Iranian J Publ Health, Vol. 41, No.9, Sep 2012, pp. 18-24

Original Article

Life Expectancy at Birth in Rural Areas Based on Corrected Data of the Iranian Vital Horoscope

ME Motlagh [1], R Safari [2], M Karami [3], *A Khosravi [4]

1. *Dept. of Pediatrics, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran*
2. *Dept. of Biostatistics and Epidemiology, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran*
3. *Dept. of Biostatistics and Epidemiology, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran*
4. *Deputy for Public Health, Iranian Ministry of Health and Medical Education, Tehran, Iran*

***Corresponding Author:** Tel:+892166705173, Email: khosravi-a@health.gov.ir

(Received 11 Nov 2011; accepted 12 Jun 2012)

Abstract

Background: Life expectancy at birth as an alternative summary measure of mortality represents number of years which a newborn will be alive based on the current age specific death rates. As it summarizes death rates across all age range in a given population is the most common summary measure of mortality. The aim of this study was to correct death rates for underreport and estimate life expectancy at birth in rural population of Iran in 2008. In addition, this study aimed to assess the Vital Horoscope system's data quality.

Methods: Data were obtained from all Health Houses in Iranian villages in 2008. In order to adjust over 5 years old death rates for underreport, we used Brass Growth Balance method. Since this method is not applicable to under 5 years old, we used child mortality rates projected based on the Iranian Demographic and Health survey 2000 to correct death rates.

Results: Adjusted life expectancy at birth for males was 71.5 year and for females was 74.4 year. Completeness of the death data was 88% for males and 79% for females. Adjusted child (under 5) mortality rate by sex in males and females was 25.9 and 23.8 per 1000 live births respectively. Adult mortality for males was 167.2 and 98.3 for females per 1000.

Conclusion: Data based on Vital Horoscope system are a suitable source to estimate life expectancy and other mortality statistics. Also has an acceptable completeness on death registration. Further studies to investigate accuracy of data from the Vital Horoscope system are suggested.

Keywords: Life expectancy, Birth, Mortality indicators, Vital horoscope system

Introduction

Health information as the foundation of public health is essential for health planning and priority setting (1-6). Mortality data are used widely by authorities to monitor and compare health in a population over time and between different populations at the same time (7-10). In fact, mortality pattern is needed in different level from local to global (11). Life expectancy at birth as an alternative summary measure of mortality represents number of years which a newborn can live based on the current age specific death rates (8). It is interpretable by public and policy makers. In addition, it is not dependent on the age structure of a population, so it is widely used (10). There are two methods to estimate life expectancy, direct and indirect methods. When population and mortality data are available, life tables can be constructed and life expectancies can be estimated directly. If not, there are statistical models to estimate these using indirect methods (9).

In Iran, National Organization for Civil Registration (NOCR) is legally responsible for death registration. NOCR which was established in 1918, is in charge of registration vital events including birth, marriage, divorce and death. Ministry of

Health and Medical Education (MoH&ME), Deputy of Health operated a national program for death registration science 1999. This program at first initiated in Bushehr province (about 700,000 population) then expanded to the country by the end of 2004 (2, 12).

Other mortality data sources include censuses and surveys. In this way, data on mortality and death will be collected directly (asking about death in the household during a defined recall period for instance the past 12 months). Obviously, underreporting and misreporting of age and sex and especially in adults will threat the data quality (2). Vital Horoscope (VH) also is another system to collect data on population and mortality particularly in rural areas of Iran (12-13).

VH-a facility based data source- has been introduced by MoH&ME from 1988. It is a 50x70 sheet designed to display up to date data on vital events and services provided by health houses during the year (12-14). Community health workers (called *BEHVARZ*) must fill these papers monthly (15). At the end of the year, they send it to the District Health Center and finally will be sent to Tehran after entering into a defined computer program (14).

According to a report by the World Health Organization, complete data on mortality are available only for a few countries in the world. In developed countries, completeness of the data is the highest and lowest in developing countries. Previous study in Iran showed such as other developing countries data on mortality are not complete (14). Researcher must always assess the completeness the data on mortality by sex and age unless the registration system certainly captured all deaths. It is ideal to have data from two censuses by at least 10 years interval and registered death in this interval to adjust the data for underreport. However, in situation that data on mortality are available only for one year, there are several demographic techniques to adjust for underreporting of death (9, 16-17).

This study aims to estimate life expectancy at birth, adult mortality (15-60 yr) and child (under 5 yr) mortality rate by using data extracted from VH after adjusting for underreport. Although several studies previously had estimated life expectancies at birth and the other mortality indices based on VH data, it is for the first time to adjust the data from Vital Horoscope for underreporting (18-19). Of course, there are some studies which applied correction methods and then estimate life expectancy and other mortality indices even by provinces but they had used data from national death registration program (2, 20).

Materials and Methods

This is a cross sectional study using Vital Horoscope data which estimates life expectancy at birth and other mortality indices by applying direct method and constructing life table for the year 2008. We used Brass Growth Balance method to adjust over 5years old data on mortality. This method assumes that the population is stable and there is no migration. Death rate in any population is related to growth rate and birth rate. In other words, partial birth rate and partial death rate has linear correlation (the fraction population at exact age x to population at age x and above is called partial birth rate and the fraction death at exact age x and above to population at exact age x and above is called partial death rate) (16). We plotted partial death rate against partial death rate, used statistical procedure to fit the best line to the data and estimate the completeness of the death registration. By implementing the completeness factor to the death rates corrected rates were calculated for adult mortality. We used under five mortality rate projected based on the Demographic and Health Survey carried out in 2000 to adjust underreporting of deaths in under 5 years old (2, 20-22).

Results

The registered population by the Vital Horoscope system was 19998642, and registered death was 99226 in rural areas in 2008. Of the total population, about 51% were males. 9% were under five years old, and 8.5% were over 60. Of registered deaths, 8% were in under 5 and 26% adult 15 to 60 years old.

Adjusted life expectancy at birth for males was 71.5 years and for females was 74.4 years. Tables 1

and 2 represent the life tables for males and females in rural areas for Iran 2008, respectively. Completeness of the death data was 88% for males and 79% for females.

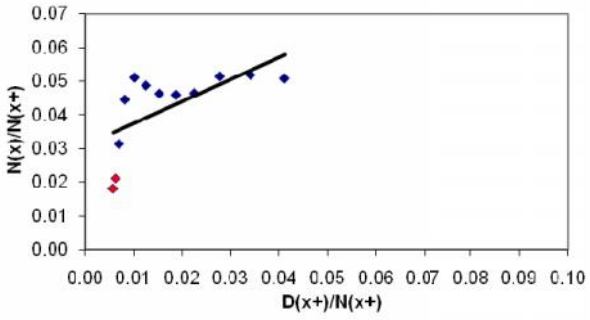

Fig. 1: Partial birth rates against partial death rates for Iranian men, rural areas, 2008/ *The red dots were deleted from the calculation of the correction factor

Figures1 and 2 show the plots of partial birth rate against partial death rate for males and females, respectively.

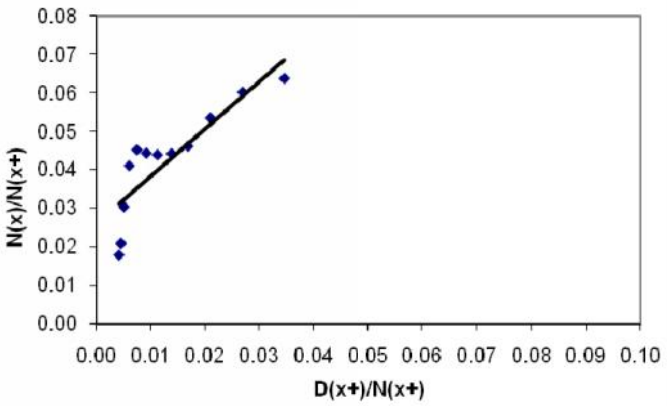

Fig. 2: Partial birth rates against partial death rates for Iranian women, rural areas, 2008

Table 1: Life table for males, rural population, Iran, 2008

Age group	Years in Interval	National Population	Adjusted Deaths	Mortality Rate	Linearity Adjustment	Probability of Dying	Probability of Surviving	Individuals Surviving	Deaths in Interval x	Years Lived in Interval x	Cumulative Years Lived	Expectancy of Life at Age x
	n	$_nN_x$	$_nD_x$	$_nM_x$	a_x	$_nq_x$	$_np_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0	1	187843	4035	0.0215	0.3	0.021	0.979	100,000	2,116	98,519	7,152,365	71.52
1-4	4	692651	848	0.0012	0.4	0.005	0.995	97,884	478	390,389	7,053,846	72.06
5-9	5	807723	501	0.0006	0.5	0.003	0.997	97,066	300	484,577	6,640,165	68.41
10-14	5	994465	567	0.0006	0.5	0.003	0.997	96,765	275	483,138	6,155,588	63.61
15-19	5	1361326	1907	0.0014	0.5	0.007	0.993	96,490	673	480,766	5,672,450	58.79
20-24	5	1380782	2612	0.0019	0.5	0.009	0.991	95,817	902	476,828	5,191,683	54.18
25-29	5	1057682	2061	0.0019	0.5	0.010	0.990	94,915	920	472,273	4,714,856	49.67
30-34	5	752518	1640	0.0022	0.5	0.011	0.989	93,994	1,019	467,426	4,242,583	45.14
35-39	5	618521	1553	0.0025	0.5	0.012	0.988	92,976	1,160	461,979	3,775,157	40.60
40-44	5	456361	1541	0.0034	0.5	0.017	0.983	91,816	1,537	455,236	3,313,179	36.09
45-49	5	417805	2094	0.0050	0.5	0.025	0.975	90,279	2,234	445,808	2,857,943	31.66
50-54	5	335421	2453	0.0073	0.5	0.036	0.964	88,044	3,162	432,318	2,412,135	27.40
55-59	5	249956	2739	0.0110	0.5	0.053	0.947	84,883	4,527	413,096	1,979,817	23.32
60-64	5	196218	3140	0.0160	0.5	0.077	0.923	80,355	6,181	386,324	1,566,721	19.50
65-69	5	182721	4366	0.0239	0.5	0.113	0.887	74,174	8,361	349,966	1,180,397	15.91
70-74	5	211191	7543	0.0357	0.5	0.164	0.836	65,813	10,789	302,089	830,431	12.62
75-79	5	155619	9054	0.0582	0.5	0.254	0.746	55,023	13,974	240,181	528,342	9.60
80-84	5	92640	9718	0.1049	0.5	0.416	0.584	41,049	17,057	162,604	288,161	7.02
85+	5	38435	7344	0.1911		1	0.000	23,992	23,992	125,557	125,557	5.23

The circled dots were excluded from the calculation of the correction factor. Adjusted child mortality rate (probability of dying by age 5) (23) for males and females was 25.9 and 23.8 per 1000 live births, respectively. Adult mortality (probability of dying between 15 and 60) (23) for males was 167.2 and for females was 98.3 per 1000 population.

.

Table 2: Life table for females, rural population, Iran, 2008

Age group	Years in Interval	National Population	Adjusted Deaths	Mortality Rate	Linearity Adjustment	Probability of Dying	Probability of Surviving	Individuals Surviving	Deaths in Interval x	Years Lived in Interval x	Cumulative Years Lived	Expectancy of Life at Age x
	n	$_nN_x$	$_nD_x$	$_nM_x$	a_x	$_nq_x$	$_np_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0	1	178948	3533	0.0197	0.3	0.019	0.981	100,000	1,947	98,637	7,439,118	74.39
1-4	4	661279	742	0.0011	0.4	0.004	0.996	98,053	439	391,158	7,340,481	74.86
5-9	5	770046	386	0.0005	0.5	0.003	0.997	97,892	245	488,846	6,969,094	71.19
10-14	5	949206	362	0.0004	0.5	0.002	0.998	97,646	186	487,767	6,480,249	66.36
15-19	5	1255395	787	0.0006	0.5	0.003	0.997	97,460	305	486,539	5,992,482	61.49
20-24	5	1207907	929	0.0008	0.5	0.004	0.996	97,155	373	484,844	5,505,942	56.67
25-29	5	957477	754	0.0008	0.5	0.004	0.996	96,782	380	482,962	5,021,098	51.88
30-34	5	741392	658	0.0009	0.5	0.004	0.996	96,402	427	480,943	4,538,136	47.08
35-39	5	614787	733	0.0012	0.5	0.006	0.994	95,975	571	478,448	4,057,193	42.27
40-44	5	479294	808	0.0017	0.5	0.008	0.992	95,404	801	475,018	3,578,745	37.51
45-49	5	441068	1260	0.0029	0.5	0.014	0.986	94,603	1,341	469,662	3,103,726	32.81
50-54	5	388817	1688	0.0043	0.5	0.021	0.979	93,262	2,003	461,302	2,634,064	28.24
55-59	5	310791	2344	0.0075	0.5	0.037	0.963	91,259	3,378	447,851	2,172,762	23.81
60-64	5	232518	2917	0.0125	0.5	0.061	0.939	87,881	5,345	426,044	1,724,911	19.63
65-69	5	192883	4205	0.0218	0.5	0.103	0.897	82,536	8,531	391,353	1,298,866	15.74
70-74	5	185401	6649	0.0359	0.5	0.165	0.835	74,005	12,178	339,578	907,513	12.26
75-79	5	132144	8267	0.0626	0.5	0.271	0.729	61,826	16,724	267,321	567,935	9.19
80-84	5	74680	8507	0.1139	0.5	0.443	0.557	45,102	19,995	175,522	300,614	6.67
85+	5	34731	6971	0.2007		1	0.000	25,107	25,107	125,092	125,092	4.98

Discussion

This study primarily designed to estimate life expectancies at birth for Iranian rural population, also to assess the application of Vital Horoscope system as a source of mortality information. It was for the first time that data from VH system were corrected due to underreport to estimate life expectancy at birth and the other mortality indices in Iran. The results showed that, life expectancy at birth for males was 71.5 years and for females was 74.4 years. Adjusted child (under 5) mortality rate by sex for males and females was 25.9 and 23.8 per 1000 live births respectively. Adult mortality for males was 167.2 and 98.3 for females per 1000. Besides completeness of the death reporting was 88% for males and 79% for females.

Study by Malekafzali in 1997 showed identical results (70.7 for males and 73.4 for males). This is in spite of the health progress during this time period (19). It might be because of unadjustment and didn't consider correction procedure of the rates. A study on estimation of life expectancy for Kohgiloye & Boyer Ahmad Province in 2003 shows same results (70.8 for males and 73.8 for females) (18). VH data has been used as a source

to calculate the health indices including mortality indices but there were no adjustment for death underreporting this may result in over estimation of the life expectancy in the previous studies.

A study based on data from national death registration program in 2003 estimated life expectancy at birth for males and females 70.09 and 73.17 years, respectively. In this study, data on mortality were available only for 23 out o 30 provinces of Iran (20). Khosravi also estimated life expectancy at birth for 68.7 for males and 71.2 for females. Results of these two national studies are lower than results presented here. These two separate studies had corrected data on death by Growth Balance Method as we did but reported lower Life expectancy than the presented study. Which may indicate the better quality of the data from VH that results in the smaller correction factor was lower in this study compare to mentioned studies (2).

According to a report by WHO the life expectancy for the Iranian people in 2008 was 70 years for males and 75 for females taking the consideration it is estimated based on the model and by indirect methods, our results are concordant to them. Also the life expectancy is higher for females, similar to these study findings. Adult mortality rates, estimated by WHO, were 0.153 for males and 0.124 for females, respectively. Compare to the present study the adult mortality rate for males, is higher and it is lower for females. This may be due to the method of the estimation and also the rates projected by WHO are for entire population of Iran but we present the results for rural population only (24).

Adjusted adult mortality rate for males was higher than females and was 167.2 and 98.3, respectively. This is concordant to other studies as Khosravi et al. showed higher adult mortality rate for males than females (0.124 for females and 0.175 for males)(2). Furthermore, national burden of disease study showed the YLL rate (years of potential life lost) was 100.4 year per 1,000 males in comparison with 65.3 years per 1,000 people for females Corrected child (under5) mortality was 29.34 for males and 21.08 for females (25). Adult mortality rate for male is estimated 0.152 for males and 0.124 for females based on statistical models by WHO (24), again it is higher for males.

Child mortality rate as the fourth Goal of Millennium Development Goals (MDGs) is an important indicator which reflect the living environmental and economic setting (23, 26). Moreover, this indicator can reflect both infant mortality rate and child (1-4 year) (27). In present study, we attempted to estimate it after adjustment for underreport. It was 25.9 and 23.8 per 1000 live births for males and females respectively. These results are consistent to other sources as estimated rates by WHO were 37 per 1000 for males and 28 for females. Although WHO estimates are for the whole population of Iran (24).

In order to adjust death rates to construct the life table and estimate life expectancy at birth we assess the Vital Horoscope system to evaluate the completeness of death registration. Results showed this system has an acceptable completeness that it was higher for males than females (88% for males and 79% for females) which is consistent with the study by Pourmalek (90% for males and 79% for females) (20). This shows that Vital Horoscope system can act as good as a national mortality data source and is a strength point for health information system in Iran.

Stability of the population is one of the assumptions of the Brass Growth Balance method (9, 16). It is ideal to use data of two censuses which is done by a 10 years interval. In this case it is necessary to have data on mortality between two censuses which were not available now (9). To under 5 adjustment we used results of Demographic and Health Survey 2000 (DHS) (22). Due to the fact that there was no new estimation for child mortality rate in rural population based on new survey, we used rates projected based on the results of this study.

This study was carried out to estimate life expectancies at birth for rural population of Iran. Obviously, levels of mortality are different between the provinces. It is suggested to study on inequality in health indicators such as life expectancy at the provincial level of Iran. Although data on VH system are used for estimate various health indica-

tors, it is strongly recommended to investigate the accuracy of data from this system.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

Acknowledgement

The study was fully supported by Ministry of Health and Medical Education, Center for Health Network Management. Also special gratitude to the Technical Group for Health Information Management and Technology and Health Applied Research is required. The authors declare that there is no conflict of interest.

References

1. Evans T, Stansfield S (2003). Health information in the new millennium: a gathering storm? *Bulletin of the World Health Organization*. 81 (12): 856**.**
2. Khosravi A, Taylor R, Naghavi M, Lopez AD (2007). Mortality in the Islamic Republic of Iran, 1964-2004. *Bulletin of the World Health Organization*. 85(8): 607-14**.**
3. Murray CJL, Lopez AD (1997). Mortality by cause for eight regions of the world: Global Burden of Disease Study. *The Lancet*, 349(9061): 1269-76.
4. Mathers CD, Boerma T, Ma Fat D (2009). Global and regional causes of death. *British Medical Bulletin*, 92(1): 7-32.
5. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ (2006). Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *The Lancet*, 367(9524): 1747-57**.**
6. Murray CJL, Lopez AD (1994). Global and regional cause-of-death patterns in 1990. *Bulletin of the World Health Organization*, 72(3): 447-70**.**
7. Toson B, Baker A (2003). Life expectancy at birth: methodological options for small populations. National Statistics Methodological Series 33. Available from: http://www.statistics.gov.uk/hub/search/in-x.html?newquery=Life+expectancy+at+birth%3A+methodological+options+for+small+
8. Silcocks PB, Jenner DA, Reza R (2001). Life expectancy as a summary of mortality in a population: statistical considerations and suitability for use by health authorities. *J Epidemiol Community Health*, 55(1): 38-43**.**
9. WHO (2001). *National Burden of Disease Studies: A Practical Guide*. WHO, Geneva.
10. CDC (2003). Summary Measures of Population Health reports on finding and methodological and data issue *CDC***.** Available from: http://www.cdc.gov/nchs/data/misc/pophealth.pdf
11. Byass P (2007). Who needs cause-of-death data? *PLoS Medicine*, 4(11): 1715-16**.**
12. 12. WHO (2001). Review of Health Information Systems (HIS) in Selected Countries (The Islamic Republic of Iran). Available from: http://www.who.int/healthmetrics/documents/hmnassessment_irn.pdf
13. Mehryar AH, Naghavi M, Ahmad-Nia S, Kazemipour S (2008). Vital Horoscope: Longitudinal Data Collection in the Iranian Primary Health Care System. *Asia-Pacific Population Journal*, 23(3): 55.
14. Khosravi A, Motlagh ME, Emami Razavi SH (2009). The Iranian Vital Horoscope; Appropriate Tool to Collect Health Statistics in Rural Areas. *Iranian J Publ Health*, 38 (1): 74-80**.**
15. Anonymous (2008). Iranian health houses open the door to primary care. *Bulletin of the World Health Organization*, 86 (8): 585-86**.**
16. United Nations (1983). Manual X: *Indirect techniques for demographic estimation*. United Nations, New York, pp.: 139-146.
17. Mathers CD, Ma Fat D, Inoue M, Rao C, Lopez AD (2005). Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bulletin of the World Health Organization*, 83 (3): 171-7.

18. Ghaffarian Shirazi HR, Chaman R, Ghorbani A, Hatami Pour E, Zadeh Bagheri Gh, Jabar Nejad (2005). Life expectancy and longevity in men and women in rural areas in Kohgiloyeh and Boyer Ahmad province in 2003. *Armaghane Danesh* [Farsi], 10 (38): 80-86.
19. Malekafzali H (1998). The life expectancy of Iranian men and women in 1996 (1375 Iranian Hegira calendar). *Hakim Journal* [Farsi], 2 (1): 107-10.
20. Pourmalek F, Abolhasani F, Naghavi M et al (2009). Direct estimation of life expectancy in the Islamic Republic of Iran in 2003. *East Mediterr Health J*, 15 (1):76-84.
21. Khosravi A, Taylor R, Naghavi M Lopez AD (2007). Differential mortality in Iran. *Population Health* Metrics, 5 (7): 1-15.
22. Iranian Ministry of Health & Medical Education: *Population and Health in the Islamic Republic of Iran: Demographic and Health Survey (DHS)* (2000). Tehran, Iranian Ministry of Health and Medical Education, p.44.
23. WHO (2009). *World Health Statistics Indicator compendium*. Available from: http://www.who.int/gho/publications/world_health_statistics/WHS2012_Indicator-Compendium.pdf
24. WHO (2010). *Global Health Statistics 2010 part 2, Global Health Indicators*. WHO.
25. Naghavi M, Abolhassani F, Pourmalek F et al. (2009). The burden of disease and injury in Iran 2003. *Popul Health Metr*, 7(9): 1-21.
26. Krishnadas N (2010). Millennium Development Goals. Available from: http://msja.anu.edu.au/archive/issue/01/mdgs.php
27. WHO (1983). *Development of Indicators for Monitoring Progress towards Health for All by the Year 2000*. WHO.