

# Years of potential life lost in the south of Iran in 2011 and 2015: A population-based study

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## Abstract

**Introduction:** “Years of potential life lost (YPLL)” index is utilized to determine lost social and economic burdens in a population because of premature death due to various causes. This study aimed to determine the YPLL due to premature death in Jahrom County in 2011 and 2015.

**Method:** This study was cross-sectional and conducted through a secondary data analysis of Jahrom County in 2011 and 2015. Excel Template software of the World Health Organization (WHO) and standard Coale-Demeny “West” Model Life Table, levels 25 and 26, which estimated life expectancy (LE) at birth in 82.5 year old females and 80 year old males, were used to calculate the YPLL.

**Results:** Results indicate that cardiovascular diseases (35.5%), transportation accidents (6.8%), and cancer and tumors (6.4%) were three main causes of death in 2011, and cardiovascular diseases (38.4%), cancer and tumors (11.1%), and transportation accidents (6.6%) were respectively the leading causes of death in 2015. Furthermore, 26,491 years in 2011 and 19,262.5 years in 2015 were lost due to premature death in 2011; and conditions originating in the perinatal period, cardiovascular diseases, and transportation accidents were respectively three main causes of imposing YPLL on Jahrom County in 2011 and 2015.

**Conclusion:** Cardiovascular diseases were the first and most common causes of mortality in both genders. On the other hand, non-communicable diseases were the main causes of premature death in the population of Jahrom indicating the epidemiological transition and replacement of non-communicable diseases with communicable diseases in Jahrom as the main causes of death in accordance with results of national statistics of Iran.

**Key words:** Years of potential life lost (YPLL), cause of death, life expectancy

Please cite this article as: Rahmanian K. et al. Years of potential life lost in the south of Iran in 2011 and 2015: A population-based study World Family Medicine. 2017; (10):91-98..DOI: 10.5742/MEWFM.2017.93144

## Introduction

Health provision and improvement require specific policies and strategies which require precise information and indices for adoption (1). Due to resource constraints, governments need to identify the most important health needs by ongoing monitoring of health system and plan and work for reducing their burdens through effective interventions (2).

In developing countries, which constitute four-fifths of the world's population, non-communicable diseases are rapidly replacing communicable diseases, and it is anticipated that non-communicable diseases, which are currently causes of less than 50% of deaths, will account for 70% of mortality rates in 2020; hence, complex prioritization of diseases for resource allocation has challenged health policy makers (3).

On the other hand, achievement of priorities is the first step in planning health interventions, and indices should be prioritized after clear reflection of real health needs of the population (4).

Comparison of reliable, valid and comparable indices of individual and population health status is an essential stage in provision of evidence and information for health system management. Collection of personal data for calculating ratio of a specific problem or disease susceptibility is the easiest and most common way to measure population health indices. On the other hand, this method has become ineffective due to the emergence of many problems and the need to compare indices between populations over time or before and after specific interventions (5).

Years of potential life lost (YPLL) index is used to determine social and economic burdens in a population due to premature death due to various causes (3).

This index is among the indices of Summary Measures of Population Health (SMH) which includes health expectancy indices such as Disability Free Life Expectancy (DALE) indices and health interruption indices such as Disability Adjusted Life Years (DALY) indices which are very important in prioritization of health interventions (6).

Life expectancy represents average survival expectancy for all ages, and even if it shows a low expectancy for older ages, it does not reach zero and can be useful for evaluation of health and welfare level planning of population. Standard life expectancy is used to calculate years of potential life lost (4, 6).

YPLL index due to premature death by choosing a time unit as a unit of measuring and comparing years of life lost due to death with a standard life expectancy curve is a valuable analysis tool for prioritization of health problems and it can be applied in different geographical areas (2).

In study on burdens of diseases, DALY is obtained from adding number of potential years of life lost due to death and number of years elapsed due to disability and it can

reflect a gap between current and ideal health status (5). The YPLL, which is the mortality section of DALY, emphasizes the concept of early mortality and it is calculated by subtracting age at death from life expectancy of the same age in the same gender. In addition, the total life lost in a population is calculated by algebraic addition of dead people's YPLLs in that population (7, 8).

Center for Disease Control and Prevention (CDC) defines YPLL as a standard index in tables of disease for reporting. According to difference between YPLL index and mortality indexes such as Crude Death Rate (CDR), this index gives more weight to younger people's death. In addition, YPLL examines outcome of death from a social and economic point of view and reflects burden of loss resulting from life lost due to disease, while Proprietary and Crude Death Rates indicate only number of deaths in the human population, but they do not indicate burdens of these diseases; hence, it is impossible to perform regional, national, and international comparison (9).

In fact, the ultimate goal of estimating burdens of diseases through YPLL index is to provide the most objective evidence necessary to design and manage health programs, prioritize strategic research on population health, and develop and allocate human and financial resources, and expand organizational capacities for design, implementation and evaluation of cost-efficiency interventions, prevention, treatment and rehabilitation (10).

This study was conducted with the aim to determine YPLL due to premature death in Jahrom County in 2011 and 2015 and compare it with estimates in Iran and the world.

## Material and Methods

This cross-sectional study was conducted by secondary data analysis of Jahrom city in 2011 and 2015. Death certificates were compatible with the International Classification of Diseases, Tenth Revision (ICD-10) consisting of two sections, namely death certificate and burial permission. In Iran, these death certificates are completed for stillbirth (from the beginning of the 20th week of pregnancy), newborn infants, those infants who died in less than 7 days after birth, and other ages, and there is no need for completion of these certifications for abortions (before the 20th week of pregnancy).

YPLL is defined as the years when a person could have a useful life, but these years are lost due to premature death, in other words, they indicate society losses due to the loss of human capital as a result of premature death. The concept of life lost is related to concept of life expectancy. Life expectancy is a demographic index and means average time (in terms of years) when any person (with preservation of current conditions in terms of birth and death) can expect to survive at any age (4).

Excel Template software of the World Health Organization (WHO) and also standard Coale-Demeny "West" Model Life Table, levels 25 and 26, which estimates life expectancy

at birth (LE) in 82.5-year-old females (life expectancy for Japanese females) and 80-year-old males, were used to calculate the YPLL. In this table, the following equation was used to apply discount rate at discrete times:

$$n_{\text{present value}} = (1+r)^{0.5} \times \frac{1}{r} \times \left[ 1 - \left( \frac{1}{1+r} \right)^n \right]$$

Where, discount rate was considered to be 0.03 per year ( $r=0.03$ ).

$Cxe^{-Ax}$  Equation was also utilized for valuation of ages. In this equation, C is the constant value of 0.1658; x is equal to age, and B=0.04 (7).

For YPLL estimation, age of death due to each cause of death was deducted from age of life expectancy for the same gender. The sum of years of potential life lost due to various causes of death was calculated based on the following formula for different age groups:

$$YPLL = \sum Di (E - I)$$

**I:** Real age at death

**Di:** Number of deaths at age I

**E:** Life expectancy for the same gender

**Ethics approval:** This project was approved by the Ethics Committee, Deputy of Research, Jahrom University of Medical Sciences (IR.jums.REC.1395.131).

## Results

In general, we analyzed data of 2,262 deaths among which 1,230 were reported in 2011 and 1,032 in 2015. Details of database are shown in Table 1. (next page)

Major causes of death were compared in terms of frequency and years of potential life lost based on general death groups of ICD10 classification in Jahrom County during 2011 and 2015 (Figure 1 and Figure 2).

These results indicate that cardiovascular diseases (35.5%), transportation accidents (6.8%) and cancer and tumors (4.6%) were respectively the three main causes of mortality in both genders in Jahrom County during 2011, while cardiovascular diseases (38.4%), cancer and tumors (11.1%) and transportation accidents (6.6%) were respectively the main causes of mortality in 2015. In addition, diseases of the respiratory system had a rise from the 8th rank of mortality in 2011 to the 4th rank; infectious and parasitic diseases from the 12th to 8th rank; unintentional events from the 4th to 12th rank; suicide from the 16th to 13th rank; and violence by others from 15th to 14th rank in 2015.

26,491 years in 2011, and 19,262.5 years in 2015 were lost due to the premature death, so that conditions originating in the perinatal period (4335.5 years), cardiovascular diseases (3675.5 years), transportation accidents (3592 years), unintentional events (2275.5 years), congenital and

chromosomal abnormalities (1607.5 years), and cancer and tumors (1132 years) were generally the first 6 causes of mortality in both genders according to the YPLL rate in 2011.

In 2015, conditions originating in the perinatal period (3,789 years), cardiovascular diseases (3,024.5 years), transportation accidents (2,716 years), congenital and chromosomal abnormalities (1,690.5 years), cancer and tumors (1,681.5 years) and respiratory system diseases (1,111.5 years) were the first 6 causes of mortality according to the YPLL rate.

Displacement of conditions originating in the perinatal period from the fifth rank of mortality in 2011 and the sixth rank of mortality in 2015 to the first rank of causes of YPLL due to premature death is the interesting point in this regard.

Figure 3 shows the age-specific mortality rates by gender in Jahrom County in 2011 and 2015. As shown, mortality rate was high for people under the age of 5 and then it rapidly decreased. It again increased at the age of 50 and reached its peak at 75-79 years. In 2011 and 2015, mortality rate was higher in males than females in all age groups. In 2011, the YPLL was higher in males (15,973 years) than females (10,490 years). In 2015, the YPLL was 12,255 for males and 7,370.5 for females, and also the YPLL due to premature death was higher in males than females. In 2011, the YPLL due to cancer and tumors, mental illness and behavioral disorder, congenital and chromosomal abnormalities, unintentional events, violence by others, suicide, and transportation accidents were much higher in males than females, but the YPLL was higher in females than males due to cardiovascular diseases, endocrine, nutritional and metabolic diseases, and conditions originating in the perinatal period.

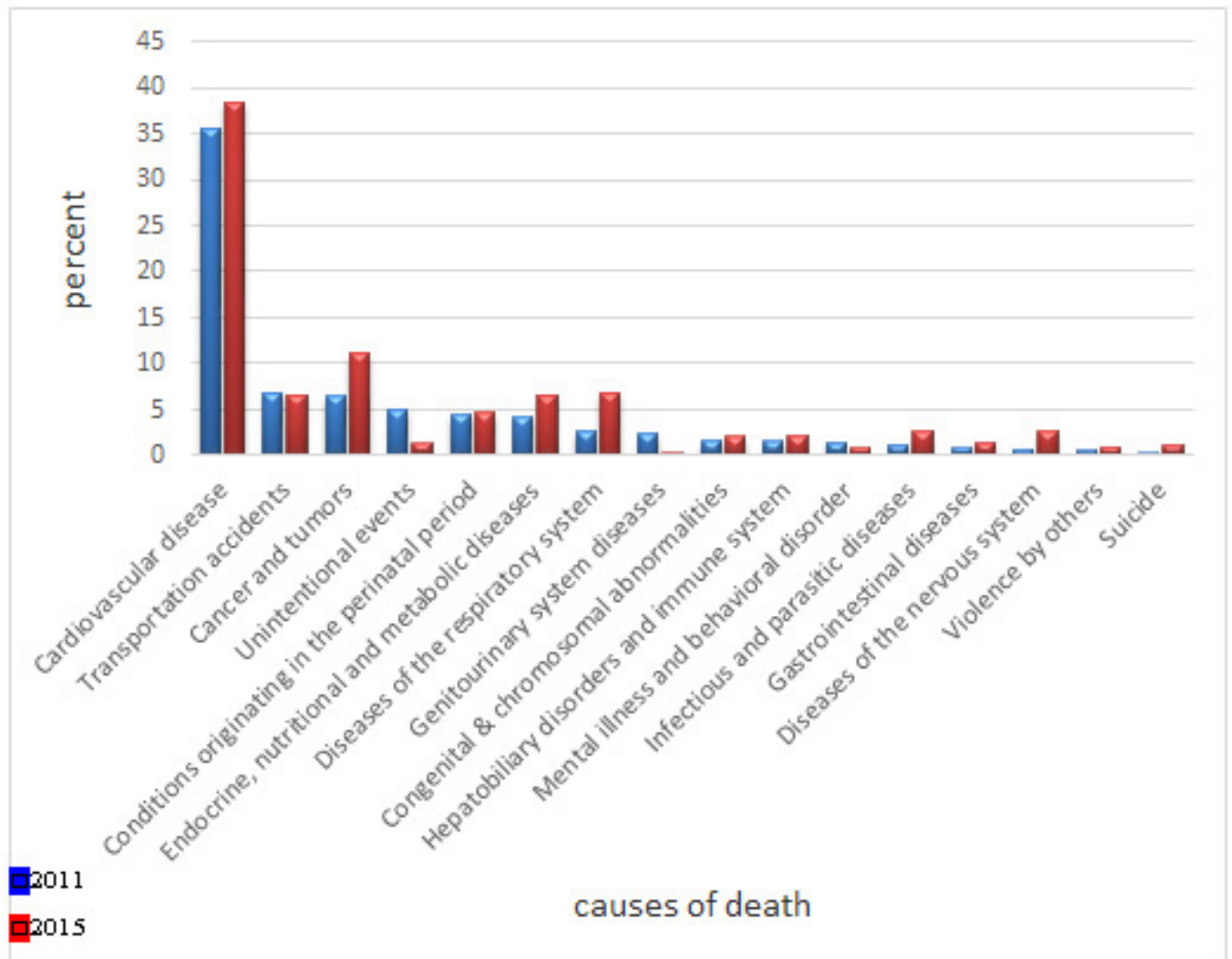
In 2015, the YPLL was higher in males than females due to mental illness and behavioral disorder, cardiovascular diseases, transportation accidents, violence by others, suicide, and congenital and chromosomal abnormalities, but the YPLL was higher in females than males due to cancer and tumors, endocrine, nutritional and metabolic diseases, and unintentional events (Table 2).



Table 1: Frequency of causes of death and YPLL according to ICD10 classification according to gender

Causes of Death according to ICD10	2011						2015					
	Male			Female			Male			Female		
	Frequency	Percentage	YPLL	Frequency	Percentage	YPLL	Frequency	Percentage	YPLL	Frequency	Percentage	YPLL
Infectious and parasitic diseases	11	1.5	291	3	0.6	61.5	21	3.3	562	6	1.5	26
Cancer and tumors	48	6.4	630	31	6.5	502	69	10.8	794	46	11.6	887
Hepatobiliary disorders and immune diseases	11	1.5	138	7	1.5	184.5	16	2.5	403	6	1.5	278.5
Endocrine, nutritional and metabolic diseases	25	3.3	146	27	5.7	271	43	6.8	441	24	6.1	240.5
Mental illness and behavioral disorder	16	2.1	421	1	0.2	52.5	7	1.1	307	1	0.3	52.5
Diseases of nervous system	6	0.8	245	2	0.4	152	17	2.7	346	11	2.8	230.5
Cardiovascular disease	245	32.6	1908	192	40.3	1770.5	243	38.2	1690	153	38.6	1334.5
Diseases of respiratory system	21	2.8	307	11	2.3	219	38	6	574	32	8.1	537.5
Gastrointestinal diseases	6	0.8	6	4	0.8	53	8	1.3	265	6	1.5	68
Genitourinary system diseases	14	1.9	332	15	3.1	214	2	0.3	94	0	0	0
Congenital and chromosomal abnormalities	15	2	1200	5	1	407.5	14	2.2	1113	7	1.8	577.5
Conditions originating in the perinatal period	20	2.6	1448	34	7.1	2805	35	5.5	2800	12	3	989
Bad and vague symptoms and conditions	108	14.4	1346	64	13.4	626	58	9.1	553	44	11.1	321
Unintentional events	47	6.3	1681	14	2.9	596	6	0.9	137	7	1.8	228
Violence by others	7	0.9	327	0	0	0	4	0.6	221	45	1.3	198.5
Suicide	4	0.5	204	0	0	0	7	1.1	365	34	1	233
Unknown	79	10.5	2346	53	11.1	1925	8	1.4	43	293	0.8	0
Transportation accidents	70	9.3	2997	14	2.9	595	39	6.1	1547	29	7.3	1169
Total	753	100	15973	477	100	10490	636	100	12255	396	100	7370.5

Figure 1: Frequency of causes of death based on ICD10 classification



## Discussion

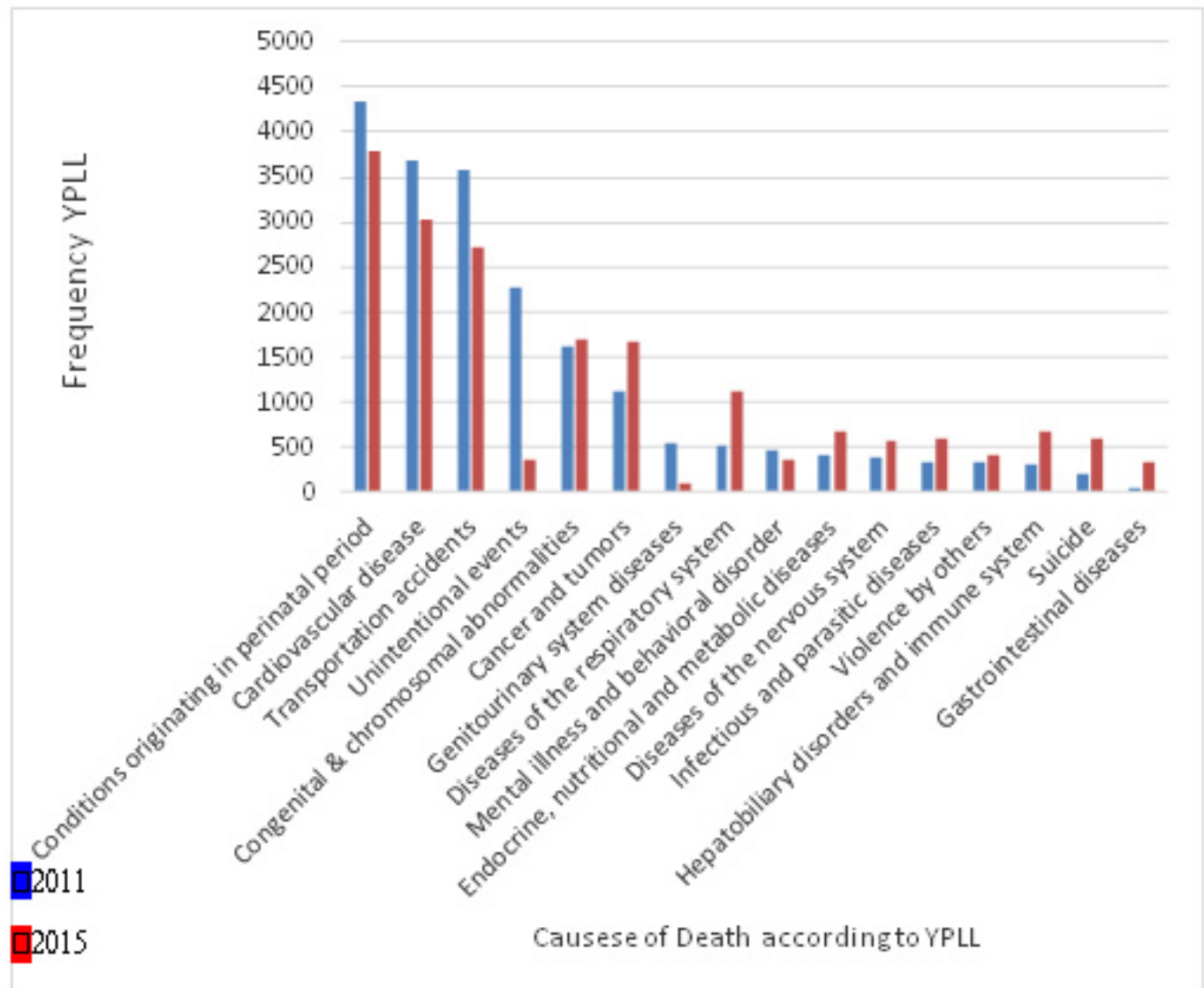
According to results of the present study, cardiovascular diseases, transportation accidents, and cancer and tumors were respectively the three main causes of mortality in Jahrom city in 2011, while cardiovascular diseases, cancer and tumors, and transportation accidents were respectively major causes of mortality in 2015, and cancer and tumors surpassed transportation accidents, so that cause of death was increased from 6.4% in 2011 to 11.1% in 2015.

Based on results of this study, conditions originating in the perinatal period, cardiovascular diseases, and transportation accidents were respectively the three main factors that imposed YPLL on Jahrom County in 2011 and 2015, and generally non-communicable diseases constituted the first five causes of premature death in Jahrom and this indicated epidemiological transition and replacement of non-communicable diseases with communicable diseases as the main causes of death. According to research by Khazaei et al. (2012) in Tuyserkan County, cardiovascular diseases, transportation accidents, and diseases of the respiratory system were respectively the main three causes of death (3).

It was found that conditions originating in the perinatal period were the first factor in YPLL in this study and occurred during infancy and childhood, as a total of 101 deaths were due to conditions originating in the perinatal period, and 8,124.5 years of potential life were lost according to this study. Displacement of conditions originating in the perinatal period from the fifth rank of mortality in 2011 and the sixth mortality rank in 2015 to the first rank of causes of death leading to years of potential life lost due to premature death is an interesting point as its significant importance in total years of potential life lost is obviously due to the young age at death.

Cardiovascular disease was the second cause of premature death in this study, so that the average age of deaths from cardiovascular diseases was  $72 \pm 13.71$  years leading to 3,678.5 years of potential life lost in Jahrom County in 2011, and 3,024.5 years of potential life lost in 2015. Cardiovascular diseases are the major causes of disability and premature deaths in addition to huge health costs worldwide (11).

According to research by Pourajal et al., who studied data of death in Hamadan province in 2010, cardiovascular diseases and transportation accidents were estimated as the two main causes of YPLL (4). In research by

**Figure 2: Frequency of YPLL based on ICD10 classification**

Farahbakhsh et al in the East Azarbaijan Province in 2010, Ischemic and myocardial infarction, unintentional events, and cerebrovascular diseases were classified as the three main causes of premature death (5).

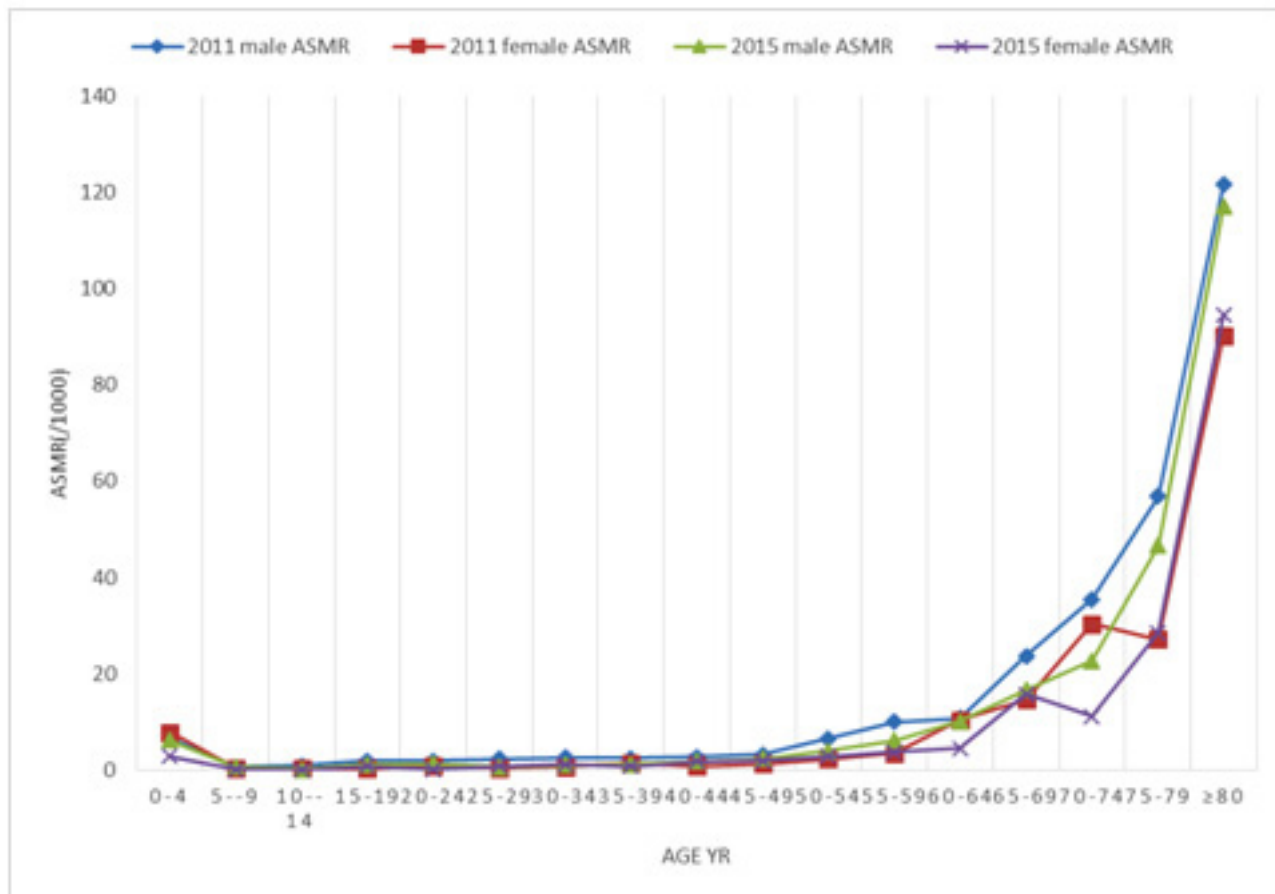
According to Maleras's research in Spain, cancer and tumors and cardiovascular diseases were respectively the two main causes of YPLL in Spain (12).

26,491 years of life in 2011, and 19,262.5 years in 2015 were lost due to premature death. In both studied years, YPLL was higher in males than females, as the main difference between females and males was related to transportation accidents. Death from transportation accidents mainly occur in males; and the present study also confirmed this case. This finding is based on the fact that burdens of premature events and consequences are higher in males who are more likely to suffer more from transportation accidents. 64.7% of males' accidents were reported in a research in Turkey (13).

In Africa and countries with low-middle income, males have the highest rates of death from transportation accidents worldwide (14).

YPLL level is higher in males than females in all age groups except for age groups of 0-4, 47-70 and 75-79 years, and this may be due to differences in lifestyles in both genders and more transportation accidents in males in addition to more high risk behavior in males such as tobacco use. According to studies by Pourajal et al in Hamadan of Iran (13) and Maleras et al in Spain (12), males had more YPLL.

Despite the fact that suicide is not the most significant problem in the world, released statistics by the World Health Organization (WHO) and health organizations of countries have raised global concern about suicide rates in young people. About one million suicides occur per year. Suicide rate is 16 people per 100,000 people in the world. Death rate due to suicide has been rising in both genders in Jahrom County, as it increased from 0.3 percent of death in 2011 to 1.1 percent in 2015. The young population of the county and the rising trend of suicide in addition to non-reporting of such deaths and failure to record unsuccessful suicide attempts increase sensitivity of this problem, so that mean age at suicide was  $29 \pm 13.85$  in this study, and it is essential to take appropriate measures in this regard.

**Figure 3: ASMR per 1,000 by year and sex**

In this study, the mortality rate was higher in males than females in all age groups, as ratio of male's death to females was 1.6 times; and 158 males against 100 females died in 2011, but they were 160 males against 100 women in 2015.

Lack of complete coverage of this system is one of the current problems in the registration system of death in Iran (15). The present study defined ratio of registered codes as "bad and vague symptoms and conditions" decreased from 14% in 2011 to 9.9% in 2015, and this decrease reflects authorities' greater concern for registering deaths in the male system because these percentages of death have other real causes which are not recorded in data and have different effects on calculated indices; and we hope there will be no further instances of these codes in the coming years.

## Conclusion

Results of this study indicated that cardiovascular diseases were the first and most common causes of mortality in both genders. On the other hand, conditions originating in the perinatal period, cardiovascular diseases, and transportation accidents were respectively three main factors that imposed YPLL on Jahrom County in 2011 and 2015, and in general, the non-communicable diseases were the main causes of premature death in the Jahrom population indicating the epidemiological transition and replacement of non-communicable diseases with communicable diseases as the main causes of death in accordance with results of national statistics in Iran.

## Acknowledgments

The present study was sponsored by Jahrom University of Medical Sciences.

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**Table 2. Distribution of deaths, ASMR per 1,000, and YPLL by year, gender and age group**

Age (yr)	2011						2015					
	Male			Female			Male			Female		
	Death	ASMR	YPLL	Death	ASMR	YPLL	Death	ASMR	YPLL	Death	ASMR	YPLL
0-4	54	6.61	4309	61	7.81	5100.5	60	6.17	4779	25	2.79	2058.5
5-9	5	0.66	368	3	0.41	226.5	5	0.58	370	1	0.12	75.5
10-14	6	0.80	407	2	0.27	142	1	0.12	67	0	0	0
15-19	18	1.94	1127	2	0.23	132	10	1.17	637	5	0.70	323.5
20-24	23	1.83	1328	10	0.81	600	13	1.24	752	7	0.76	421.5
25-29	31	2.31	1653	5	0.39	247.5	8	0.59	422	9	0.78	494.5
30-34	24	2.59	1153	6	0.62	308	14	1.01	684	14	1.11	705
35-39	17	2.37	728	10	1.40	457	11	1.06	470	7	0.72	312
40-44	18	2.72	680	5	0.78	204.5	13	1.73	486	12	1.70	487
45-49	18	3.15	591	7	1.21	252.5	16	2.32	525	12	1.90	423
50-54	34	6.51	930	11	2.26	336.5	22	3.90	604	15	2.75	452
55-59	40	9.95	910	14	3.47	358	31	6.18	715	17	3.63	426.5
60-64	30	10.68	543	32	10.29	665	38	10.07	675	17	4.48	350.5
65-69	37	23.62	489	27	14.62	415	45	16.67	590	25	15.69	402.5
70-74	65	35.42	517	60	30.31	625	32	22.58	264	17	11.05	177.5
75-79	86	56.80	240	35	27.17	386	70	46.60	215	42	28.55	225
≥80	246	121.72	0	157	90.28	34	247	117.06	0	171	94.57	36
Total	752	-	15973	477	-	10490	636	-	12255	396	-	7370.5

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