 1990-2007. Mahapatra used Preston and Coale method to measure the completeness for this study. Results showed that completeness of death registration by SRS begun to decline during 1990-2007. Mahapatra recommended that studies on the evaluation of completeness of death registration should be continued at regular intervals with both direct and indirect methods.

In Iran, Ministry of Health and Medical Education initiated a new death registration system and this system was implemented in a pilot province in 1997. After that, it was expanded to all provinces except Tahran by 2006. Khosravi, Taylor, Naghavi, and Lopez (2007) assessed the completeness of this new death registration system for the year 2004 and analyzed the differences of completeness between provinces (Khosravi, Taylor, Naghavi, & Lopez, 2007). Data for infant mortality gathered from Statistical Center of Iran for the year 2001. Additionally, for some calculations of child mortality they benefitted from Iranian Demographic Health Survey-2000. Brass Growth Balance method was used to assess the completeness of adult mortality. Since for some provinces this method was inapplicable, modified logit life table and literacy rate were used. It was seen that, for such provinces literacy was a good way to predict adult mortality. Results showed that there were huge differences by provinces at completeness of child and adult mortality. This rate ranged between 26 percent and 95 percent for females and between 30 percent and 92 percent for males in child mortality. For adult mortality, this rates varied between 48 and 92 percent for females, 53 and 100 percent for males. Although there were discrepancies between provinces, Khosravi et al. considered that if this new registration system would be used efficiently, there could be an improvement in the quality and coverage of mortality data.

2.5.2. Studies that assess the completeness of death registration from surveys

Mikkelsen et.al. (2015) carried out a study by using Global Burden of Disease Study- 2010 for the years 1980-2012. They used this data to calculate vital statistics performance index (VSPI) score. This index includes 6 components: quality of cause of death reporting, quality of age and sex reporting, internal consistency, completeness of death reporting, level of cause-specific detail, and public availability of vital statistics data. VSPI is determined according to score of these 6 components. In this study, VSPI was calculated for 148 countries. This study showed that death registration in the world wide have made very little progress since 1980. Despite this, due to technological improvement in vital registration today more deaths are registered by reliable systems than in the past. Although some countries such as Argentina, Chile, Italy, Puerto Rico, Singapore had efficient CRVS in 1980s (> 0.85), they failed to continue this efficiency in 2000s. On the other hand, however some countries such as Cyprus, Egypt, and Iran got ahead after 2000s. When it comes to Turkey, the result isn't satisfying (41 percent for 2010-2012).

In Thailand, Vapattanawong and Prasartkul (2011) conducted a study to assess the under registration of deaths by cross matching two sources (Vapattanawong & Prasartkul, 2011). In this study, mortality data of civil registration was compared with Survey of Population Change (SPC). SPC which was used in this survey was carried out in 2005–2006. Aim of this study is to assess the data quality of registration system. Data source used in this study was gathered from the death records of ministry of interior for the years of 2005-2006. These records had a 13 digit unique ID number. Matching process was made according to PID number and individual records. Chandrasekaran-Deming method was used to estimate the registration data that were missing from both systems.Under some assumptions, results showed that the estimated number of unregistered deaths for males and females were 9 percent and 8.36 percent, respectively.

Another study for Thailand was conducted by Tangcharoensathien, Faramnuayphol, Teokul, Bundhamcharoen, and Wibulpholprasert (2006). Before this study, Mathers et al. (2004) published a paper about the global status of cause of death data. In this study, Mathers et al. found that mortality statistics of Thailand was low quality. Upon this conclusion, Tangcharoensathien et al. (2006) prepared a study for self-assessment (Tangcharoensathien, Faramnuayphol, Teokul, Bundhamcharoen, & Wibulpholprasert, 2006). For this aim, they reviewed the literature about Thailand's mortality statistics and they used Health Metrics Network (HMN) tool with 15 stakeholders. This tool permits countries to assess their information system. It has questions and each question has scores between 0 and 3. Results showed that the completeness of death registration ranged between 86 and 95 percent. Two weaknesses were found in the process of the system. The first one was, the deceased can be buried without a death certificate or death registration. Even if the death certificate exists, the deceased may not be registered. The second weakness was related to notification of cause of death. Ill- defined category of cause of death was found quite high. Tangcharoensathien et al. drew attention to necessity for trainings of physicians, coders and village headmen.

In Egypt, Becker, Waheeb, Bothaina, Khallaf, and Black (1996) conducted a study to assess the completeness of under-5 death registration (Becker, Waheeb, Bothaina, Khallaf, & Black, 1996). Two data sources were used in this study: Pan Arab project for child development survey (PAPCHILD survey) which was conducted in 1990-1991 and Egyptian Demographic and Health Survey (EDHS) - 1992. Households in these two surveys were combined and under-5 mortality were determined in these households. A questionnaire were prepared and it included the name of child, date of death, name of the office for registered deaths and a verbal autopsy part. If cause of death of child was ill-defined in verbal autopsy part, reinterview was carried out for these households. For deaths that reported as registered in an office were controlled from these offices. Ratio of death notification was analyzed according to age, parity and schooling situation of mother. Results showed that notification of neonatal deaths was found lower than notification in 1-4 age group deaths.

Williams (2014) observed completeness of births and deaths registration for Mokola city in Nigeria (Willams, 2014). In this study, completeness was estimated from a survey carried out in Mokola. Brass Growth Balance method (1975) was chosen to estimate completeness. Because this method was the most suitable method for Nigeria death data that it requires only one census. The completeness of death registration in Mokola was found %21 and growth rate of % 1.7. Because of the different completeness of children and adults, some violations were determined. One of the assumption of this method is that populations are closed to migration and no changes in fertility or mortality. So, this situation was not suitable for Mokola. But because the Bennett- Horuichi (1981) and Preston- Coale (1983) require two censuses and the last two censuses were counducted in 1991 and 2006, these censuses wouldn’t give the current state of death registration system.

2.5.3. Studies that assess the completeness of death registration from censuses and surveys

Another study for assessment of validity and completeness of death reporting and registration is carried out by Huy, Long, Hoa, Byass, and Eriksson (2003) for FilaBavi area in Vietnam (Huy, Long, Hoa, Byass, & Eriksson, 2003). To assess the validity of mortality estimates, mortality data were collected during 1999-2000 by the quarterly follow-up in FilaBavi and compared these mortality data with those from re-census, Commune Population Registration System, and neighborhood survey. In quarterly follow-up survey, all households in FilaBavi were followed- up quarterly by the field surveyors. Each surveyor was responsible for a certain number of households and mortality data was obtained by them. Re-census was conducted in 2001. Surveyors were responsible to ask households occurred deaths between 1 January 1999 and 31 December 2000. In Commune Population registration system (CPRS), for deaths occurred in a village, responsible person to record information about deaths were population counselor. In Neighborhood survey, participants who were close relationships in the region filled the lists about occurred deaths in their region. After data collection with these methods, all deaths were matched according to identity infromations such as name, age, gender etc. According to this study, it was found that the method quarterly follow-up was the best method to determine deaths. The worst method was found as CPRS which couldn’t register % 19 of total deaths. In this method, most of infant deaths and elderly female deaths were not captured.

Bannister and Hill (2008) carried out a study to evaluate the mortality data in China for 1964- 2000 period (Bannister & Hill, 2008). They used data from censuses and surveys to re-estimate mortality levels and trends from 1960s to 2000. Study consists of two parts: for ages 15 and above, for ages below age 5. Since age reporting was good, data had satisfactory quality and population were neither stable nor quasi stable, they used General Growth Balance method (Hill, 1987) to evaluate the adult mortality. For under 5 mortality, mortality data was gathered from 1982 fertility survey, 1987 population survey, and the 1995 intercensal survey, and from 1982, 1990, 2000 censuses. According to results of analyses, quality of death data was found satisfactory. Net unregistered declined from 6 percent of the total population in 1964 to 4 percent in 1982, 3 percent in 1990, and to 2 percent in 2000. In addition to this, infant mortality in China were fallen substantially in the 1970s for both males and females. According to Bannister and Hill, reasons for this decline can be explained by rising quality of life such as rising incomes, increasing of the level of education, improved health facilities. According to study, adult mortality continued to decrease for both sexes in all age groups.

In Indonesia, because of the lack of death and cause of death registration, Ministry of Health in Indonesia has launched the Indonesian Mortality Registration System Strengthening Project (IMRSSP) in 2006. Aim of this project is to improve completeness of death registration and to provide a regular registration of cause of deaths for both occurred at health centers and at home. Before applying this project to whole country, it was implemented in two pilot cities, Pekalongan (represents rural) and Surakarta (represents urban). To see the efficiency of IMRSSP, Rao et al. (2010) carried out a study to assess the completeness of death registration of IMRSSP for the two cities by using death records from another two sources: household and civil registration system. Deaths from these sources were matched according to age, gender, age at death, address and date of death. According to results, completeness of death in IMRSSP 73 percent in Pekalongan and 52 percent in Surakarta. The best death registration was found in civil registration system, 85 percent. Rao and et al. suggested that collaboration of ministry of health and civil registration would improve the completeness of death registration in Indonesia. With regard to cause of deaths, Rao and et al. offered training for health personnel for accurate coding process of of death data.

2.5.4. Studies that assess the completeness of death registration with Verbal autopsy

Mortality Information System (MIS) compiles cause of death data for whole country in Brazil (França, Campos, Guimarães, & Maria de Fátima, 2011). França, Campos, Guimarães, and Maria de Fátima (2011) used verbal autopsy sampling method to determine the injury- specific mortality among ill-defined causes of death in the northeastern region of Minas Gerais state, Brazil. They applied two forms according to age. One of them was for aged between 28 days and 10 years old. The second was for the age 10 years and above. Results showed that 12.6 percent of ill-defined causes were in fact due to injury. Ill-defined conditions were seen among children (1-4) and the elderly.

In China, since Ministry of Health vital registration data didn't reflect the true profile of mortality, Chinese Disease Surveillance Points (DSP) system was established (Yang et al. 2005). This system is a representative sample of Chinese population (nearly 1% of population). Aim of this system is to control data quality compiled by registration system. To determine the cause of deaths, it uses international form of death certificate and verbal autopsy. These forms are then compared with registration system.

2.5.5. Technical (methodological) studies

Apart from above studies, some studies were conducted for some countries to determine the weaknesses and strengths of methods used for assessing the completeness of death registration. Last two studies in this section are related to technical studies.

Bennett and Horiuchi (1984) suggested a method by comparing with previous methods by Bennett and Horiuchi (1981) and Preston and Coale (1982) (Bennett &Horiuchi, 1984). This method provides to construct a life table using age- specific growth rates. Since the used data may be exposed to some common errors, they examined the possible effects of these errors on estimated life expectancies (e(x)). Effects were analyzed under 4 error: error in estimated growth rates, net intercensal international migration, age-dependent completeness of death registration, misreporting of age at death, and age in the population. Error in estimated growth rates occurs when the same proportion of completeness rate are applied to all age groups.

Because completeness rate varies across age groups, it creates a bias in growth rates. Errors from net intercensal international migration occurs due to lack of information about age-specific net migration rates. This deficiency causes to make assumption for closed population. Age-dependent completeness of death registration errors are related to different rate of completeness among age groups. Since under-5 mortality, especially infant mortality, are more vulnerable to under-registered, Bennett and Horiuchi took the estimates of e(x) for ages 5 and above. Misreporting of age at death errors were seen at older ages. It was found that Bennett and Horiuchi method (1984) was more sensitive to age misreporting than those mentioned above. To see the efficiency of the method, they applied it to registration data of Argentina for females for the period 1960-1970. For estimation of completeness, they also used Latin American life table. Considering with the possible errors mentioned above, they found almost the same mortality pattern with Latin American model. At the end of this study, they recommended Bennett- Horiuchi method (1984) and Bennett Horiuchi (1981) method to construct a life table, if the deaths are registered but completeness is suspicious. Additionally, if data for mortality isn't recorded by registration system and it is only available from censuses, it is good to use Preston and Bennett (1983) and Preston (1983) methods.

Another technical study was carried out by Kenneth Hill (2000). Hill (2000) made a comparative analysis of indirect methods for census, registration and survey data of Guatemala for the years 1981- 1994 (Hill, 2000). This study is important in that understanding the weaknesses and strengths of indirect methods. Indirect methods for completeness of adult mortality were tested for Guatemala. Contrary to what was believed for this country that had a good mortality data, analyses with these methods showed that the data, especially censuses, had problems. Results showed that while General Growth Balance Method is more vulnerable to age misreporting, Extinct Generations Method is more vulnerable to census coverage. Upon this conclusion, Hill suggested that the most suitable method was the combine usage of General Growth Balance and Extinct Generation methods. The former was used firstly for adjusting censuses and after that the latter was used to assess death recordings.

2.6. STUDIES THAT ASSESS THE COMPLETENESS OF DEATH REGISTRATION SYSTEM IN TURKEY

Concerning Turkey, these kind of studies are very limited. Akgün et al. (2007), assessed the situation of cause of death data and determined the deficiencies in the data collection processes of mortality for the year 2000. The sources that they used and the methods that they applied were differed for urban and rural. Because, death records were compiled by different institutions; by Ministry of Health and Ministry of Internal Affairs in urban areas, and by village headmen in rural areas. In these years, there were no regular and reliable death data for rural areas. For urban areas, data on deaths were gathered from TURKSTAT and General Growth Balance method was used for age 5 and over. Under-5 mortality estimation was made using 1998 Demographic and Health Survey and model life tables. For rural areas, they made use of nationwide Special Mortality and Verbal Autopsy Survey which was conducted in 2000 by Ministry of Health. In rural areas, estimation of child mortality was controlled by using DHS and for adult mortality estimation, Modified Logit Life table System was used. With regard to cause of death data, for urban areas these data were collected from health centers, hospitals, and traffic police records. These causes were categorized again according to International Classification of Diseases (ICD) cause list for international comparison. Since it wasn't available any cause of death data for rural areas, Akgün et al. used Causes of Death model (CODMOD) which was founded by Salomon and Murray (2002). This model provides cause-specific mortality patterns through using total mortality by age and sex and GDP per capita. Three groups of cause of mortality were constituted and with CODMOD model a plausible cause of mortality pattern was obtained. Results showed an urgent improvement in death registration systems and also cause of death registrations in both urban and rural areas.

Recently, Özdemir, Öcek and Horasan (2015) conducted a study to determine the quality of death registration system and to see the effect of reform that was made in 2009 on quality of mortality data and cause of death data by Turkish Statistical Institute (TURKSTAT) for Turkey and İzmir city (Özdemir, Öcek & Horasan, 2015b). For this reason, Özdemir et al. made analyzes for the periods 2001- 2008 and 2009-

2013. Besides, they analyzed the proportion of ill- defined causes of deaths for İzmir for 2009- 2013. Data was gathered from TURKSTAT database. They used General Growth Balance and Extinct Generation methods for assessment. Results showed that there is very good improvement completeness of death registration. It was found that for the period of 2001 -2008 completeness was 57.7 percent for males and 61.1 percent for females, in 2009- 2013 this rate was 99.2 percent and 99.7 percent respectively for Turkey. For İzmir, completeness was better than Turkey, it was 100 percent for both sex. However, it was found for ill -defined codes that there should be more attention for this information. According to results ill-defined code was 25.7 percent for İzmir. This study showed that there is a satisfying improvement in the completeness of death registration. Another study was carried out by Güder (2001) in the unpublished mater thesis. In this study, she evaluated the reliability and the statistical usefulness of burial records of cemeteries in Ankara for the year 1997 (Güder, 2001). Additionally, Yüksel (2008) presented a dissertation to assess the infant mortality level from 1950 to 2005 for each year by using regression analysis. Additionally, this study also researched the cultural and social factors in terms of the impact of them on mothers anfd their infants (Yüksel, 2008).

Özdemir and Öcek (2015) carried out another study for İzmir by using capture- recapture method (Özdemir & Öcek, 2015a). They assessed the consistency of all death records between İzmir Metropolitan Municipality Cemeteries Manager and İzmir Health Department for the year 2010. Deaths that occurred in 2010, were matched one to one. Results have showed that there is underreporting in İzmir Health Department records (9 percent of registered deaths in Cemeteries Manager isn’t registered in Health Department). It was found that there is significantly underreporting at stillbirths and infant mortality (98.6 percent and 46.9 percent respectively).

Korkmaz et al. (2013) examined the causes of infant mortality. Data was gathered from infant mortality monitoring system. Two groups were created to measure the reliability of the system. These groups were infant mortality study group in provinces and working group whose members were instructor in medicine. A sample was selected from infant mortality monitoring system. Cases in this sample were firstly examined by study group. Study group determined the main, intermediate, and final cause of death and then sent these forms to working group. After working group determined the main, intermediate, and final cause of death, these results were compared. Results showed that main cause of death is more consistent than intermediate and final cause of death.

Another assessment of cause of death is made for Cumhuriyet hospital (Bütün, Beyaztaş, Çelik, & Kılıcçıoğlu, 2006). Cause of death that occurred in this hospital were compared with cause of death that determined in death certificate. It was seen that ill-defined cause of death is 10.7 percent in hospital records, this ratio is 52 percent in death certificate. This result shows that death certificates must be completed carefully. Similar to this study, Osman and Seçkin (2006) prepared a study for Nilüfer district of Bursa city (Osman & Seçkin, 2006). Cause of death registry of Nilüfer Municipality was examined in terms of suitability with the ICD-10 coding list. Etiler, Çolak and Demirbaş (2005) conducted a study Kocaeli University (Etiler, Çolak & Demirbaş, 2005). They analyzed the consistency of recorded cause of deaths that occurred in Kocaeli University Hospital in the years 2002 and 2003 with the recorded cause of deaths in TURKSTAT for the same years. Korkmaz and Balaban (2013) conducted a study for deaths that occurred in Abant İzzet Baysal University Hospital in the 2009 and 2010 (Korkmaz & Balaban, 2013). They compared the recorded cause of death in University Hospital with that of in TURKSTAT death certificate (Korkmaz & Balaban, 2013).

Wunsch and Hancıoğlu (1997) carried out a study on the problems of death data comparability (Wunsch & Hancıoğlu, 1997). Firstly they mentioned about the death registration system in Turkey, and then about other data sources (censuses and surveys) for data on mortality. They mentioned about the reliability of 1965-68 Turkish Demographic Survey (TDS) and death registration system. Results showed that 1965-68 TDS has some reliability problems with respect to infant mortality. Additionally, registration system was found lacking with regard to functioning of the registration system such as different procedures in the compilation of vital events for urban and rural areas, weak coordination between institutions. Tezcan (1997) prepared a study on the morbidity and mortality trends in Turkey (Tezcan, 1997). She emphasized the lack of standardized form in the morbidity records in the study.

In 2005, National Maternal Mortality Study (NMMS) was conducted to determine the level and causes of maternal mortality in Turkey. This study also enabled to understand the deficiencies in the existing recording and reporting systems (Türkyılmaz, Koç, Schumacher, and Campbell, 2009). Field work of this study was conducted in 29 provinces. Maternal mortality indicators were calculated based on the burial records of cemeteries, death records of hospitals for maternal death that occurred in hospitals, and lastly based on the verbal autopsies for maternal deaths that occurred outside hospitals. According to results, pregnancy-related mortality ratio and maternal mortality were found as 38.3 per 100,000 live births and 29 per 100,000 live births, respectively (Türkyılmaz et al., 2009).

Ergöçmen and Yüksel (2006) prepared a qualitative study with regard to problems encountered at maternal mortality burial processes (Ergöçmen & Yüksel, 2006). It was utilized from 2005 -Turkey National Maternal Mortality Study. In this concept, 23 in depth and 2 focus group interview were made. Based on the interviews with village headmen, cemetery officials and doctors, it was tried to determine deficiency in registration process.

Eryurt and Koç (2006) prepared a study to determine the mortality level and pattern of adult mortality for both sexes (Eryurt & Koç, 2006). They gathered mortality data from 1998 and 2003 Turkey Demographic Health Survey (TDHS) data. Synthetic Orphanhood Method (Zlotnik & Hill, 1981) was applied to these datasets. At the end of the analysis, life tables were prepared for the year 2001 for both sexes. Acccording to these life tables, life expectancy at birth was found 72 for women and 70 for men.

3. DATA SOURCES AND METHODS

In this section, firstly, it is mentioned about assumptions and calculations of indirect methods used to estimate adult mortality in the literature. Secondly, data sources and methods used in this thesis are presented. Finally, encountered limitations in the use of method and data are stated.

3.1. Indirect methods for adult mortality used in the literature

Estimation of adult mortality can be categorized into 3 groups (Hill, 2001).

- Methods that assess the completeness of death recording relative to census enumeration
- Intercensal survival methods
- Indirect methods based on the survival of close relatives

3.1.1. Methods that assess the completeness of death recording relative to census enumeration

These methods are known as Death Distribution Methods (DDM). They are generally categorized as shown in Table 3.1.1.

Table 3.1.1. Death distribution methods

One census methods	**Multiple census methods**
• Growth Balance Method (Brass, 1975) • Preston-Coale Method (Preston, Coale, Trussell, & Weinstein, 1980)	• General Growth Balance Method (Hill, 1987) • Synthetic Extinct Generations Method (Bennett & Horiuchi 1981;1984) • Hybrid Method (General Growth Balance Method + Synthetic Extinct Generations Method)

3.1.1.1. One Census Methods

Growth Balance Method (Brass, 1975)

According to this method, in a population which is stable and closed to migration and reported data is accurate, growth rate is equal to the entry rate of population aged x and older by those aged x minus death rate of the same population (UNDESA 2002, Moultrie, Dorrington et al. 2013). That is,

$$r = b(x+) - d(x+)$$

In this equation

$$b\,(x+) = \frac{N(x)}{PYL(x+)}$$

and

$$d(x+) = \frac{D(x+)}{PYL\,(x+)}$$

where N(x) is the number of people who turned x in the population, D(x+) is the number of deaths of population aged x and over, and PYL(x+) is the person years of life lived by persons aged x and over. Completeness of death registration is calculated by

$$c(x) = \frac{D^r(x+)}{D^c(x+)}$$

where $D^r(x+)$ is the reported number of deaths of population aged x and over and $D^c(x+)$ denotes the number of deaths of population aged x and over, estimated from census age distribution. This method assumes that (Moultrie, Dorrington et al. 2013):

- Population is stable and closed to migration
- Completeness of death reporting doesn't change by age.

This method requires one census age distribution and corresponding death distribution by five year age group for both sexes.

Preston- Coale Method (Preston et al., 1980)

Preston-Coale assumes that (Moultrie, Dorrington et al. 2013):

- Population is stable and closed to migration
- Completeness of death reporting is the same for all ages

According to this method, in a population that assure the first assumption above and the data are accurate, the number of alive persons of an age is equal to the number of dead persons from this cohort until the time that all persons in this cohort have died (Moultrie, Dorrington et al. 2013 and UNDESA 2002). That is (UN 1983),

$$N^{est}(x) = \sum_{a=x}^{w} D(x) \times e^{r \times (a-x)}$$

where $N^{est}(x)$ is the estimated number of people aged x derived from reported deaths, $D(x)$ is the number of deaths aged x, and r is the growth rate. Completeness of death registration can be found from below equation (UN 1983):

$$c = \frac{\sum_{x=0}^{w} N^{est}(x,5)}{\sum_{x=0}^{w} N(x,5)}$$

where $N(x,5)$ is the number of people from aged x to x+5 derived from census. This method requires one census age distribution and corresponding death distribution by five year age group for both sexes.

3.1.1.2. Multiple Census Methods

General Growth Balance Method (GGB) (Hill, 1987)

This method is generalization of growth balance method (Brass, 1975) to non-stable populations. It also enables to estimate relative completeness of the two censuses (Moultrie, Dorrington et al., 2013; UNDESA, 2002). GGB method assumes that (Moultrie, Dorrington et al., 2013)

- Completeness of each censuses and death reporting is independent of age
- Population is closed to migration.

This method requires the number of population by five- year age group for each sexes from two censuses (surveys) and total number of deaths by five year age group and sex between these two censuses (surveys) (Moultrie, Dorrington et al., 2013).

Synthetic Extinct Generations Method (SEG) (Bennett & Horiuchi 1981; 1984)

It is also known as Bennett - Horiuchi method. This method is generalization of Preston - Coale method (1980) to non- stable population. So, e^{rt} function in Preston-Coale method substitutes as $e^{\int_a^x r(y,t)dy}$ where r(y, t) is the growth rate of population aged y at time t (Moultrie, Dorrington et al., 2013). It requires the number of population by five year age and sex from two censuses or surveys and number of deaths of population by five year age group and sex between two censuses and surveys (Moultrie, Dorrington et al., 2013). Bennett- Horiuchi method assumes that completeness of each censuses and death reporting is independent of age and population is closed to migration (Moultrie, Dorrington et al., 2013; UNDESA, 2002).

Hybrid Method (GGB+SEG)

This method combines GGB and SEG methods. GGB method is more vulnerable to age reporting errors than SEG method and SEG method is more sensitive to changes in census coverage than GGB method (Hill, 2001; Hill, Choi & Timæus, 2005), it is suggested that combined methods reduce the effect of these errors. According to this, firstly GGB method should be used for adjusting censuses and then SEG method should be applied to adjusted census population (Hill, 2001).

3.1.2. Intercensal survival methods

Census survival methods estimate mortality levels through survival ratios for each age cohort. These methods are appropriate for closed population. They are also sensitive to age reporting errors. Census survival methods require age distributions by five year age group for each sex two points in time (UNDESA, 2002).

Preston-Bennett Method (1983)

Unlike other census survival methods, this method uses age specific growth rate of intercensal period rather than survival ratios to estimate corresponding life table population. Preston- Bennett method requires two age distribution of population and it can be applied to any two censuses irrespective of the interval between the censuses (Hill 2001). This method is sensitive to completeness of coverage of censuses and intercensal migration (Preston &Bennett, 1983).

3.1.3. Indirect methods based on the survival of the close relatives

Orphanhood Method

This method estimates the adult mortality from censuses or surveys based on the questions about survival status of respondents' mothers and fathers (Moultrie, Dorrington et al., 2013; UNDESA, 2002;). For this method, censuses or surveys must include at least these questions: "Is your mother alive?" and "Is your father alive?" In addition to this information, orphanhood method requires data on the number of births which occur in the year of the survey or census by five year age group of women giving birth and mean age of fathers in the course of their children's conception (UNDESA, 2002). This method don't assume a closed population (Moultrie, Dorrington et al., 2013; UNDESA, 2002).

Sibling Method

This method is based on the data gathered by adults on their siblings. It requires full sibling histories. Sibling histories include questions on the name, sex, age, survival status, and age and year of death of deceased siblings (Moultrie, Dorrington et al., 2013). This method allows estimation of men mortality from data on brothers and women mortality from data on sisters (Moultrie, Dorrington et al., 2013).

3.2. DATA SOURCES AND METHODS USED IN THE THESIS

In this thesis, quality of death registration is examined in terms of completeness and timeliness. Data sources and method used for analysis are explained below and presented in table 3.2.1, table 3.2.2 and 3.2.3 in detail.

3.2.1. Data sources

Population data

Other than regular total population though Address Based Population Registration System issued in every December, 31, a special data on population age-sex distribution is obtained by individual application to TURKSTAT. This data includes only citizens of the Republic of Turkey. Based on the interview with authorized persons from MERNIS, while majority of legally residing foreigners are registered in Address Based Population Registration System (ABPRS), due to the lack of legal sanctions, negligible number of legally residing foreigners are included in the death registration system. Additionally, number of legally residing foreigners in ABPRS are two times of the number of those registered in the records of migration management. The possible reason is that legally residing foreigners who leave Turkey aren't fallen from the records of ABPRS. Because of this reason, in the thesis, all population sex and age distributions used in the calculations include only citizens of the Republic of Turkey.

Death Data

Data on number of deaths are obtained from TURKSTAT website and by individual application to TURKSTAT particularly for this thesis. Number of death distribution by age and sex are gathered from TURKSTAT website. Death data of any year is updated only for deaths that are registered to the death registration system within the following 3 years. As of 29 February 2016, updated data is used in the thesis. Apart from this, data for the time between death and death registration is obtained by individual application to TURKSTAT. This data is also updated as of 29 February 2016. This data is given by sex, age groups, and 81 provinces from the year of 2009 to 2015. Age groups are in the form of "0", "1-4", "5-14", "15-34", "35-54", "55-74", "75+", and "unknown age". For each province, number of death by time of registration as within 0-10 days, 11-30 days, 31-90 days, 91-180 days, 181-365 days, registration after 1 year, and unknown registry date is available by sex and age groups. Unknown death registry date means that these deaths are notified to TURKSTAT by Provincial Health Directorate but not matched with registered deaths in MERNIS.

To better understand the deaths with unknown death registry date which is hereinafter referred to as deaths without registration date, it will be useful to explain how the deaths are recorded in TURKSTAT database by matching deaths in MERNIS database and cause of death datebase. For the period 2009-2012 death data were compiled through cause of death database of TURKSTAT based on the TURKSTAT death certificates and through MERNIS database based on the MERNIS death reporting form. Additionally, TURKSTAT added all registered deaths in MERNIS database to its own database in this period. Adding process was made according to matching of ID numbers of the deceased person to prevent duplication. It is impossible to get a death without ID number from MERNIS database. Because, if a dead doesn't have an ID number (not even registered in MERNİS) and this dead is reported to directorate of district civil registration, firstly, an ID number is given for this dead and then registered to MERNIS database with this ID number. In this case, two situation emerge for unmatched deaths:

- **Unmatched deaths that have ID number in TURKSTAT death certificate**: If a death has an ID number on TURKSTAT death certificate and this death isn't matched with any deaths registered in MERNIS, this means that these deaths aren't registered in MERNIS database. This reason probably stems from not filling or transferring the MERNIS death reporting form to directorate of district civil registration by related institutions. These deaths are recorded as deaths without registration date in TURKSTAT database.

- **Unmatched deaths that don't have an ID number in TURKSTAT death certificate:** TURKSTAT matches these deaths according to other information (name, surname, mother/father name, place of death, birthdate etc.) of dead with registered deaths in MERNIS database and with recorded deaths in its own database to prevent duplication. If death is matched with any death from MERNIS database, then the date of registration of this death in MERNIS are recorded to TURKSTAT database. If death is matched with any death only from its own database, then one of this death is recorded and also it is recorded as deaths without registration date. If death matches none of these databases, then it is recorded as a new death and also as deaths without registration date.

By the year 2013, death registration system has changed and Death Notification System (DNS) has been put into practice. According to this system, all deaths has been recorded electronically to this system and TURKSTAT takes death data from this system electronically. Based on the printouts of death certificates that are filled in the DNS and sent by Provincial Health Directorate to Directorate of District Civil Registration, deaths are registered to MERNIS database. Additionally, printouts of death certificates that don't have a DNS number aren't registered to MERNIS database. TURKSTAT matches these deaths that are recorded to DNS and deaths that are registered to MERNIS. There are again 2 cases emerged at unmatched deaths.

- **Unmatched deaths that have ID number in DNS:** If a death has an ID number and recorded to DNS by physicians, an unmatched case occurs only when the printout of this death is not transferred to Directorate of District Civil Registration by Provincial Directorate of Health. In this case, this death is not registered to MERNIS database, and so it is recorded as deaths without registration date in TURKSTAT database.

- **Unmatched deaths that don't have an ID number in DNS:** If a death doesn't have an ID number and recorded to DNS by physicians, matching process of this death is made according to other information (name, surname, mother/father name, place of death, birthdate etc.)that are recorded in DNS. If this death is matched with a registered death in MERNIS, then all information including registration date of death in MERNIS death database are recorded to TURKSTAT database. If none of registered deaths is matched, either printout of death certificate is not transferred by Provincial Directorate of Health to Directorate of District Civil Registration, or this printout is not the DNS number on it. So, this death is recorded with the information stored in the DNS and it is determined as death without registration date in TURKSTAT database.

Other data sources used in the thesis

Another data source that is used in the thesis is 2013-TURKSTAT life table. This data is used to estimate completeness for the years 2013, 2014, and 2015. TURKSTAT have first produced the life table for the year 2013 for both sexes. This life table is based on the deaths occurred in the year of 2013. For this life table, ABPRS population age distribution of the years 2012 and 2013 and MERNIS death data and TURKSTAT cause of death data were used. The first version of this life table was constituted by using Bennett-Horiuchi technique (SEG method). Death data was adjusted according to this method, and 2013 life table was produced based on this adjustment for both sexes. The second version of this life table is calculated without using the SEG method. Assumptions for the second versions are as follows:

• Legally residing foreigners are excluded from the calculations, and

• Without changing the total, age adjustment was made on population and mortality data with moving average method.

In this thesis, the second version of the life table is used. This data is used on the assumption that age specific death rates of TURKSTAT life table is almost same for the year of 2015.

The last data used in the thesis is the value of life expectancy at the age of 75 and over (e_{75+}) for both sexes. This value is used in the SEG method. Value for e_{75} was firstly tried to gather by constructing a life table for both sexes. Life tables were constructed by using Synthetic Orphanhood Method and Preston- Bennett Method. However, constructed life tables by these methods did not give consistent results. Because of this reason, e_{75} values are obtained from 2013-Global Burden of Diseases (GBD) database for Turkey. GBD study compiles mortality data for 188 countries using all available data sources (surveys, censuses, vital registration systems, disease surveillance, and sample registration systems) to analyze mortality levels and patterns of countries[10]. Because both having a large dataset and being a different data source, e75 values of the year of 2013 for both sexes are gathered from this database to use in SEG method.

3.2.2. Methodology

Preparation of data

Before applying any methods, some regulations are made on the population distribution and death data.

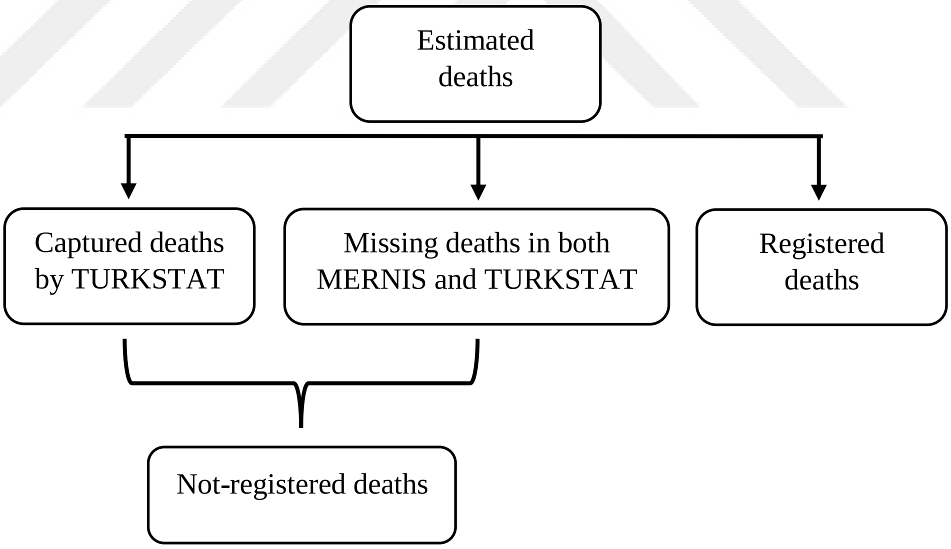
1) **Distribution of unknown ages:** Unknown ages are distributed according to below equation for both sexes,

[10] http://vizhub.healthdata.org/mortality/

$$f = \frac{\text{Total number of deaths}}{\text{Total number of deaths known ages}}$$

then, all age groups (five-year age groups) are multiplied by the factor f.

2) After distribution of unknown ages, number of deaths without registration date in each age group are subtracted from total deaths of correspondence age groups. Reason for subtraction is that while deaths without registration date are captured by cause of death database of TURKSTAT, these deaths aren't registered in MERNIS. These deaths are part of the not-registered deaths. So, estimated deaths found after the Hybrid method and TURKSTAT life table applied, include the deaths without registration date (captured deaths by TURKSTAT).



Deaths without registration date of some age groups which consist of more than one age group (five-year age group), are distributed evenly among these age groups.

3) Based on the reason that mentioned above in "Data sources" section, population distribution by age and sex includes only citizens of the Republic of Turkey for all years from 2009 to 2015.

Completeness of death registration is evaluated with two methods: Hybrid Method and by means of the ratio of observed nMx in the years 2013, 2014, and 2015 and 2013-TURKSTAT life table. Reason for selecting the Hybrid Method to evaluate the completeness of death data is that this method decreases the coverage error of populations with GGB method. In the preparation of thesis, Preston-Bennett Method (1983) and Synthetic Orphanhood Method (Zlotnik and Hill,1981) were applied. Outputs of the Preston-Bennett Method didn't allow a comment about results. Reason for this situation may be due to the sensitivity of the method to census coverage and migration. Apart from this, Synthetic Orphanhood Method was applied to 2008 – Turkey Demographic Health Survey (TDHS) and 2013-TDHS to produce a life table for the mid-year of the surveys, that is 2011.Then, it was aimed to use the value of age specific death rate (${}_nm_x$) from produced life table for the year 2011 to compare the observed ${}_nM_x$ of the year 2011. However, ratio of observed and estimated age specific death rates of both sexes gave inconsistent results with each other. In addition to these applied methods, it was aimed to estimate the completeness of death registration with Address Based Population Registration System (ABPRS) populations by following the cohort each year. However, this method didn't allow to estimate the completeness due to the effect of migration and coverage error in itself.

1) **Hybrid method**: Completeness is evaluated for two periods, 2009-2013 and 2013-2015. These periods are selected for the reason that death registration system has been changed in the year of 2013 and so, it is aimed to observe effect of the system change on completeness of death registration. Additionally, to see the annual variation of completeness of death registration, completeness is also calculated for single years from 2009 to 2015. The steps of the method are presented in tables 3.2.2 and table 3.2.3 in detail. Basically, GGB is used to analyze relative census coverage and then population distributions of first and second census are adjusted according to adjusting factors, k_1 and k_2 respectively. Using adjusted populations (standardized population) and e_{75} values, SEG method is applied for both sexes.

2) Another evaluation of completeness is made for the years of 2013, 2014, and 2015 for both sexes. It is evaluated by the ratio of observed age specific death rates (${}_nM_x$) (observed deaths without using any method) of the years 2013, 2014, and 2015 to age specific death rates of 2013- TURKSTAT life table (${}_nm_x$).

Timeliness is evaluated by calculating the percentage of death registration within the legal time that is 10 days for Turkey. If more than 10 days elapsed between death and death registration, it is called late registration.

Limitations

- Hybrid method gives estimation on completeness of death registration for the age of 5 and over, so this method does not present any estimation for the age group 0-4. Because of this reason, completeness of under five mortality is estimated only by means of the TURKSTAT life table.
- Data source of population distribution and death distribution is the same source, MERNIS. Hybrid method gives more reliable results when the data source of death and population distribution is different.
- While population distribution includes only citizens of Republic of Turkey, lack of data on net international migration, prevents to calculate age specific growth rate truly in SEG method.
- Although number of legally residing foreigner’s deaths are negligible, there is still some deaths who were legally residing foreigners, and this creates a bias for calculations.

Table 3.2.1. Used data and method to analyze completeness and timeliness of death registration system

	Method	Required data	Source of data
Completeness	**Hybrid method (GGB+SEG)** 1) Standardization of population size by GGB 2) Computation of completeness with SEG method for each sex and age group using standardized population	Distribution of population size that **excludes legally residing foreigners** by sex and five year-age group for the years 2009-2015	Address Based Population Registration System-TURKSTAT
		Distribution of death number that **excludes death registry date unknown deceases** by sex and five year age group for the years 2009-2015	TURKSTAT
		Life expectancy at age of 75 for both sexes – e_{75}	Global Burden of Diseases (GBD)-2013
	Ratio of observed $_{n}M_{x}$ of 2013, 2014 and 2015 to estimated $_{n}m_{x}$ of TURKSTAT life table	2013-TURKSTAT life table for male and female	TURKSTAT
		Distribution of population size that **excludes legally residing foreigners** by sex and five year-age group for the years 2013,2014, and 2015	Address Based Population Registration System-TURKSTAT
		Distribution of death number that **excludes death registry date unknown deceases** by sex and five year age group for the years 2013,2014, and 2015	TURKSTAT
Timeliness	Percentage of death registration **within first 10 days** by age group, sex, and 81 provinces	Time elapsed between death and registration of death by sex, age group, and 81 provinces	TURKSTAT

Table 3.2.2. Application of General Growth Balance Method (GGB Method)

Age	x	$_5N_x(t_1)$	$_5N_x(t_2)$	$_5D_x$	$P_1(x+)$	$P_2(x+)$	D(x+)	PYL(x+)	N(x)	b(x+)	r(x+)	d(x+) = X	b(x+)-r(x+) = Y	a+bx	Residuals y-(a+bx)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0-4	0														
5-9	5														
10-14	10														
15-19	15														
20-24	20														
:	:														
:	:														

Column 3: ABPRS population age distribution at time t_1 by sex

Column 4: ABPRS population age distribution at time t_2 by sex

Column 5: Intercensal deaths between the time t_1 and t_2

Column 6: Population aged x+ in time t_1, that is,

$$P_1(x+) = {}_5N_x(t_1) + P_1((x+5)+)$$

Column 7: Population aged x+ in time t_1, that is,

$$P_2(x+) = {}_5N_x(t_2) + P_2((x+5)+)$$

Column 8: Number of deaths above age x, that is,

$$D(x+) = {}_5D_x + D((x+5)+)$$

Column 9: Person years lived d above age x, that is,

$$PYL\ (x+) = (t_2 - t_1) * \sqrt{P_1(x+) * P_2(x+)}$$

Column 10: Number of persons reaching age x, that is,

$$N(x) = (t_2 - t_1) * 0.2 * \sqrt{{}_5N_{x-5}(t_1) * {}_5N_x(t_2)}$$

Column 11: Entry rate aged x and over, that is,

$$b(x+) = N(x)/PYL(x+)$$

Column 12: Growth rate of population aged x, that is,

$$r(x+) = [(P_2(x+) - P_1(x+)]/PYL(x+)$$

Column 13: Death rate above age x, that is,

$$d(x+) = D(x+)/PYL(x+)$$

Column 14: Difference between entry rate growth rate over age x

Slope: $b = \sigma(Y)/\sigma(X)$ where $\sigma(Y)$ and $\sigma(X)$ are standard deviation of Y and X values, respectively.

Intercept: $a = \bar{Y} - b * \bar{X}$ where $\bar{Y}$ and $\bar{X}$ are means of Y and X values, respectively.

$\frac{k_1}{k_2} = \exp[a * (t_2 - t_1)]$ if $\frac{k_1}{k_2} > 1$, then $k_1 = 1$, if not $k_1 = k_1/k_2$ and $k_2 = k_1/(\frac{k_1}{k_2})$

Table 3.2.3. Application of Synthetic Extinct Generations Method (SEG Method)									
Age	**x**	**N1(x,5)**	**N2(x,5)**	**D(x,5)**	**r(x,5)**	**N*(x)**	**N(x)**	**N*(x)/N(x)**	**Adjusted deaths**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
0-4	0								
5- 9	5								
10-14	10								
15-19	15								
20-24	20								
:	:								
:	:								

Column 3: Standardized population age distribution at time t_1, that is,

$$\mathbf{N1(x,5) = {}_5N_x(t_1)/k_1}$$

Column 4: Standardized population age distribution at time t_2, that is,

$$\mathbf{N2(x,5) = {}_5N_x(t_2)/k_2}$$

Column 5: Intercensal deaths between the time t_1 and t_2

Column 6: Age specific growth rate

$$\mathbf{r(x,5) = \ln\left(\frac{N2(x,5)}{N1(x,5)}\right) \Big/ (t_2 - t_1)}$$

Column 7: Number of persons reaching age x from deaths

$$\mathbf{N^*(x) = N^*(x+5) * exp(5 * r(x,5) + D(x,5) * exp(2.5 * r(x,5)}$$

For the last age group,

$\mathbf{N^*(75+) = D(75+) * (T_1 - T_2)}$ where

$\mathbf{T_1 = exp(r(75+) * e_{75}}$ and

$\mathbf{T_2 = [r(75+) * (e_{75})]^2 / 6}$

Column 8: Number of persons reaching age x from age distribution

$$\mathbf{N(x) = (t_2 - t_1) * 0.2 * \sqrt{N2(x,5) * N1(x-5,5)}}$$

Column 9: Ratio of N*(x)/N(x)

Column 10: Adjusted deaths = $\mathbf{D(x,5)/Median[\frac{N^*(x)}{N(x)}]}$

4. RESULTS

This chapter includes 3 sections. The first section contains the evaluation of data that is used for analysis. The second section contains the results of analysis on completeness of death registration system. The third section includes the tables and figures on the timeliness of death registration system for Turkey and 81 provinces. In the these sections all calculations are evaluated based on ABPRS population distribution that excludes legally residing foreigners.

4.1. DESCRIPTIVE RESULTS

Evaluation of ABPRS population data

In this section, data quality of ABPRS population data is evaluated. For this aim, population distribution which exclude the legally residing foreigners of ABPRS is evaluated with sex ratio and age ratio of the population for each age groups.

Figure 4.1.1 shows the sex ratios of population by age groups for the years 2008-2015 and sex ratios calculated from the data of UN World Population Prospects (UN-WPP)[11] population estimations for the years 2010 and 2015. Sex ratios are calculated by dividing the male population in an age group by the female population in the same age group times 100. According to this figure, sex ratios follow similar pattern for the period 2008-2015. Ratios are above 100 until the age group 25-29, around 100 until the age group 55-59, and begin to decrease with the age group 55-59.

[11] https://esa.un.org/unpd/wpp/Download/Standard/Population/

Figure 4.1.1. Sex ratio of population by age groups for the years 2008-2015,Turkey.

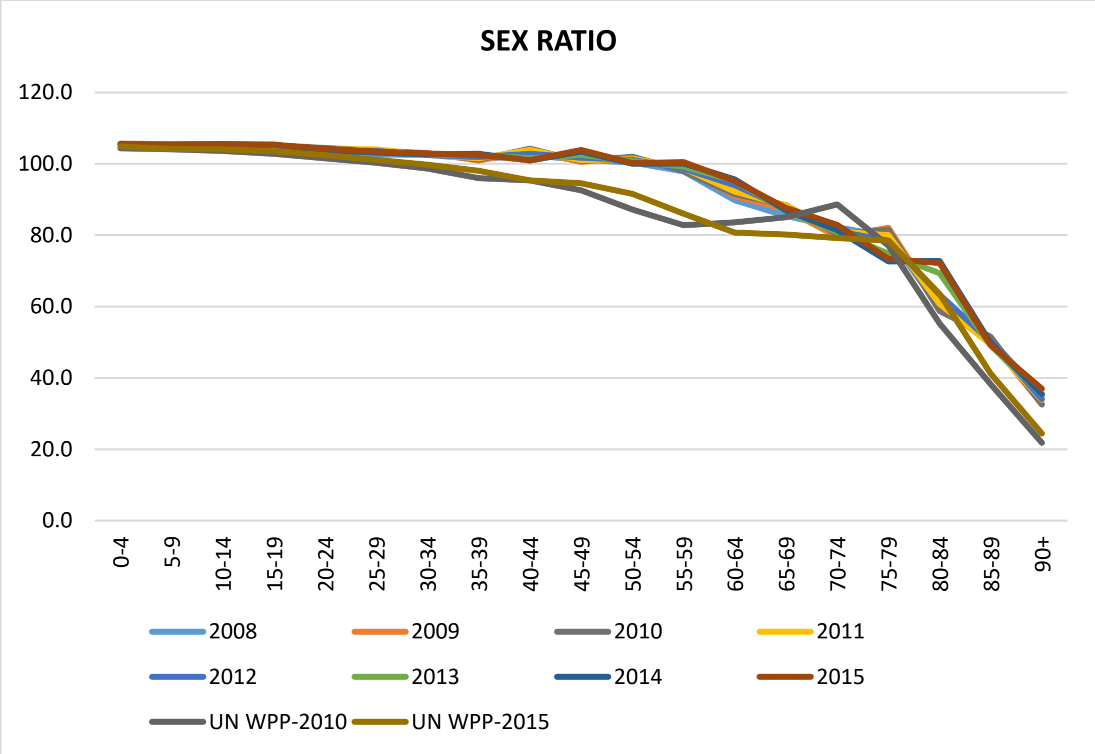


Figure 4.1.2 and figure 4.1.3 shows the age ratios of male and females by grouped ages, respectively. Age ratios for 5-year age groups help to detect possible age misreporting in populations where fertility has not varied suddenly during the past and where international migration has not been significant (Arriaga et. al. 1994). Age ratios are calculated as follows:

$$ {}_{5}\mathbf{AR}_{x} = \frac{{}_{5}\mathbf{P}_{x}}{({}_{5}\mathbf{P}_{x-5} + {}_{5}\mathbf{P}_{x+5}) * \frac{1}{2}} $$

The larger distance from 1, means larger probability of error in the data (Arriaga et. al. 1994).

According to figure 4.1.2 age ratios of male are around 1 up to age groups 65-69, however by the age group 75-79 distances from 1 is increased. So, especially by age 75 and over, age misreporting is increasing. In figure 4.1.3, age ratios of female population are around 1 up to age group 70-74, and by this age group, distances are increased.

Figure 4.1.2. Age ratios of male population by age groups, 2008-2015.

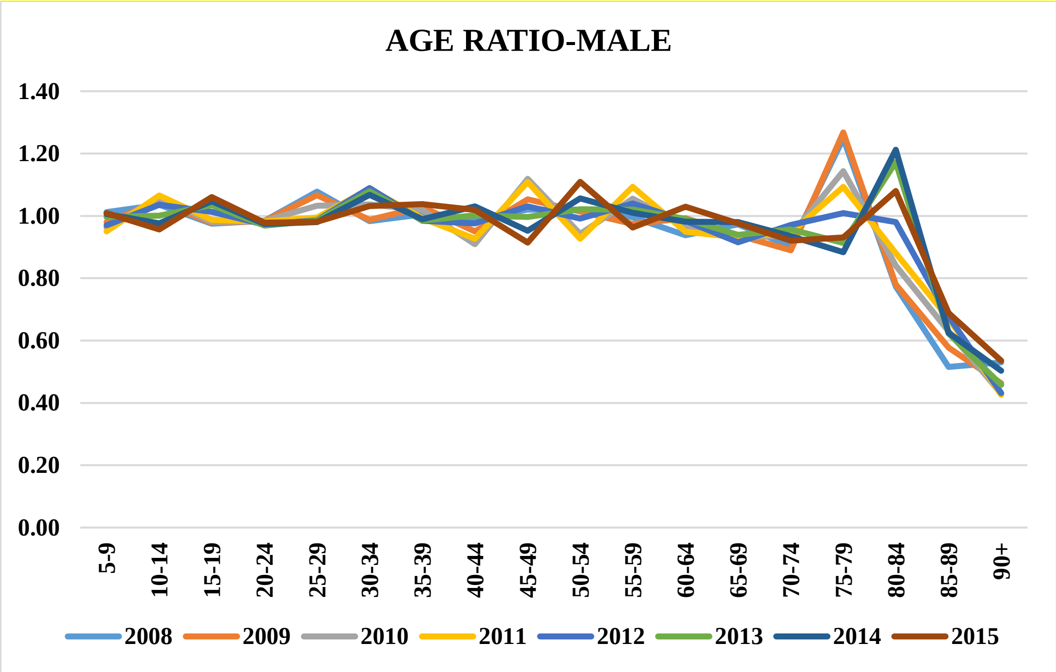
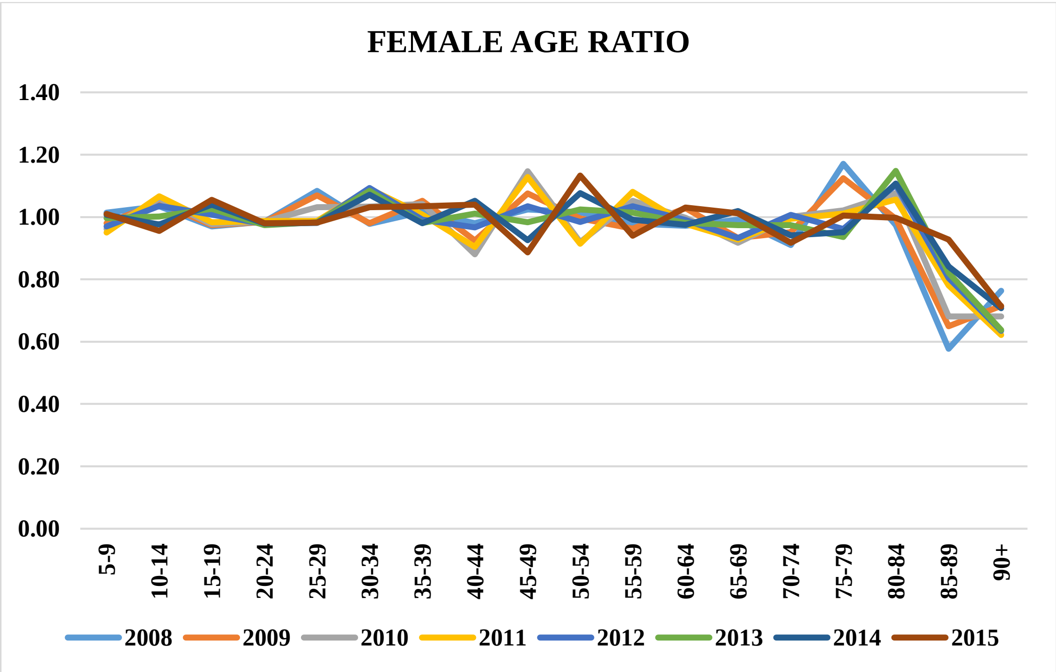


Figure 4.1.3. Age ratios of female population by age groups, 2008-2015



Evaluation of death data

In this section, death data is generally evaluated by looking at the distribution of number of deaths over the years from 2009 to 2015 and age specific death rates of males and females.

Table 4.1.1 shows the distribution of the total number of deaths by sex and age groups for the years 2009-2015. Except the age group 75+, male deaths are much more than female deaths. This is because, life expectancy at birth (e_0) of females are is higher than that of males. Most of deaths occur in 55-74 and 75+ age groups for both sexes. It is seen that the number of deaths in unknown age group is decreasing over the years. Because, unknown age population groups in the previous years are decreasing with deaths and lack of information on date of birth isn’t seen at younger ages. In the year 2014 there is not seen unknown age death. Figure 4.1.4 and figure 4.1.5 shows age specific death rates (ASDR) of males and females respectively for the years 2009-2015. Mortality trends are similar and J-shape mortality pattern (deaths are low in infant and childhood period and high in old-age period) are seen for both sexes.

Table 4.1.1. Distribution of deaths by sex and age groups														
	2009		2010		2011		2012		2013		2014		2015	
Age group	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
0	9,541	8,066	8,242	6,922	7,843	6,724	8,022	6,952	7,594	6,420	8,319	6,846	7,716	6,448
1-4	2,490	2,267	2,292	2,036	2,130	1,912	1,884	1,728	1,778	1,549	1,638	1,334	1,482	1,297
5-9	1,834	1,672	1,509	1,435	1,361	1,259	1,272	1,165	995	875	876	659	817	577
10-14	1,471	1,113	1,340	986	1,192	876	1,148	679	1,076	665	1,033	577	973	547
15-19	2,261	1,194	2,225	1,111	2,300	1,113	2,203	1,032	2,200	884	2,207	801	2,229	867
20-24	2,430	1,178	2,313	1,020	2,333	1,081	2,477	922	2,196	839	2,406	916	2,486	812
25-29	2,799	1,398	2,582	1,259	2,447	1,287	2,531	1,089	2,267	974	2,305	865	2,435	893
30-34	2,763	1,522	2,748	1,444	2,772	1,502	2,736	1,426	2,495	1,296	2,674	1,200	2,663	1,146
35-39	3,516	2,053	3,310	1,912	3,257	2,023	3,181	1,803	3,026	1,680	3,031	1,664	2,990	1,632
40-44	5,082	2,720	4,436	2,510	4,384	2,306	4,385	2,315	4,408	2,358	4,496	2,368	4,286	2,394
45-49	7,952	4,004	7,683	3,794	7,506	3,890	7,139	3,557	7,018	3,385	6,692	3,457	6,435	3,232
50-54	11,632	5,110	11,183	4,889	10,389	4,687	10,714	4,725	10,657	4,897	10,892	5,027	10,980	5,025
55-59	14,937	6,691	14,316	6,475	15,365	7,085	15,671	7,014	15,330	6,680	15,265	6,928	16,020	7,073
60-64	17,171	9,081	17,711	9,345	18,547	9,506	18,659	8,992	18,845	9,015	19,339	9,402	19,905	9,612
65-69	20,647	12,811	20,116	12,453	21,049	12,419	20,835	12,312	20,830	12,231	21,679	12,892	23,563	13,639
70-74	23,646	17,943	24,154	18,645	25,456	18,821	25,454	18,641	24,818	18,013	25,129	18,240	26,097	18,566
75+	72,752	86,993	74,194	89,767	78,167	93,158	79,319	94,528	79,862	95,761	85,705	104,147	90,869	109,512
unknown age	729	234	91	23	7	8	4	6	3	0	0	0	0	0
Total	**203,653**	**166,050**	**200,445**	**166,026**	**206,505**	**169,657**	**207,634**	**168,886**	**205,398**	**167,522**	**213,686**	**177,323**	**221,946**	**183,272**

Figure 4.1.4. Age specific death rate (ASDR) of male population for the years 2009-2015

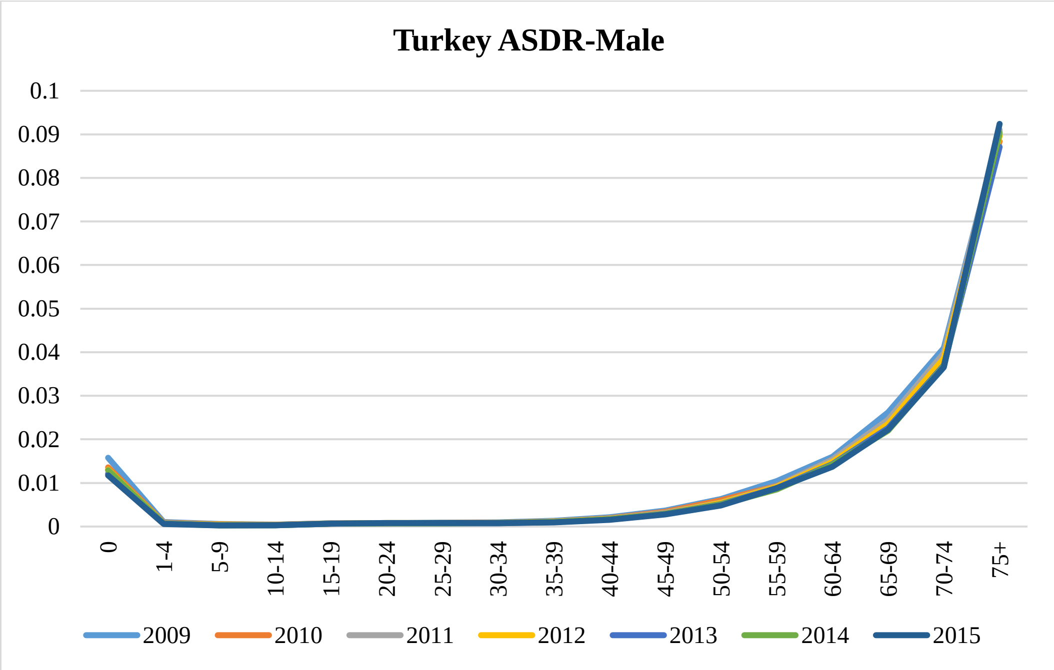


Figure 4.1.5. Age specific death rate of female population for the years 2009-2015

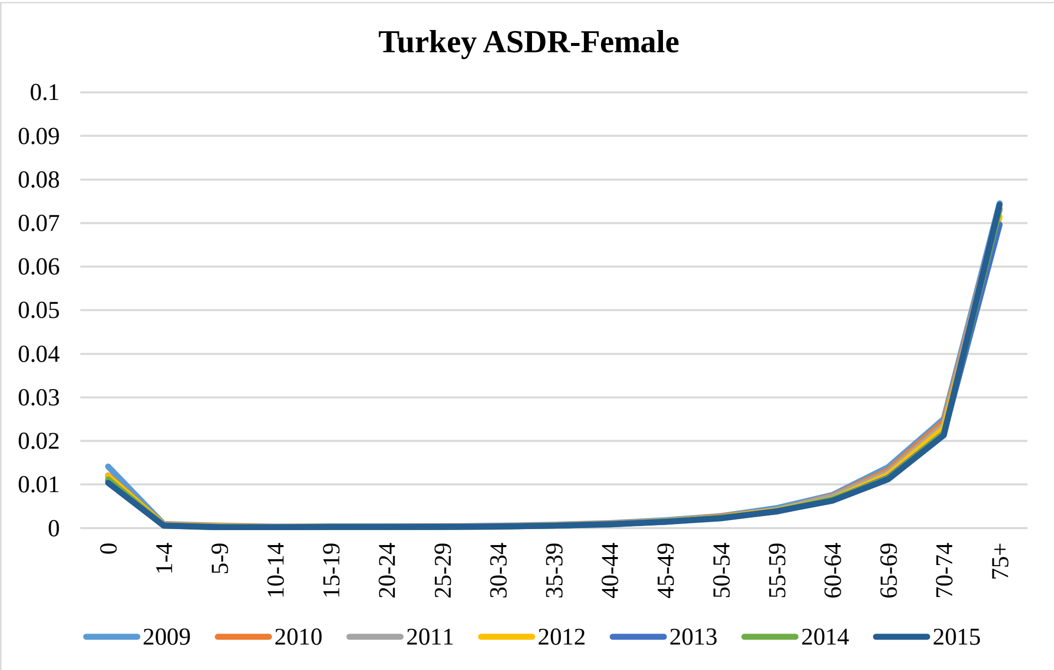
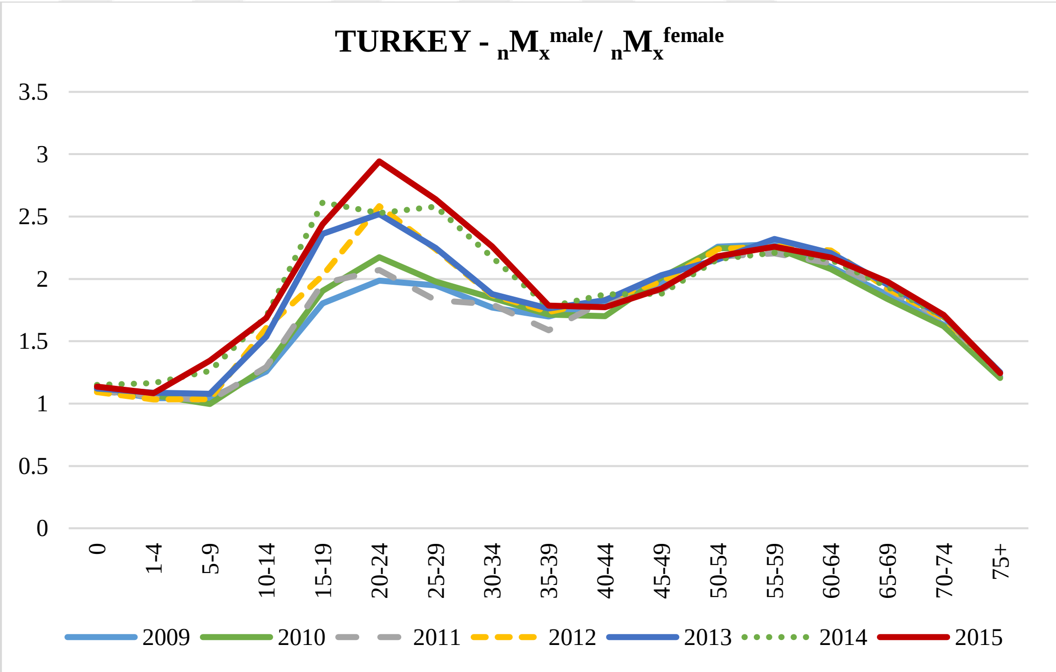


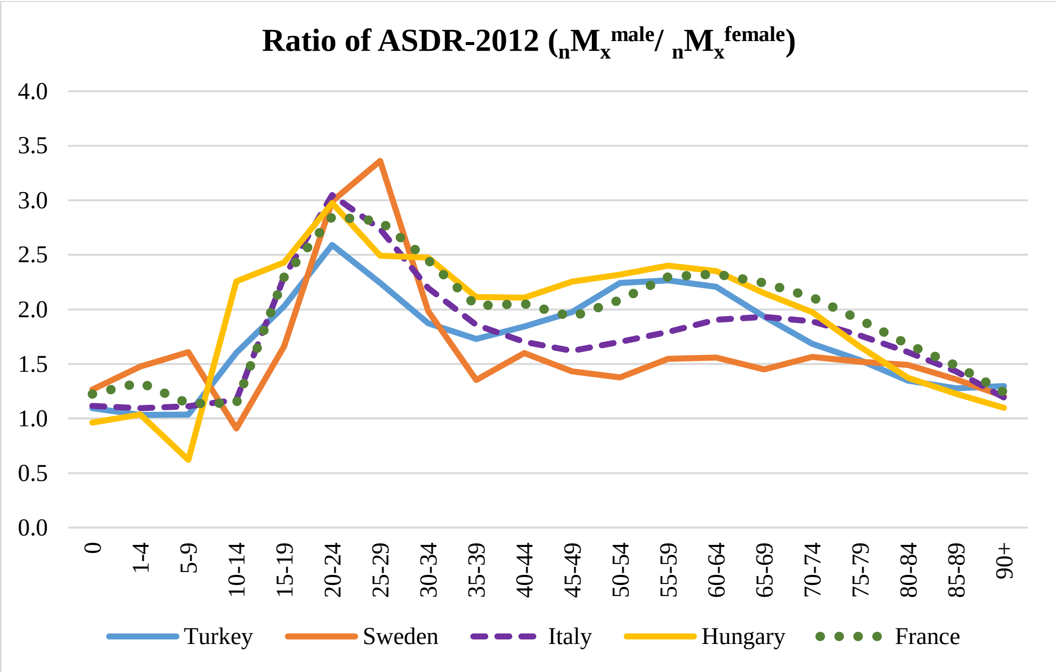
Figure 4.1.6 shows the ratio of male ASDR to female ASDR during the period 2009-2015. It is seen that male mortality is higher than female mortality at all age groups,especially at the age group 20-24. Higher ASDR is predictable because of higher life expectancy of female. However, another possible problem may be missing female deaths in the system. Therefore, we compared sex ratio of ASDR of Turkey with some selected countries' rates. Figure 4.1.7 is a comparison of ASDRs of some countries with Turkey's for the year 2012. The reason for the selection of 2012 is that the most recent death and population distribution data is available for the year 2012 for these countries. Data for countries shown in figure 4.7 is gathered from Human Mortality Database (HMD)[12]. Turkey follows the similar pattern with these countries especially after age 40.

Figure 4.1.6. Ratio of male ASDR to female ASDR for the years 2009-2015



[12] http://www.mortality.org/

Figure 4.1.7 Ratio of male ASDR to female ASDR for the years 2009-2015



In Table 4.1.2 percent distribution of deaths without registration date is given by sex and age groups. These deaths are captured by TURKSTAT through cause of death database, but not in the MERNIS database. Majority of deaths without registration date constitute the dead that don't have an TR- Identification number. These groups are either the dead who have no birth registration or the dead who are legally residing foreigners in Turkey. Reason of this problem may be due to not transferring the certificate of deaths to Directorate of District Civil Registration by Provincial Health Directorates. According to Table 4.1.2, majority of deaths without registration date is seen at the 0 age group for both sexes. This shows that there are infants who died before birth registration. If death certificate of an infant dead who died before birth registration is sent to Directorate of District Civil Registration by Provincial Health Directorates, firstly, birth registration is done in MERNIS database and given an ID number for this infant. Then, death registration is done according to this ID number. If death certificates of these deaths aren't transferred to Directorate of District Civil Registration, these deaths cannot be registered to MERNIS database. Table 4.1.2 shows that there is an improvement over the years, especially by the year 2013. It can be said that the DNS which was being used in 2013 has contributed to reduce the number of deaths without registration date. Before the year 2013, while deaths without registration date are seen in all age groups, by the year 2013, almost all of these deaths are seen in the 0 age group. Because of the being careful of Ministry of Health to monitor infant deaths, it is provided to capture died infants who have no birth registration.

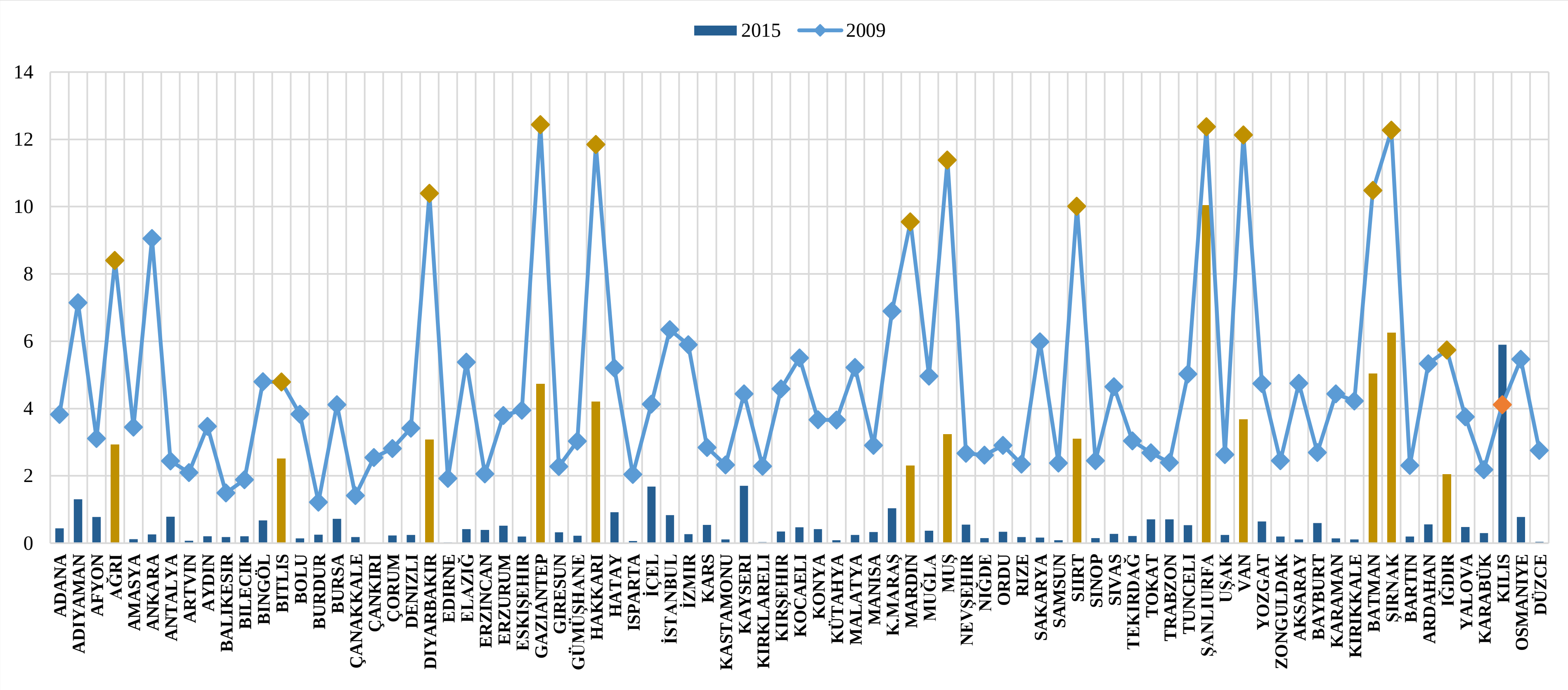
Table 4.1.2 Percent distribution of deaths without registration date by sex and age groups

Year	Sex	0	1-4	5-14	15-34	35-54	55-74	75+	Unknown age	Total (count)
2009	**Male**	40.41	1.44	1.53	5.11	9.32	17.45	17.57	7.16	10,118
	Female	37.80	1.68	1.25	3.21	5.52	15.44	32.49	2.61	8,860
	Total	**39.19**	**1.55**	**1.40**	**4.22**	**7.55**	**16.51**	**24.54**	**5.03**	**18,978**
2010	**Male**	47.34	1.08	1.50	3.96	8.26	19.37	17.04	1.45	6,269
	Female	42.90	0.91	1.30	3.31	5.47	15.55	30.14	0.41	5,613
	Total	**45.24**	**1.00**	**1.41**	**3.65**	**6.94**	**17.56**	**23.23**	**0.96**	**11,882**
2011	**Male**	56.92	0.86	1.35	4.04	7.27	16.40	13.07	0.09	4,652
	Female	50.94	0.84	1.04	5.41	4.85	11.86	24.99	0.07	4,309
	Total	**54.05**	**0.85**	**1.21**	**4.70**	**6.10**	**14.22**	**18.80**	**0.08**	**8,961**
2012	**Male**	62.30	0.50	1.05	3.89	6.35	13.05	12.77	0.10	4,191
	Female	58.21	0.59	1.05	3.98	4.82	10.61	20.68	0.08	3,922
	Total	**60.32**	**0.54**	**1.05**	**3.93**	**5.61**	**11.87**	**16.59**	**0.09**	**8,113**
2013	**Male**	88.42	0.65	0.60	1.86	2.36	2.76	3.31	0.05	1,994
	Female	82.35	0.76	0.47	1.17	1.99	4.75	8.50	0.00	1,705
	Total	**85.62**	**0.70**	**0.54**	**1.54**	**2.19**	**3.68**	**5.70**	**0.03**	**3,699**
2014	**Male**	86.02	0.78	0.74	2.47	3.38	3.77	2.86	0.00	2,310
	Female	83.87	0.63	0.63	1.52	1.94	3.73	7.67	0.00	1,903
	Total	**85.05**	**0.71**	**0.69**	**2.04**	**2.73**	**3.75**	**5.03**	**0.00**	**4,213**
2015	**Male**	85.70	0.47	0.62	2.50	2.86	4.37	3.48	0.00	1,923
	Female	80.13	1.15	0.55	1.52	2.49	4.62	9.54	0.00	1,646
	Total	**83.13**	**0.78**	**0.59**	**2.05**	**2.69**	**4.48**	**6.28**	**0.00**	**3,569**

In Figure 4.1.8, percentage of deaths without registration date in 2009 and in 2015 by 81 provinces is presented to see the improvement in unknown death registration date from 2009 to 2015. According to this table, deaths without registration date decreased between 2009 and 2015. However, some provinces in Southeastern Anatolia and Eastern Anatolia regions have higher percentage than in others. These provinces is colored yellow in the figure. Especially Şanlıurfa in these provinces has the highest percentage for the year of 2015. Another important point is that while percentage of deaths without registration date decreased from 2009 to 2015 in all provinces, in Kilis, percentage of unknown death registry increased. When we look at the age distribution of deaths without registration dates in Kilis between 2009 and

2015, it is seen that recording of infant deaths have been increased in number by the year of 2013. The reason why of this increase might be that the high amount of unregistered deaths that were not captured by TURKSTAT before the establishment of DNS.

Figure 4.1.8 Percentage of deaths without registration date by 81 provinces, 2009 and 2015



4.2. COMPLETENESS OF DEATH REGISTRATION

In this section, completeness of death registration is assessed with hybrid method and 2013 TURKSTAT life table. Firstly results of hybrid method and then results of 2013 TURKSTAT life table are presented.

4.2.1. Results of Hybrid Method (GGB and SEG)

Completeness of death registration is evaluated with hybrid method for the periods 2009-2013 and 2013-2015 for both sexes. Additionally, with the same method, completeness is assessed for single years from 2009 to 2015. In the first phase of the Hybrid method, relative coverage of censuses is determined with GGB method. After that censuses are adjusted with correction factors k_1 and k_2. Correction factors k_1 and k_2 explain the relative coverage of censuses. If $k_1<k_2$, then "the second census is complete relative to the first" and the first census is standardized according to the second census. After standardization process, SEG method is applied to censuses and intercensal deaths of these censuses. SEG method estimates the completeness with the ratio of the number of persons reaching age x from death distribution to the number of persons reaching age x from age distribution of population.

In the following tables, results of hybrid method are presented for males then for females. At the end of the hybrid method, if the median completeness is found greater than 1 for any period or year, than the number of adjusted deaths are not calculated for this period or year. Table 4.2.1 presents adjusted 2009 and 2013 ABPRS male population distribution. Detailed results of the method are presented in the appendix. According to application of the GGB method to 2009 and 2013 male population distribution, 2013 ABPRS is complete relative to 2009 ABPRS (k_1=0.998 for the year 2009 and k_2=1 for the year 2013). Then, 2009 population distribution is standardized according to 2013 population distribution. After standardization, standardized populations are used in the SEG method (Table 4.2.2). According to Table 4.2.2, completeness of death registration of male population for the period of

2009-2013 is 98.4 percent. This ratio is the median of the completeness ratios of age groups. According to this result, 12,798 male deaths are not registered. The most missing deaths are seen at the 75+ age group (4,930 deaths). Missing number of male deaths rise over 1000 by the age agroup of 60-64, while this number is the lowest at the age groups 5-9 and 10-14 (80 and 74, respectively).

Table 4.2.1 Adjusted male population 2009-2013				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
	31.12.2009	**31.12.2013**	k_1 =0.997969	k_2 =1
0-4	3,159,120	3,178,431	3,165,550	3,178,431
5-9	3,181,037	3,207,503	3,187,511	3,207,503
10-14	3,333,455	3,259,305	3,340,240	3,259,305
15-19	3,189,793	3,306,601	3,196,285	3,306,601
20-24	3,192,783	3,134,546	3,199,281	3,134,546
25-29	3,298,628	3,163,306	3,305,342	3,163,306
30-34	2,991,146	3,285,116	2,997,234	3,285,116
35-39	2,757,354	2,928,738	2,762,966	2,928,738
40-44	2,372,479	2,657,678	2,377,308	2,657,678
45-49	2,235,994	2,376,130	2,240,545	2,376,130
50-54	1,874,362	2,112,702	1,878,177	2,112,702
55-59	1,458,956	1,761,362	1,461,925	1,761,362
60-64	1,121,691	1,339,942	1,123,974	1,339,942
65-69	800,517	944,380	802,146	944,380
70-74	585,334	670,993	586,525	670,993
75+	831,576	932,678	833,269	932,678
Total	**36,384,225**	**38,259,411**	**36,458,279**	**38,259,411**

Table 4.2.2. Synthetic Extinct Generations Method (SEG Method) – Male 2009-2013									
Age Group	**Age x**	**Adj. population 2009 N1(x,5)**	**Adj. population 2013 N2(x,5)**	**Intercensal Deaths D(x,5)**	**Age Specific Growth Rate r(x,5)**	**Number Reaching Age x from Deaths N*(x)**	**Number Reaching Age x from Age Dist. N(x)**	**Ratio N*(x)/N(x)**	**Adjusted Deaths**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0-4	**0**	3,165,550	3,178,431	29,653	0.001015	2,563,474	NA	NA	30,126
5- 9	**5**	3,187,511	3,207,503	5,031	0.001563	2,520,917	2,549,166	0.989	5,111
10-14	**10**	3,340,240	3,259,305	4,650	-0.006132	2,496,281	2,578,567	0.968	4,724
15-19	**15**	3,196,285	3,306,601	8,769	0.008483	2,569,283	2,658,702	0.966	8,909
20-24	**20**	3,199,281	3,134,546	9,160	-0.005110	2,454,002	2,532,212	0.969	9,306
25-29	**25**	3,305,342	3,163,306	9,668	-0.010981	2,508,238	2,544,994	0.986	9,822
30-34	**30**	2,997,234	3,285,116	10,592	0.022928	2,639,860	2,636,171	1.001	10,761
35-39	**35**	2,762,966	2,928,738	12,482	0.014567	2,343,927	2,370,230	0.989	12,681
40-44	**40**	2,377,308	2,657,678	17,321	0.027871	2,167,244	2,167,849	1.000	17,597
45-49	**45**	2,240,545	2,376,130	29,054	0.014688	1,869,171	1,901,375	0.983	29,517
50-54	**50**	1,878,177	2,112,702	42,651	0.029417	1,708,808	1,740,548	0.982	43,331
55-59	**55**	1,461,925	1,761,362	60,038	0.046583	1,435,455	1,455,066	0.987	60,995
60-64	**60**	1,123,974	1,339,942	73,118	0.043939	1,083,758	1,119,684	0.968	74,283
65-69	**65**	802,146	944,380	82,186	0.040809	804,491	824,217	0.976	83,496
70-74	**70**	586,525	670,993	99,238	0.033636	581,787	586,916	0.991	100,820
75+	**75**	833,269	932,678	309,267	0.028176	400,494	NA	NA	314,197
Total		**36,458,279**	**38,259,411**	**802,876**			Median	**0.984**	**815,674**

When we look at the distribution of male deaths without registration date (presented in Table 4.1.2) for the years from 2010 to 2013, it is found as 17,006 male deaths that are captured by TURKSTAT. We see that estimated not registered number of deaths by hybrid method (12,798) less than the number of deaths that are captured by TURKSTAT (17,006). When we compare the estimated number of not registered deaths and captured deaths by TURKSTAT by age groups;

Table 4.2.3. Number of not captured deaths by TURKSTAT based on the results of Table 4.2.2.

Age	**Not registered deaths (Adjusted deaths – Intercensal deaths) (1)**	**Captured deaths by TURKSTAT (2)**	**Not captured deaths by TURKSTAT (1) - (2)**
0-4	473	10,132	
5-14	154	213	
15-34	609	636	
35-54	1,618	1,169	449
55-74	5,014	2,579	2,435
75+	4,930	2,277	2,653
Total	**12,798**	**17,006**	

According to above table, we see that estimated deaths by hybrid method is more at the age groups 35-54 ,55-74, and 75+ than captured deaths by TURKSTAT. If we compute the missing deaths that couldn’t be captured by TURKSTAT for these age groups; 449, 2,435, and 2,653 deaths are couldn’t be captured by TURKSTAT for the age groups 35-54, 55-74, and 75+, respectively.

Table 4.2.4 shows the adjusted population of 2009 and 2013 female population distribution. In this table, k1 and k2 values are found 0.999 and 1, respectively. This means that 2013 female population is complete relative to 2009 female population. All age groups of 2009 female population is divided by k1, and those of 2013 female population is divided by k2. After standardization, these female population is used in SEG method (Table 4.2.5). Results show that values of completeness are more than 1. These results, first, bring to mind an over-reporting (re-reporting) problem at death registration system. However, death registration is made according to unique identification number, and for some dead who has not got an ID number, other information, such as mother/father name, date of birth, place of death, are matched to prevent re-reporting, and then it is assigned a new ID number for these dead. So, over-reporting is not expected in Turkey context. This result (completeness >1) may be due to the following reasons:

- There may be more coverage error in ABPRS population age distributions than the coverage error that is calculated by GGB method. This error may be in both population age distributions (in 2009 and in 2013). Although there is an improvement in the sex and age distribution of the population over the years, there may be underreporting in the population distribution. Not registered women in the ABPRS, may cause to appear as if there were more female deaths.

- Another reason is that assumptions of the SEG method may be violated by the used data in this method. SEG method assumes that coverage of each census is same for all ages. It is clear that there is an improvement in the quality and coverage of sex and age distribution of the ABPRS population over the years. However, since it is not made an adjustment in the population retrospectively, this causes different coverage ratio for each year. This situation may cause the result of completeness ratio greater than 1.

Based on the above reasons, we could not estimate the completeness of death registration for females for the period 2009-2013 by hybrid method, that is, results of this analysis don’t give a consistent result for females in 2009-2013 period.

Table 4.2.4. Adjusted female population 2009-2013				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
	31.12.2009	**31.12.2013**	k_1 =0.9991	k_2=1
0-4	2,992,273	3,011,240	2,995,066	3,011,240
5-9	3,015,272	3,042,579	3,018,086	3,042,579
10-14	3,161,981	3,093,192	3,164,932	3,093,192
15-19	3,031,543	3,136,003	3,034,373	3,136,003
20-24	3,062,215	3,017,428	3,065,073	3,017,428
25-29	3,188,342	3,059,507	3,191,318	3,059,507
30-34	2,901,436	3,205,597	2,904,144	3,205,597
35-39	2,731,843	2,856,549	2,734,393	2,856,549
40-44	2,290,216	2,616,300	2,292,354	2,616,300
45-49	2,222,957	2,317,237	2,225,032	2,317,237
50-54	1,842,948	2,097,054	1,844,668	2,097,054
55-59	1,479,901	1,775,690	1,481,282	1,775,690
60-64	1,233,387	1,405,987	1,234,538	1,405,987
65-69	918,387	1,089,007	919,244	1,089,007
70-74	735,468	829,265	736,154	829,265
75+	1,201,574	1,399,312	1,202,696	1,399,312
Total	**36,009,743**	**37,951,947**	**36,043,353**	**37,951,947**

Table 4.2.5. Synthetic Extinct Generations Method (SEG Method)- Female 2009-2013

Age Group	Age x	Adj. population 2009.000 N1(x,5)	Adj. population 2013.000 N2(x,5)	Intercensal Deaths D(x,5)	Age Specific Growth Rate r(x,5)	Number Reaching Age x from Deaths N*(x)	Number Reaching Age x from Age Dist. N(x)	Ratio N*(x)/N(x)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0-4	**0**	2,995,066	3,011,240	25,830	0.001346	2,616,675	NA	**NA**
5- 9	**5**	3,018,086	3,042,579	4,651	0.002021	2,573,375	2,414,983	**1.066**
10-14	**10**	3,164,932	3,093,192	3,123	-0.005732	2,542,879	2,444,327	**1.040**
15-19	**15**	3,034,373	3,136,003	3,991	0.008236	2,613,645	2,520,348	**1.037**
20-24	**20**	3,065,073	3,017,428	3,713	-0.003917	2,504,290	2,420,711	**1.035**
25-29	**25**	3,191,318	3,059,507	4,460	-0.010545	2,550,066	2,449,831	**1.041**
30-34	**30**	2,904,144	3,205,597	5,519	0.024690	2,683,547	2,558,760	**1.049**
35-39	**35**	2,734,393	2,856,549	7,233	0.010926	2,366,708	2,304,199	**1.027**
40-44	**40**	2,292,354	2,616,300	9,304	0.033046	2,233,842	2,139,756	**1.044**
45-49	**45**	2,225,032	2,317,237	14,441	0.010151	1,885,063	1,843,809	**1.022**
50-54	**50**	1,844,668	2,097,054	19,013	0.032059	1,777,694	1,728,076	**1.029**
55-59	**55**	1,481,282	1,775,690	26,784	0.045320	1,496,858	1,447,880	**1.034**
60-64	**60**	1,234,538	1,405,987	36,388	0.032511	1,169,438	1,154,515	**1.013**
65-69	**65**	919,244	1,089,007	48,945	0.042367	960,441	927,593	**1.035**
70-74	**70**	736,154	829,265	73,651	0.029775	733,063	698,477	**1.050**
75+	**75**	1,202,696	1,399,312	369,493	0.037854	563,296	NA	**NA**
Total		**36,043,353**	**37,951,947**	**656,542**			Median	**1.036**

Table 4.2.6 presents the relative coverage of 2013 and 2015 ABPRS male populations. 2013 ABPRS male population is found coverage relative to 2015. According to Table 4.2.7, completeness is bigger than 1 for males. Table 4.2.9 also shows the completeness ratio greater than 1 for females. Based on the reasons that were explained above (for the Table 4.2.5), results of the analysis aren’t consistent for the 2013-2015 period for both sexes.

Table 4.2.6. Adjusted Male Population 2013-2015				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
	31.12.2013	**31.12.2015**	$k_1 = 1$	$k_2 = 0.999$
0-4	3,178,431	3,261,250	3,178,431	3,264,333
5-9	3,207,503	3,233,704	3,207,503	3,236,760
10-14	3,259,305	3,150,351	3,259,305	3,153,329
15-19	3,306,601	3,354,261	3,306,601	3,357,431
20-24	3,134,546	3,176,943	3,134,546	3,179,946
25-29	3,163,306	3,139,771	3,163,306	3,142,739
30-34	3,285,116	3,221,301	3,285,116	3,224,346
35-39	2,928,738	3,108,187	2,928,738	3,111,125
40-44	2,657,678	2,766,328	2,657,678	2,768,943
45-49	2,376,130	2,318,214	2,376,130	2,320,405
50-54	2,112,702	2,302,304	2,112,702	2,304,480
55-59	1,761,362	1,832,931	1,761,362	1,834,663
60-64	1,339,942	1,507,340	1,339,942	1,508,765
65-69	944,380	1,094,034	944,380	1,095,068
70-74	670,993	733,279	670,993	733,972
75+	932,678	1,000,846	932,678	1,001,792
Total	**38,259,411**	**39,201,044**	**38,259,411**	**39,238,097**

Table 4.2.7. Synthetic Extinct Generations Method (SEG Method)- Male 2013-2015								
Age Group	**Age x**	**Population 2013 N1(x,5)**	**Population 2015 N2(x,5)**	**Intercensal Deaths D(x,5)**	**Age Specific Growth Rate r(x,5)**	**Number Reaching Age x from Deaths N*(x)**	**Number Reaching Age x from Age Dist. N(x)**	**Ratio N*(x)/N(x)**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0-4	0	3,178,431	3,264,333	15,493	0.013334	1,559,877	NA	NA
5- 9	5	3,207,503	3,236,760	1,679	0.004540	1,444,287	1,282,985	**1.126**
10-14	10	3,259,305	3,153,329	1,992	-0.016528	1,410,211	1,272,120	**1.109**
15-19	15	3,306,601	3,357,431	4,410	0.007628	1,529,624	1,323,202	**1.156**
20-24	20	3,134,546	3,179,946	4,866	0.007190	1,468,058	1,297,062	**1.132**
25-29	25	3,163,306	3,142,739	4,714	-0.003262	1,411,440	1,255,456	**1.124**
30-34	30	3,285,116	3,224,346	5,311	-0.009336	1,429,894	1,277,472	**1.119**
35-39	35	2,928,738	3,111,125	5,988	0.030206	1,492,787	1,278,775	**1.167**
40-44	40	2,657,678	2,768,943	8,749	0.020506	1,277,976	1,139,088	**1.122**
45-49	45	2,376,130	2,320,405	13,094	-0.011866	1,145,125	993,329	**1.153**
50-54	50	2,112,702	2,304,480	21,839	0.043444	1,201,631	936,012	**1.284**
55-59	55	1,761,362	1,834,663	31,242	0.020387	947,427	787,512	**1.203**
60-64	60	1,339,942	1,508,765	39,201	0.059332	825,921	652,071	**1.267**
65-69	65	944,380	1,095,068	45,199	0.074022	580,105	484,533	**1.197**
70-74	70	670,993	733,972	51,183	0.044856	363,092	333,022	**1.090**
75+	75	932,678	1,001,792	176,441	0.035743	244,390	NA	**NA**
Total		**38,259,411**	**39,238,097**	**431,399**			Median	**1.142**

Table 4.2.8. Adjusted female Population 2013-2015				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
			$k_1 = 0.999$	$k_2 = 1$
0-4	3,011,240	3,093,017	3,011,826	3,093,017
5-9	3,042,579	3,067,576	3,043,171	3,067,576
10-14	3,093,192	2,985,168	3,093,793	2,985,168
15-19	3,136,003	3,183,490	3,136,613	3,183,490
20-24	3,017,428	3,047,081	3,018,015	3,047,081
25-29	3,059,507	3,034,601	3,060,102	3,034,601
30-34	3,205,597	3,130,994	3,206,220	3,130,994
35-39	2,856,549	3,035,130	2,857,104	3,035,130
40-44	2,616,300	2,737,589	2,616,809	2,737,589
45-49	2,317,237	2,231,836	2,317,688	2,231,836
50-54	2,097,054	2,298,034	2,097,462	2,298,034
55-59	1,775,690	1,824,675	1,776,035	1,824,675
60-64	1,405,987	1,584,033	1,406,260	1,584,033
65-69	1,089,007	1,248,484	1,089,219	1,248,484
70-74	829,265	884,300	829,426	884,300
75+	1,399,312	1,503,693	1,399,584	1,503,693
Total	**37,951,947**	**38,889,701**	**37,959,327**	**38,889,701**

Table 4.2.9. Synthetic Extinct Generations Method (SEG Method)- Female 2013-2015

Age Group	Age x	Population 2013 N1(x,5)	Population 2015 N2(x,5)	Intercensal Deaths D(x,5)	Age Specific Growth Rate r(x,5)	Number Reaching Age x from Deaths N*(x)	Number Reaching Age x from Age Dist. N(x)	Ratio N*(x)/N(x)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0-4	0	3,011,826	3,093,017	12,979	0.013300	1,395,276	NA	NA
5- 9	5	3,043,171	3,067,576	1,226	0.003994	1,292,951	1,215,829	**1.06**
10-14	10	3,093,793	2,985,168	1,114	-0.017871	1,266,175	1,205,612	**1.05**
15-19	15	3,136,613	3,183,490	1,655	0.007417	1,383,358	1,255,329	**1.10**
20-24	20	3,018,015	3,047,081	1,715	0.004792	1,331,370	1,236,609	**1.08**
25-29	25	3,060,102	3,034,601	1,745	-0.004184	1,298,152	1,210,519	**1.07**
30-34	30	3,206,220	3,130,994	2,333	-0.011871	1,323,834	1,238,138	**1.07**
35-39	35	2,857,104	3,035,130	3,277	0.030223	1,402,387	1,247,801	**1.12**
40-44	40	2,616,809	2,737,589	4,743	0.022561	1,202,664	1,118,683	**1.07**
45-49	45	2,317,688	2,231,836	6,670	-0.018873	1,069,887	966,668	**1.11**
50-54	50	2,097,462	2,298,034	10,033	0.045663	1,168,770	923,136	**1.27**
55-59	55	1,776,035	1,824,675	13,964	0.013509	921,243	782,528	**1.18**
60-64	60	1,406,260	1,584,033	18,977	0.059520	847,571	670,916	**1.26**
65-69	65	1,089,219	1,248,484	26,494	0.068235	613,051	530,010	**1.16**
70-74	70	829,426	884,300	36,769	0.032031	413,501	392,570	**1.05**
75+	75	1,399,584	1,503,693	213,356	0.035874	318,368	NA	**NA**
Total		**37,959,327**	**38,889,701**	**357,046**			Median	**1.09**

Figure 4.2.1 and figure 4.2.2 show the change of completeness of death registration of both sexes by age age groups, for the period 2009-2013 and 2013-2015, respectively. We see from these figures that except the period 2009-2013 for males, due to the coverage error in the age distribution of ABPRS population or because the used population data does not meet the assumptions of the hybrid method, completeness results are above the line 1.

Figure 4.2.1. Completenes of death registration for the period of 2009-2013 for both sexes.

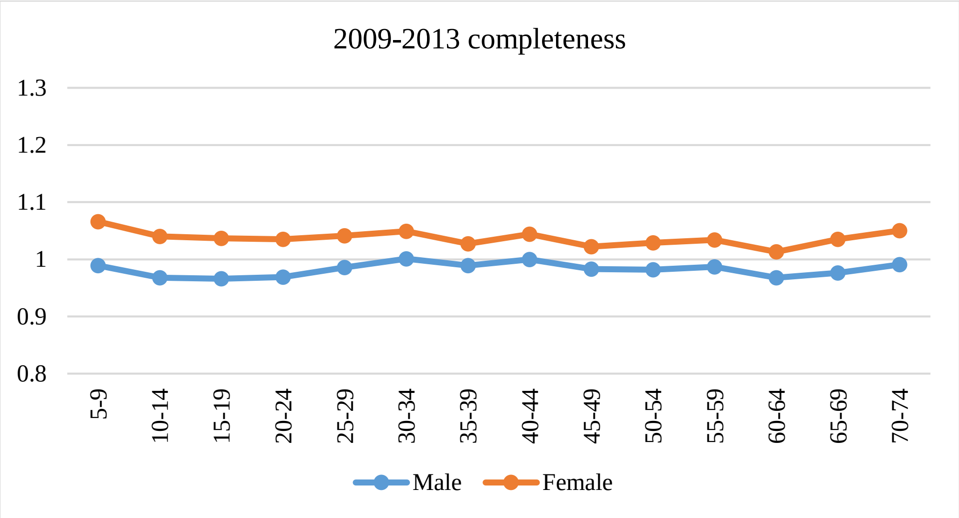
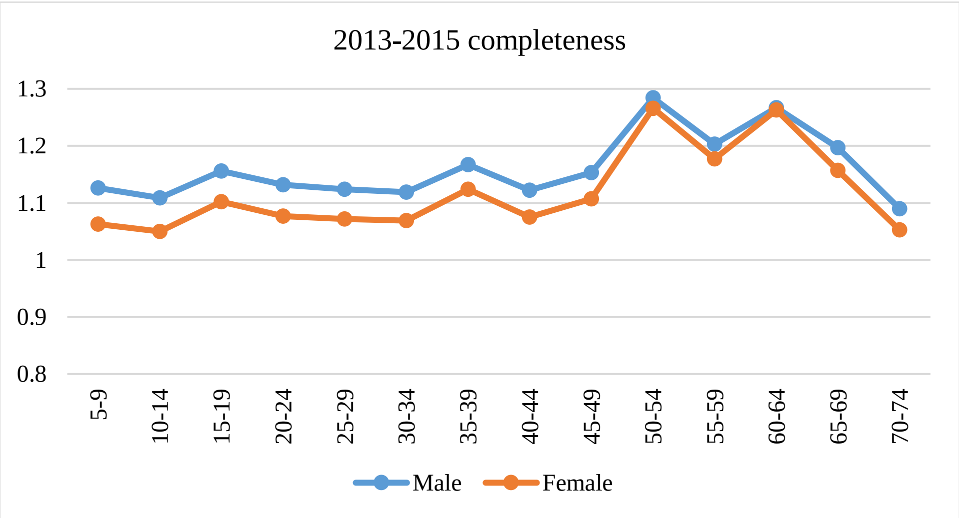


Figure 4.2.2. Completenes of death registration for the period of 2013-2015 for both sexes.



In the following tables, it is presented the results of hybrid method for single years for males and then females. Upon the inconsistency results for the periods 2009-2013 and 2013-2015 above, hybrid method is used for single years to see the irregularity over years. Calculations of completeness for these periods are made similar to that is made for 2009-2013 and 2013-2015 period. In the first step GGB is applied, and then standardized population by GGB method are used in SEG method.

Table 4.2.10 shows the results of the completeness of male deaths for single years. In this table, periods show the beginning and ending population and intercensal deaths show occurred deaths between these periods. For example, in Table 4.2.10, for the period 2009-2010, completeness of death registration is measured by taking 31 December 2009 male population for the beginning population and 31 December 2010 male population as the ending population. Intercensal male deaths are for this period are male deaths that occurred in the year 2010. According to Table 4.2.10, fluctuation is seen in the completeness ratio between years. Except the periods 2010-2011 and 2012-2013, this analysis does not give a consistent result for males. Similar to that of males, analysis don’t give a consistent result for females, except the periods 2010-2011 and 2012-2013 (Table 4.2.11).

	Table 4.2.10. Completeness of death registration for single years -male						
	2009-2010		**2010-2011**			**2011-2012**	
Age	**completeness**	**Intercensal deaths**	**completeness**	**adjusted deaths**	**Intercensal deaths**	**completeness**	**Intercensal deaths**
0-4	**NA**	7,498	**NA**	8,495	7,285.11	**NA**	7,274
5- 9	**0.976**	1,462	**0.835**	1,550	1,329.52	**1.073**	1,250
10-14	**1.019**	1,293	**0.846**	1,353	1,160.52	**0.985**	1,126
15-19	**0.994**	2,163	**0.824**	2,627	2,253.03	**1.020**	2,162.25
20-24	**1.010**	2,251	**0.835**	2,666	2,286.03	**0.985**	2,436.25
25-29	**1.029**	2,520	**0.880**	2,799	2,400.04	**1.018**	2,490.25
30-34	**1.110**	2,686	**0.960**	3,178	2,725.04	**1.022**	2,695.25
35-39	**0.994**	3,180.5	**0.857**	3,699	3,172.55	**1.032**	3,114.5
40-44	**1.087**	4,306.5	**0.924**	5,014	4,299.56	**1.058**	4,318.5
45-49	**1.283**	7,553.5	**0.851**	8,654	7,421.61	**0.889**	7,072.5
50-54	**1.165**	11,053.5	**0.858**	12,016	10,304.65	**1.014**	10,647.5
55-59	**1.401**	14,012.5	**0.902**	17,695	15,174.48	**0.875**	15,534.25
60-64	**1.113**	17,407.5	**0.812**	21,405	18,356.52	**0.971**	18,522.25
65-69	**1.082**	19,812.5	**0.877**	24,323	20,858.56	**0.985**	20,698.25
70-74	**1.032**	23,850.5	**0.912**	29,462	25,265.63	**1.042**	25,317.25
75+	**NA**	73,126	**NA**	90,442	77,560.15	**NA**	78,784
Total	**1.057**	**194,176**	**0.858**	**235,379**	**201,853**	**1.016**	**203,443**

	Table 4.2.10. Completeness of death registration for single years –male (Continue)						
	2012-2013			**2013-2014**		**2014-2015**	
Age	**completeness**	**adjusted deaths**	**Intercensal deaths**	**completeness**	**Intercensal deaths**	**completeness**	**Intercensal deaths**
0-4	NA	8,713.0	7,596.1	NA	6,405.0	NA	7,541.0
5- 9	**0.900**	1,134.4	989.0	**0.957**	1,236.5	**1.149**	811.0
10-14	**0.824**	1,227.3	1,070.0	**0.927**	853.5	**1.147**	967.0
15-19	**0.883**	2,512.9	2,190.8	**0.993**	1,054.8	**1.197**	2,217.0
20-24	**0.865**	2,508.3	2,186.8	**0.984**	1,022.8	**1.148**	2,474.0
25-29	**0.870**	2,589.8	2,257.8	**0.981**	1,228.8	**1.134**	2,423.0
30-34	**0.854**	2,851.3	2,485.8	**0.980**	1,443.8	**1.129**	2,651.0
35-39	**0.896**	3,457.5	3,014.3	**1.030**	1,970.8	**1.208**	2,976.3
40-44	**0.920**	5,042.7	4,396.3	**1.047**	2,253.8	**1.071**	4,272.3
45-49	**0.842**	8,036.6	7,006.3	**1.000**	3,837.8	**1.166**	6,421.3
50-54	**0.885**	12,210.7	10,645.4	**1.125**	4,634.8	**1.361**	10,966.3
55-59	**0.819**	17,568.6	15,316.4	**1.049**	6,957.3	**1.245**	15,999.0
60-64	**0.863**	21,600.5	18,831.4	**1.096**	9,378.3	**1.406**	19,884.0
65-69	**0.902**	23,877.4	20,816.5	**1.161**	12,291.3	**1.212**	23,542.0
70-74	**0.874**	28,451.8	24,804.5	**1.056**	18,693.3	**1.126**	26,076.0
75+	NA	91,530.4	79,796.8	NA	92,081.0	NA	90,802.0
Total	**0.872**	**233,313.4**	**203,404**	**1.015**	**165,343**	**1.158**	**220,023**

	Table 4.2.11. Completeness of death registration for single years -female						
	2009-2010		**2010-2011**			**2011-2012**	
Age	**completeness**	**Intercensal deaths**	**completeness**	**adjusted deaths**	**Intercensal deaths**	**completeness**	**Intercensal deaths**
0-4	**NA**	6,499	**NA**	6,993.8	6,405.2	**NA**	6,374.1
5- 9	**1.029**	1,398.5	**0.913**	1,350.2	1,236.5	**1.144**	1,144.5
10-14	**1.074**	949.5	**0.919**	932.0	853.5	**1.048**	658.5
15-19	**1.042**	1,064.5	**0.890**	1,151.7	1,054.8	**1.090**	993.0
20-24	**1.054**	973.5	**0.895**	1,116.8	1,022.8	**1.052**	883.0
25-29	**1.076**	1,212.5	**0.923**	1,341.7	1,228.8	**1.073**	1,050.0
30-34	**1.171**	1,397.5	**1.008**	1,576.5	1,443.8	**1.055**	1,387.0
35-39	**1.028**	1,835.25	**0.877**	2,151.9	1,970.8	**1.054**	1,755.8
40-44	**1.146**	2,433.25	**0.966**	2,460.9	2,253.8	**1.104**	2,267.8
45-49	**1.391**	3,717.25	**0.878**	4,190.5	3,837.9	**0.892**	3,509.8
50-54	**1.269**	4,812.25	**0.891**	5,060.8	4,634.9	**1.047**	4,677.8
55-59	**1.546**	6,256.75	**0.920**	7,596.8	6,957.5	**0.895**	6,910.1
60-64	**1.155**	9,126.75	**0.839**	10,240.3	9,378.5	**0.984**	8,888.2
65-69	**1.134**	12,234.75	**0.936**	13,421.1	12,291.6	**1.073**	12,208.2
70-74	**1.149**	18,426.75	**0.969**	20,411.6	18,693.8	**1.083**	18,537.3
75+	**NA**	8,8075	**NA**	100,545.5	92,083.8	**NA**	93,718.7
Total	**1.140**	**160,413**	**0.916**	**180,542.1**	**165,348**	**1.054**	**164,964**

	Table 4.2.11. Completeness of death registration for single years –female (Continue)						
	2012-2013			**2013-2014**		**2014-2015**	
Age	**Completeness**	**Adjusted deaths**	**Intercensal deaths**	**Completeness**	**Intercensal deaths**	**Completeness**	**Intercensal deaths**
0-4	NA	7,229.8	6,552.0	NA	6,572	NA	6,407
5- 9	**0.948**	9,61.1	871.0	**1.018**	653	**1.043**	572.5
10-14	**0.864**	729.4	661.0	**0.989**	571	**1.046**	542.5
15-19	**0.926**	969.9	879.0	**1.068**	793.75	**1.099**	860.75
20-24	**0.908**	920.3	834.0	**1.054**	908.75	**1.050**	805.75
25-29	**0.906**	1,069.2	969.0	**1.040**	857.75	**1.054**	886.75
30-34	**0.875**	1,424.6	1,291.0	**1.025**	1,192.75	**1.065**	1,139.75
35-39	**0.914**	1,844.4	1,671.5	**1.086**	1,654.75	**1.153**	1,621.75
40-44	**0.959**	2,592.6	2,349.5	**1.110**	2,358.75	**1.005**	2,383.75
45-49	**0.835**	3,725.8	3,376.5	**1.038**	3,447.75	**1.112**	3,221.75
50-54	**0.906**	5,394.2	4,888.5	**1.210**	5,017.75	**1.330**	5,014.75
55-59	**0.826**	7,348.7	6,659.8	**1.082**	6,910.25	**1.225**	7,054
60-64	**0.890**	9,925.3	8,994.8	**1.155**	9,384.25	**1.399**	9,593
65-69	**0.970**	13,474.0	12,210.8	**1.169**	12,874.25	**1.140**	13,620
70-74	**0.893**	19,854.1	17,992.8	**1.000**	18,222.25	**1.073**	18,547
75+	NA	105,507.6	95,616.0	NA	104,001	NA	109,355
Total	**0.906**	**182,970.99**	**165,817**	**1.061**	**175,420**	**1.086**	**181,626**

4.2.2. Evaluation of 2013, 2014, and 2015 death registration completeness with 2013-TURKSTAT life table

In this section, completeness of death registration system for the years 2013, 2014, and 2015 is assessed by means of 2013-TURKSTAT life table. Results are given for males and then for females. Additionally, if completeness ratio of any age group is found as greater than 1 (${}_nM_x/{}_nm_x > 1$), than the number of adjusted deaths at this age group have been assumed as equal to the number of observed deaths.

Table 4.2.12 and Table 4.2.13 show the ratio of observed age specific death rates of the year 2015 to estimated age specific death rates of TURKSTAT life tables for males and females, respectively. It is seen that the lowest completeness ratio belongs to infant mortality. 1,885 male infant deaths and 1,504 female infant deaths aren't registered. The difference between total adjusted deaths and observed deaths are 13,493 for males and 18,629 for females. These numbers are unregistered deaths by MERNIS. When number of captured deaths by TURKSTAT (number of deaths without registration date) are subtracted from these numbers (number of captured deaths by TURKSTAT in the year 2015 is 1,923 for males and 1,646 for females), under recorded deaths by TURKSTAT are found as 11,570 for males and 16,983 for females. When we look at the difference between adjusted and registered deaths by age groups, most of the missing deaths occur at the age groups 75+, especially at women deaths (8,527 for males and 14,642 for females).

Table 4.2.12. Comparison of 2015 observed male age specific death rate with male age specific death rate of 2013-TURKSTAT life table									
AGE GROUP	**2013 - TURKSTAT male life table**				**Observed**			**Obs./Est.**	
	lx	**ndx**	**ex**	**nmx**	**Registered deaths-2015**	**2015-mid-year pop. (no foreign)**	**nMx**	**nMx/nmx**	**Adjusted deaths**
0	100,000.00	1,206.27	75.3	**0.012136**	6,068	655,302	**0.00926**	**0.76**	**7,953**
1	98,793.73	261.94	75.2	**0.000664**	1,473	2,585,929	**0.00057**	**0.86**	**1,716**
5	98,531.80	142.73	71.4	**0.00029**	811	3,230,827	**0.00025**	**0.87**	**937**
10	98,389.07	164.72	66.5	**0.000335**	967	3,174,142	**0.00030**	**0.91**	**1,064**
15	98,224.35	313.34	61.6	**0.000639**	2,217	3,339,859	**0.00066**	**1.04**	**2,217***
20	97,911.01	359.91	56.8	**0.000737**	2,474	3,165,358	**0.00078**	**1.06**	**2,474***
25	97,551.09	353.34	52	**0.000726**	2,423	3,144,475	**0.00077**	**1.06**	**2,423***
30	97,197.75	385.77	47.2	**0.000795**	2,651	3,245,959	**0.00082**	**1.03**	**2,651***
35	96,811.99	506.80	42.4	**0.00105**	2,976	3,042,195	**0.00098**	**0.93**	**3,193**
40	96,305.18	802.26	37.6	**0.001673**	4,272	2,757,403	**0.00155**	**0.93**	**4,613**
45	95,502.93	1,382.49	32.9	**0.002916**	6,421	2,339,142	**0.00275**	**0.94**	**6,822**
50	94,120.44	2,368.20	28.3	**0.005096**	10,966	2,254,381	**0.00486**	**0.95**	**11,489**
55	91,752.24	3,910.82	24	**0.00871**	15,999	1,826,368	**0.00876**	**1.01**	**15,999***
60	87,841.42	5,981.33	19.9	**0.014098**	19,884	1,451,674	**0.01370**	**0.97**	**20,466**
65	81,860.09	8,717.69	16.2	**0.022497**	23,542	1,059,426	**0.02222**	**0.99**	**23,834**
70	73,142.40	12,344.59	12.8	**0.036866**	26,076	714,371	**0.03650**	**0.99**	**26,336**
75+	60,797.81	60,797.81	9.9	**0.10101**	90,802	983,356	**0.09234**	**0.91**	**99,329**
Total					**220,023**	**38,970,165**			**233,516**

*Since the completeness ratio is greater than 1 in this age group, number of adjusted deaths are assumed as equal to the number of observed deaths.

Table 4.2.13. Comparison of 2015 observed female age specific death rate with female age specific death rate of TURKSTAT life table 2013									
AGE GROUP	**2013 - TURKSTAT female life table**				**Observed**			**Obs./Est.**	
	lx	**ndx**	**ex**	**nmx**	**Registered deaths-2015**	**2015-mid-year pop. (no foreign)**	**nMx**	**nMx/nmx**	**Adjusted deaths**
0	100,000.00	1,061.80	80.7	**0.010675**	5,129.00	621,363.50	**0.00825**	**0.77**	**6,633**
1	98,938.20	232.78	80.6	**0.000589**	1,278.00	2,451,629.50	**0.00052**	**0.89**	**1,444**
5	98,705.42	123.30	76.8	**0.00025**	572.50	3,064,692.00	**0.00019**	**0.75**	**766**
10	98,582.11	100.60	71.9	**0.000204**	542.50	3,008,340.50	**0.00018**	**0.88**	**614**
15	98,481.52	131.09	66.9	**0.000266**	860.75	3,168,636.00	**0.00027**	**1.02**	**861***
20	98,350.43	140.10	62	**0.000285**	805.75	3,042,237.00	**0.00026**	**0.93**	**867**
25	98,210.33	147.62	57.1	**0.000301**	886.75	3,043,532.50	**0.00029**	**0.97**	**916**
30	98,062.71	194.41	52.2	**0.000397**	1,139.75	3,158,571.50	**0.00036**	**0.91**	**1,254**
35	97,868.29	286.06	47.3	**0.000585**	1,621.75	2,965,315.00	**0.00055**	**0.93**	**1,736**
40	97,582.23	442.50	42.4	**0.000909**	2,383.75	2,730,186.00	**0.00087**	**0.96**	**2,482**
45	97,139.74	715.39	37.6	**0.001478**	3,221.75	2,256,793.50	**0.00143**	**0.97**	**3,336**
50	96,424.35	1,125.79	32.9	**0.002349**	5,014.75	2,251,709.00	**0.00223**	**0.95**	**5,289**
55	95,298.56	1,819.28	28.2	**0.003855**	7,054.00	1,820,821.00	**0.00387**	**1.00**	**7,054***
60	93,479.27	2,995.93	23.7	**0.006514**	9,593.00	1,521,891.50	**0.00630**	**0.97**	**9,914**
65	90,483.34	5,104.39	19.4	**0.01161**	13,620.00	1,213,571.50	**0.01122**	**0.97**	**14,090**
70	85,378.95	8,849.71	15.4	**0.021864**	18,547.00	869,167.50	**0.02134**	**0.98**	**19,003**
75+	76,529.23	76,529.23	11.9	**0.084033**	109,355.00	1,475,562.50	**0.07411**	**0.88**	**123,997**
Total					**181,626**	**38,664,020**			**200,255**

*Since the completeness ratio is greater than 1 in this age group, number of adjusted deaths are assumed as equal to the number of observed deaths.

The same process that was made for the year 2015 was applied for the years 2013 and 2014 for both sexes. Table 4.2.14 shows the ratio of observed age specific death rate and estimated age specific death rate for males and females. Ratio of ASDRs are low in the 0 and 75+ age groups for males in the years 2013 and 2014. For female deaths, these ratios are low for 0 and 75+ age groups in 2013 and in addition to these age groups, the age group 5-9 is found low (0.86) in 2014.

Table 4.2.14. Ratio of observed ASDR and estimated ASDR for the years 2013, 2014, and 2015 of both sexes

	Male ($_nM_x/_nm_x$)			**Female ($_nM_x/_nm_x$)**		
Age groups	**2013**	**2014**	**2015**	**2013**	**2014**	**2015**
0	0.77	0.81	0.76	0.79	0.81	0.77
1-4	1.04	0.96	0.86	1.08	0.93	0.89
5-9	1.07	0.93	0.87	1.15	0.86	0.75
10-14	0.97	0.95	0.91	1.04	0.91	0.88
15-19	1.04	1.03	1.04	1.06	0.95	1.02
20-24	0.95	1.03	1.06	0.97	1.05	0.93
25-29	0.98	1.00	1.06	1.05	0.93	0.97
30-34	0.95	1.02	1.03	1.01	0.94	0.91
35-39	0.99	0.97	0.93	1.01	0.98	0.93
40-44	1.01	0.99	0.93	1.01	0.97	0.96
45-49	1.01	0.97	0.94	0.98	1.01	0.97
50-54	1.01	0.99	0.95	1.02	0.99	0.95
55-59	1.01	0.98	1.01	0.98	0.998	1.00
60-64	1.02	1.00	0.97	0.99	1.01	0.97
65-69	1.01	0.98	0.99	0.99	0.98	0.97
70-74	0.997	1.00	0.99	0.99	0.99	0.98
75+	0.86	0.89	0.91	0.83	0.87	0.88

Table 4.2.15 shows the registered number of deaths, number of captured deaths by TURKSTAT, and estimated number of deaths from TURKSTAT life table by TURKSTAT by years of 2013, 2014, and 2015 and age groups for males. Number of captured deaths by TURKSTAT are given from TURKSTAT in the form of cumulated age groups (“0”,”1-4”,”5-14”,”15-34”,”35-54”,”55-74”, and “75+”). Because of this reason, captured number of deaths in these age groups are evenly distributed for 5-year age groups. For example; captured number of deaths by

TURKSTAT are given as 37 for male deaths at the age groups 15-34 in the year 2013. Since 15-34 age groups include the five-year age groups “15-19”, “20-24”, “25-29”, and “30-34”, captured number of deaths for each age group is found by dividing 37 by 4.

According to Table 4.2.15, underregistered male deaths are seen at the 0 and 75+ age groups for the years 2013. While TURKSTAT is successful to capture not registered male infant deaths, for the age group 75+, it is failed to capture. Totally, 14,938 male deaths are unregistered and majority of these deaths are at the age group 75+. For the year 2014, totally 13,360 male deaths are unregistered and 11,050 male deaths couldn’t captured by TURKSTAT. Majority of these unregistered and not captured death constitute the 75+ age group.

Table 4.2.16 presents the distribution of number of registered deaths, captured deaths by TURKSTAT, and estimated deaths by age groups for females. Similar to unregistered male deaths, majority of unregistered female deaths constitute the age group 75+ for the years 2013 and 2014. According to these results, 21,588 female deaths are not registered in 2013, and 19,885 of these deaths are at the age group 75+. TURKSTAT captured 1,994 and 2,310 of these unregistered deaths in the year 2013 and 2014, respectively. Most of these captured deaths by TURKSTAT are infant deaths. Additionally, unregistered deaths at the age group 75+, is much more at female deaths than male deaths. In 2013, number of unregistered females 19,885 at 75+ and this number is 12,753 for male deaths. These numbers are 15,601 for females and 10,247 for male deaths in 2014.

Table 4.2.15. Number of registered deaths, captured deaths by TURKSTAT, and estimated deaths by TURKSTAT life table-MALE									
	2013			2014			2015		
Age groups	Registered deaths	Captured deaths by TURKSTAT	Estimated deaths	Registered deaths	Captured deaths by TURKSTAT	Estimated deaths	Registered deaths	Captured deaths by TURKSTAT	Estimated deaths
0	5,830.2	1,763.9	7,609.8	6,332.0	1,987.0	7,817.7	6,068.0	1,648.0	7,952.7
1-4	1,765.0	13.0	1,765.0*	1,620.0	18.0	1,696.2	1,473.0	9.0	1,716.3
5-9	989.0	6.0	989.0*	867.5	8.5	932.9	811.0	6.0	936.7
10-14	1,070.0	6.0	1,103.9	1,024.5	8.5	1,082.0	967.0	6.0	1,063.7
15-19	2,190.8	9.3	2,190.8*	2,192.8	14.3	2,192.8*	2,217.0	12.0	2,217.0*
20-24	2,186.8	9.3	2,307.0	2,391.8	14.3	2,391.8*	2,474.0	12.0	2,474.0*
25-29	2,257.8	9.3	2,298.3	2,290.8	14.3	2,290.8*	2,423.0	12.0	2,423.0*
30-34	2,485.8	9.3	2,617.0	2,659.8	14.3	2,659.8*	2,651.0	12.0	2,651.0*
35-39	3,014.3	11.8	3,049.0	3,011.5	19.5	3,099.3	2,976.3	13.8	3,193.5
40-44	4,396.3	11.8	4,396.3*	4,476.5	19.5	4,522.4	4,272.3	13.8	4,613.3
45-49	7,006.3	11.8	7,006.3*	6,672.5	19.5	6,906.0	6,421.3	13.8	6,821.6
50-54	10,645.3	11.8	10,645.3*	10,872.5	19.5	11,006.0	10,966.3	13.8	11,489.2
55-59	15,316.4	13.8	15,316.4*	15,243.3	21.8	15,596.7	15,999.0	21.0	15,999.0*
60-64	18,831.4	13.8	18,831.4*	19,317.3	21.8	19,317.3*	19,884.0	21.0	20,466.4
65-69	20,816.4	13.8	20,816.4*	21,657.3	21.8	22,150.4	23,542.0	21.0	23,833.8
70-74	24,804.5	13.8	24,804.5*	25,107.3	21.8	25,187.9	26,076.0	21.0	26,336.0
75+	79,796.8	66.0	92,594.6	85,639.0	66.0	95,886.1	90,802.0	67.0	99,328.9
Total	**203,403.0**	**1,994.0**	**218,341.1**	**211,376.0**	**2,310.0**	**224,735.8**	**220,023.0**	**1,923.0**	**233,515.9**

*Since the completeness ratio is greater than 1 in this age group, number of adjusted deaths are assumed as equal to the number of observed deaths.

Table 4.2.16. Number of registered deaths, captured deaths by TURKSTAT, and estimated deaths by TURKSTAT life table- FEMALE									
	2013			2014			2015		
Age groups	**Registered deaths**	**Captured deaths by TURKSTAT**	**Estimated deaths**	**Registered deaths**	**Captured deaths by TURKSTAT**	**Estimated deaths**	**Registered deaths**	**Captured deaths by TURKSTAT**	**Estimated deaths**
0	5,016.0	1,404.0	6,338.3	5,250.0	1,596.0	6,505.7	5,129.0	1,319.0	6,632.9
1-4	1,536.0	13.0	1,536.0*	1,322.0	12.0	1,426.7	1,278.0	19.0	1,443.7
5-9	871.0	4.0	871.0*	653.0	6.0	763.0	572.5	4.5	766.2
10-14	661.0	4.0	661.0*	571.0	6.0	625.3	542.5	4.5	614.3
15-19	879.0	5.0	879.0*	793.8	7.3	837.8	860.8	6.3	860.8*
20-24	834.0	5.0	859.7	908.8	7.3	908.8	805.8	6.3	867.4
25-29	969.0	5.0	920.4	857.8	7.3	919.4	886.8	6.3	915.6
30-34	1,291.0	5.0	1,291.0*	1,192.8	7.3	1,268.5	1,139.8	6.3	1,253.6
35-39	1,671.5	8.5	1,671.5*	1,654.8	9.3	1,683.7	1,621.8	10.3	1,736.0
40-44	2,349.5	8.5	2,349.5*	2,358.8	9.3	2,426.6	2,383.8	10.3	2,481.7
45-49	3,376.5	8.5	3,428.5	3,447.8	9.3	3,447.8*	3,221.8	10.3	3,336.3
50-54	4,888.5	8.5	4,888.5*	5,017.8	9.3	5,052.8	5,014.8	10.3	5,288.8
55-59	6,659.8	20.3	6,786.5	6,910.3	17.8	6,924.6	7,054.0	19.0	7,054.0*
60-64	8,994.8	20.3	9,046.2	9,384.3	17.8	9,384.3*	9,593.0	19.0	9,913.9
65-69	12,210.8	20.3	12,275.5	12,874.3	17.8	13,163.8	13,620.0	19.0	14,089.5
70-74	17,992.8	20.3	18,100.6	18,222.3	17.8	18,401.4	18,547.0	19.0	19,003.1
75+	95,616.0	145.0	115,501.2	104,001.0	146.0	119,611.1	109,355.0	157.0	123,996.8
Total	**165,817.0**	**1,705.0**	**187,404.5**	**175,420.0**	**1,903.0**	**193,351.1**	**181,626.0**	**1,646.0**	**200,254.6**

*Since the completeness ratio is greater than 1 in this age group, number of adjusted deaths are assumed as equal to the number of observed deaths.

4.3. TIMELINESS OF DEATH REGISTRATION

In this section, timeliness of death registration system is evaluated from 2009 to 2015 by sex, age groups and 81 provinces. Except Figure 4.3.2, evaluation of timeliness is made according to estimated deaths by means of 2013-TURKSTAT life table for the years 2013, 2014, and 2015 under the assumption that estimated number of deaths from TURKSTAT life table is correct. Since estimated number of deaths couldn't be calculated for the years from 2009 to 2012, evaluation is made according to observed number of deaths which are gathered from TURKSTAT.

Table 4.3.1 presents the percent distribution of time between death and death registration by sex and years. For the period 2009-2012, improvement is seen in timely (in 10 days) registration for both sexes. Late registration (registration after 10 days) decreases over the years. Percentage of deaths without registration date is declining over the years for both sexes. Detailed tables about timeliness are given in Appendix B. Percentage of timely registration of the period 2013-2015 is lower than that of the period 2009-2012. Because, estimated number of deaths is greater than observed number of deaths, percentage of timely registration is decreased. Timely registration of male deaths is higher than that of females and late registration is decreased over the years in the 2013-2015 period. Additionally, percentage of not captured deaths by TURKSTAT and MERNIS, decreases for both sexes in this period.

Table 4.3.1. The time between death and death registration by sex and year

	Sex	0-10 days (%)	11-30 days (%)	31-90 days (%)	91-180 days (%)	181-365 days (%)	1 Year+ (%)	Deaths without registration date (%)	Not captured deaths by both TURKSTAT and MERNIS (%)	Total count
2009	**M**	80.85	11.16	1.7	0.42	0.32	0.58	4.97	-	**203,653**
	F	79.26	11.3	1.87	0.48	0.39	1.37	5.34	-	**166,050**
	T	**80.13**	**11.22**	**1.78**	**0.44**	**0.35**	**0.93**	**5.13**	-	**369,703**
2010	**M**	86.33	8.33	1.18	0.33	0.27	0.43	3.13	-	**200,445**
	F	85.87	8.12	1.09	0.36	0.41	0.77	3.38	-	**166,026**
	T	**86.12**	**8.24**	**1.14**	**0.35**	**0.33**	**0.58**	**3.24**	-	**366,471**
2011	**M**	88.57	7.29	1.1	0.3	0.23	0.25	2.25	-	**206,505**
	F	88.62	6.82	0.95	0.31	0.26	0.5	2.54	-	**169,657**
	T	**88.59**	**7.08**	**1.03**	**0.31**	**0.24**	**0.36**	**2.38**	-	**376,162**
2012	**M**	89.85	6.54	0.95	0.26	0.16	0.21	2.02	-	**207,634**
	F	89.9	6.11	0.75	0.27	0.23	0.42	2.32	-	**168,886**
	T	**89.87**	**6.35**	**0.86**	**0.27**	**0.19**	**0.3**	**2.15**	-	**376,520**
2013	**M**	83.15	8.56	1.01	0.21	0.11	0.11	0.91	5.93	**218,341**
	F	79.22	7.79	0.86	0.25	0.17	0.19	0.91	10.61	**187,405**
	T	**81.33**	**8.21**	**0.94**	**0.23**	**0.14**	**0.15**	**0.91**	**8.09**	**405,746**
2014	**M**	86.44	6.46	0.83	0.18	0.10	0.05	1.03	4.92	**224,736**
	F	83.96	5.62	0.70	0.23	0.12	0.09	0.98	8.29	**193,351**
	T	**85.29**	**6.07**	**0.77**	**0.21**	**0.11**	**0.07**	**1.01**	**6.48**	**418,087**
2015	**M**	87.30	6.04	0.68	0.16	0.05	0.01	0.82	4.95	**233,516**
	F	84.71	5.15	0.61	0.15	0.07	0.01	0.82	8.48	**200,255**
	T	**86.10**	**5.63**	**0.64**	**0.15**	**0.06**	**0.01**	**0.82**	**6.58**	**433,771**

In Table 4.3.2, percentage of timeliness of death registration is given according to sex and age groups. It is seen that registration in 10 days is the lowest in infants and timely registration is raised with increasing age at death for both sexes in the period 2009-2012. For the period 2013-2015, it couldn't be seen a specific pattern in timely registration. Similar to 2009-2012, timely registration is the lowest in infants in this period. Additionally, because of the underregistered number of 75+ is high in both sexes, in 2013-2015 period, registration in 10-days at 75+ age group is lower than that is observed in 2009-2012 period.

Table 4.3.2. Percentage of death registration in 10 days by sex and age groups

Age group		2009	2010	2011	2012	2013	2014	2015
0	Male	39.16	50.13	53.98	56.68	58.78	64.01	60.80
	Female	40.81	50.82	54.68	56.23	60.36	65.28	61.65
1-4	Male	63.82	72.29	74.08	79.41	80.32	75.64	67.76
	Female	62.46	72.25	75.05	77.31	81.96	71.99	70.16
5-14	Male	63.93	73.75	72.86	75.79	77.28	73.50	70.24
	Female	67.07	75.92	76.11	79.56	85.95	70.80	66.21
15-34	Male	66.25	71.29	72.85	75.18	73.54	80.07	80.57
	Female	68.59	74.33	75.76	78.38	82.42	79.59	78.88
35-54	Male	80.85	84.69	86.67	88.28	88.02	87.10	84.77
	Female	79.53	85.52	88.01	89.27	88.48	90.39	87.47
55-74	Male	85.56	89.79	91.84	92.71	91.71	92.61	93.23
	Female	82.85	88.28	90.95	91.98	89.64	92.05	91.82
75+	Male	85.59	90.40	92.20	93.32	78.65	84.10	86.69
	Female	82.54	88.58	91.22	92.40	75.17	81.60	83.39
Total		**80.13**	**86.12**	**88.59**	**89.87**	**81.33**	**85.29**	**86.10**

Figure 4.3.1 presents the percentage of late registration (registration after 10 days) by age groups and years. Pattern of late registration is similar for the period 2009-2012 and 2013-2015. Late registration is highest at 1-4, 5-14, and 15-34 age groups, and lowest at 55-74 and 75+ age groups in all years.

Figure 4.3.1. Percentage of late registration of deaths by age groups

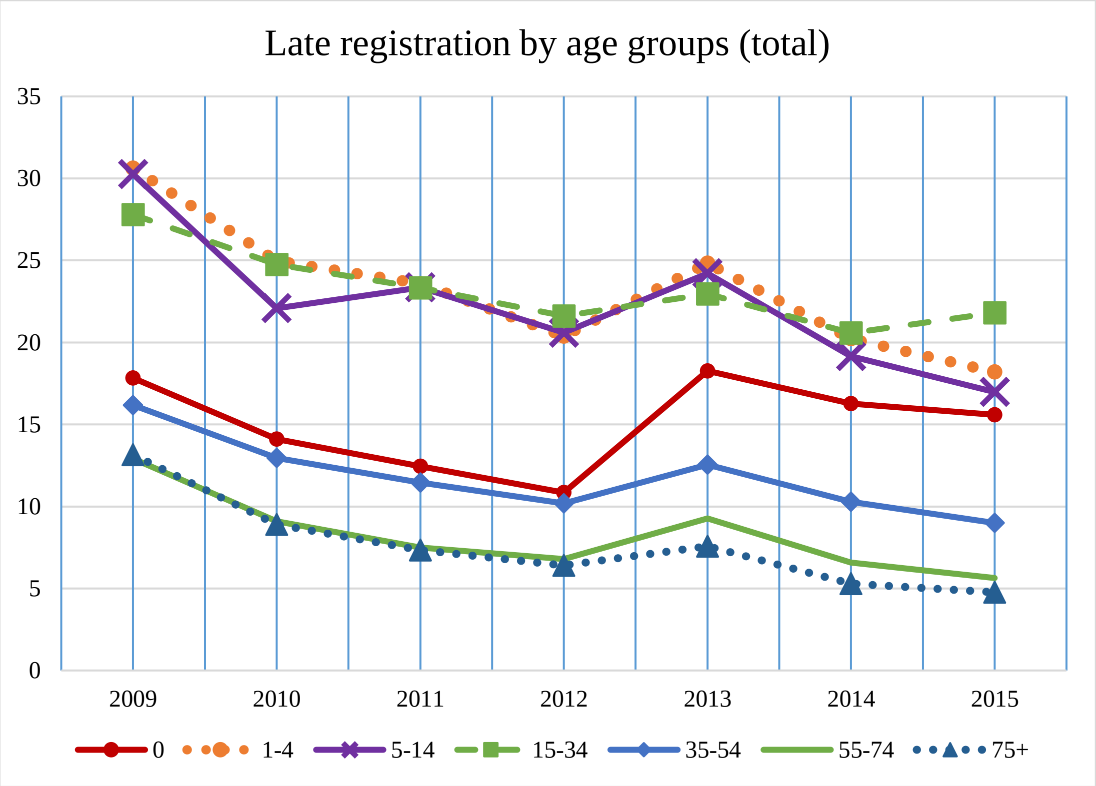
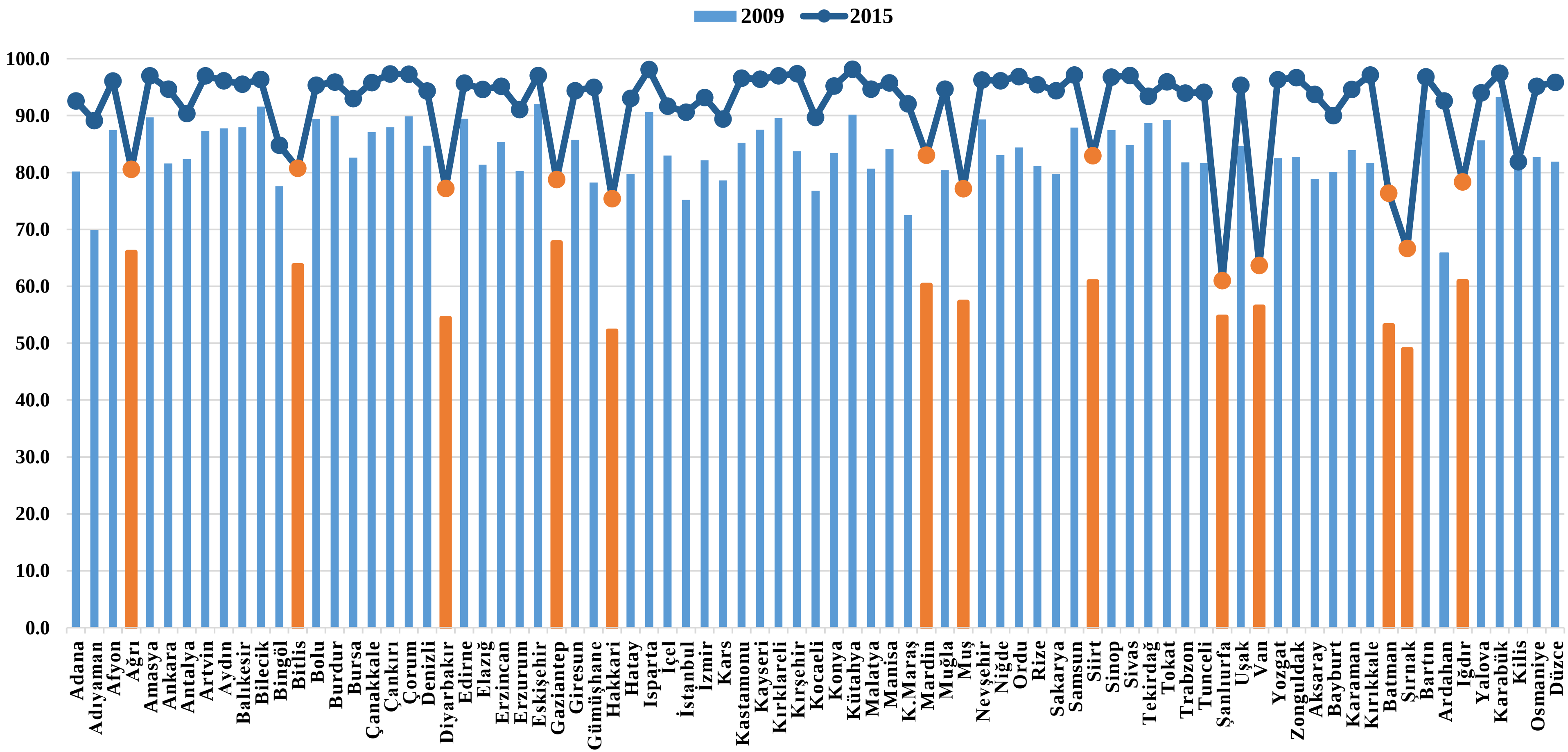


Figure 4.3.2 shows the percent distribution of timely registration in 2009 and 2015 by 81 provinces. Since the estimated number of deaths couldn't be calculated by provinces, percentages of timely registration are calculated based on the observed deaths. According to this figure, while there is an improvement in timely registration from the year 2009 to 2015, some provinces have lower percent than in other provinces. These provinces shown in orange in the figure, are Southeastern and Eastern Anatolia provinces. Şanlıurfa, Van, and Şırnak are the lowest three provinces in timely registration in the year of 2015.

Figure 4.3.2. Percentage of death registration in 10 days by 81 provinces



5. CONCLUSION AND RECOMMENDATIONS

Death registration system provides legal rights to family members to transfer inheritance of the deceased. Additionally, death registration system with registration of cause of death enables essential information about the level and pattern of the mortality of an infant, a child and an adult. Additionally, this system provides the possiblity to observe the burden of disease of societies, and helps producing accurate policies in health sectors. Most of the sustainable development goals (from poverty and health related targets to the peace and justice related targets) require efficient death registration systems with cause of death registration to be achieved by the year of 2030.

This thesis aims to analyze the completeness and timeliness of death registration system for the years 2009-2015 in Turkey. Completeness is evaluated with two methods: Hybrid method and the ratio of age specific death rate of 2013-TURKSTAT life table and observed age specific death rates of 2013, 2014, and 2015. 2009-2013 and 2013-2015 periods, and each year from 2009 to 2015 are assessed by Hybrid Method for both sexes. Completeness of the years 2013, 2014, and 2015 are also assessed by 2013 TURKSTAT life table for both sexes. Data used to evaluate completeness, which is the distribution of population by age and sex, excludes the legally residing foreigners, and distribution of deaths by age and sex excludes the dead whose date of registry is unknown in TURKSTAT database.

Timeliness is evaluated by sex, age groups, and 81 provinces by calculating the percentage of death registration within 10 days, 11-30 days, 31-90 days, 91-180 days, 181-365 days, and after 1 year, respectively.Timeliness is calculated based on the observed number of deaths for the years from 2009 to 2012 and estimated number of deaths, which are computed from 2013-TURKSTAT life table, for the years from 2013 to 2015.

Hybrid method is applied in two steps. Firstly, ABPRS population distributions are adjusted by GGB method, and secondly, SEG method is applied to these adjusted populations. Completeness of death registration system for the period 2009-2013 is found to be 0.984 for males and 1.036 for females. These results are found to be 1.14 for males and 1.09 for females for the period 2013-2015. The reason why for the results of completeness being greater than 1 may be arisen from the coverage error of ABPRS population age distribution. Due to the unregistered population, especially women, completeness is greater than 1. Another reason for this result (c>1) may be arisen from the violation of the assumptions of SEG method by population data. As a result, results of hybrid method don't provide a consistent result for these periods, except the period 2009-2013 for males. Apart from hybrid method, previous calculations gave the result of survivalship ratios of over 1. This reason may be arisen from errors that stem from baseline population.

When we look at the completeness of any year between 2009 and 2015, except the years 2011 and 2013, results of analyses don't give consistent results. For 2011, completeness is found to be 0.86 for males and 0.92 for females. Similarly, this ratio is found to be 0.87 for males and 0.91 for females for 2013. Although there isn't a major change in the number of the distribution of deaths in the year 2011 and 2013, completeness changes substantially.

Another evaluation of completeness is made for 2013, 2014, and 2015 by comparison with the age specific death rate of 2013 TURKSTAT life table. According to these results, estimated number of unregistered male deaths are 14,935 in 2013, 13,360 in 2014, and 13,493 in 2015. Majority of these deaths are at the 75+ age group. According to results, 86 percent in 2013, 89 percent in 2014, and 91 percent in 2015 are registered at the 75+ age group for males. Analyses of results show that female deaths, especially in the age group 75+, are exposed to more nonregistration than male deaths. These percentages are 83 percent in 2013, 87 percent in 2014, and 88 percent in 2015 for 75+ female deaths. According to results, estimated number of unregistered female deaths are 21,588 in 2013, 17,931 in 2014, and 18,629 in 2015. Some of these unregistered deaths are captured by TURKSTAT. These are seen as deaths without registration date in TURKSTAT database and majority of these deaths are infant deaths. Captured deaths by TURKSTAT are 1,994 in 2013, 2,310 in 2014, and 1,923 in 2015 for males and 1,705 in 2013,1,903 in 2014, and 1,646 in 2015 for females.

Timeliness of death registration increases over the years from 2009 to 2012. Registration in 10 days increases from 80 percent in 2009 to 90 percent in 2012. For the period 2013-2015, timely registration increases from 81 percent in 2013 to 86 percent in 2015. Late registration is mainly seen in the age groups "1-4", "5-14" and "15-34". When we look at the improvement of death registration in 10-days for 81 provinces, it is seen that provinces that have low percentage in timely death registration, belong to Southeastern Anatolia and Eastern Anatolia.

Based on the above results and the problems encountered in the death registration system during writing the thesis, the following suggestions are offered to improve the registration system;

- Death data gathered from TURKSTAT by individual application shows that some deaths recorded in cause of death database of Ministry of Health are not registered in MERNIS database. Majority of these kind of deaths constitute infant deaths. While lack of notification of infant deaths is reduced by Death Notification System in the year of 2013, however, this percentage is still high in 2015 (21 percent). Additionally, according to a phone call with an authorized person from Çankaya Municipality Department of Cemetery Work, death certificate of live born infants who died before the 8th week without ID number are not sent to MERNIS. This shows that authorized people who give death certificates take decisions based on their own initiative. In this regard, Ministry of Health, and municipalities should develop control mechanisms to prevent lack of notifications for infant deaths.This situation is more apparent in Eastern and Southeastern regions. Some qualitative and quantitave studies should be carried out in these provinces. Specific studies by using indirect and direct methods, quality of death registration should be evaluated and also interview with responsible person in death registration should be a guide for understanding the deficiency of death registration system in these provinces.

- Available death registration system should be strengthened by providing cooperation between related institutions and all deaths should be registered to one system rather than creating new systems to observe deaths of vulnerable groups (maternal and infant mortality monitoring system). Creating an only one data store for death registration under the General Directoate of Civil Registration and Nationality and allowing access to Ministry of Health, TURKSTAT, Ministry of Justice and other related institutions may be more useful for strengthening the system.

- Population and Citizenship Affairs are unable to provide electronic access to death data from DNS. Death data in MERNIS are gathered by printouts of death certificates that are sent by Provincial Health Directorates. This situation may cause some of the death certificate not to be transferred at all, or to be transferred with a delay to Population and Citizenship Affairs. Hence, to receive accurate data, Population and Citizenship Affairs should provide electronic access to DNS, and gather death data from this system.

- According to legislation, certificate of death is given by village headmen or officer of burial permit if physician is unavailable. However, information on cause of death in the certificate can be filled by a physician. In this case, although a deceased can be buried with such a certificate, this certificate cannot be used for cause of death statistics. Considering the accurate coding of cause of death according to ICD, burden of disease in Turkey could be understood better by giving the responsibility of issuing death certificate to physicians.

- Legislation related to death registration should be revised and inconsistencies in the circulars and regulations should be eliminated. Duties of all institutions and organizations responsible for death registration should be determined clearly. Additionally, legislation should contain regulations to enable the reporting and registering of infant deaths who aren't registered at birth and also regulations to provide reporting of legally residing foreigners' deaths. Furthermore, legal sanctions should be applied for authorized people who do not issue death certificates or who do not send these certificates to related institutions when they are legally bound to do so.

- Quality of death data should be analyzed by both direct and indirect methods and deficiencies in death registration should be determined by TURKSTAT and Ministry of Health. For this, there is a need for data sources differ from death registration system such as census or field survey. Since death data and population data are gathered from the same source (MERNIS), analysis show that indirect methods for completeness of adult mortality do not give reliable results. Additionally, since international migration have great importance on the age and sex structure of the population, more reliable data on the number of population distribution is essential. Because of this reason, it would be useful to make census every 5 years to to measure the quality of data by direct and indirect methods. Furthermore, field surveys that are conducted by independent institutions would permit matching the data of registration system and that of the survey.

- Analyzes for timeliness show that death registration in 10 days in most of the provinces of Southeastern Anatolia and Eastern Anatolia regions lag behind the that of other provinces. So, physicians and other responsible persons to fill the death certificates should be informed about the importance of timeliness of death reporting and registering. Additonally, training for physicians should be provided.

GLOSSARY OF TERMS

- **Demographic Surveillance Sites (DSS)**

This method is similar to sample registration systems with regard to recording events by visiting households. But this method is limited to a defined geographic region and doesn't represent the national population (Hill et al. 2007). Bangladesh is seen as the best known example of this system (Hill et al. 2007).

- **Health metrics network (HMN)**

Health metrics network (HMN) was established in 2005 to improve global health through strengthening the health information systems (WHO 2008). Data for health information systems are generated from two kinds of sources: population based sources and institution based sources. Population based sources can be either census or civil registration and household surveys (WHO 2008). HMN describes components in terms of health information system resources, indicators, data sources, data management, information products, and dissemination and use (WHO 2008). In addition to this, HMN determines the standards for these components.

- **Information and Communications Technology (ICT)**

It contains "*the computers, software, data-capture devices, wireless communication devices, and local and wide area networks that move information, and the people that are required to design, implement and support these systems"* (WHO 2008).

- **International statistical classification of diseases and related health problems** (**ICD**)

This classification is enhanced by WHO to classify diseases and health problems in a standard form. Similar diseases are grouped in mutually exclusive form and each of them has alphanumeric code (Strengthening CRVS for births, deaths, and cause of death. (WHO, 2013). It provides national mortality and morbidity statistics and allows for international comparison. 117 country use this classification to report mortality data (http://www.who.int/classifications/icd/en/). The last version of ICD is its 10th revision. It is very important to code and interpret cause of death correctly by physicians and statisticians (WHO 2013).

- **Sample Registration Systems (SRS)**

The most successful example of this system is India (Hill et al. 2007). This system is used for meeting the deficiency of an inadequate registration system by applying registration to a sample of births and deaths. In these sample areas, there are 2 groups that record births and deaths. One group register vital events continuously, the other group is independent survey team. This team interviews with all sample twice a year and asks about births and deaths that occur in previous 6 months. Then these two records are matched and inconsistencies are determined (Hill et al. 2007). The name of this system is Disease Surveillance Point System in China (Yang et al. 2005).

- **Verbal Autopsy**

According to definition of WHO (2008), verbal autopsy is an interview with family or caregiver of the deceased to identify the possible cause of death.Verbal autopsy is mostly used in the regions where majority of deaths occur outside of hospitals and use of medial certification is rare .

- **Vital statistics performance index (VSPI)**

This index is used to estimate the performance of CRVS system. It has six indicators derived from mortality data. These are (Philips et al. 2014):

1) Quality of cause of death reporting,
2) Quality of age and sex reporting,
3) Internal consistency,
4) Completeness of death reporting,
5) Level of cause-specific detail, and
6) Public availability of VS data.

Then these indicators are combined according to empirical simulation technique (Philips et al. 2015).

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APPENDIX A

DEATH CERTIFICATES

Figure A.1. New Death Certificate

ÖLÜM BELGESİ

Bu nüsha istatistik amaçlı kullanılacaktır. S1 Form no: 0000000001

İl .... Belde ya da köy ....

İlçe .... Kurum adı ....

A ÖLEN KİŞİNİN BİLGİLERİ

Kimlik numarası

☐ Kimlik numarası yok

Uyruğu ☐ TC

☐ Diğer ....

Adı ve soyadı ....

Baba adı ....

Doğum tarihi Gün Ay Yıl

Nüfusa kayıtlı olduğu ilçe* ....

Cilt no* Aile sıra no*

Birey sıra no*

Cinsiyet ☐ Erkek ☐ Kadın

Öğrenim durumu (bitirilen) ....

Meslek ....

Daimi ikametgah

İl ....

İlçe ....

Belde ya da köy ....

Yurtdışı ....

B Ölüm Saati Gün Ay Yıl

Ölüm tarihi

Ölüm yeri ☐ Ev ☐ Hastane ☐ İşyeri

☐ Ambulans ☐ Diğer taşıt ☐ Diğer

C Ölümün şekli

☐ Doğal ölüm ☐ Trafik kazası ☐ Diğer

☐ İntihar ☐ İş kazası ☐ Araştırma aşamasında

☐ Cinayet ☐ Diğer kazalar ☐ Bilinmeyen

D Ölüm yaralanma sonucu mu gerçekleşti?

☐ Evet ☐ Hayır → **Bölüm E'ye geçiniz**

İş yerinde yaralanma ☐ Evet ☐ Hayır

Tarihi: Gün Ay Yıl

Yaralanmanın yeri:

☐ Evde ☐ Spor alanı

☐ Yatılı kuruluş ☐ Cadde ve otoyol

☐ Kırsal alan *(Çiftlik)* ☐ Ticaret ve hizmet alanı

☐ Sanayi ve inş. yeri ☐ Okul, diğer kur. ve idari yer

☐ Diğer *(Açıklayınız)* ....

E Otopsi yapıldı mı?

☐ Evet ☐ Hayır → **Bölüm F'ye geçiniz**

Aşağıda belirtilen ölüm nedeni, otopsi bulgularından mı elde edildi?

☐ Evet ☐ Hayır → **Bölüm F'ye geçiniz**

Daha sonra daha fazla bilgi elde edilebilir mi?

☐ Evet ☐ Hayır

Ölüm Belgesindeki, adı soyadı ve hüviyeti yazılı ölünün gömülmesine izin verilmiştir. Belge mevcut bilgiler ışığında doldurulmuştur.

Doktor aynı zamanda F, G ve H kutularını doldurmakla sorumludur.

BİLGİYİ VEREN
Adı ve Soyadı :
Telefon :
Yakınlık derecesi:
İmza :

FORMU DOLDURAN HEKİM
Adı ve Soyadı :
Ünvanı:
Tarih:
İmza:
Kaşe:

KURUM ONAYI

F Ölü doğum ☐ Evet ☐ Hayır } **Bölüm G'ye geçiniz** Annenin TC No

Bebek ölümü ☐ Evet ☐ Hayır Annenin yaşı Doğum sırası

Doğum Saati Gebelik süresi Doğum ağırlığı

G Kadın ise, ☐ Ölüm hamileliği esnasında gerçekleşti ☐ Ölüm doğum esnasında gerçekleşti ☐ Ölüm doğumdan sonraki 42 gün içerisinde gerçekleşti

☐ Ölüm doğumdan sonraki 43 gün ile 365 gün içerisinde gerçekleşt ☐ Anne ölümü değil

H Ölüm Nedeni — Hastalığın başlangıcından ölüme kadar geçen yaklaşık süre

Bölüm I

Doğrudan ölüme sebep olan hastalık veya durum*

a) ....

Bağlı olarak

Önceki nedenler

Eğer yukarıda verilen nedene yol açan ölüm ile sonuçlanan durumlar varsa, altta yatan durum en son belirtilecek

b) ....

Bağlı olarak

c) ....

Bağlı olarak

d) ....

Bölüm II

Ölümün gerçekleşmesinde etkisi olan, fakat ölüme neden olan hastalık veya durumla ilgili olmayan diğer önemli durumlar yazılacaktır.

....

....

**Bu bölüme kalp arresti ve solunum yetmezliği gibi ölüm şekilleri değil, ölüme sebebiyet veren hastalık, yaralanma veya komplikasyon türü yazılacaktır.*

Figure A.2. Old Death Certificate

DIP KOÇAN

Not: Bu kısım formun doldu-rulduğu kurumda kalacaktır.

Sıra No: ....

I-Formun doldurulduğu:

a)İl: ....

b)İlçe: ....

II-Ölenin:

T.C. Kimlik No : ....

a)Adı: ....

b)Soyadı: ....

c)Baba Adı: ....

d)Ana Adı: ....

e)Yaşı (Bitirilen yaş): ....

f)Cinsiyeti: ....

g)Açık ev adresi: ....

....

....

h)Ölüm nedeni: (Esas neden yazılacak)

....

ı)Öldüğü tarih: ...../...../20......

III-Ölümü tespit eden hekimin:

a)Adı: ....

b)Soyadı: ....

Yukarıda adı, soyadı ve hüviyeti yazılı ölünün gömülmesine izin verilmiştir.

Resmi Mühür ve İmza

...../...../20.....

T.C.
BAŞBAKANLIK
Türkiye Istatistik Kurumu Başkanlığı

İl merkezlerinde Sağlık Müdürlükleri, İlçelerde Sağlık Ocakları kanalıyla BAŞBAKANLIK TÜRKİYE İSTATİSTİK KURUMU BÖLGE MÜDÜRLÜĞÜNE gönderilecektir.

OLUM ISTATISTIK FORMU

I-Ölümün meydana geldiği yerin:

a)Il adı: ....

b)Ilçe adı: ....

II-Ölenin:

T.C. Kimlik No : ....

a)Adı ve Soyadı: ....

b)Yaşı (Bitirilen yaş): ....yaşında

c)Bir yaşından küçükse: ....aylık

d)Bir aylıktan küçükse: ....günlük

e)Cinsiyeti: ☐ Erkek ☐ Kadın

f)Daimi Ikametgahı: Ili

☐ Il merkezi ☐ Ilçe merkezi ☐ Bucak veya köy

g)Medeni hali: **(12 ve daha büyük yaştakiler için sorunuz)**

☐ Hiç evlenmedi ☐ Evli ☐ Eşi öldü ☐ Boşandı

h)Eğitim durumu: **(6 ve daha yukarı yaştakiler için sorunuz)**

☐ Okuma yazma bilmiyor ☐ Okuma-yazma biliyor, fakat bir okuldan mezun değil ☐ Ilk-okul ☐ Ilk öğretim ☐ Ortaokul ve dengi ☐ Lise ve dengi ☐ Yüksek-okul veya fakülte

(Çalışma sorusunu 12 ve daha yukarı yaştakiler için sorunuz)

i) 1: Çalışıyor ise, yaptığı iş: ....

2: Çalışmıyor ise, durumu: **(ilgili kutuyu işaretleyiniz)**

☐ Ev kadını ☐ Emekli ☐ Oğrenci ☐ Irat sahibi ☐ Diğer

k)Olümün meydana geldiği ay:

☐ 01 Ocak ☐ 02 Şubat ☐ 03 Mart ☐ 04 Nisan

☐ 05 Mayıs ☐ 06 Haziran ☐ 07 Temmuz ☐ 08 Ağustos

☐ 09 Eylül ☐ 10 Ekim ☐ 11 Kasım ☐ 12 Aralık

l)Olümün esas nedeni (Olümü meydana getiren hal yada hastalığı yazınız) ....

m)Olümü tespit için otopsi: ☐ Yapıldı ☐ Yapılmadı

III-Ölüm nedenini tespit eden kurum:

☐ Hastane veya Sağlık Merkezi ☐ Sağlık Ocağı ☐ Belediye Tabibi

Gömmeye izin veren makamın adı

Resmi Mühür ve Imza

......./......./20.....

DIKKAT: Arkadaki açıklamayı okuduktan sonra bu formu doldurunuz

T.C.
SAGLIK
BAKANLIGI

Olü sahibine verilecektir.

GOMME IZIN KAGIDI

Dip Koçanı Sıra No: ....

I-Formun doldurulduğu:

a)Il: ....

b)Ilçe: ....

II-Ölenin:

a)Adı: ....

b)Soyadı: ....

c)Baba Adı: ....

d)Ana Adı: ....

e)Yaşı (Bitirilen yaş): ....

f)Cinsiyeti: ....

g)Açık ev adresi: ....

....

....

h)Olüm nedeni: (Esas neden yazılacak)

....

ı)Oldüğü tarih: ..../......../20........

III-Ölümü tespit eden hekimin:

a)Adı: ....

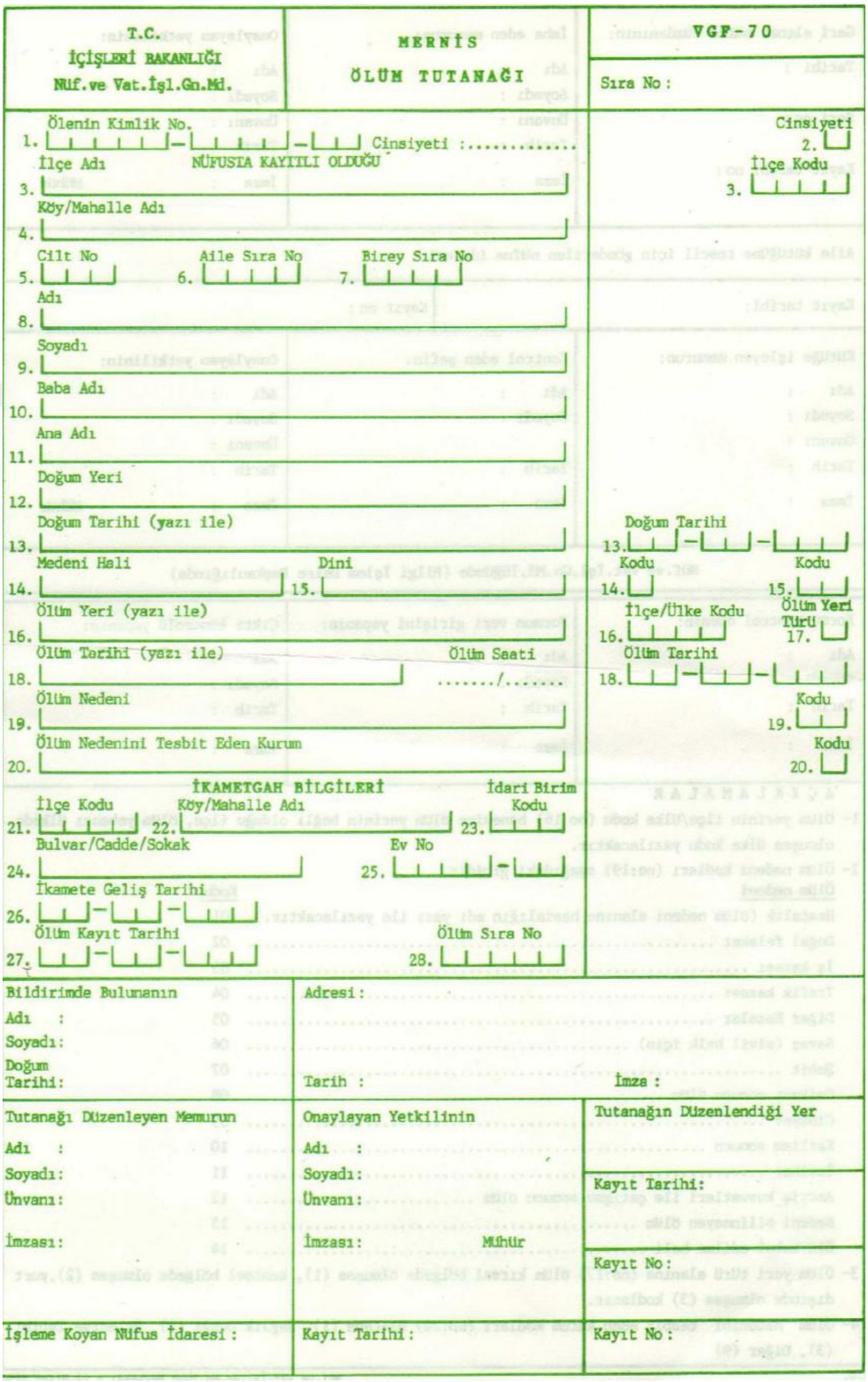
b)Soyadı: ....

Yukarıda adı, soyadı ve hüviyeti yazılı ölünün gömülmesine izin verilmiştir.

Resmi Mühür ve Imza

......./......./20....

Figure A.3. MERNIS Death Certificate- The front page



T.C.
İÇİŞLERİ BAKANLIĞI
Nüf.ve Vat.İşl.Gn.Md.

MERNİS
ÖLÜM TUTANAĞI

VGF-70
Sıra No :

NÜFUSTA KAYITLI OLDUĞU

1. Ölenin Kimlik No. — Cinsiyeti :............
2. Cinsiyeti
3. İlçe Adı — İlçe Kodu
4. Köy/Mahalle Adı
5. Cilt No 6. Aile Sıra No 7. Birey Sıra No
8. Adı
9. Soyadı
10. Baba Adı
11. Ana Adı
12. Doğum Yeri
13. Doğum Tarihi (yazı ile) — Doğum Tarihi
14. Medeni Hali — Kodu
15. Dini — Kodu
16. Ölüm Yeri (yazı ile) — İlçe/Ülke Kodu
17. Ölüm Yeri Türü
18. Ölüm Tarihi (yazı ile) — Ölüm Saati ..../....... — Ölüm Tarihi
19. Ölüm Nedeni — Kodu
20. Ölüm Nedenini Tesbit Eden Kurum — Kodu

İKAMETGAH BİLGİLERİ

21. İlçe Kodu 22. Köy/Mahalle Adı 23. İdari Birim Kodu
24. Bulvar/Cadde/Sokak 25. Ev No
26. İkamete Geliş Tarihi
27. Ölüm Kayıt Tarihi 28. Ölüm Sıra No

Bildirimde Bulunanın	Adresi :	
Adı :		
Soyadı:		
Doğum Tarihi:	Tarih :	İmza :
Tutanağı Düzenleyen Memurun	Onaylayan Yetkilinin	Tutanağın Düzenlendiği Yer
Adı :	Adı :	
Soyadı:	Soyadı:	Kayıt Tarihi:
Ünvanı:	Ünvanı:	
İmzası:	İmzası: Mühür	Kayıt No:
İşleme Koyan Nüfus İdaresi :	Kayıt Tarihi :	Kayıt No :

Source: http://www.megep.meb.gov.tr/mte_program_modul/moduller_pdf/Kurum%20Yaz%C4%B1%C5%9Fmalar%C4%B1.pdf

Figure A.4. MERNIS Death Certificate- The back page

Geri alınan nüfus cüzdanının:	İmha eden memurun:	Onaylayan yetkilinin:
Tarihi :	Adı : Soyadı :	Adı : Soyadı :
Seri no : Kayıt tarihi no :	Ünvanı : Tarih : İmza :	Ünvanı : Tarih : İmza : Mühür

Aile kütüğüne tescil için gönderilen nüfus idaresi:

Kayıt tarihi:	Kayıt no :

Kütüğe işleyen memurun:	Kontrol eden şefin:	Onaylayan yetkilinin:
Adı : Soyadı : Ünvanı : Tarih : İmza :	Adı : Soyadı : Tarih : İmza :	Adı : Soyadı : Ünvanı : Tarih : İmza : Mühür

Nüf.ve Vat.İşl.Gn.Md.lüğünde (Bilgi İşlem Daire Başkanlığında)

Formu kontrol edenin:	Formun veri girişini yapanın:	Çıktı kontrolü yapanın:
Adı : Soyadı : Tarih : İmza :	Adı : Soyadı : Tarih : İmza :	Adı : Soyadı : Tarih : İmza :

A Ç I K L A M A L A R

1- Ölüm yerinin ilçe/ülke kodu (no:16) hanesine ölüm yerinin bağlı olduğu ilçe, ölüm yabancı ülkede olmuşsa ülke kodu yazılacaktır.

2- Ölüm nedeni kodları (no:19) aşağıdaki gibidir.

Ölüm nedeni	Kodu
Hastalık (ölüm nedeni alanına hastalığın adı yazı ile yazılacaktır.)	01
Doğal felaket	02
İş kazası	03
Trafik kazası	04
Diğer Kazalar	05
Savaş (sivil halk için)	06
Şehit	07
Suikast sonucu ölüm	08
Cinayet	09
Katliam sonucu	10
İntihar	11
Asayiş kuvvetleri ile çatışma sonucu ölüm	12
Nedeni bilinmeyen ölüm	13
Ölü kabul edilme hali	14

3- Ölüm yeri türü alanına (no:17) ölüm kırsal bölgede olmuşsa (1), kentsel bölgede olmuşsa (2), yurt dışında olmuşsa (3) kodlanır.

4- Ölüm nedenini tesbit eden kurum kodları (no:20) Hastane (1), Sağlık Ocağı (2), Belediye Tabibi (3), Diğer (9)

A.O. Nüf.ve Vat.İşl.Gn.Md.lüğü Matbaası - 22.Nisan.1996

Source: http://www.megep.meb.gov.tr/mte_program_modul/moduller_pdf/Kurum%20Yaz%C4%B1%C5%9Fmalar%C4%B1.pdf

APPENDIX B

ADDITIONAL TABLES OF ANALYSIS

Table B.1.Generalized Growth Balance method (GGB method)- Male 2009-2013

Age	**x**	$_5N_x(t_1)$	$_5N_x(t_2)$	$_5D_x$	**P1(x+)**	**P2(x+)**	**D(x+)**	**PYL(x+)**	**N(x)**	**b(x+)**	**r(x+)-i(x+)**	**d(x+) = X**	**b(x+)-r(x+) +i(x+) = Y**	**a+bx**	**Residuals y-(a+bx)**
		Male Population 31.12.2009	Male Population 31.12.2013	Intercensal male deaths											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0-4	0	3,159,120	3,178,431	29,653	36,384,225	38,259,411	802,876	149,376,387			N/A	0.00000		-0.0005	
5-9	5	3,181,037	3,207,503	5,031	33,225,105	35,080,980	773,223	136,686,394	2,548,900	0.01865	0.01358	0.00566	0.00507	0.0051	-0.0001
10-14	10	3,333,455	3,259,305	4,650	30,044,068	31,873,477	768,192	123,894,017	2,578,298	0.02081	0.01477	0.00620	0.00604	0.0057	0.0004
15-19	15	3,189,793	3,306,601	8,769	26,710,613	28,614,172	763,543	110,684,999	2,658,425	0.02402	0.01720	0.00690	0.00682	0.0064	0.0004
20-24	20	3,192,783	3,134,546	9,160	23,520,820	25,307,571	754,774	97,680,462	2,531,948	0.02592	0.01829	0.00773	0.00763	0.0072	0.0004
25-29	25	3,298,628	3,163,306	9,668	20,328,037	22,173,025	745,614	84,999,514	2,544,729	0.02994	0.02171	0.00877	0.00823	0.0083	0.0000
30-34	30	2,991,146	3,285,116	10,592	17,029,409	19,009,719	735,946	72,035,053	2,635,896	0.03659	0.02749	0.01022	0.00910	0.0097	-0.0006
35-39	35	2,757,354	2,928,738	12,482	14,038,263	15,724,603	725,354	59,484,358	2,369,983	0.03984	0.02835	0.01219	0.01149	0.0117	-0.0002
40-44	40	2,372,479	2,657,678	17,321	11,280,909	12,795,865	712,872	48,101,998	2,167,623	0.04506	0.03149	0.01482	0.01357	0.0143	-0.0007
45-49	45	2,235,994	2,376,130	29,054	8,908,430	10,138,187	695,551	38,048,451	1,901,177	0.04997	0.03232	0.01828	0.01765	0.0178	-0.0001
50-54	50	1,874,362	2,112,702	42,651	6,672,436	7,762,057	666,497	28,812,893	1,740,366	0.06040	0.03782	0.02313	0.02259	0.0226	0.0000
55-59	55	1,458,956	1,761,362	60,038	4,798,074	5,649,355	623,846	20,844,388	1,454,914	0.06980	0.04084	0.02993	0.02896	0.0294	-0.0004
60-64	60	1,121,691	1,339,942	73,118	3,339,118	3,887,993	563,808	14,425,633	1,119,568	0.07761	0.03805	0.03908	0.03956	0.0386	0.0010
65-69	65	800,517	944,380	82,186	2,217,427	2,548,051	490,691	9,516,669	824,131	0.08660	0.03474	0.05156	0.05186	0.0510	0.0008
70-74	70	585,334	670,993	99,238	1,416,910	1,603,671	408,505	6,035,108	586,855	0.09724	0.03095	0.06769	0.06629	0.0671	-0.0008
75+		831,576	932,678	309,267	831,576	932,678	309,267	3,525,925		N/A	N/A	N/A	-	N/A	N/A
Total		**36,384,225**	**38,259,411**	**802,876**									a =	-0.0005079	
													k1/k2 =	0.997969	
													k1 =	0.997969	
													k2 =	1	
													k1*k2 =	0.997969	
													b =	0.999377	
													Completeness, C =	**1.00**	

Table B.2. Adjusted male population 2009-2013				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
	31.12.2009	**31.12.2013**	Obs. $_5N_x(t_1)$/k1	Obs. $_5N_x(t_2)$/k2
0-4	3,159,120	3,178,431	3,165,550	3,178,431
5-9	3,181,037	3,207,503	3,187,511	3,207,503
10-14	3,333,455	3,259,305	3,340,240	3,259,305
15-19	3,189,793	3,306,601	3,196,285	3,306,601
20-24	3,192,783	3,134,546	3,199,281	3,134,546
25-29	3,298,628	3,163,306	3,305,342	3,163,306
30-34	2,991,146	3,285,116	2,997,234	3,285,116
35-39	2,757,354	2,928,738	2,762,966	2,928,738
40-44	2,372,479	2,657,678	2,377,308	2,657,678
45-49	2,235,994	2,376,130	2,240,545	2,376,130
50-54	1,874,362	2,112,702	1,878,177	2,112,702
55-59	1,458,956	1,761,362	1,461,925	1,761,362
60-64	1,121,691	1,339,942	1,123,974	1,339,942
65-69	800,517	944,380	802,146	944,380
70-74	585,334	670,993	586,525	670,993
75+	831,576	932,678	833,269	932,678
Total	**36,384,225**	**38,259,411**	**36,458,279**	**38,259,411**

Table B.3. Synthetic Extinct Generations Method (SEG Method) – Male 2009-2013										
Age Group	**Age x**	**Adj. population 2009 N1(x,5)**	**Adj. population 2013 N2(x,5)**	**Inter-censal Deaths D(x,5)**	**Age Specific Growth Rate r(x,5)**	**Number Reaching Age x from Deaths N*(x)**	**Number Reaching Age x from Age Dist. N(x)**	**Ratio N*(x)/N(x)**	**Adjusted Deaths**	**Adjusted Death Rate**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0-4	**0**	3,165,550	3,178,431	29,653	0.001015	2,563,474	NA	NA	30,126	0.00237
5- 9	**5**	3,187,511	3,207,503	5,031	0.001563	2,520,917	2,549,166	0.989	5,111	0.00040
10-14	**10**	3,340,240	3,259,305	4,650	-0.006132	2,496,281	2,578,567	0.968	4,724	0.00036
15-19	**15**	3,196,285	3,306,601	8,769	0.008483	2,569,283	2,658,702	0.966	8,909	0.00069
20-24	**20**	3,199,281	3,134,546	9,160	-0.005110	2,454,002	2,532,212	0.969	9,306	0.00073
25-29	**25**	3,305,342	3,163,306	9,668	-0.010981	2,508,238	2,544,994	0.986	9,822	0.00076
30-34	**30**	2,997,234	3,285,116	10,592	0.022928	2,639,860	2,636,171	1.001	10,761	0.00086
35-39	**35**	2,762,966	2,928,738	12,482	0.014567	2,343,927	2,370,230	0.989	12,681	0.00111
40-44	**40**	2,377,308	2,657,678	17,321	0.027871	2,167,244	2,167,849	1.000	17,597	0.00175
45-49	**45**	2,240,545	2,376,130	29,054	0.014688	1,869,171	1,901,375	0.983	29,517	0.00320
50-54	**50**	1,878,177	2,112,702	42,651	0.029417	1,708,808	1,740,548	0.982	43,331	0.00544
55-59	**55**	1,461,925	1,761,362	60,038	0.046583	1,435,455	1,455,066	0.987	60,995	0.00950
60-64	**60**	1,123,974	1,339,942	73,118	0.043939	1,083,758	1,119,684	0.968	74,283	0.01513
65-69	**65**	802,146	944,380	82,186	0.040809	804,491	824,217	0.976	83,496	0.02398
70-74	**70**	586,525	670,993	99,238	0.033636	581,787	586,916	0.991	100,820	0.04018
75+	**75**	833,269	932,678	309,267	0.028176	400,494	NA	NA	314,197	0.08910
Total		**36,458,279**	**38,259,411**	**802,876**					**815,674**	
	e75=	**9.5**		*exp(r(75+)*e75) = T1 =*	1.306919		Median	**0.984**		
				*((r(75+)*e75)^2)/6 = T2 =*	0.011941		0.5 * IQ Range	0.009		
				N(75)=D(75+)[T1 - T2] =	400,494		Percent	0.9		

Table B.4. SEG method- Male life table 2009-2013					
Age x	5qx	lx/l5	5Lx/l5	Tx/l5	ex
0	NA	NA	NA	NA	NA
5	0.00200	1.0000	4.9950	69.8996	69.9
10	0.00179	0.9980	4.9855	64.9046	65.0
15	0.00343	0.9962	4.9725	59.9191	60.1
20	0.00368	0.9928	4.9548	54.9465	55.3
25	0.00380	0.9891	4.9363	49.9917	50.5
30	0.00430	0.9854	4.9163	45.0554	45.7
35	0.00559	0.9811	4.8920	40.1391	40.9
40	0.00879	0.9757	4.8569	35.2471	36.1
45	0.01612	0.9671	4.7965	30.3902	31.4
50	0.02757	0.9515	4.6919	25.5938	26.9
55	0.04867	0.9253	4.5138	20.9018	22.6
60	0.07864	0.8802	4.2281	16.3881	18.6
65	0.12756	0.8110	3.7964	12.1599	15.0
70	0.22332	0.7076	3.1428	8.3635	11.8
75	1.00000	0.5495	NA	5.2207	9.50

Table B.5. Generalized Growth Balance Method (GGB Method) - Female 2009-2013

Age	**x**	**$_5N_x(t_1)$**	**$_5N_x(t_2)$**	**$_5D_x$**	**P1(x+)**	**P2(x+)**	**D(x+)**	**PYL(x+)**	**N(x)**	**b(x+)**	**r(x+)-i(x+)**	**d(x+) = X**	**b(x+)-r(x+) +i(x+) = Y**	**a+bx**	**Residuals y-(a+bx)**
		Female Population 31.12.2009	Female Population 31.12.2013	Intercensal female deaths											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0-4	0	2,992,273	3,011,240	25,830	36,009,743	37,951,947	656,542	148,007,351			N/A	0.00000	-	-0.0002	
5-9	5	3,015,272	3,042,579	4,651	33,017,470	34,940,707	630,712	135,985,933	2,416,060	0.01777	0.01414	0.00464	0.00362	0.0041	-0.0005
10-14	10	3,161,981	3,093,192	3,123	30,002,198	31,898,128	626,061	123,855,524	2,445,417	0.01974	0.01531	0.00505	0.00444	0.0045	-0.0001
15-19	15	3,031,543	3,136,003	3,991	26,840,217	28,804,936	622,939	111,322,439	2,521,472	0.02265	0.01765	0.00560	0.00500	0.0051	-0.0001
20-24	20	3,062,215	3,017,428	3,713	23,808,674	25,668,933	618,947	98,975,512	2,421,790	0.02447	0.01880	0.00625	0.00567	0.0057	0.0000
25-29	25	3,188,342	3,059,507	4,460	20,746,459	22,651,505	615,234	86,791,415	2,450,924	0.02824	0.02195	0.00709	0.00629	0.0065	-0.0002
30-34	30	2,901,436	3,205,597	5,519	17,558,117	19,591,998	610,774	74,256,518	2,559,901	0.03447	0.02739	0.00823	0.00708	0.0075	-0.0005
35-39	35	2,731,843	2,856,549	7,233	14,656,681	16,386,401	605,254	62,046,295	2,305,226	0.03715	0.02788	0.00975	0.00928	0.0090	0.0003
40-44	40	2,290,216	2,616,300	9,304	11,924,838	13,529,852	598,021	50,854,456	2,140,710	0.04209	0.03156	0.01176	0.01053	0.0109	-0.0003
45-49	45	2,222,957	2,317,237	14,441	9,634,622	10,913,552	588,717	41,054,110	1,844,632	0.04493	0.03115	0.01434	0.01378	0.0133	0.0005
50-54	50	1,842,948	2,097,054	19,013	7,411,665	8,596,315	574,275	31,957,316	1,728,847	0.05410	0.03707	0.01797	0.01703	0.0167	0.0003
55-59	55	1,479,901	1,775,690	26,784	5,568,717	6,499,261	555,262	24,086,062	1,448,526	0.06014	0.03863	0.02305	0.02151	0.0215	0.0000
60-64	60	1,233,387	1,405,987	36,388	4,088,816	4,723,571	528,478	17,595,040	1,155,030	0.06565	0.03608	0.03004	0.02957	0.0281	0.0014
65-69	65	918,387	1,089,007	48,945	2,855,429	3,317,584	492,089	12,322,615	928,007	0.07531	0.03750	0.03993	0.03780	0.0375	0.0003
70-74	70	735,468	829,265	73,651	1,937,042	2,228,577	443,144	8,318,396	698,789	0.08401	0.03505	0.05327	0.04896	0.0501	-0.0011
75+		1,201,574	1,399,312	369,493	1,201,574	1,399,312	369,493	5,191,451		N/A	N/A	N/A	-	N/A	N/A
Total		**36,009,743**	**37,951,947**	**656,542**									a =	-0.000233	
													k1/k2 =	0.9991	
													k1 =	0.9991	
													k2 =	1.0000	
													k1*k2 =	0.9991	
													b =	0.9445	
													Completeness, C =	**1.06**	

Table B.6.Adjusted female population 2009-2013				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
			Obs. $_5N_x(t_1)/k1$	Obs. $_5N_x(t_2)/k2$
0-4	2,992,273	3,011,240	2,995,066	3,011,240
5-9	3,015,272	3,042,579	3,018,086	3,042,579
10-14	3,161,981	3,093,192	3,164,932	3,093,192
15-19	3,031,543	3,136,003	3,034,373	3,136,003
20-24	3,062,215	3,017,428	3,065,073	3,017,428
25-29	3,188,342	3,059,507	3,191,318	3,059,507
30-34	2,901,436	3,205,597	2,904,144	3,205,597
35-39	2,731,843	2,856,549	2,734,393	2,856,549
40-44	2,290,216	2,616,300	2,292,354	2,616,300
45-49	2,222,957	2,317,237	2,225,032	2,317,237
50-54	1,842,948	2,097,054	1,844,668	2,097,054
55-59	1,479,901	1,775,690	1,481,282	1,775,690
60-64	1,233,387	1,405,987	1,234,538	1,405,987
65-69	918,387	1,089,007	919,244	1,089,007
70-74	735,468	829,265	736,154	829,265
75+	1,201,574	1,399,312	1,202,696	1,399,312
Total	**36,009,743**	**37,951,947**	**36,043,353**	**37,951,947**

Table B.7. Synthetic Extinct Generations Method (SEG Method)- Female 2009-2013										
Age Group	**Age x**	**Adj. population 2009.000 N1(x,5)**	**Adj. population 2013.000 N2(x,5)**	**Inter-censal Deaths D(x,5)**	**Age Specific Growth Rate r(x,5)**	**Number Reaching Age x from Deaths N*(x)**	**Number Reaching Age x from Age Dist. N(x)**	**Ratio N*(x)/N(x)**	**Adjusted Deaths**	**Adjusted Death Rate**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0-4	**0**	2,995,066	3,011,240	25,830	0.001346	2,616,675	NA	**NA**	24,928	0.00208
5- 9	**5**	3,018,086	3,042,579	4,651	0.002021	2,573,375	2,414,983	**1.066**	4,488	0.00037
10-14	**10**	3,164,932	3,093,192	3,123	-0.005732	2,542,879	2,444,327	**1.040**	3,013	0.00024
15-19	**15**	3,034,373	3,136,003	3,991	0.008236	2,613,645	2,520,348	**1.037**	3,852	0.00031
20-24	**20**	3,065,073	3,017,428	3,713	-0.003917	2,504,290	2,420,711	**1.035**	3,584	0.00029
25-29	**25**	3,191,318	3,059,507	4,460	-0.010545	2,550,066	2,449,831	**1.041**	4,304	0.00034
30-34	**30**	2,904,144	3,205,597	5,519	0.024690	2,683,547	2,558,760	**1.049**	5,326	0.00044
35-39	**35**	2,734,393	2,856,549	7,233	0.010926	2,366,708	2,304,199	**1.027**	6,981	0.00062
40-44	**40**	2,292,354	2,616,300	9,304	0.033046	2,233,842	2,139,756	**1.044**	8,979	0.00092
45-49	**45**	2,225,032	2,317,237	14,441	0.010151	1,885,063	1,843,809	**1.022**	13,937	0.00153
50-54	**50**	1,844,668	2,097,054	19,013	0.032059	1,777,694	1,728,076	**1.029**	18,349	0.00233
55-59	**55**	1,481,282	1,775,690	26,784	0.045320	1,496,858	1,447,880	**1.034**	25,848	0.00398
60-64	**60**	1,234,538	1,405,987	36,388	0.032511	1,169,438	1,154,515	**1.013**	35,116	0.00666
65-69	**65**	919,244	1,089,007	48,945	0.042367	960,441	927,593	**1.035**	47,235	0.01180
70-74	**70**	736,154	829,265	73,651	0.029775	733,063	698,477	**1.050**	71,077	0.02274
75+	**75**	1,202,696	1,399,312	369,493	0.037854	563,296	NA	**NA**	356,580	0.06872
Total		**36,043,353**	**37,951,947**	**656,542**					**633,596**	
	e75=	**11.7**		*exp(r(75+)*e75) = T1 =*	1.557201		Median	**1.036**		
				*((r(75+)*e75)^2)/6 = T2 =*	0.032692		0.5 * IQ Range	0.007		
				N(75)=D(75+)[T1 - T2] =	563,296		Percent	0.6		

Table B.8.SEG method-female 2009-2013					
Age x	5qx	lx/l5	5Lx/l5	Tx/l5	ex
0	NA	NA	NA	NA	NA
5	0.00185	1.0000	4.9954	76.1314	76.1
10	0.00120	0.9981	4.9877	71.1360	71.3
15	0.00156	0.9969	4.9808	66.1483	66.4
20	0.00147	0.9954	4.9733	61.1675	61.5
25	0.00172	0.9939	4.9653	56.1942	56.5
30	0.00218	0.9922	4.9556	51.2289	51.6
35	0.00313	0.9900	4.9425	46.2733	46.7
40	0.00459	0.9869	4.9234	41.3308	41.9
45	0.00770	0.9824	4.8931	36.4074	37.1
50	0.01173	0.9748	4.8456	31.5143	32.3
55	0.02012	0.9634	4.7686	26.6686	27.7
60	0.03388	0.9440	4.6401	21.9001	23.2
65	0.06081	0.9120	4.4215	17.2599	18.9
70	0.12057	0.8566	4.0247	12.8384	15.0
75	1.00000	0.7533	NA	8.8137	11.70

Table B.9. Generalized Growth Balance Method (GGB Method)- Male 2013-2015

Age	**x**	**$_5N_x(t_1)$**	**$_5N_x(t_2)$**	**$_5D_x$**	**P1(x+)**	**P2(x+)**	**D(x+)**	**PYL(x+)**	**N(x)**	**b(x+)**	**r(x+)-i(x+)**	**d(x+) = X**	**b(x+)-r(x+) +i(x+) = Y**	**a+bx**	**Residuals y-(a+bx)**
		Male Population 31.12.2013	Male Population 31.12.2015	Intercen-sal male deaths											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0-4	0	3,178,431	3,261,250	15,493	38,259,411	39,201,044	431,399	77,507,746			N/A	0.00000		0.0005	
5-9	5	3,207,503	3,233,704	1,679	35,080,980	35,939,794	415,906	71,064,189	1,283,257	0.01806	0.01209	0.00585	0.00597	0.0052	0.0008
10-14	10	3,259,305	3,150,351	1,992	31,873,477	32,706,090	414,228	64,618,398	1,272,390	0.01969	0.01289	0.00641	0.00681	0.0056	0.0012
15-19	15	3,306,601	3,354,261	4,410	28,614,172	29,555,739	412,236	58,202,100	1,323,482	0.02274	0.01618	0.00708	0.00656	0.0062	0.0004
20-24	20	3,134,546	3,176,943	4,866	25,307,571	26,201,478	407,826	51,536,543	1,297,337	0.02517	0.01735	0.00791	0.00783	0.0068	0.0010
25-29	25	3,163,306	3,139,771	4,714	22,173,025	23,024,535	402,961	45,220,469	1,255,722	0.02777	0.01883	0.00891	0.00894	0.0077	0.0013
30-34	30	3,285,116	3,221,301	5,311	19,009,719	19,884,764	398,247	38,911,253	1,277,743	0.03284	0.02249	0.01023	0.01035	0.0087	0.0016
35-39	35	2,928,738	3,108,187	5,988	15,724,603	16,663,463	392,936	32,396,614	1,279,046	0.03948	0.02898	0.01213	0.01050	0.0102	0.0003
40-44	40	2,657,678	2,766,328	8,749	12,795,865	13,555,276	386,948	26,358,225	1,139,329	0.04322	0.02881	0.01468	0.01441	0.0123	0.0021
45-49	45	2,376,130	2,318,214	13,094	10,138,187	10,788,948	378,200	20,931,331	993,539	0.04747	0.03109	0.01807	0.01638	0.0150	0.0013
50-54	50	2,112,702	2,302,304	21,839	7,762,057	8,470,734	365,106	16,228,414	936,211	0.05769	0.04367	0.02250	0.01402	0.0186	-0.0046
55-59	55	1,761,362	1,832,931	31,242	5,649,355	6,168,430	343,267	11,814,461	787,679	0.06667	0.04394	0.02905	0.02274	0.0239	-0.0012
60-64	60	1,339,942	1,507,340	39,201	3,887,993	4,335,499	312,025	8,216,927	652,209	0.07937	0.05446	0.03797	0.02491	0.0311	-0.0062
65-69	65	944,380	1,094,034	45,199	2,548,051	2,828,159	272,824	5,372,583	484,636	0.09021	0.05214	0.05078	0.03807	0.0414	-0.0033
70-74	70	670,993	733,279	51,183	1,603,671	1,734,125	227,624	3,337,529	333,093	0.09980	0.03909	0.06820	0.06072	0.0554	0.0053
75+		932,678	1,000,846	176,441	932,678	1,000,846	176,441	1,933,645		N/A	N/A	N/A		N/A	N/A
Total		**38,259,411**	**39,201,044**	**431,399**									a =	0.000472	
													k1/k2 =	1.000945	
													k1 =	1	
													k2 =	0.999056	
													k1*k2 =	0.999056	
													b =	0.805863	
													Completeness, C =	**1.24**	

Table B.10. Adjusted Male Population 2013-2015				
Age	**Observed $_5N_x(t_1)$**	**Observed $_5N_x(t_2)$**	**Adjusted $_5N_x(t_1)$**	**Adjusted $_5N_x(t_2)$**
			Obs. $_5N_x(t_1)/k1$	Obs. $_5N_x(t_2)/k2$
0-4	3,178,431	3,261,250	3,178,431	3,264,333
5-9	3,207,503	3,233,704	3,207,503	3,236,760
10-14	3,259,305	3,150,351	3,259,305	3,153,329
15-19	3,306,601	3,354,261	3,306,601	3,357,431
20-24	3,134,546	3,176,943	3,134,546	3,179,946
25-29	3,163,306	3,139,771	3,163,306	3,142,739
30-34	3,285,116	3,221,301	3,285,116	3,224,346
35-39	2,928,738	3,108,187	2,928,738	3,111,125
40-44	2,657,678	2,766,328	2,657,678	2,768,943
45-49	2,376,130	2,318,214	2,376,130	2,320,405
50-54	2,112,702	2,302,304	2,112,702	2,304,480
55-59	1,761,362	1,832,931	1,761,362	1,834,663
60-64	1,339,942	1,507,340	1,339,942	1,508,765
65-69	944,380	1,094,034	944,380	1,095,068
70-74	670,993	733,279	670,993	733,972
75+	932,678	1,000,846	932,678	1,001,792
Total	**38,259,411**	**39,201,044**	**38,259,411**	**39,238,097**

Table B.11. Synthetic Extinct Generations Method (SEG Method)- Male 2013-2015

Age Group	Age x	Population 2013 N1(x,5)	Population 2015 N2(x,5)	Inter-censal Deaths D(x,5)	Age Specific Growth Rate r(x,5)	Number Reaching Age x from Deaths N*(x)	Number Reaching Age x from Age Dist. N(x)	Ratio N*(x)/N(x)	Adjusted Deaths	Adjusted Death Rate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0-4	0	3,178,431	3,264,333	15,493	0.013334	1,559,877	NA	NA	13,563	0.00211
5- 9	5	3,207,503	3,236,760	1,679	0.004540	1,444,287	1,282,985	**1.126**	1,469	0.00023
10-14	10	3,259,305	3,153,329	1,992	-0.016528	1,410,211	1,272,120	**1.109**	1,743	0.00027
15-19	15	3,306,601	3,357,431	4,410	0.007628	1,529,624	1,323,202	**1.156**	3,860	0.00058
20-24	20	3,134,546	3,179,946	4,866	0.007190	1,468,058	1,297,062	**1.132**	4,260	0.00067
25-29	25	3,163,306	3,142,739	4,714	-0.003262	1,411,440	1,255,456	**1.124**	4,126	0.00065
30-34	30	3,285,116	3,224,346	5,311	-0.009336	1,429,894	1,277,472	**1.119**	4,649	0.00071
35-39	35	2,928,738	3,111,125	5,988	0.030206	1,492,787	1,278,775	**1.167**	5,242	0.00087
40-44	40	2,657,678	2,768,943	8,749	0.020506	1,277,976	1,139,088	**1.122**	7,659	0.00141
45-49	45	2,376,130	2,320,405	13,094	-0.011866	1,145,125	993,329	**1.153**	11,462	0.00244
50-54	50	2,112,702	2,304,480	21,839	0.043444	1,201,631	936,012	**1.284**	19,118	0.00433
55-59	55	1,761,362	1,834,663	31,242	0.020387	947,427	787,512	**1.203**	27,350	0.00761
60-64	60	1,339,942	1,508,765	39,201	0.059332	825,921	652,071	**1.267**	34,317	0.01207
65-69	65	944,380	1,095,068	45,199	0.074022	580,105	484,533	**1.197**	39,568	0.01945
70-74	70	670,993	733,972	51,183	0.044856	363,092	333,022	**1.090**	44,806	0.03192
75+	75	932,678	1,001,792	176,441	0.035743	244,390	NA	**NA**	154,458	0.07990
Total		**38,259,411**	**39,238,097**	**431,399**					**377,650**	
	e75=	***9.5***		*exp(r(75+)*e75) = T1 =*	1.404325		Median	**1.142**		
				*((r(75+)*e75)^2)/6 = T2 =*	0.019216		0.5 * IQ Range	0.034		
				N(75)=D(75+)[T1 - T2] =	244,390		Percent	2.9		

Table B.12.SEG method-male life table 2013-2015					
Age x	*5qx*	*lx/l5*	*5Lx/l5*	*Tx/l5*	*ex*
0	NA	NA	NA	NA	NA
5	0.00114	1.0000	4.9971	71.6561	71.7
10	0.00136	0.9989	4.9909	66.6590	66.7
15	0.00290	0.9975	4.9803	61.6681	61.8
20	0.00338	0.9946	4.9646	56.6878	57.0
25	0.00328	0.9912	4.9481	51.7232	52.2
30	0.00358	0.9880	4.9312	46.7751	47.3
35	0.00435	0.9845	4.9116	41.8439	42.5
40	0.00708	0.9802	4.8835	36.9323	37.7
45	0.01228	0.9732	4.8363	32.0488	32.9
50	0.02190	0.9613	4.7538	27.2124	28.3
55	0.03877	0.9402	4.6100	22.4586	23.9
60	0.06222	0.9038	4.3783	17.8486	19.7
65	0.10224	0.8476	4.0211	13.4703	15.9
70	0.17346	0.7609	3.4745	9.4491	12.4
75	1.00000	0.6289	NA	5.9746	9.50

Table B.13. Generalized Growth Balance Method (GGB Method)- Female 2013-2015															
Age	**x**	**$_5N_x(t_1)$**	**$_5N_x(t_2)$**	**$_5D_x$**	**P1(x+)**	**P2(x+)**	**D(x+)**	**PYL(x+)**	**N(x)**	**b(x+)**	**r(x+)-i(x+)**	**d(x+) = X**	**b(x+)- r(x+) +i(x+) = Y**	**a+bx**	**Residuals y-(a+bx)**
		Female Population 31.12.2013	Female Population 31.12.2015	Inter-censal deaths											
1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	18
0-4	0	3,011,240	3,093,017	12,979	37,951,947	38,889,701	357,046	76,888,517			#N/A	0.00000		-0.0001	
5-9	5	3,042,579	3,067,576	1,226	34,940,707	35,796,684	344,067	70,780,625	1,216,543	0.01719	0.01209	0.00486	0.00509	0.0040	0.0011
10-14	10	3,093,192	2,985,168	1,114	31,898,128	32,729,108	342,842	64,666,125	1,206,320	0.01865	0.01285	0.00530	0.00580	0.0044	0.0014
15-19	15	3,136,003	3,183,490	1,655	28,804,936	29,743,940	341,728	58,581,415	1,256,066	0.02144	0.01603	0.00583	0.00541	0.0048	0.0006
20-24	20	3,017,428	3,047,081	1,715	25,668,933	26,560,450	340,074	52,257,518	1,237,335	0.02368	0.01706	0.00651	0.00662	0.0054	0.0012
25-29	25	3,059,507	3,034,601	1,745	22,651,505	23,513,369	338,359	46,188,421	1,211,229	0.02622	0.01866	0.00733	0.00756	0.0061	0.0015
30-34	30	3,205,597	3,130,994	2,333	19,591,998	20,478,768	336,615	40,088,373	1,238,865	0.03090	0.02212	0.00840	0.00878	0.0070	0.0018
35-39	35	2,856,549	3,035,130	3,277	16,386,401	17,347,774	334,282	33,743,554	1,248,534	0.03700	0.02849	0.00991	0.00851	0.0082	0.0003
40-44	40	2,616,300	2,737,589	4,743	13,529,852	14,312,644	331,006	27,850,539	1,119,340	0.04019	0.02811	0.01189	0.01208	0.0099	0.0022
45-49	45	2,317,237	2,231,836	6,670	10,913,552	11,575,055	326,263	22,494,262	967,235	0.04300	0.02941	0.01450	0.01359	0.0121	0.0015
50-54	50	2,097,054	2,298,034	10,033	8,596,315	9,343,219	319,594	17,936,247	923,678	0.05150	0.04164	0.01782	0.00986	0.0149	-0.0050
55-59	55	1,775,690	1,824,675	13,964	6,499,261	7,045,185	309,561	13,542,703	782,987	0.05782	0.04031	0.02286	0.01750	0.0191	-0.0016
60-64	60	1,405,987	1,584,033	18,977	4,723,571	5,220,510	295,597	9,938,454	671,310	0.06755	0.05000	0.02974	0.01755	0.0249	-0.0073
65-69	65	1,089,007	1,248,484	26,494	3,317,584	3,636,477	276,620	6,951,500	530,322	0.07629	0.04587	0.03979	0.03041	0.0333	-0.0029
70-74	70	829,265	884,300	36,769	2,228,577	2,387,993	250,125	4,616,975	392,801	0.08508	0.03453	0.05418	0.05055	0.0454	0.0051
75+		1,399,312	1,503,693	213,356	1,399,312	1,503,693	213,356	2,903,114		#N/A	#N/A	#N/A	#VALUE!	#N/A	#N/A
Total		**37,951,947**	**38,889,701**	**357,046**									a =	-0.0000972	
													k1/k2 =	0.999806	
													k1 =	0.999806	
													k2 =	1	
													k1*k2 =	0.999806	
													b =	0.84003	
													Completeness, C =	**1.19**	

Table B.14. Adjusted female Population 2013-2015

Age	Observed $_5N_x(t_1)$	Observed $_5N_x(t_2)$	Adjusted $_5N_x(t_1)$	Adjusted $_5N_x(t_2)$
			Obs. $_5N_x(t_1)/k1$	Obs. $_5N_x(t_2)/k2$
0-4	3,011,240	3,093,017	3,011,826	3,093,017
5-9	3,042,579	3,067,576	3,043,171	3,067,576
10-14	3,093,192	2,985,168	3,093,793	2,985,168
15-19	3,136,003	3,183,490	3,136,613	3,183,490
20-24	3,017,428	3,047,081	3,018,015	3,047,081
25-29	3,059,507	3,034,601	3,060,102	3,034,601
30-34	3,205,597	3,130,994	3,206,220	3,130,994
35-39	2,856,549	3,035,130	2,857,104	3,035,130
40-44	2,616,300	2,737,589	2,616,809	2,737,589
45-49	2,317,237	2,231,836	2,317,688	2,231,836
50-54	2,097,054	2,298,034	2,097,462	2,298,034
55-59	1,775,690	1,824,675	1,776,035	1,824,675
60-64	1,405,987	1,584,033	1,406,260	1,584,033
65-69	1,089,007	1,248,484	1,089,219	1,248,484
70-74	829,265	884,300	829,426	884,300
75+	1,399,312	1,503,693	1,399,584	1,503,693
Total	**37,951,947**	**38,889,701**	**37,959,327**	**38,889,701**

Table B.15. Synthetic Extinct Generations Method (SEG Method)- Female 2013-2015

Age Group	**Age** *x*	**Population 2013** *N1(x,5)*	**Population 2015** *N2(x,5)*	**Inter-censal Deaths** *D(x,5)*	**Age Specific Growth Rate** *r(x,5)*	**Number Reaching Age x from Deaths** *N*(x)*	**Number Reaching Age x from Age Dist** *N(x)*	**Ratio** *N*(x)/N(x)*	**Adjusted Deaths**	**Adjusted Death Rate**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0-4	0	3,011,826	3,093,017	12,979	0.013300	1,395,276	NA	NA	11,915	0.00195
5- 9	5	3,043,171	3,067,576	1,226	0.003994	1,292,951	1,215,829	**1.063**	1,125	0.00018
10-14	10	3,093,793	2,985,168	1,114	-0.017871	1,266,175	1,205,612	**1.050**	1,022	0.00017
15-19	15	3,136,613	3,183,490	1,655	0.007417	1,383,358	1,255,329	**1.102**	1,519	0.00024
20-24	20	3,018,015	3,047,081	1,715	0.004792	1,331,370	1,236,609	**1.077**	1,574	0.00026
25-29	25	3,060,102	3,034,601	1,745	-0.004184	1,298,152	1,210,519	**1.072**	1,601	0.00026
30-34	30	3,206,220	3,130,994	2,333	-0.011871	1,323,834	1,238,138	**1.069**	2,141	0.00034
35-39	35	2,857,104	3,035,130	3,277	0.030223	1,402,387	1,247,801	**1.124**	3,008	0.00051
40-44	40	2,616,809	2,737,589	4,743	0.022561	1,202,664	1,118,683	**1.075**	4,354	0.00081
45-49	45	2,317,688	2,231,836	6,670	-0.018873	1,069,887	966,668	**1.107**	6,123	0.00135
50-54	50	2,097,462	2,298,034	10,033	0.045663	1,168,770	923,136	**1.266**	9,210	0.00210
55-59	55	1,776,035	1,824,675	13,964	0.013509	921,243	782,528	**1.177**	12,819	0.00356
60-64	60	1,406,260	1,584,033	18,977	0.059520	847,571	670,916	**1.263**	17,421	0.00584
65-69	65	1,089,219	1,248,484	26,494	0.068235	613,051	530,010	**1.157**	24,322	0.01043
70-74	70	829,426	884,300	36,769	0.032031	413,501	392,570	**1.053**	33,755	0.01971
75+	75	1,399,584	1,503,693	213,356	0.035874	318,368	NA	**NA**	195,864	0.06751
Total		**37,959,327**	**38,889,701**	**357,046**					**327,773**	
	e75=	**11.7**		*exp(r(75+)*e75) = T1 =*	1.521553		Median	**1.089**		
				*((r(75+)*e75)^2)/6 = T2 =*	0.029362		0.5 * IQ Range	0.039		
				N(75)=D(75+)[T1 - T2] =	318,368		Percent	3.6		

Table B.16.SEG method- female life table 2013-2015					
Age x	*5qx*	*lx/l5*	*5Lx/l5*	*Tx/l5*	*ex*
0	NA	NA	NA	NA	NA
5	0.00092	1.0000	4.9977	76.8861	76.9
10	0.00084	0.9991	4.9933	71.8884	72.0
15	0.00120	0.9982	4.9882	66.8951	67.0
20	0.00130	0.9970	4.9820	61.9069	62.1
25	0.00131	0.9957	4.9754	56.9250	57.2
30	0.00169	0.9944	4.9680	51.9495	52.2
35	0.00256	0.9928	4.9574	46.9816	47.3
40	0.00407	0.9902	4.9410	42.0241	42.4
45	0.00675	0.9862	4.9143	37.0831	37.6
50	0.01054	0.9795	4.8718	32.1689	32.8
55	0.01796	0.9692	4.8024	27.2971	28.2
60	0.02961	0.9518	4.6885	22.4947	23.6
65	0.05354	0.9236	4.4944	17.8062	19.3
70	0.10364	0.8742	4.1443	13.3118	15.2
75	1.00000	0.7836	NA	9.1676	11.70

Table B.17. Timeliness of death registration for male deaths 2009-2015									
	Age groups	**0-10 days (%)**	**11-30 days (%)**	**31-90 days (%)**	**91-180 days (%)**	**181-365 days (%)**	**1 Year+ (%)**	**Reg.date is unknown (%)**	**Total deaths –male (count)**
2009	**0**	39.16	11.41	2.77	0.69	0.84	2.27	**42.86**	**9,541**
	1-4	63.82	18.23	4.62	1.69	1.08	4.70	5.86	**2,490**
	5-14	63.93	19.85	5.23	1.48	1.79	3.03	4.69	**3,305**
	15-34	66.25	21.80	4.43	0.99	0.71	0.78	5.04	**10,253**
	35-54	80.85	12.78	2.08	0.47	0.22	0.26	3.35	**28,182**
	55-74	85.56	10.08	1.23	0.31	0.22	0.29	2.31	**76,401**
	75+	85.59	9.60	1.29	0.30	0.26	0.51	2.44	**72,752**
	Unknown age	0.41	0.00	0.14	0.00	0.00	0.14	99.31	**729**
	Total	**80.85**	**11.16**	**1.70**	**0.42**	**0.32**	**0.58**	**4.97**	**203,653**
2010	**0**	50.13	8.84	2.15	0.53	0.92	1.41	**36.01**	**8,242**
	1-4	72.29	15.14	2.75	1.61	1.44	3.80	2.97	**2,292**
	5-14	73.75	15.13	3.37	0.98	1.23	2.25	3.30	**2,849**
	15-34	71.29	19.96	3.48	1.20	0.71	0.85	2.51	**9,868**
	35-54	84.69	10.68	1.78	0.41	0.23	0.26	1.95	**26,612**
	55-74	89.79	7.22	0.85	0.20	0.13	0.21	1.59	**76,297**
	75+	90.40	6.57	0.76	0.24	0.21	0.37	1.44	**74,194**
	Unknown age	0.00	0.00	0.00	0.00	0.00	0.00	100.00	**91**
	Total	**86.33**	**8.33**	**1.18**	**0.33**	**0.27**	**0.43**	**3.13**	**200,445**
2011	**0**	53.98	8.27	2.22	0.65	0.50	0.61	**33.76**	**7,843**
	1-4	74.08	14.98	3.05	1.08	1.88	3.05	1.88	**2,130**
	5-14	72.86	16.76	3.56	1.45	1.02	1.88	2.47	**2,553**
	15-34	72.85	19.11	3.94	0.88	0.73	0.58	1.91	**9,852**
	35-54	86.67	9.63	1.56	0.42	0.23	0.16	1.32	**25,536**
	55-74	91.84	6.05	0.73	0.20	0.13	0.10	0.95	**80,417**
	75+	92.20	5.69	0.72	0.21	0.17	0.23	0.78	**78,167**
	Unknown age	28.57	0.00	0.00	14.29	0.00	0.00	57.14	**7**
	Total	**88.57**	**7.29**	**1.10**	**0.30**	**0.23**	**0.25**	**2.25**	**206,505**
2012	**0**	56.68	7.83	1.43	0.70	0.29	0.52	**32.55**	**8,022**
	1-4	79.41	12.90	3.03	0.96	0.85	1.75	1.11	**1,884**
	5-14	75.79	14.63	3.39	1.24	1.45	1.69	1.82	**2,420**
	15-34	75.18	16.76	3.77	1.22	0.63	0.80	1.64	**9,947**
	35-54	88.28	8.75	1.30	0.32	0.16	0.14	1.05	**25,419**
	55-74	92.71	5.67	0.65	0.13	0.07	0.09	0.68	**80,619**
	75+	93.32	4.91	0.62	0.18	0.12	0.18	0.67	**79,319**
	Unknown age	0.00	0.00	0.00	0.00	0.00	0.00	100.00	**4**
	Total	**89.85**	**6.54**	**0.95**	**0.26**	**0.16**	**0.21**	**2.02**	**207,634**

Table B.17. Timeliness of death registration for male deaths 2009-2015 (continued)									
	Age groups	**0-10 days (%)**	**11-30 days (%)**	**31-90 days (%)**	**91-180 days (%)**	**181-365 days (%)**	**1 Year+ (%)**	**Reg.date is unknown (%)**	**Total deaths –male (count)**
2013	**0**	58.90	12.85	3.42	0.82	0.42	0.37	**23.22**	**7,594**
	1-4	76.49	16.42	3.15	1.18	0.90	1.12	0.73	**1,778**
	5-14	75.62	17.91	3.28	0.87	0.72	1.01	0.58	**2,071**
	15-34	74.87	19.83	3.56	0.70	0.24	0.39	0.40	**9,158**
	35-54	87.15	10.98	1.35	0.18	0.08	0.07	0.19	**25,109**
	55-74	90.93	8.02	0.74	0.12	0.07	0.05	0.07	**79,823**
	75+	91.19	7.62	0.71	0.18	0.10	0.11	0.08	**79,862**
	Unknown age	0.00	33.33	0.00	33.33	0.00	0.00	33.33	**3**
	Total	**88.39**	**9.10**	**1.07**	**0.22**	**0.12**	**0.12**	**0.97**	205,398
2014	**0**	60.15	11.19	3.04	0.87	0.58	0.29	**23.89**	**8,319**
	1-4	78.33	15.14	3.42	0.92	0.61	0.49	1.10	**1,638**
	5-14	77.58	16.71	2.99	0.79	0.58	0.47	0.89	**1,909**
	15-34	77.91	17.80	2.62	0.53	0.41	0.15	0.59	**9,592**
	35-54	88.57	9.73	1.12	0.16	0.07	0.04	0.31	**25,111**
	55-74	93.53	5.61	0.58	0.11	0.05	0.02	0.11	**81,412**
	75+	94.09	5.01	0.57	0.15	0.07	0.03	0.08	**85,705**
	Total	**90.91**	**6.79**	**0.87**	**0.19**	**0.10**	**0.05**	**1.08**	213,686
2015	**0**	62.66	12.73	2.40	0.64	0.22	0.00	**21.36**	**7,716**
	1-4	78.48	17.00	2.36	0.94	0.54	0.07	0.61	**1,482**
	5-14	78.49	17.09	2.74	0.84	0.17	0.00	0.67	**1,790**
	15-34	76.60	18.90	2.69	0.96	0.33	0.03	0.49	**9,813**
	35-54	89.67	9.12	0.79	0.15	0.03	0.02	0.22	**24,691**
	55-74	94.27	5.08	0.46	0.07	0.02	0.00	0.10	**85,585**
	75+	94.76	4.52	0.50	0.10	0.04	0.00	0.07	**90,869**
	Total	**91.85**	**6.35**	**0.71**	**0.16**	**0.06**	**0.01**	**0.87**	221,946

Table B.18. Timeliness of death registration for female deaths 2009-2015									
	Age groups	**0-10 days (%)**	**11-30 days (%)**	**31-90 days (%)**	**91-180 days (%)**	**181-365 days (%)**	**1 Year+ (%)**	**Reg.date is unknown (%)**	**Total deaths – female (count)**
2009	**0**	40.81	10.44	2.73	0.92	0.79	2.79	**41.52**	**8,066**
	1-4	62.46	16.10	4.63	1.28	1.32	7.63	6.57	**2,267**
	5-14	67.07	16.84	4.17	1.51	1.83	4.60	3.99	**2,785**
	15-34	68.59	17.82	3.85	1.10	0.64	2.63	5.37	**5,292**
	35-54	79.53	12.44	2.33	0.62	0.47	1.08	3.52	**13,887**
	55-74	82.85	11.00	1.60	0.39	0.29	0.93	2.94	**46,526**
	75+	82.54	10.69	1.59	0.38	0.31	1.18	3.31	**86,993**
	Unknown age	0.43	0.00	0.00	0.43	0.00	0.43	98.72	**234**
	Total	**79.26**	**11.30**	**1.87**	**0.48**	**0.39**	**1.37**	**5.34**	**166,050**
2010	**0**	50.82	9.72	1.76	0.43	1.00	1.47	**34.79**	**6,922**
	1-4	72.25	13.56	3.14	0.83	1.47	6.24	2.50	**2,036**
	5-14	75.92	11.32	2.97	1.57	1.53	3.68	3.02	**2,421**
	15-34	74.33	15.33	2.69	0.91	0.89	2.01	3.85	**4,834**
	35-54	85.52	9.25	1.14	0.56	0.43	0.76	2.34	**13,105**
	55-74	88.28	7.76	0.94	0.31	0.34	0.51	1.86	**46,918**
	75+	88.58	7.43	0.92	0.28	0.31	0.59	1.88	**89,767**
	Unknown age	0.00	0.00	0.00	0.00	0.00	0.00	100.00	**23**
	Total	**85.87**	**8.12**	**1.09**	**0.36**	**0.41**	**0.77**	**3.38**	**166,026**
2011	**0**	54.68	8.52	1.99	0.73	0.71	0.71	**32.64**	**6,724**
	1-4	75.05	13.70	2.98	1.57	1.46	3.35	1.88	**1,912**
	5-14	76.11	13.26	3.14	1.17	1.26	2.95	2.11	**2,135**
	15-34	75.76	13.95	2.81	0.70	0.64	1.46	4.68	**4,983**
	35-54	88.01	8.07	1.09	0.38	0.35	0.48	1.62	**12,906**
	55-74	90.95	6.45	0.74	0.26	0.19	0.34	1.07	**47,831**
	75+	91.22	6.04	0.78	0.22	0.19	0.40	1.16	**93,158**
	Unknown age	12.50	25.00	12.50	0.00	0.00	12.50	37.50	**8**
	Total	**88.62**	**6.82**	**0.95**	**0.31**	**0.26**	**0.50**	**2.54**	**169,657**
2012	**0**	56.23	7.78	1.70	0.50	0.43	0.52	**32.84**	**6,952**
	1-4	77.31	12.50	3.13	1.74	0.93	3.07	1.33	**1,728**
	5-14	79.56	9.54	2.93	1.74	1.46	2.55	2.22	**1,844**
	15-34	78.38	13.20	2.15	1.07	0.76	0.94	3.49	**4,469**
	35-54	89.27	7.40	0.94	0.28	0.18	0.42	1.52	**12,400**
	55-74	91.98	5.85	0.57	0.21	0.20	0.30	0.89	**46,959**
	75+	92.40	5.43	0.60	0.19	0.17	0.35	0.86	**94,528**
	Unknown age	33.33	0.00	0.00	0.00	0.00	16.67	50.00	**6**
	Total	**89.90**	**6.11**	**0.75**	**0.27**	**0.23**	**0.42**	**2.32**	**168,886**

Table B.18. Timeliness of death registration for female deaths 2009-2015 (continued)									
	Age groups	**0-10 days (%)**	**11-30 days (%)**	**31-90 days (%)**	**91-180 days (%)**	**181-365 days (%)**	**1 Year+ (%)**	**Reg.date is unknown (%)**	**Total deaths – female (count)**
2013	**0**	59.60	13.44	3.29	0.95	0.50	0.36	**21.87**	**6,420**
	1-4	75.34	16.46	3.68	1.42	1.29	0.97	0.84	**1,549**
	5-14	77.73	14.94	3.18	1.43	1.04	1.17	0.52	**1,540**
	15-34	80.22	14.60	2.53	0.93	0.58	0.65	0.50	**3,993**
	35-54	87.79	10.21	1.06	0.31	0.15	0.20	0.28	**12,320**
	55-74	90.17	8.37	0.80	0.19	0.15	0.15	0.18	**45,939**
	75+	90.67	7.90	0.73	0.21	0.15	0.19	0.15	**95,761**
	Unknown age	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0**
	Total	**88.62**	**8.71**	**0.96**	**0.28**	**0.19**	**0.21**	**1.02**	**167,522**
2014	**0**	62.04	10.77	2.42	0.80	0.38	0.28	**23.31**	**6,846**
	1-4	76.99	15.14	3.75	1.35	0.82	1.05	0.90	**1,334**
	5-14	79.53	14.00	2.43	1.62	0.73	0.73	0.97	**1,236**
	15-34	81.84	13.80	2.17	0.66	0.53	0.24	0.77	**3,782**
	35-54	90.72	7.57	0.87	0.24	0.18	0.11	0.30	**12,516**
	55-74	92.75	6.13	0.62	0.17	0.11	0.07	0.15	**47,462**
	75+	93.72	5.16	0.61	0.21	0.09	0.08	0.14	**104,147**
	Total	**91.54**	**6.13**	**0.77**	**0.25**	**0.13**	**0.10**	**1.07**	**177,323**
2015	**0**	63.42	12.41	2.96	0.54	0.20	0.02	**20.46**	**6,448**
	1-4	78.10	16.65	2.31	0.93	0.54	0.00	1.46	**1,297**
	5-14	81.32	12.90	3.29	0.89	0.71	0.09	0.80	**1,124**
	15-34	82.33	14.07	1.83	0.62	0.43	0.05	0.67	**3,718**
	35-54	91.46	7.18	0.72	0.19	0.11	0.00	0.33	**12,283**
	55-74	93.95	5.24	0.48	0.11	0.06	0.00	0.16	**48,890**
	75+	94.42	4.73	0.52	0.12	0.06	0.01	0.14	**109,512**
	Total	**92.56**	**5.63**	**0.67**	**0.16**	**0.08**	**0.01**	**0.90**	**183,272**

Table B.19. Timeliness of death registration for total deaths 2009-2015

	Age groups	0-10 days (%)	11-30 days (%)	31-90 days (%)	91-180 days (%)	181-365 days (%)	1 Year+ (%)	Reg.date is unknown (%)	Total deaths (count)
2009	**0**	39.92	10.97	2.75	0.80	0.82	2.51	42.24	**17,607**
	1-4	63.17	17.22	4.62	1.49	1.20	6.10	6.20	**4,757**
	5-14	65.37	18.47	4.75	1.49	1.81	3.74	4.37	**6,090**
	15-34	67.05	20.44	4.23	1.02	0.69	1.41	5.15	**15,545**
	35-54	80.42	12.67	2.16	0.52	0.30	0.53	3.40	**42,069**
	55-74	84.53	10.43	1.37	0.34	0.24	0.53	2.55	**122,927**
	75+	83.93	10.20	1.45	0.34	0.29	0.88	2.92	**159,745**
	Unknown age	0.42	0.00	0.10	0.10	0.00	0.21	99.17	**963**
	Total	**80.13**	**11.22**	**1.78**	**0.44**	**0.35**	**0.93**	**5.13**	**369,703**
2010	**0**	50.45	9.25	1.97	0.49	0.96	1.44	35.45	**15,164**
	1-4	72.27	14.39	2.93	1.25	1.46	4.94	2.75	**4,328**
	5-14	74.74	13.38	3.19	1.25	1.37	2.90	3.17	**5,270**
	15-34	72.29	18.44	3.22	1.10	0.77	1.23	2.95	**14,702**
	35-54	84.97	10.21	1.57	0.46	0.30	0.43	2.08	**39,717**
	55-74	89.22	7.43	0.89	0.24	0.21	0.32	1.69	**123,215**
	75+	89.41	7.04	0.85	0.26	0.27	0.49	1.68	**163,961**
	Unknown age	0.00	0.00	0.00	0.00	0.00	0.00	100.00	**114**
	Total	**86.12**	**8.24**	**1.14**	**0.35**	**0.33**	**0.58**	**3.24**	**366,471**
2011	**0**	54.31	8.39	2.11	0.69	0.60	0.66	33.25	**14,567**
	1-4	74.54	14.37	3.02	1.31	1.68	3.19	1.88	**4,042**
	5-14	74.34	15.17	3.37	1.32	1.13	2.37	2.30	**4,688**
	15-34	73.83	17.38	3.56	0.82	0.70	0.88	2.84	**14,835**
	35-54	87.12	9.10	1.40	0.41	0.27	0.27	1.42	**38,442**
	55-74	91.50	6.20	0.73	0.22	0.16	0.19	0.99	**128,248**
	75+	91.67	5.88	0.75	0.22	0.18	0.32	0.98	**171,325**
	Unknown age	20.00	13.33	6.67	6.67	0.00	6.67	46.67	**15**
	Total	**88.59**	**7.08**	**1.03**	**0.31**	**0.24**	**0.36**	**2.38**	**376,162**
2012	**0**	56.47	7.81	1.56	0.61	0.35	0.52	32.68	**14,974**
	1-4	78.41	12.71	3.07	1.33	0.89	2.38	1.22	**3,612**
	5-14	77.42	12.43	3.19	1.45	1.45	2.06	1.99	**4,264**
	15-34	76.17	15.66	3.27	1.17	0.67	0.85	2.21	**14,416**
	35-54	88.60	8.31	1.18	0.31	0.17	0.23	1.20	**37,819**
	55-74	92.44	5.74	0.62	0.16	0.12	0.17	0.75	**127,578**
	75+	92.82	5.19	0.61	0.19	0.14	0.27	0.77	**173,847**
	Unknown age	20.00	0.00	0.00	0.00	0.00	10.00	70.00	**10**
	Total	**89.87**	**6.35**	**0.86**	**0.27**	**0.19**	**0.30**	**2.15**	**376,520**

Table B.19.Timeliness of death registration for total deaths 2009-2015 (continued)									
	Age groups	**0-10 days (%)**	**11-30 days (%)**	**31-90 days (%)**	**91-180 days (%)**	**181-365 days (%)**	**1 Year+ (%)**	**Reg.date is unknown (%)**	**Total deaths (count)**
2013	**0**	59.22	13.12	3.36	0.88	0.46	0.36	22.60	**14,014**
	1-4	75.95	16.44	3.40	1.29	1.08	1.05	0.78	**3,327**
	5-14	76.52	16.64	3.24	1.11	0.86	1.08	0.55	**3,611**
	15-34	76.50	18.24	3.25	0.77	0.34	0.47	0.43	**13,151**
	35-54	87.36	10.73	1.25	0.22	0.10	0.11	0.22	**37,429**
	55-74	90.65	8.15	0.76	0.15	0.10	0.09	0.11	**125,762**
	75+	90.91	7.77	0.72	0.20	0.13	0.15	0.12	**175,623**
	Unknown age	0.00	33.33	0.00	33.33	0.00	0.00	33.33	**3**
	Total	**88.49**	**8.93**	**1.03**	**0.25**	**0.15**	**0.16**	**0.99**	**372,920**
2014	**0**	61.00	2.76	0.84	0.49	0.28	0.16	23.63	**15,165**
	1-4	77.73	3.57	1.11	0.71	0.74	0.27	1.01	**2,972**
	5-14	78.35	2.77	1.11	0.64	0.57	0.29	0.92	**3,145**
	15-34	79.02	2.49	0.57	0.44	0.17	0.10	0.64	**13,374**
	35-54	89.28	1.04	0.19	0.11	0.06	0.02	0.31	**37,627**
	55-74	93.24	0.60	0.13	0.07	0.04	0.01	0.12	**128,874**
	75+	93.89	0.59	0.18	0.08	0.06	0.01	0.11	**189,852**
	Total	**91.20**	**0.82**	**0.22**	**0.12**	**0.07**	**0.03**	**1.08**	**391,009**
2015	**0**	63.00	12.58	2.65	0.59	0.21	0.01	20.95	**14,164**
	1-4	78.30	16.84	2.34	0.94	0.54	0.04	1.01	**2,779**
	5-14	79.58	15.48	2.95	0.86	0.38	0.03	0.72	**2,914**
	15-34	78.18	17.57	2.45	0.86	0.35	0.04	0.54	**13,531**
	35-54	90.26	8.47	0.77	0.16	0.06	0.01	0.26	**36,974**
	55-74	94.16	5.14	0.46	0.09	0.04	0.00	0.12	**134,475**
	75+	94.57	4.63	0.51	0.11	0.05	0.01	0.11	**200,381**
	Total	**92.17**	**6.02**	**0.69**	**0.16**	**0.07**	**0.01**	**0.88**	**405,218**

APPENDIX C

Table C.1. Turkish equivalent of jobs and institutions responsible in the death registration processes

Civilian Authority	Mülki Amirlik
Commander of Gendarmerie	Jandarma Karakol Komutanı
Community Health Center Physician	Toplum Sağlığı Merkezi Hekimi
Coroner	Adli Tabip
Directorate of District Civil Registration	İlçe Nüfus Müdürlüğü
Family Physician	Aile Hekimi
Government Physician / Government Doctor	Hükümet Tabibi
Health Clinic	Sağlık Ocağı
Medical Personnel	Sağlık Personeli
Ministry of Interior General Directorate of Civil Registration and Nationality	İçişleri Bakanlığı Nüfus ve Vatandaşlık İşleri Genel Müdürlüğü
Municipal Health Officer	Belediye Tabipliği
Municipal Physician	Belediye Tabibi
Officer of Burial Permit	Ölüm Belgesi Düzenleme Yetkilisi
Official Physician	Resmi Tabip
On-call Physician	Nöbetçi Hekim
Provincial Directorate of Health	İl Sağlık Müdürlüğü
Public Official	Kamu Görevlisi
Regional Directorate of TURKSTAT	TÜİK Bölge Müdürlüğü
Village Headman	Köy Muhtarı

APPENDIX D

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INSTITUTE OF POPULATION STUDIES
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INSTITUTE OF POPULATION STUDIES
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Student No: N13220382

Department: Demography

Program: Demography

Status: ☒ Masters ☐ Ph.D. ☐ Integrated Ph.D.

ADVISOR APPROVAL

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Assos. Prof. Alanur ÇAVLİN

21/09/16

ASSESSMENT OF THE COMPLETENESS AND TIMELINESS OF DEATH REGISTRATION IN TURKEY: 2009-2015

by Zehra Yayla

ASSESSMENT OF THE COMPLETENESS AND TIMELINESS OF DEATH REGISTRATION IN TURKEY: 2009-2015

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