MORTALITY TABLE PROBLEMS IN THE LIFE INSURANCE SECTOR: AN ADVISORY ALTERNATIVE SOLUTION FOR TURKEY*

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The main objective of this study is to develop an updated mortality table that will be used in the insurance sector in Turkey and test the functionality of this table by comparing it with American CSO 1980, which is a life table commonly used by life insurance companies in Turkey. The main contribution of the study is to put forth to what extent the premium and compensation calculated in the insurance sector in Turkey will differentiate from premium and compensation calculated from the mortality data of Turkey. The Orphanhood method, an indirect method, was used to generate this table, and in this way, estimated death rates, life expectations and insurance premiums were compared with American CSO 1980. The results indicate that the life expectancies of CSO 1980 show a similarity with the average of male and female life expectancies of Turkey. On the other hand, 15 years death rates of CSO 1980 have higher values than male and female death rates of Turkey until age 50. Additionally, it can be observed that the endowment life insurance, the most preferred life insurance type, whose premiums are calculated from the Turkish male and female mortality table has the lowest premiums for the most suitable starting ages (25-40) for insurance. This situation shows that insurance companies have increased the premiums in crucial age groups, leading to unjustified losses for the insured.

INTRODUCTION

The insurance sector, which is among the sectors where the trust factor is of great importance in social and economical life, has to have the purpose of ensuring stability and order both for its employees in its internal structure and for the clients outside. In addition this stability and order will provide the application of the right plan, policies and strategies and require regulations, laws and rules both on an organizational and industrial basis. Therefore, regulations that will enhance trust in society in the sector are required for the insurance companies, which are considered as a warranty of lives and properties of the individuals, to be stable and efficient. In Turkey, governments intervening legally and politically in sectors such as accounting and banking could not manage to realize the necessary regulations for the insurance sector until the end of 2000. More clearly, the government and its supervisory body in the insurance sector, Turkish Undersecretariat of Treasury, were insufficient for a long time in realizing the legal regulations necessary both for insurance companies and insurers. Although the “Insurance Law”, effective in 2007, provided several legal regulations for the insurance firms, it does not cover a regulation towards developing the current mortality tables, which is the most basic problem, especially for life insurance firms (Akmut, 1980; Özsoy, 1970; Kırkbeşoğlu, 2007). Not having updated mortality tables developed by using the reliable mortality data or information of the insured in Turkey will cause a decrease in trust in and demand for the sector, and miscalculations of premiums; developing reliable mortality tables requires reliable mortality data.

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Mortality data have a great importance in the insurance sector, social security system and various institutions' provident funds, where actuarial balances are calculated. Besides this, it makes it difficult to use mortality ratios and commutation (insurance premium- income) tables by insurance firms. None of the insurance firms in Turkey uses a table developed by using Turkish mortality data. Instead, mortality tables from abroad reflecting mortality ratios of different countries are preferred. Therefore, there is a two-way problem at this point. The first is that reliable mortality data is needed in Turkey and alternative studies are necessary to realize this. The second is that mortality ratios of foreign countries that are used particularly by the insurance companies do not represent the real mortality profile of Turkey, leading to premiums that are either too high or too low. Therefore, reliable studies that will provide alternative mortality data and mortality tables developed using these data are needed. These tables facilitate the calculation of premiums and the compensation to be paid to them. Hence, it is important, and of critical importance for insurance companies, that these tables should include the most reliable mortality ratios possible for ensuring actuarial balance – more clearly, for premiums to be charge at a rate equal to the compensation paid. Therefore, mortality data to be used by life insurance companies and hence mortality tables need to involve reliable mortality data reflecting the demographical characteristics of that country.

The main aim of this study is to develop an updated mortality table to be used in the insurance sector in Turkey and test the functionality of this table by comparing it with foreign – origin – mortality tables used by the insurance sector. The Orphanhood method, an indirect method, is used to generate this table (Zlotnik and Hill, 1981). In this way, the insurance premiums will be calculated and an insurance premium comparison will be made with American CSO 1980, which is a life table commonly used by life insurance companies in Turkey. Hence, the main contribution of the study is to put forth to what extent premiums and compensation calculated in the insurance sector in Turkey will differentiate from premiums and compensation calculated based on the mortality data of Turkey.

MORTALITY DATA IN LIFE INSURANCES

Mortality tables are defined as tables that list how many people will die and how many will survive in a year at every age as foreseen from the results obtained based on life and death statistics developed by keeping a certain group of the population under observation (Life Insurances Regulation, 1996). Mortality tables are used by particularly actuaries, demographist or people dealing with public health to make various studies on issues like migration, fertility, population estimations, orphanhood or widowing, life expectation, marriage and working life. In the insurance sector where mortality tables are of great importance (especially in life insurances), it is significant how reliable these tables are in calculating premiums and compensation. In addition, mathematical allowances and shares that insurance companies have are closely associated with the reliability of these tables.

Even though mortality tables are so important in life insurance, today there is no mortality table in Turkish the insurance sector developed from mortality data belonging to Turkey. On the other hand, although limited in number, there are a few studies where mortality tables were developed from Turkish mortality data starting from the year 1950. However, none of these tables were taken into consideration for use in the insurance sector by the Undersecretariat of Treasury Directorate General of Insurance Department.

Mortality tables generated at certain intervals in developed countries over years are used both in these countries and in developing or less developed countries in various fields. That there is no table generated from the Turkish data in the insurance sector in our country so far shows that the same situation is valid for Turkey. Developed countries, such as the USA, Germany, France, Switzerland and the UK are using mortality tables that include the mortality ratios of their own citizens. Such tables are far from representing the mortality ratios of Turkish society. These countries' current and previous mortality ratios have no similarities with the mortality ratios of Turkey today; particularly as the developments in medicine, economical improvements and developments in life standards have led to the extension of the average lifetime in Turkey as well.

In particular, retirement insurances having been sold based on the mortality tables of the 1950s will lead to companies facing a great amount of risk in the future. Since tables designed with old data involve high mortality ratios, it is assumed that retirement income is paid in a shorter time and it does not take into account that the insured may live longer than expected (Osmançavuşoğlu, 1999: 52). Therefore, insurance companies have the risk of encountering financial problems. Also, high mortality ratios cause the premiums to be higher than they should actually be in insurances covering death indemnity. Indeed, foreign tables, as they involve higher mortality ratios, assume that the insured may die at an earlier age.

Consequently, that the mortality tables used in the insurance sector in a country put forth the exact premiums and compensation depends on two factors. The first of these is the requirement that mortality data by which the mortality table is prepared should belong to that country and the second is that the mortality data is reliable. Thus, the reliability of mortality data seems to be of great importance.

The rest of the study deals with calculating mortality ratios according to ages with the Orphanhood Method, which is often preferred in countries where it is not possible to obtain direct mortality ratios. Turkish mortality and insurance premium tables will be developed by using the mortality ratios obtained.

DATA SOURCES AND METHODOLOGY

Data Sources: 1998 and 2003 Turkish Demographic and Health Survey

In Turkey, mortality data can be taken from the several different sources. These are Central Record Systems (MERNIS), Turkish Statistical Institute mortality statistics, burial records, Turkish Ministry of Health records and census. However, taking reliable mortality data related to Turkey includes several problems. One of the problems is different registration procedures in urban and rural areas. Muhtar is responsible for reporting deaths to the DDP in rural areas if medical doctors or medical personnel are not present there owing to the fact that different persons can be responsible for reporting deaths in rural areas. Additionally, muhtars may not have a good level of education, so reliable information cannot be obtained for the most of rural areas. The other problem is that the MERNIS is based on the family ledgers system. Migration movements do not affect the MERNIS records if persons do not change their family ledgers. Therefore, although any person lives permanently in one district, he/she can appear in another district in the family ledger (Wunsch and Hancıoğlu, 1995). In addition, death records provided by health personnel or muhtar are not filled out; therefore, many people still appear as alive who died several decades ago. The other mortality data source is the national population census. Although the last national population census, 2000 General Population Census, contained mortality questions for adults, the results have not yet been published. Therefore, it can be seen that obtaining information pertaining to mortality data is problematic.

Because of these reasons, in this study, 2003 Turkish Demographic and Health Survey will be used as a main data and 1998 Turkish Demographic and Health Survey will be used as a supplementary data to make mortality estimations and to construct mortality and commutation tables. TDHS-2003 is a national representative sample survey which is designed to provide information about infant and child mortality, levels and trends on fertility, family planning and maternal and child health. The results of the survey are presented as an urban and rural residence at the national level for the five regions in the country. Besides, the TDHS-2003 sample also provides information about 12 geographical regions (NUTS1) to analyze and compare with European Country within the context of Turkey's move to join the European Union.

The primary objective of the TDHS-2003 is to provide information about socioeconomic characteristics of households and women, fertility, mortality, marriage patterns, family planning, maternal and child health, nutritional status of women and children, and reproductive health. Detailed information is provided from a sample of ever-married women in reproductive ages (15-49). The TDHS-2003 was designed to produce information in the field of demography and health which cannot collect from other sources. Especially it has been useful to obtain direct and indirect factors that determine levels and trends infant and childhood mortality.

The sample design and sample size of the TDHS-2003 make possible to analyze for whole Turkey, urban and rural areas and five demographic regions of the country which are West, East, Central, South and North regions. The TDHS-2003 sample also provides information about 12 geographical regions (NUTS1) for a limited number of variables which were adopted at the second half of the year 2002 to analyze and compare with European Country within the context of Turkey's move to join the European Union (HUIPS, 2004). In the selection of the TDHS-2003 sample, the approach of a weighted, multistage, stratified cluster sampling method was used. The distribution of the target sample was based on the results of the 2000 Turkey General Population Census. The target size of the TDHS-2003 was set as 13,160 households which is 30 percent larger than of the TDHS-1998.

On the other hand, 1998 Turkey Demographic and Health Survey (TDHS-1998) will be used as a secondary data in this study. TDHS-1998 shows similarities with TDHS-2003. The results of the survey are presented as an urban and rural residence at the national level for the five regions. But 12 geographical regions (NUTS 1) were not included in this survey. In the selection of the TDHS-1998 sample, the approach of a weighted, multistage, stratified cluster sampling method was used. The target size of the TDHS-1998 was set as 9,970 households and 8,596 of them were applied in the survey. The interview was completed successfully with 94 percent of 8,596 households. 9,468 women were determined to interviewing. 8,576 of women were identified as eligible. In the half of the selected households, husbands of currently married eligible women who were present in the household on the nigh before the interview or who usually lived in that particular household were eligible for the husband survey. (HUIPS, 1999).

Data Quality

The important indicator to determine the data quality from the surveys is missing on key variable. Among births in the 15 year preceding the TDHS-2003, 4 percent are missing information on year of birth. Information on age at death is missing for just 1 percent of these births. Marriage age or date was not taken from less than 1 percent of ever-married women. Height or weight measurements are missing for nearly 8 percent of the children under age 5. Compared with data from TDHS-1998, these figures show that the missing information is very limited in the survey (HUIPS, 2004).

One of the most powerful interviewing tools is the birth history for collecting information on births and deaths. Complete information on birth dates were collected almost all births occurring since 2001 and nearly 94 percent of births during 1998-2000. On the other hand it can be said that the complete information on birth dates were collected accurately from the TDHS-1998 data. The TDHS-2003 and the TDHS-1998 data appear to be good quality with respect to the completeness of the information collected on dates of birth and ages at death. A detail inspection of the birth history data from the TDHS-2003 and the TDHS-1998 point out age heaping at death was also minimal. One of the commonly observed failures of the sampling surveys is age heaping at death to 6, 12, 18 and 24 months. Therefore, infant deaths may record as a child dates because of the respondents heaping the age at death to 12 months or interviewers recording ages of death as “1 year”. This situation causes calculated bias rates. These biases are not seen much more during 10 years before the 2003 survey (HUIPS, 2004).

The other evaluation related to reliability of birth history is calculation of sex ratios at birth for all five births. This ratio is expected to fluctuate around 105 male births per 100 female births. The overall sex ratio is calculated 104.4 for all births in the birth history for the TDHS-2003 and 105.6 for the TDHS-1998. On the other hand, sex ratio of death for age 0-1 interval is 1.08 for ten years preceding the TDHS-2003. This shows that male mortality rate is higher than female mortality rate for infant mortality, which is expected situation for early age mortality. When investigating the sampling errors of TDHS-2003 and 1998, infant mortality rate (IMR) during 4 years before the survey is calculated 28.767 for the TDHS-2003 and 42.702 for the TDHS-1998. Standard error of the IMR is calculated 2.914 for the TDHS-2003 and its confidence limits are calculated between 22.938 and 34.596 which refer 11.658 years interval in 95 percent confidence limit. Standard error of the IMR is calculated 4.659 for the TDHS-1998 and its confidence limits are calculated between 33.384 and 52.020. This numeral refers to 18.636 years interval which is larger interval than the TDHS-2003 in 95 percent confidence limit.

METHODOLOGY

Orphanhood Method

Besides the increase in population studies in recent years, the requirements of basic data for such studies are not available or too deficient in many countries. The inadequacy of registration statistics and difficulty in collecting accurate data directly causes that indirect methods of analysis, particularly those based on orphanhood, represent an important source of adult mortality estimates in developing countries (Timæus, 1990). Especially the lacks of accurate vital registration and censuses have led demographers to project indirect methods to estimate basic demographic parameters from incomplete or inaccurate data. Although, these methods can not be considered as substitutes for the mortality measures obtained from complete and accurate vital registration system, in the absence of such data, these would provide reasonable basis for demographic analyses and other purposes (Sivamurthy and Seetharam, 1980).

The plausible information about orphanhood for the measurement of adult mortality was first explored by Henry in 1960. He developed the ideas of Lotka, who had considered the reverse problem, estimating orphanhood from data on mortality (Timæus, 1990). He argued that if the information on infant and child mortality can be obtained by asking the mothers about the survival of their children, why can not be done the same for adult mortality by asking the children about the survival of their parents? (Blacker, 1977). Henry’s idea was taken up by Brass, who established an equation relating the female probability of surviving from age 25 to age 25 + n to proportions of respondent in two contiguous five year age groups whose mother was still alive at the time of the interview (United Nations, 1983). Final version of Brass's methods is published by Brass and Hill (1973). Later, Hill and Blacker, working under the Brass' guidance, developed an equation to estimate adult male mortality from proportions of persons with fathers alive.

Orphanhood approach has obvious advantages. The questions, "Is your mother alive?" and "Is your father alive?" are simple and easy to answer. These questions does not include date of the death or reference period and can be answered by outspokenly "Yes" or "No"; they takes little place on the questionnaires and the results are simple to code, punch and tabulate. Furthermore, every additional question inserted in survey has an additional cost, but the cost of the orphanhood questions are minimal (Blacker, 1977). These questions applied in the survey questionnaire of African countries in 1960's with the opinion of Brass and Hill. The quality of the answers for these questions would be better than the direct questions about the deaths 12 months preceding the survey.

For orphanhood method, it is needed the mean age at maternity for females and mean age at conception for males and the proportion of not orphaned respondent by five year age groups form males and females. Estimates of adult mortality taken from close relatives that represent averages of the mortality experienced during the relatives were exposed to the risk of dying (United Nations, 1983). Respondents' mothers must have been alive at the birth of the respondents. Thus, the period of exposure to die is the age of respondent (Coşkun, 2002). But there is a difference for the paternal orphanhood. Although, the risk of dying for mothers has started with the birth of their child, the risk of dying for fathers has started with conception of the child. For this reason, approximately nine moths should be incorporated in calculations.

Brass established an equation relating to the female probability of surviving from age 25 to 25+n. This equation has the form:

$$l_{(25+n)} / l_{(25)} = W_{(n)} \,.\, S_{(n-5)} + (1-W_{(n)}) \,.\, S_{(n)}$$

Where, $S_{(n)}$ is the proportion of respondents aged from n to n+4 with mother alive. $W_{(n)}$ is a weighting factor which is employed to make allowance for typical age patterns of fertility and mortality. Brass and Hill (1973) are calculated the set of $W_{(n)}$ values from the African standard mortality pattern and model fertility schedules of fixed shape but variable age locations. The weighting factor depends on value of n and the mean age of childbearing.

Later, Hill and Trussell (1977) have performed another estimation by using regression coefficients. This equation has the form:

$$l_{(25+n)} / l_{(25)} = a_{(n)} + b_{(n)} \,.\, M + c_{(n)} \,.\, S_{(n-5)}$$

$a_{(n)}$, $b_{(n)}$ and $c_{(n)}$ are the regression coefficient which is calculated with four different Coale-Demeny mortality patterns as standards. These regression coefficients were calculated only for females. Thus, estimating of adult mortality is not available with this equation for males (Coşkun, 2002).

In case of calculating adult male mortality, the value is replaced by the values 32.5 or 37.5. Because the men are usually older than women at the birth of their children. So the survivorship probabilities are estimated from the following two formulas:

$$l_{(35+n)} / l_{(32,5)} = W_{(n)} \cdot S_{(n-5)} + (1-W_{(n)}) \cdot S_{(n)}$$

$$l_{(40+n)} / l_{(37,5)} = W_{(n)} \cdot S_{(n-5)} + (1-W_{(n)}) \cdot S_{(n)}$$

If the mean age of paternity is less than 36, the first equation is used; on the other hand if the mean age is greater than 36, the second equation is used.

On the other hand, the reference date of the mortality level is calculated. The formula is changed separately for females and males. For females, the formula is:

$$t_{(n)} = n\,(1.0 - u_{(n)}) / 2.0$$

where,

$$u_{(n)} = 0.3333 . \ln({}_{10}S_{(n-5)}) + Z_{(M+n)} + 0.0037.(27-M)$$

The value of $Z_{(M+n)}$ is provided by interpolation by using value of the standards function table.

For males, the formula is:

$$t_{(n)} = (n + 0.75) . (1.0 - u_{(n)}) / 2.0$$

Where,

$$u_{(n)} = 0.3333 . \ln({}_{10}S_{(n-5)}) + Z_{(M+n)} + 0.0037.(27-M+0.75)$$

In this case $10S_{(n-5)}$ represents the proportion of respondents in the age group from n-5 to n+4 with mother alive; on the other hand, n is the mid-point of the 10 year age group being considered.

According to Zlotnik and Hill (1981), if information of orphanhood has been collected by two censuses or surveys between the five or ten years periods, the hypothetical intersurvey cohort of respondents can be calculated. Shortly, "hypothetical cohort" method is occurred to estimate the adult mortality between the censuses or surveys. This method has additionally advantages than the Brass' method. Firstly time reference time of the estimates stay between two surveys. The other advantage of synthetic cohorts is that deaths are reported fully during the intersurvey and omission of more distant deaths will have no effect on the result. Therefore, synthetic cohort data on the survival of the parents are less vulnerable than lifetime data to the adoption effect that is underreporting of orphanhood by respondents (Timæus, 1991).

The proportions of not orphaned among a hypothetical intersurvey cohort of respondents are calculated from this formula:

$$S_{(n,s)} = S_{(n,2)} \qquad \text{for } n < T;$$

$$S_{(n,s)} = S_{(n-T,s)} \cdot S_{(n,2)} / S_{(n-T,1)} \qquad \text{for } n \geq T.$$

In this formula, "T" is defined by length of interval between the surveys. $S_{(n,1)}$ is the proportion of persons in the age group from n to n+4 whose mother alive at the time of the first survey and $S_{(n,2)}$ is at the second survey with same rationale. Proportions of not orphaned among a hypothetical intersurvey cohort is constructed with these formulas and also the other calculations are the same with Brass's orphanhood method.

In Turkey, the questions about survival of the parents were not asked in any censuses but it has been applied in the surveys. In years 1973, and in 1974-75 TPS, 1978 TFS, 1983 TPHS, 1988 TPHS, 1993 TDHS, 1998 TDHS and 2003 TDH surveys.

Life Insurance Premium Calculations

The main responsibility of the insured person in life insurances is to pay the premium to the insurer. The insurance premium calculated thanks to the commutation or annuity tables are defined as net premium or risk premium. Like all organizations, the insurance companies also have some expenditure. Therefore, the manufacturing and administrative costs of the company should be added to the net premium. Furthermore, the reserved amounts put aside for unexpected losses should be added to the net premium as well. All these additions are called loading, and by adding the loading to the net premium the gross premium is measured.

Gross premium = Net premium + Loading (The expenditures of the insurer + the commission of the insurer)

The net premium, which is in the gross premium, is based on the fundamental of equality in the responsibilities of insurer and insured person (Moralı, 1997). That is, the net premiums calculated from the commutation tables according to the types of life insurance are thought to be equal to the present value of the life insurance guarantee that is taken by insurer.

The present value of the net premiums = the present value of the insurer's responsibility.

The insured can make their premium payments both in cash and in installments. For both payment styles the insurers have to make different calculations. The premium payments are calculated differently according to the life insurance types. But in this study, it is assumed that the premium payments are made at the moment of policy starting for net single premium payments.

In this study, the comparisons for insurance premiums will be done over endowment life insurance, which is the most sold type of insurance by the insurance companies in Turkey. As known, endowment life insurance is a type of life insurance where the amount in the policy is paid to the relatives of the insured in case s/he dies in a certain period of time or to the insured in case he survives during this period of time. As it can be understood from the definition, endowment life insurance covers the outcome of both death and survival. The formula for the net amount of single premium that the insured pays is given below (Moralı, 1997: 131),

$$A_{x:\overline{n}|} = \sum_{t=0}^{n-1} v^{n+1} {}_{n|}q_x + v^n {}_n p_x$$

(A) presents value of the life insurance premium
(p) the probability of living,
(q) the probability of dying,
(v) presents value of 1 TL at the end of the year. (V= 1 / (1+i)),
(n) life insurance period.

Net premium refers to the net risk except all expenses and profit margin.

CONSTRUCTION OF MORTALITY TABLES FOR TURKEY

Background of Mortality Tables in Turkey

The death rates of any country should represent the population characteristics of that country to use in mortality tables for the calculation of premiums and reserves in the insurance sector. Although mortality tables have gained importance in the insurance sector, there are no mortality tables constructed from Turkish data, and what is more, this deficiency has been loosely compensated by foreign mortality tables. In Turkey, sixteen different mortality tables had been used until 1978 (Duransoy, 1993). These tables were

1. American CSO 1953-1958
2. English Hm
3. English Om
4. French AF
5. French PF 1952-1956
6. French PM
7. French PMF 1931
8. French RF
9. German Abel
10. German General ADST
11. Swiss SM 1901-1910
12. Swiss SM 1921-1930
13. Swiss SM 1941-1950
14. Swiss SM 1948-1953
15. Swiss SM 1958-1963
16. Swiss TG 1960

But the surplus of these tables has caused the blocking of standardization use in the life insurance sector. Therefore, a lot of research has been applied to decrease these tables. On 5th May 1978, with Article 14 (950.1/7) 12665 and Clause 28 of law no. 7397, the Insurance Inspection Committee (Sigorta Murakabe Kurulu) of the Turkish Treasury Undersecretariat reduced the mortality table total from sixteen to just three (Duransoy, 1993). These are;

1. Swiss Male (SM) Mortality Table (1948-1953)
2. Allgemeine Deutsche Sterbetafel Tabelle (ADST) General German Mortality Table (1949-1951)
   and, the
3. Commissioners Standard Ordinary (CSO) Mortality Table (1953-1958).

Later, the Undersecretariat added the American Commissioners Standard Ordinary (CSO) 1980 mortality table to include gender differences with Article B.02.1HM.O.SGM.0.2.1.2 /Gen/99/62885 on 31st July 2001 (Ataman, 2002).

The Undersecretariat of the Turkish Treasury has undertaken the control and inspection of mortality tables for life insurance companies in Turkey. The mortality tables used to determine risk premiums have been chosen with great care. The Undersecretariat of the Turkish Treasury can determine the mortality and the morbidity tables according to the results of the portfolio of life insurance companies or the data of the Turkish Statistics Institute. The Under-secretaryship can request the table and the results of the portfolio, which are constructed by the Association of Insurance and Reinsurance Companies of Turkey, from the insurance companies at the end of the year. The Association of the Insurance and Reinsurance Companies of Turkey consolidate these tables and then they are sent to The Undersecretariat of the Turkish Treasury and insurance companies (Life Insurance Regulation, 1996).

If insurance companies have ten years or more mortality experience, these companies can construct their own mortality tables or they can replace current mortality tables with their own mortality experience. But these companies have to send the new constructed mortality tables to the Undersecretariat of the Turkish Treasury with related formulas, methods of calculation, and assumptions in order to receive confirmation from the Undersecretariat of the Turkish Treasury (Life Insurance Regulation, 1996).

Although the insurance companies can construct their own mortality tables, no insurance company has yet used their own mortality table. All insurance companies have used four mortality tables accepted by The Undersecretariat of the Turkish Treasury. But these four different mortality tables are not used with same frequency. Insurance companies use these mortality tables for different payments of different life insurance policies.

The life insurance companies use 1980 CSO mortality tables more than the tables of the 1950s because they are more up to date, being not so old, and it is important not lose the most up to date measures for insurance policies.

On the other hand, when investigating profitability, out dated mortality tables are more profitable for whole life insurance policies and term life insurance policies for insurance companies; old mortality tables contain higher death rates and therefore, risk premiums for death will be charged at an equally higher rate. However, insurance companies cannot always easily use these high death rate mortality tables as a result of growing life insurance competition. A company can ensure that they have a large client base by using a mortality table with lower death rates.

Turkey Male and Female Mortality Tables (2001)

In this study, it is aimed to construct the mortality table from the join of both sexes with orphanhood method. In this study, 1998 and 2003 TDHS results were used to adult mortality. In two surveys, the question about the survival status of the parents is asked in the household questionnaire. The question about the survival status of mothers is asked at question number 10 and the question about the survival status of fathers is asked at question number 12 in household questionnaire. These questions are;

- Is ……………'s natural mother alive? (Question 10)
- Is ……………'s natural father alive? (Question 12)

In these questions "natural" word is used to avoid the adoption effect. If this word is not used in questionnaires, it can affect the results of orphanhood method negatively. According to these questions, the respondents give an answer as "yes", "no" or "don't know" and these answers assist to calculate proportions of alive mother and proportions of alive father.

Table 1 shows that the proportion of persons whose mother/father alive in 1998 and 2003 TDHS. The synthetic orphanhood method assumes that proportion of respondents' age (n) of the first survey will decrease when they pass the next age group (n+5) in the second survey.

But for synthetic orphanhood method, intersurvey cohort of respondents should be calculated. Table 2 shows that 1998 and 2003 intersurvey proportion of persons whose father and mother alive.

Table 1: Proportion of Persons Whose Mother/Father Alive in 1998 and 2003 TDHS

	Proportion of Alive Mother		Proportion of Alive Father	
age	**1998 TDHS**	**2003 TDHS**	**1998 TDHS**	**2003 TDHS**
0 - 4	0.9972	0.9978	0.9942	0.9959
5 - 9	0.9923	0.9944	0.9824	0.9858
10 - 14	0.9823	0.9891	0.9589	0.9658
15 - 19	0.9753	0.9750	0.9203	0.9377
20 - 24	0.9547	0.9585	0.8863	0.8936
25 - 29	0.9228	0.9377	0.7937	0.8276
30 - 34	0.8650	0.8804	0.7083	0.7069
35 - 39	0.8035	0.8061	0.5959	0.5914
40 - 44	0.7190	0.6938	0.4606	0.4653
45 - 49	0.5863	0.6230	0.3247	0.3586
50 - 54	0.3761	0.4577	0.1650	0.2185
55 - 59	0.2113	0.2534	0.0704	0.0976
60 - 64	0.0894	0.1008	0.0266	0.0332
65 - 69	0.0517	0.0463	0.0179	0.0178
70 - 74	0.0233	0.0151	0.0033	0.0043
75+	0.0255	0.0132	0.0153	0.0095

Brass established an equation relating to the female probability of surviving; Hill and Blacker established an equation relating to the male probability of surviving from age 25 to 25+n. These equations have the form:

$$l_{(25+n)} / l_{(25)} = W_{(n)} \cdot S_{(n-5)} + (1-W_{(n)}) \cdot S_{(n)} \quad \text{for females}$$
$$l_{(35+n)} / l_{(32,5)} = W_{(n)} \cdot S_{(n-5)} + (1-W_{(n)}) \cdot S_{(n)} \quad \text{for males}$$

Where, $S_{(n)}$ is the proportion of respondents aged from n to n+4 of alive mother or father. $W_{(n)}$ is a weighting factor which is calculated according to mean age at maternity and paternity using interpolation formula. Mean age at maternity can be calculated directly by using TDSH-1998 and 2003 Individual Questionnaire. But it is not possible for the mean age of paternity which cannot be calculated directly from data. Therefore, first age of marriage of males subtract from the first age of marriage of females. And than it added to mean age at maternity and later, nine-month pregnancy periods is subtracted from this number, since males are also under the risk of dying during this pregnancy period.

Table 2: 1998 and 2003 Intersurvey Proportion of Persons Whose Mother/Father Alive

	1998-2003 intersurvey proportion of alive mother	1998-2003 intersurvey proportion of alive father
5-9	0.9950	0.9874
10-14	0.9918	0.9708
15-19	0.9845	0.9494
20-24	0.9675	0.9219
25-29	0.9503	0.8609
30-34	0.9066	0.7667
35-39	0.8449	0.6401
40-44	0.7296	0.4999
45-49	0.6322	0.3892
50-54	0.4936	0.2619
55-59	0.3327	0.1549
60-64	0.1587	0.0730
65-69	0.0822	0.0489
70-74	0.0239	0.0117
75+	0.0136	0.0334

In this study, it is used only the last one year data preceding the 1998 and 2003 surveys. So, the average mean age of childbearing can be calculated for 2001.2 as a reference time. Table 3 shows that the mean age at maternity and paternity for 1998 and 2003. Table 4 and Table 5 indicate female and male adult survivorship probabilities which are calculated by Brass formula.

Table 3: Mean Age of Childbearing for Females and Males

	Mean Age of Childbearing	
	Females	**Males**
1998	27.09	30.52
2003	26.79	30.73
Average	26.94	30.62

Female and male adult survivorship probabilities assist to determine suitable mortality level and then e20 values from the west model life table between 1998 and 2003. So, orphanhood method is important to estimate adult mortality. The value of e20 provides already crucial information about adult mortality.

Table 4: Female Adult Survivorship Probability $l_{(25+n)}/l_{(25)}$

Age (n)	Weighting factor $W_{(n)}$	Proportion with mother surviving $S_{(n-5)}$	Complement of weighing factor $(1-W_{(n)})$	Proportion with mother surviving $S_{(n)}$	Female adult survivorship probability $l_{(25+n)}/l_{(25)}$
20	0.8334	0.9845	0.1666	0.9675	0.9817
25	0.9072	0.9675	0.0928	0.9503	0.9659
30	0.9502	0.9503	0.0498	0.9066	0.9481
35	0.9781	0.9066	0.0219	0.8449	0.9053
40	0.9412	0.8449	0.0588	0.7296	0.8381
45	0.8742	0.7296	0.1258	0.6322	0.7174
50	0.6887	0.6322	0.3113	0.4936	0.5891

Table 5: Male Adult Survivorship Probability $l_{(35+n)}/l_{(35)}$

Age (n)	Weighting factor $W_{(n)}$	Proportion with father surviving $S_{(n-5)}$	Complement of weighing factor $(1-W_{(n)})$	Proportion with father surviving $S_{(n)}$	Male adult survivorship probability $l_{(35+n)}/l_{(35)}$
20	0.3610	0.9494	0.6390	0.9219	0.9318
25	0.2817	0.9219	0.7183	0.8609	0.8781
30	0.1011	0.8609	0.8989	0.7667	0.7762
35	-0.1090	0.7667	1.1090	0.6401	0.6263
40	-0.4452	0.6401	1.4452	0.4999	0.4375
45	-0.7096	0.4999	1.7096	0.3892	0.3106

Table 6: Mean Mortality Level, and e20 values for 1998-2003 Intersurvey Cohort

	Mean West Level	e_{20}
Female	22,62	55,99
Male	22,17	52,14

In this study, COMBIN application of MORTPAK is used to construct abridged life tables which joins the infant and the child mortality rate and estimated e20 values by using west model life table (United Nations, 1988). This application produces mortality tables; however these mortality tables are constructed as an abridged mortality table. Thus, UNABR application of MORTPAK is used to transform abridged mortality tables to unabridged mortality tables which consist of single ages (United Nations, 1988).

Table 7: Turkey Female Mortality Table (2001)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
0	100,000	2,886	0.02886	0.97114	0.02928	0.98331	98,557	7,285,398	72.85
1	97,114	403	0.00415	0.99585	0.00416	0.99706	96,912	7,186,841	74.00
2	96,711	166	0.00172	0.99828	0.00172	0.99867	96,628	7,089,928	73.31
3	96,545	90	0.00093	0.99907	0.00093	0.99924	96,500	6,993,301	72.44
4	96,455	56	0.00058	0.99942	0.00058	0.99951	96,427	6,896,801	71.50
5	96,399	38	0.00039	0.99961	0.00039	0.99966	96,380	6,800,374	70.54
6	96,361	27	0.00028	0.99972	0.00028	0.99975	96,348	6,703,994	69.57
7	96,334	21	0.00022	0.99978	0.00022	0.99980	96,324	6,607,646	68.59
8	96,313	16	0.00017	0.99983	0.00017	0.99984	96,305	6,511,322	67.61
9	96,297	14	0.00015	0.99985	0.00015	0.99985	96,290	6,415,017	66.62
10	96,282	13	0.00014	0.99986	0.00014	0.99986	96,276	6,318,728	65.63
11	96,269	13	0.00014	0.99986	0.00014	0.99986	96,262	6,222,452	64.64
12	96,255	14	0.00015	0.99985	0.00015	0.99984	96,248	6,126,190	63.65
13	96,241	17	0.00018	0.99982	0.00018	0.99980	96,232	6,029,942	62.65
14	96,224	21	0.00022	0.99978	0.00022	0.99976	96,213	5,933,710	61.67
15	96,202	25	0.00026	0.99974	0.00026	0.99972	96,190	5,837,497	60.68
16	96,177	29	0.00030	0.99970	0.00030	0.99968	96,163	5,741,307	59.69
17	96,149	33	0.00034	0.99966	0.00034	0.99964	96,132	5,645,144	58.71
18	96,116	37	0.00038	0.99962	0.00038	0.99960	96,098	5,549,012	57.73
19	96,079	40	0.00042	0.99958	0.00042	0.99957	96,059	5,452,914	56.75
20	96,039	43	0.00045	0.99955	0.00045	0.99954	96,017	5,356,855	55.78
21	95,996	45	0.00047	0.99953	0.00047	0.99953	95,973	5,260,837	54.80
22	95,951	46	0.00048	0.99952	0.00048	0.99952	95,928	5,164,864	53.83
23	95,905	47	0.00049	0.99951	0.00049	0.99951	95,881	5,068,937	52.85
24	95,858	48	0.00050	0.99950	0.00050	0.99950	95,834	4,973,055	51.88
25	95,810	48	0.00050	0.99950	0.00050	0.99950	95,786	4,877,222	50.91
26	95,762	49	0.00051	0.99949	0.00051	0.99949	95,737	4,781,436	49.93
27	95,713	49	0.00051	0.99949	0.00051	0.99949	95,689	4,685,699	48.96
28	95,664	50	0.00052	0.99948	0.00052	0.99948	95,639	4,590,010	47.98

Table 7: Turkey Female Mortality Table (2001) (Continued)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
29	95,614	51	0.00053	0.99947	0.00053	0.99947	95,589	4,494,371	47.01
30	95,564	52	0.00054	0.99946	0.00054	0.99945	95,538	4,398,782	46.03
31	95,512	53	0.00056	0.99944	0.00056	0.99943	95,485	4,303,244	45.05
32	95,459	56	0.00059	0.99941	0.00059	0.99940	95,430	4,207,759	44.08
33	95,402	59	0.00062	0.99938	0.00062	0.99936	95,373	4,112,328	43.11
34	95,343	63	0.00066	0.99934	0.00066	0.99932	95,312	4,016,956	42.13
35	95,280	68	0.00071	0.99929	0.00071	0.99926	95,246	3,921,644	41.16
36	95,213	73	0.00077	0.99923	0.00077	0.99920	95,176	3,826,397	40.19
37	95,139	80	0.00084	0.99916	0.00084	0.99912	95,099	3,731,222	39.22
38	95,059	87	0.00092	0.99908	0.00092	0.99904	95,016	3,636,122	38.25
39	94,972	96	0.00101	0.99899	0.00101	0.99894	94,924	3,541,107	37.29
40	94,876	106	0.00112	0.99888	0.00112	0.99882	94,823	3,446,183	36.32
41	94,770	118	0.00125	0.99875	0.00125	0.99868	94,710	3,351,360	35.36
42	94,651	132	0.00139	0.99861	0.00139	0.99853	94,585	3,256,649	34.41
43	94,520	147	0.00155	0.99845	0.00155	0.99836	94,446	3,162,064	33.45
44	94,373	163	0.00173	0.99827	0.00173	0.99817	94,292	3,067,618	32.51
45	94,210	183	0.00194	0.99806	0.00194	0.99795	94,119	2,973,326	31.56
46	94,027	204	0.00217	0.99783	0.00217	0.99770	93,925	2,879,208	30.62
47	93,823	229	0.00244	0.99756	0.00244	0.99742	93,709	2,785,282	29.69
48	93,594	256	0.00273	0.99727	0.00273	0.99710	93,466	2,691,574	28.76
49	93,339	287	0.00307	0.99693	0.00307	0.99675	93,195	2,598,107	27.84
50	93,052	320	0.00344	0.99656	0.00345	0.99635	92,892	2,504,912	26.92
51	92,732	359	0.00387	0.99613	0.00388	0.99590	92,553	2,412,020	26.01
52	92,373	401	0.00434	0.99566	0.00435	0.99540	92,173	2,319,467	25.11
53	91,972	448	0.00487	0.99513	0.00488	0.99483	91,748	2,227,295	24.22
54	91,524	501	0.00547	0.99453	0.00549	0.99419	91,274	2,135,546	23.33
55	91,024	560	0.00615	0.99385	0.00617	0.99348	90,744	2,044,272	22.46
56	90,464	624	0.00690	0.99310	0.00692	0.99268	90,152	1,953,529	21.59
57	89,840	696	0.00775	0.99225	0.00778	0.99177	89,492	1,863,377	20.74

Table 7: Turkey Female Mortality Table (2001) (Continued)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
58	89,143	776	0.00871	0.99129	0.00875	0.99076	88,755	1,773,885	19.90
59	88,367	864	0.00978	0.99022	0.00983	0.98962	87,935	1,685,130	19.07
60	87,503	961	0.01098	0.98902	0.01104	0.98835	87,022	1,597,195	18.25
61	86,542	1,066	0.01232	0.98768	0.01240	0.98693	86,009	1,510,173	17.45
62	85,476	1,182	0.01383	0.98617	0.01393	0.98533	84,885	1,424,164	16.66
63	84,294	1,308	0.01552	0.98448	0.01564	0.98354	83,640	1,339,279	15.89
64	82,985	1,445	0.01741	0.98259	0.01756	0.98154	82,263	1,255,640	15.13
65	81,541	1,592	0.01953	0.98047	0.01972	0.97930	80,744	1,173,377	14.39
66	79,948	1,751	0.02190	0.97810	0.02214	0.97679	79,073	1,092,632	13.67
67	78,197	1,920	0.02455	0.97545	0.02486	0.97398	77,237	1,013,559	12.96
68	76,278	2,099	0.02752	0.97248	0.02790	0.97085	75,228	936,322	12.28
69	74,178	2,287	0.03083	0.96917	0.03131	0.96735	73,035	861,094	11.61
70	71,891	2,482	0.03452	0.96548	0.03513	0.96346	70,651	788,059	10.96
71	69,410	2,682	0.03864	0.96136	0.03940	0.95911	68,069	717,409	10.34
72	66,728	2,885	0.04323	0.95677	0.04419	0.95427	65,285	649,340	9.73
73	63,843	3,086	0.04834	0.95166	0.04954	0.94889	62,300	584,054	9.15
74	60,757	3,282	0.05402	0.94598	0.05552	0.94292	59,116	521,754	8.59
75	57,475	3,467	0.06032	0.93968	0.06220	0.93630	55,741	462,638	8.05
76	54,008	3,635	0.06730	0.93270	0.06964	0.92897	52,191	406,897	7.53
77	50,373	3,780	0.07503	0.92497	0.07795	0.92087	48,483	354,706	7.04
78	46,594	3,893	0.08356	0.91644	0.08720	0.91194	44,647	306,223	6.57
79	42,700	3,970	0.09297	0.90703	0.09750	0.90211	40,715	261,576	6.13
80	38,731	4,002	0.10332	0.89668	0.10895	0.89131	36,730	220,860	5.70
81	34,729	3,983	0.11468	0.88532	0.12166	0.87949	32,738	184,131	5.30
82	30,746	3,908	0.12710	0.87290	0.13573	0.86658	28,792	151,393	4.92
83	26,838	3,775	0.14066	0.85934	0.15130	0.85252	24,951	122,601	4.57
84	23,063	3,584	0.15541	0.84459	0.16850	0.83727	21,271	97,650	4.23
85	19,479	3,339	0.17140	0.82860	0.18747	0.82078	17,810	76,379	3.92
86	16,140	3,045	0.18866	0.81134	0.20831	0.80302	14,618	58,569	3.63

Table 7: Turkey Female Mortality Table (2001) (Continued)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
87	13,095	2,714	0.20723	0.79277	0.23118	0.78398	11,738	43,951	3.36
88	10,382	2,358	0.22711	0.77289	0.25620	0.76365	9,203	32,213	3.10
89	8,024	1,992	0.24830	0.75170	0.28350	0.74205	7,028	23,010	2.87
90	6,031	1,633	0.27078	0.72922	0.31318	0.71922	5,215	15,983	2.65
91	4,398	1,295	0.29450	0.70550	0.34535	0.69521	3,751	10,768	2.45
92	3,103	991	0.31938	0.68062	0.38007	0.67011	2,607	7,017	2.26
93	2,112	729	0.34534	0.65466	0.41742	0.64401	1,747	4,410	2.09
94	1,383	515	0.37225	0.62775	0.45738	0.61706	1,125	2,663	1.93
95	868	347	0.39997	0.60003	0.49995	0.58938	694	1,537	1.77
96	521	223	0.42836	0.57164	0.54511	0.56114	409	843	1.62
97	298	136	0.45722	0.54278	0.59272	0.53252	230	434	1.46
98	162	79	0.48637	0.51363	0.64265	0.50370	122	204	1.26
99	83	43	0.51562	0.48438	0.69473	0.32632	62	82	0.98
100	40	40	1.00000	0.00000	2.00000	0.00000	20	20	0.50

Table 8: Turkey Male Mortality Table (2001)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
0	100,000	3,010	0.03010	0.96990	0.03056	0.98253	98,495	6,865,775	68.66
1	96,990	432	0.00445	0.99555	0.00446	0.99660	96,774	6,767,280	69.77
2	96,558	227	0.00235	0.99765	0.00235	0.99804	96,445	6,670,506	69.08
3	96,331	150	0.00156	0.99844	0.00156	0.99864	96,256	6,574,061	68.24
4	96,181	111	0.00115	0.99885	0.00115	0.99897	96,126	6,477,804	67.35
5	96,071	87	0.00091	0.99909	0.00091	0.99917	96,027	6,381,679	66.43
6	95,983	72	0.00075	0.99925	0.00075	0.99930	95,947	6,285,652	65.49
7	95,911	61	0.00064	0.99936	0.00064	0.99939	95,880	6,189,705	64.54
8	95,850	55	0.00057	0.99943	0.00057	0.99945	95,822	6,093,824	63.58
9	95,795	50	0.00052	0.99948	0.00052	0.99949	95,770	5,998,002	62.61
10	95,745	47	0.00049	0.99951	0.00049	0.99951	95,722	5,902,231	61.65
11	95,698	47	0.00049	0.99951	0.00049	0.99950	95,675	5,806,509	60.68
12	95,652	49	0.00051	0.99949	0.00051	0.99946	95,627	5,710,834	59.70
13	95,603	54	0.00057	0.99943	0.00057	0.99939	95,576	5,615,207	58.73
14	95,548	62	0.00065	0.99935	0.00065	0.99930	95,517	5,519,632	57.77
15	95,486	72	0.00075	0.99925	0.00075	0.99919	95,450	5,424,114	56.81
16	95,415	83	0.00087	0.99913	0.00087	0.99907	95,373	5,328,664	55.85
17	95,332	95	0.00100	0.99900	0.00100	0.99894	95,284	5,233,291	54.90
18	95,236	107	0.00112	0.99888	0.00112	0.99883	95,183	5,138,007	53.95
19	95,130	116	0.00122	0.99878	0.00122	0.99874	95,072	5,042,824	53.01
20	95,013	124	0.00131	0.99869	0.00131	0.99866	94,951	4,947,753	52.07
21	94,889	130	0.00137	0.99863	0.00137	0.99861	94,824	4,852,802	51.14
22	94,759	134	0.00141	0.99859	0.00141	0.99858	94,692	4,757,978	50.21
23	94,625	136	0.00144	0.99856	0.00144	0.99856	94,557	4,663,285	49.28
24	94,489	137	0.00145	0.99855	0.00145	0.99855	94,421	4,568,728	48.35
25	94,352	138	0.00146	0.99854	0.00146	0.99854	94,283	4,474,307	47.42
26	94,214	138	0.00146	0.99854	0.00146	0.99854	94,146	4,380,024	46.49
27	94,077	137	0.00146	0.99854	0.00146	0.99854	94,008	4,285,879	45.56
28	93,939	137	0.00146	0.99854	0.00146	0.99854	93,871	4,191,870	44.62

Table 8: Turkey Male Mortality Table (2001) (Continued)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
29	93,802	138	0.00147	0.99853	0.00147	0.99852	93,733	4,097,999	43.69
30	93,664	140	0.00149	0.99851	0.00149	0.99850	93,595	4,004,266	42.75
31	93,525	142	0.00152	0.99848	0.00152	0.99846	93,454	3,910,671	41.81
32	93,383	147	0.00157	0.99843	0.00157	0.99840	93,309	3,817,218	40.88
33	93,236	152	0.00163	0.99837	0.00163	0.99833	93,160	3,723,908	39.94
34	93,084	160	0.00172	0.99828	0.00172	0.99824	93,004	3,630,748	39.01
35	92,924	168	0.00181	0.99819	0.00181	0.99813	92,840	3,537,744	38.07
36	92,756	179	0.00193	0.99807	0.00193	0.99800	92,666	3,444,904	37.14
37	92,577	193	0.00208	0.99792	0.00208	0.99784	92,481	3,352,238	36.21
38	92,384	207	0.00224	0.99776	0.00224	0.99767	92,281	3,259,757	35.28
39	92,177	223	0.00242	0.99758	0.00242	0.99748	92,066	3,167,476	34.36
40	91,954	242	0.00263	0.99737	0.00263	0.99725	91,833	3,075,411	33.45
41	91,712	263	0.00287	0.99713	0.00287	0.99700	91,581	2,983,577	32.53
42	91,449	287	0.00314	0.99686	0.00314	0.99672	91,306	2,891,997	31.62
43	91,162	313	0.00343	0.99657	0.00344	0.99640	91,006	2,800,691	30.72
44	90,849	343	0.00377	0.99623	0.00378	0.99605	90,678	2,709,685	29.83
45	90,507	374	0.00413	0.99587	0.00414	0.99567	90,320	2,619,007	28.94
46	90,133	409	0.00454	0.99546	0.00455	0.99524	89,928	2,528,687	28.06
47	89,724	448	0.00499	0.99501	0.00500	0.99477	89,500	2,438,759	27.18
48	89,276	489	0.00548	0.99452	0.00550	0.99425	89,032	2,349,259	26.31
49	88,787	535	0.00603	0.99397	0.00605	0.99367	88,519	2,260,227	25.46
50	88,252	585	0.00663	0.99337	0.00665	0.99304	87,959	2,171,708	24.61
51	87,666	640	0.00730	0.99270	0.00733	0.99234	87,346	2,083,749	23.77
52	87,026	699	0.00803	0.99197	0.00806	0.99157	86,677	1,996,403	22.94
53	86,328	763	0.00884	0.99116	0.00888	0.99072	85,946	1,909,726	22.12
54	85,564	833	0.00973	0.99027	0.00978	0.98978	85,148	1,823,779	21.31
55	84,732	907	0.01071	0.98929	0.01077	0.98875	84,278	1,738,631	20.52
56	83,824	988	0.01179	0.98821	0.01186	0.98762	83,330	1,654,353	19.74
57	82,836	1,074	0.01297	0.98703	0.01305	0.98638	82,299	1,571,023	18.97

Table 8: Turkey Male Mortality Table (2001) (Continued)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
58	81,762	1,167	0.01427	0.98573	0.01437	0.98502	81,178	1,488,724	18.21
59	80,595	1,266	0.01571	0.98429	0.01583	0.98351	79,962	1,407,545	17.46
60	79,329	1,371	0.01728	0.98272	0.01743	0.98186	78,644	1,327,583	16.74
61	77,958	1,482	0.01901	0.98099	0.01919	0.98005	77,217	1,248,940	16.02
62	76,476	1,599	0.02091	0.97909	0.02113	0.97806	75,677	1,171,723	15.32
63	74,877	1,721	0.02299	0.97701	0.02326	0.97588	74,016	1,096,046	14.64
64	73,156	1,849	0.02528	0.97472	0.02560	0.97348	72,231	1,022,030	13.97
65	71,306	1,982	0.02779	0.97221	0.02818	0.97085	70,315	949,799	13.32
66	69,325	2,117	0.03054	0.96946	0.03101	0.96798	68,266	879,484	12.69
67	67,207	2,255	0.03355	0.96645	0.03412	0.96483	66,080	811,218	12.07
68	64,953	2,394	0.03685	0.96315	0.03754	0.96138	63,756	745,138	11.47
69	62,559	2,531	0.04046	0.95954	0.04130	0.95761	61,294	681,382	10.89
70	60,028	2,666	0.04441	0.95559	0.04542	0.95348	58,695	620,088	10.33
71	57,362	2,795	0.04873	0.95127	0.04995	0.94897	55,965	561,393	9.79
72	54,567	2,916	0.05344	0.94656	0.05491	0.94406	53,109	505,429	9.26
73	51,651	3,026	0.05858	0.94142	0.06035	0.93870	50,138	452,320	8.76
74	48,625	3,121	0.06418	0.93582	0.06631	0.93288	47,065	402,182	8.27
75	45,504	3,198	0.07027	0.92973	0.07283	0.92654	43,906	355,117	7.80
76	42,307	3,253	0.07690	0.92310	0.07998	0.91965	40,680	311,211	7.36
77	39,053	3,284	0.08409	0.91591	0.08778	0.91218	37,411	270,531	6.93
78	35,769	3,287	0.09189	0.90811	0.09632	0.90409	34,126	233,120	6.52
79	32,483	3,259	0.10034	0.89966	0.10564	0.89534	30,853	198,994	6.13
80	29,223	3,199	0.10947	0.89053	0.11581	0.88589	27,624	168,141	5.75
81	26,024	3,105	0.11932	0.88068	0.12689	0.87572	24,472	140,517	5.40
82	22,919	2,978	0.12992	0.87008	0.13895	0.86478	21,430	116,046	5.06
83	19,941	2,818	0.14132	0.85868	0.15206	0.85303	18,532	94,616	4.74
84	17,123	2,629	0.15354	0.84646	0.16631	0.84047	15,809	76,083	4.44
85	14,494	2,415	0.16661	0.83339	0.18175	0.82705	13,287	60,275	4.16
86	12,079	2,181	0.18056	0.81944	0.19848	0.81276	10,989	46,988	3.89

Table 8: Turkey Male Mortality Table (2001) (Continued)

x	lx	dx	qx	px	mx	Sx	Lx	Tx	ex
87	9,898	1,934	0.19540	0.80460	0.21656	0.79758	8,931	35,999	3.64
88	7,964	1,682	0.21115	0.78885	0.23607	0.78150	7,123	27,068	3.40
89	6,282	1,431	0.22781	0.77219	0.25709	0.76454	5,567	19,945	3.17
90	4,851	1,190	0.24537	0.75463	0.27968	0.74669	4,256	14,378	2.96
91	3,661	966	0.26383	0.73617	0.30392	0.72798	3,178	10,122	2.76
92	2,695	763	0.28315	0.71685	0.32985	0.70844	2,314	6,944	2.58
93	1,932	586	0.30330	0.69670	0.35752	0.68810	1,639	4,630	2.40
94	1,346	436	0.32424	0.67576	0.38698	0.66702	1,128	2,991	2.22
95	910	315	0.34591	0.65409	0.41825	0.64526	752	1,864	2.05
96	595	219	0.36824	0.63176	0.45134	0.62289	485	1,111	1.87
97	376	147	0.39114	0.60886	0.48623	0.60000	302	626	1.67
98	229	95	0.41454	0.58546	0.52293	0.57668	181	324	1.41
99	134	59	0.43833	0.56167	0.56136	0.35966	105	142	1.06
100	75	75	1.00000	0.00000	2.00000	0.00000	38	38	0.50

COMPARISON OF THE RESULTS WITH AMERICAN CSO 1980 TABLES

The crucial objective of this study is to compare Turkish mortality tables (Tables 7 and 8) which are constructed with Turkish mortality data for both sexes, and four other foreign mortality tables which are used in Turkey. The premium payments are important for both insurer and insured. Thanks to this comparison and analysis, the real insurance premium will be calculated for Turkey.

The other important point is that calculation of net single premium will include only endowment life insurance. The results of the endowment life insurance have great importance because endowment life insurance is the most preferential type of life insurance policy by insurance companies in Turkey. Therefore, the results of this life insurance will exhibit the usability of Turkish mortality tables more precisely as other types of life insurance have a single probability factor, such as dying or living but endowment life insurance includes both probabilities.

In Table 9, the mortality ratios in CSO 1980 which is used by the insurance companies in Turkey and Turkey mortality table developed for both genders were compared.

Table 9: Comparison of 15-Year Death Rates (per thousand)

	American CSO 1980	Turkey Female 2001	Turkey Male 2001
15q30	34.21	11.97	29.66
15q40	84.77	40.62	78.55
15q50	190.51	123.71	192.00
15q60	422.71	343.17	426.39

The comparison of mortality ratios was done for the ages of 30, 40, 50 and 60 in 15-year intervals. Accordingly the mortality ratios of CSO 1980 mortality table have values close to those of Turkey Male Mortality table and higher than the values of Turkey female mortality table.

A second comparison was made on the life expectations as shown in Table 10. Accordingly, life expectations at birth in American CSO 1980 table are higher than Turkey Male Mortality table and lower than Turkey Female Mortality table.

Table 10: Comparison of Expectation of Life at Age x (Year)

	American CSO 1980	Turkey Female 2001	Turkey Male 2001
e0	70.83	72.85	64.58
e20	52.37	55.78	50.34
e40	34.05	36.32	32.32
e60	17.51	18.25	16.20
e70	10.96	10.96	9.84

Another comparison was made over the net single premium of endowment life insurance. Annual technical interest regarding the calculation of net single premium is 9%, which is the ratio determined by Undersecretariat of Treasure in Turkey. Table 11 shows that how much money insured have to pay, in order to he/she can take 10,000 TL compensation if he/she survives or dies at the end of the 15 years.

Table 11: Endowment Life Insurance Net Single Premium Payments for 15 Years (TL)

Age	American CSO 1980	Turkey Female 2001	Turkey Male 2001
20	2,817	2,765	2,801
25	2,816	2,767	2,805
30	2,827	2,773	2,816
35	2,857	2,788	2,844
40	2,910	2,817	2,896
45	2,991	2,871	2,984
50	3,115	2,967	3,124
55	3,307	3,132	3,339
60	3,588	3,408	3,660

According to Table 11, Turkey female mortality table has minimum insurance premium and Turkey male mortality table follows that. But after age 50, it is seemed that CSO 80 mortality table has lower premiums than Turkey male mortality table. For example, any insured who is 50 years old has to pay 2,967 TL for Turkey female mortality table, 3,115 TL for CSO 80 mortality table, and 3,124 TL for Turkey male mortality table in order to he/she can take 10,000 TL compensation if he/she survives or dies at the end of the 15 years. Consequently, it can be observed that the endowment life insurance whose premiums are calculated from Turkey female or male mortality table has the lowest premiums for the most suitable starting ages (25-40) for insurance. This situation shows that insurance companies have taken higher premiums from insured in crucial age groups. And it also causes loss for insured unjustly.

CONCLUSION

The most significant application field for mortality tables is life insurance. The insurance premiums can only be calculated with this essential element; however, in our country, mortality tables which do not represent the reality in Turkey have been used both in the insurance sector and in security institutions. Hence, it is evident that the insurance premiums calculated by foreign tables will be different. In order to eliminate this deficiency, Turkish mortality tables constructed from Turkish mortality data are needed.

Therefore there are two main objectives of this study. The first objective is to construct mortality tables which represent the reality of Turkey and to construct commutation tables which assist in the calculation of life insurance premiums. The second objective is also the calculation of life insurance premiums according to types of life insurance by using these tables. Thanks to this, four mortality tables which are used in the life insurance sector in Turkey are compared with a Turkish mortality table prepared from Turkish mortality data.

In this study, the synthetic maternal and paternal orphanhood method devised by Zlotnik and Hill (1981) was used to estimate adult mortality for males and females. This technique is also applied to 1998 and 2003 TDHS data sets for both genders and it gave an estimation for the year 2001/2. Both methods' mortality tables have been transformed from abridged mortality tables to complete mortality tables using UNABR application of MORTPAK. However, the mortality tables are not accurate enough to calculate insurance premiums. Therefore, insurance premiums have been formed by adding a technical interest on the mortality tables. At the end of the study, a premium comparison was made between Turkish commutation tables and the CSO 1980 mortality table, which is used in Turkey. These comparisons were applied to endowment life insurance.

The other important point is that life insurance companies can construct their own mortality table using their own mortality data. Ten years mortality data is sufficient to prepare this table legally in Turkey. Most life insurance companies in Turkey have been in business for more than ten years. So, most of them have ten years mortality data to date. Thus, it is not difficult to construct a mortality table using their own mortality data for life insurance companies which have a large insured portfolio. Lack of early and old age mortality data may create problems in the construction of this table for those companies. Thus, this deficiency in early and old ages can be solved by using certain mathematical calculations, such as the CSO mortality table.

When investigating the results of this study, they do not seem profitable for insurers. The premiums must equal the present value of compensation. Turkish mortality tables are a suitable for the demographic condition of Turkey. Thus, premium-compensation balance is provided with these tables. But, for other foreign mortality tables, insurance companies have placed higher premiums than the real premiums, especially for life insurance in terms of the probability of dying. For this reason, using foreign tables may seem more profitable for insurers but actually, if Turkish mortality tables have been used in the life insurance sector, more coherent estimations will be made to reflect current demographic condition of Turkey, premium-compensation balance will be provided, and this situation will increase the demand of life insurance, decrease passing from life insurance to private pension systems or leaving life insurance, increase the dividend amounts of the insured, increase the money directed to investments, and increase the share of life insurance in the GDP leading to higher confidence in the insurance sector. Consequently, this study clearly shows that the life insurance sector in Turkey needs reliable mortality tables prepared on the basis of the current mortality levels and patterns of Turkey.

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ÖZET

HAYAT SİGORTACILIĞINDA MORTALİTE TABLOSU SORUNSALI VE TÜRKİYE İÇİN ALTERNATİF ÇÖZÜM ÖNERİSİ

Bu çalışmanın temel amacı, Türkiye'de sigorta sektöründe kullanılabilecek güncel bir mortalite tablosu oluşturmak ve bu tablonun işlerliğini sigorta sektöründe kullanılan Amerikan CSO 1980 hayat tablosuyla karşılaştırarak sınamaktır. Çalışmanın temel katkısı, Türkiye'de sigorta sektöründe hesaplanan prim ve tazminatların, Türkiye ölüm verisinden hesaplanan prim ve tazminatlara göre ne denli farklılaşacağını ortaya koymaktır. Bu tablonun oluşturulabilmesi için dolaylı bir yöntem olan yetimlik yöntemi kullanılmıştır. Bu sayede, ölüm oranları, yaşam ümitleri ve sigorta primleri hesaplanmış ve Amerikan CSO 1980 hayat tablosu ile karşılaştırması yapılmıştır. Elde edilen sonuçlar, CSO 1980 tablosuna ait yaşam ümidi değerlerinin Türkiye kadın ve erkek mortalite tablosunun ortalama değerlerine benzerlik gösterdiğine işaret etmektedir. Diğer yandan CSO 1980 tablosunun 50 yaşına kadar olan 15 yıllık ölüm oranlarının, Türkiye kadın ve erkek mortalite tablosundan daha yüksek olduğu gözlenmiştir. Buna ek olarak, Türkiye'de en çok tercih edilen hayat sigortası türü olan karma hayat sigortası için prim karşılaştırması yapılmış ve Türkiye erkek ve kadın mortalite tablolarının, sigortaya başlamak için en uygun yaş aralıklarında (25 – 40 yaş aralığı) daha düşük sigorta primi alınması gerektiği tespit edilmiştir. Bu sonuçlar sigorta şirketlerinin, önemli yaş gruplarındaki sigortalılardan, olması gerekenden fazla sigorta primleri tahsil ettiğini ortaya koymaktadır.