Seroprevalence of Hepatitis E Virus in Iran: A Systematic Review and Meta-analysis

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ABSTRACT

BACKGROUND

Hepatitis E virus (HEV) is one of common causes of viral hepatitis worldwide with higher prevalence in tropical and subtropical regions. Although epidemics of HEV have been reported from Iran, there are variable reports of this infection out-of-epidemics from different parts of Iran. This study aimed to determine the seroprevalence of HEV in Iran.

METHODS

In this systematic review and meta-analysis we searched PubMed, Scopus, Science direct, Google Scholar, Scientific Information Databank (SID), IranMedex, and Magiran for all relevant studies published in either English or Persian languages, up to 2015. Pooled seroprevalence estimates with a DerSimonian-Laird random-effects model were calculated. Statistical heterogeneity among the included studies was evaluated by Cochrane Q statistic and I².

RESULTS

38 studies fulfilled the inclusion criteria compromising 18461 participants. The pooled seroprevalence rate of HEV in Iran was estimated about 10% (95% CI=0.09-0.12) with maximum and minimum of 46% (95 % CI=0.42-0.50), and 0.01% (95 % CI=0.000-0.002), respectively.

CONCLUSION

HEV is common in Iran although the prevalence is lower than some neighbor countries.

KEYWORDS

Hepatitis E Virus; Seroprevalence; Meta-analysis; Systematic review; Iran

INTRODUCTION

Hepatitis E virus (HEV) is a common cause of community acquired viral hepatitis.¹ The infection is endemic in many developing countries² with a prevalence of as high as 50%.³ In non-endemic countries, the prevalence varies between 1% to 20%.⁴ This virus like hepatitis A does not lead to chronic hepatitis or carrier state in immunocompetent hosts. A special feature of HEV is its high mortality among pregnant women, which may reach up to 20-25%

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of cases. The infection could also become chronic in immunocompromised hosts specially recipients of solid organ transplantation.

HEV has been reported worldwide, but it is more common in Central and South-West Asia. At least two epidemics of HEV have been reported from Iran in 1990 in Kermanshah province in western border of the country and in 1992 in Chahar Mahal and Bakhtiari province in central Iran.

Out of these epidemics there are different reports of HEV prevalence in Iran. As HEV could cause both acute hepatitis in general population, and chronic disease in immunocompromised hosts, it is of utmost importance to have an estimate of this infection in the whole nation. This is not only of importance for Iran but could also help to better understand the epidemiology of this infection in other transitional societies. This study aimed to determine the seroprevalence of HEV in Iran in a systematic review and meta-analysis.

MATERIALS AND METHODS

Databases:
We performed a literature search on PubMed, Scopus, Science direct, Google Scholar, Scientific Information Databank (SID), IranMedex, and Magiran till March 2015 for HEV. Studies published in either English or Persian languages were included in the systematic review. The references of all selected published articles from the above databases were also searched to find more relevant studies. The abstract book of national and international conferences with the topic of liver disease, hepatology, hepatitis, and infectious diseases were also searched for HEV.

Search strategy:
Search strategy was based both on Medical Education Subject Headings (Mesh) terms as well as free text words and words in the title or abstract of studies. We used the following search strategy "HEV" OR “Hepatitis E Virus” AND “seroepidemiology” OR “Epidemiology” OR “Prevalence” AND “Iran”, in Persian or English languages.

Study Selection:
The inclusion criteria were: studies that had data indicating the seroprevalence of HEV using standard methods. The exclusion criteria were: studies that did not clearly separate the prevalence of HEV from other viral diseases, studies with unknown sample origins, studies with overlapping time, subjects and place of sample collection, case reports and case series, studies focusing on treatment, studies reporting on HEV among patients with non-Iranian nationality.

Data Extraction:
Two investigators (Masoud.Behzadifar and Meysam. Behzadifar) independently applied inclusion criteria and selected studies and extracted the data. Data from the included studies, including the name of the first author, year of publication, location of study, age, sex, type of study, sample size, and number of the infected cases and conflicts were recorded for further analysis.

Assessment of studies:
STROBE questionnaire was used to assess the quality of the studies. All studies were scored by two investigators (Gholamreza.Ghoreishinia, Abouzar.Keshavarzi) separately and mean score was calculated for each study. The studies with score less than 7.5 were considered as poor quality. For 38 articles in this review, the obtained score was 18.11.

Statistical Analysis:
In studies where the SE (standard error) was not reported we calculated it from the prevalence using the following formula:

$$SE = \sqrt{\frac{P(1-P)}{N}}$$

$$P = \text{prevalence, } N = \text{sample size}$$

Confidence interval (CI) 95% = $P \pm 1.96 \times SE$

Studies were estimated with respect to the prevalence with CI and P value. Statistical heterogeneity among the included studies were measured by Cochrane Q statistic and I2. 10. Rank of I2 was predefined as a Cochrane Q of 25% = low heterogeneity, 50% = medium heterogeneity, and 75% = high heterogeneity, respectively. P < 0.05 was considered as statistically significant. We considered studies reporting HEV in Iran using random effects model. Meta-regression analysis of the variables of each study such as sample size, and the year of publication, sex, type of study, and the subgroup analyses were done when possible. Publication bias was assessed by Egger’s and Begg’s tests and graphically depicted by a funnel plot. All data analy-
Fig. 1: Flowchart of search and studies selection

RESULTS

Based on our search strategy described above 521 articles were initially retrieved. Of them, 148 articles were excluded as duplicate publications. We carefully read the titles and abstracts of the remaining 373 articles and further 170 records were excluded based on the exclusion criteria mentioned above. After reading the full text of the remaining 203 articles, an additional 135 articles were further found to have one of the exclusion criteria. Finally, 38 studies were found eligible for final analysis and were used for this meta-analysis. This systematic review and meta-analysis is reported according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines are shown in figure 1.

Included studies consisted of cross sectional and case control designs. The characteristics of all studies are...
Table 1: Characteristics of included studies in the meta-analysis

| Author            | Year | Sample | Location     | Sample population          | Sex | Type of study | Age        |
|-------------------|------|--------|--------------|----------------------------|-----|---------------|------------|
| Eini              | 2015 | 153    | Hamedan      | Hemodialysis patients       | M/F | Cr-Sec        | >40 - <60  |
| Beladi Mousavi    | 2014 | 47     | Ahvaz        | Hemodialysis patients       | M/F | Cr-Sec        | 55.27 ± 8.1|
| Rostamzadeh       | 2013 | 136    | Urmia        | Pregnant Women              | F   | Cr-Sec        | 25.12 ± 4.91|
| Ahmadi            | 2013 | 1582   | Mashhad      | General population          | M/F | Cr-Sec        | 29.06 ± 18.513|
| Ehteram           | 2013 | 530    | Arak         | Blood donors                | M/F | Cr-Sec        | 18-50      |
| Zekavat           | 2013 | 356    | Jahrom-Shiraz| Hemodialysis patients       | M/F | Cr-Sec        | 24-80      |
| Rostamzadeh       | 2011 | 91     | Urmia        | Renal Transplant Recipients | M/F | Cr-Sec        | 35.4 ± 14.5|
| Sepanlou          | 2010 | 1423   | Tehran-Golestan| General population          | M/F | Cr-Sec        | 37.9±13.4  |
| Mobaeni           | 2013 | 93     | Zanjan       | Hemodialysis patients       | M/F | Cr-Sec        | 57.0 ± 18.5|
| Saffar            | 2009 | 1102   | Sari         | General population          | M/F | Cr-Sec        | 2 - 25     |
| Taremi            | 2008 | 1824   | Nahavand     | General population          | M/F | Cr-Sec        | 34.7±19.5  |
| Ataei             | 2009 | 816    | Isfahan      | General population          | M/F | Cr-Sec        | 6 - >50    |
| Assarehzadeh      | 2008 | 400    | Khuzestan    | Blood donors                | M/F | Cr-Sec        | 18-60      |
| Taremi            | 2007 | 399    | Tabriz       | Blood donors                | F   | Cr-Sec        | 31.4±9.8   |
| Taremi            | 2005 | 324    | Tabriz       | Hemodialysis patients       | M/F | Cr-Sec        | 53.5 ± 15.1|
| Farkhani          | 2013 | 152    | Tehran       | Patients HIV                | M/F | Cr-Sec        | 38.73 ± 0.78|
| Mohebbi           | 2012 | 551    | Tehran       | General population          | M/F | Cr-Sec        | 41.28 ± 16.96|
| Nazer             | 2012 | 400    | Khorramabad  | General population          | M/F | Cr-Sec        | 36         |
| Tahamtan          | 2013 | 150    | Gorgan       | Hemodialysis patients       | M/F | Cr-Sec        | >30 - <70  |
| Ghadir            | 2007 | 697    | Golestan     | General population          | M/F | Cr-Sec        | 43±15.1    |
| Moradi            | 2010 | 1200   | Gorgan       | Pregnant Women              | F   | Cr-Sec        | 27±6.3     |
| khoshbaten        | 2001 | 324    | Tabriz       | Hemodialysis patients       | M/F | Cr-Sec        | 53±15.11   |
| Gachkar           | 2005 | 399    | Tabriz       | Blood donors                | F   | Cr-Sec        | 40.7±12.4  |
| shavakhi          | 2007 | 200    | Tehran       | liver cirrhosis             | M/F | Ca-Con        | ca=43±14.6,cl=44.9±17.5|
| Esfandifar        | 2012 | 184    | Tehran       | Patients HIV                | M/F | Ca-Con        | 38.82±0.8  |
| Rezaazadeh        | 2006 | 280    | Hamedan      | Blood donors                | M/F | Cr-Sec        | >40 - <40  |
| Alavi             | 2007 | 228    | Ahvaz        | Drug addiction              | F   | Cr-Sec        | ca=33.24±7.59,cl=31.2±7.59|
| Sharif            | 2013 | 558    | Kashan       | Children                   | M/F | Cr-Sec        | 1 to 15    |
| Noroozi           | 2012 | 740    | Qom          | General population          | M/F | Cr-Sec        | >15        |
| Mohebbi           | 2012 | 493    | Tehran       | General population          | M/F | Cr-Sec        | 40.98±17.10|
| Ghorbani          | 2007 | 800    | Tehran       | Military                   | M   | Cr-Sec        | 19±1       |
| Somi              | 2007 | 200    | Azerbaijan   | Blood donors                | M/F | Cr-Sec        | 48.26±18.19|
| Pourahmad         | 2009 | 43     | Jahrom       | Hemodialysis patients       | M/F | Cr-Sec        | 59.3 ± 14.4|
| Shamsizadeh       | 2009 | 566    | Ahvaz        | Children                   | M/F | Cr-Sec        | 6 to 15    |
| Aminiafshekar     | 2004 | 90     | Tehran       | Blood donors                | M/F | Cr-Sec        | 31.8±11    |
| Keramat           | 2014 | 262    | Hamedan      | Drug addiction              | M/F | Cr-Sec        | IDUs=35.57 ± 8.13,non IDUs=31.57 ± 8.19|
| Joulaii           | 2015 | 158    | Shiraz       | Patients with HIV           | M/F | Cr-Sec        | 39.1 ± 8   |
| Farshadpour       | 2015 | 510    | Ahvaz        | community-based             | M/F | Cr-Sec        | 45.89 ± 14.63|

M/F: Male – Female, Cr-Sec: Cross – Sectional, Ca-Con: Case-Control, IDUs= Injection Drug Users
demonstrated in table 1.

The total sample size included 18,461 participants from 38 studies. The result of Q Cochran test (chi-squared=1194.08, D.F =37, \( p=0.000 \) and I2=96.9 %) indicated strong heterogeneity among the 38 studies. According to the random model analysis, the overall seroprevalence of HEV in Iran was estimated 10% (95% CI=0.09-0.12) with a maximum and minimum value of 46% (95% CI=0.42-0.50), and 0.01% (95% CI=0.000-0.002), respectively (figure 2).

In all included studies, individuals were entered randomly. The maximum seroprevalence rate of 46% was reported by Farshadpour from Alvaz (2015) in southwest border of Iran and Iraq. The minimum seroprevalence rate of 1% was reported by Ghorbani in Tehran and by Saffar in Yazd located in the central desert of Iran in 2010 and 2006, respectively. Seroprevalence rate in both sexes (female-male) was 11% (95% CI=0.09-0.13), the seroprevalence rate in female patients was 8% (95% CI=0.05-0.10), and the seroprevalence in male patients was 1% (95% CI=0.00-0.02) (figure 3A). The seroprevalence rate was 11% (95% CI=0.09-0.13)
in cross sectional studies and 8% (95% CI=0.02-0.15) in case control studies (figure 3B).

To assess publication bias by a funnel plot, we used Begg’s and Egger test. The results of Begg’s was $p=0.068$ and Egger tests was $p=0.000$. This finding indicates a significant publication bias (figure 4).
Fig. 3B: Forest plots of hepatitis E virus prevalence in Iran by study type (B)
DISCUSSION

Studies in different parts of the world show a wide variation in the seroprevalence of HEV. The present study estimated the overall seroprevalence of HEV in Iran as 10%. There was a wide variation in HEV seroprevalence in the included studies in this meta-analysis. The highest report belonged to Ahvaz, the center of Khozestan province in our border with Iraq. The population in this region travel frequently to Iraq. There are several reports of endemicity of HEV in Iraq even in Baghdad, the capital.52,53 Interestingly although the general trend of the publications shows a lower prevalence in recent years, the situation is reverse in Khozestan and Ahvaz showing an increase in the prevalence from 11.5% in a study in 2008 to 46% in 2015. This corresponds to a period of more mobility along Iran / Iraq border in recent years. The disposal of waste water in Ahvaz also has faced many challenges especially after the recent cycles of drought and flood in the province in contrast to the low-prevalence reported from Tehran with much better sanitation. The other region with much lower prevalence is Yazd with its surrounding deserts and dry weather.

Seroprevalence of HEV decreased by reduced sample size and later publication year but it was not significant. In table 3, a summary of data related to meta-regression is shown.

Table 2: Characteristics of study population and percentage in 38 studies included in meta-analysis of hepatitis E virus prevalence in Iran

| Subgroups              | No. of studies | Sample size | Prevalence % (95%CI) | Heterogeneity |
|------------------------|----------------|-------------|----------------------|---------------|
| Blood donors           | 7              | 2298        | 12.3% [0.087 to 0.160] | 87.0% 0.000   |
| General population     | 11             | 10138       | 12.1% [0.078 to 0.164] | 98.8% 0.000   |
| Military               | 1              | 800         | 11% [0.004 to 0.019]  | - -           |
| Patients with HIV      | 3              | 494         | 10.5% [0.029 to 0.181] | 88.6% 0.000   |
| Hemodialysis patient   | 8              | 1490        | 9.5% [0.059 to 0.132] | 85.6% 0.000   |
| Drug addiction         | 2              | 490         | 9% [-0.030 to 0.211]  | 95.5% 0.000   |
| Children               | 2              | 1124        | 6% [0.014 to 0.107]   | 90.9% 0.000   |
| Liver cirrhosis        | 1              | 200         | 5.5% [0.023 to 0.087] | - -           |
| Pregnant women         | 2              | 1336        | 5.4% [0.029 to 0.079] | 56.1% 0.131   |
| Renal transplant recipients | 1 | 91         | 3.8% [0.213 to 0.403] | - -           |

Seroprevalence of HEV decreased by reduced sample size and later publication year but it was not significant. In table 3, a summary of data related to meta-regression is shown.

Table 3: Result of Meta-regression investigating the effect of sample size and year on seroprevalence of hepatitis E virus in Iran

|                  | Coefficient | Standard error | T   | p       | L CI       | UCI       |
|------------------|-------------|----------------|-----|---------|------------|-----------|
| Sample size      | -.0000275   | .0000329       | -0.84 | 0.409 | -.0000942  | .0000392 |
| Year             | .005872     | .0041553       | 1.41 | 0.166  | -.0025636  | .0143076 |
| Cons             | -11.68132   | 8.353102       | -1.40 | 0.171  | -28.63902  | 5.276378 |

LCI: Lower Confidence Interval   UCI: Upper Confidence Interval   Cons=Index is calculated in this study, SE (Standard Error)
patients receiving hemodialysis, intravenous drug users, and HIV infected patients compared to the general population. One should realize that the most common route of HIV infection in Iran is still intravenous drug use, although the trend is moving toward sexual route. This indicates that in concordance with other reports, the major route of transmission of HEV is fecal oral rather than parenteral.

It is of interest that in patients with cirrhosis the prevalence was 5.5% and in renal transplant recipients it was 3.8%. As these reports were based on serology and these patients might have exposure to HEV with loss of antibody over time due to malnutrition or immunosuppression, our estimates in these special groups might be incorrect.

This systematic review and meta-analysis has advantage of a relatively large sample size with merging data of good quality studies but it also has several limitations. Although the included studies were from many parts of the country, there were some regions with no data. For
instance we could not find any eligible study from two regions with confirmed epidemics of HEV in Iran naming Kermanshah and Chahar Mahal Bakhtiari provinces. The studies analyzed in this systematic review used several different types of serology for HEV from different sources, and their comparability is not known. There was a lack of appropriate data on the age and sex in some of the included studies. Consequently, we were not able to analyze the data by stratifying these variables. Using the information on sex and age, we could better estimate the prevalence of hepatitis E among subgroups in our society. Substantial heterogeneity of 95.7%, according to the F statistic is another limitation. Of utmost importance is that none of the studies reported the prevalence of HEV among patients suffering from acute hepatitis. Despite these limitations, our study reveals that HEV in Iran is not rare and is not limited to epidemics.

HEV in Iran has an estimated prevalence of 10%. The infection seems to have a decreasing trend overtime, which might be related to improved sanitation and better access to safe water but the pattern is not uniform across the entire country with existence of certain confounders such as mobility along borders especially to countries with high endemcity of HEV. Further prospective studies on incidence of infection, especially in patients suffering from acute hepatitis in non-epidemic conditions are required to obtain better knowledge on the dynamics of this virus in our country.

Authors’ contributions:
All of the authors significantly contributed to this systematic review and meta-analysis. All made the search in databases. Masoud Behzadifar, Meysam Behzadifar, Abouzar Keshavarzi, and Maryam Saran reviewed the literature, selected and assessed the articles. Masoud Behzadifar analyzed the data. Kamran B Lankarani provided critical comments for the subsequent drafts. All of the authors reviewed the final manuscript and approved the final version.

CONFLICT OF INTEREST
The authors declare no conflict of interest related to this work.

REFERENCES
1. Purcell RH, Emerson SU. Hepatitis E: an emerging awareness of an old disease. J Hepatol 2008;48: 494-503. doi: 10.1016/j.jhep.2007.12.008.
2. Keane F, Gompels M, Bendall R, Drayton R, Jennings L, Black J, et al. Hepatitis E virus coinfection in patients with HIV infection. HIV Med 2012;13:83-8. doi: 10.1111/j.1468-1293.
3. Taniguchi M, Kim SR, Mishiro S, Takahashi K, Shin MH, Yun H, et al. Epidemiology of hepatitis E in Northeastern China, South Korea and Japan. J Infect 2009;58:232-7. doi: 10.1016/j.jinf.
4. Dalton HR, Bendall R, Ijaz S, Banks M. Hepatitis E: An emerging infection in developed countries. Lancet Infect Dis 2008;8:698-709. doi: 10.1016/S1473-3099(08)70255-X.
5. Vasickova P, Psikal I, Kralik P. Hepatitis E virus: a review. Vet Med 2007; 8: 365-84.
6. Behrendt P, Steinemann E, Manns MP, Wedemeyer H. The impact of hepatitis E in the liver transplant setting. J Hepatol 2014;61:1418-29. doi: 10.1016/j.jhep.2014.08.047.
7. Taremi M, Khoshbaten M, Gachkar L, Ehsani-Ardakani MJ, Zali M. Hepatitis E virus infection in hemodialysis patients: A seroepidemiological survey in Iran. BMC Infect Dis 2004;5:36-8. doi: 10.1186/1471-2334-5-36.
8. Alizadeh AH, Taromi M, Ansari S, Ardalan A, Mahmoud Araabi M, Zali MR. Prevalence of hepatitis E antibodies and cofactors in the population over 6 years old in Nahavand in 2003. Res J Shaheed Beheshti Univ Med Sci 2004;7: 489-94.
9. Von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Ann Intern Med 2007;147:573-7. doi: 10.1371/journal.pmed.0040296.
10. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. Br Med J 2003;327:557-60.
11. Egger M, Davey Smith G, Schneider M, Minder C. Bias in Meta-Analysis Detected by a Simple,Graphical Test. BMJ 1997;315:629-34. doi: 10.1136/bmj.315.7109.629.
12. Begg CB, Mazumdar M. Operating Characteristics of a Rank Correlation Test for Publication Bias. Biometrics 1994;50:1088-101. doi: 10.2307/2533446.
13. Ahmadi-Ghezeldasht S, Mirda R, Hedayati-moghadam M. Population Movement and Virus Spreading: HEV Spreading in a Pilgrimage City, Mashhad in Northeast Iran; an Example. Hepat Mon 2013;13: e10255. doi: 10.5812/ hepatitis.
14. Alavi SM, Ahmadi F, Gharemierad M, Nikkhooi A. The correlation between Hepatitis E seropositivity and intravenous drug using in the drug users who referred to the drug treatment centers in Ahvaz, 2005-2006. J Shahrekord
Seroprevalence of Hepatitis E Virus Infection in Iran.

43. Sharif A, Sharif M, Taghavi A, Madani M, Khirkhah D, Afzali H. Seroepidemiology hepatitis E in children in Kashan in 2011. Iran J Infect Dis Trop Med 2013;18:31-6.

44. Shavakhi A, Esteghamat F, Sharifian A, Mohamad Alizade AH, Khodadostan M, Somi MH, et al. Hepatitis E study in patients with cirrhosis of the liver, a case - control study. Govaresh 2007;12:27-9.

45. Somi MH, Farhang S, Majid G, Shavakhi A, Pouri AA. Seroprevalence of Hepatitis E in Patients with Chronic Liver Disease from East Azerbaijan, Iran. Hepat Mon 2007;7:127-30.

46. Tahamtan A, Moradi A, Ghaemi A, Kelishadi M, Gha- fari H, Hashemi P, et al. Seroepidemiology of Hepatitis E Virus in Hemodialysis Patients in Gorgan-Iran. Med Labora J 2013;7:13-7.

47. Taremi M, Gachkar L, MahmoudArabi S, Kherad pezhouh M, Khoshbaten M. Prevalence of antibodies to hepatitis E virus among male blood donors in Tabriz, Islamic Republic of Iran. East Mediterr Health J 2007;13:98-102.

48. Taremi M, Khoshbaten M, Gachkar L, EhsanArda kan M, Zali M. Hepatitis E virus infection in hemodialysis patients: A seroepidemiological survey in Iran. BMC Infec Dis 2005;5:36. doi: 10.1186/1471-2334-5-36

49. Taremi M, Mohammad Alizadeh AH, Ardalan A, Ansari S, Zali MR. Seroprevalence of hepatitis E in Nahavand, Islamic Republic of Iran: a population-based study. East Medit Health J 2008;14:157-62.

50. Zekavat OR, Makarem A, Karami MY, Amanat A, Mohandes M, Habibagahi M. Serological investigation for hepatitis E virus infection in the patients with chronic maintenance hemodialysis from southwest of Iran. Asian J Transfu Sci 2013;7:21-5. doi: 10.4103/0973-6247.106724

51. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Ioannidis JP, et al. The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. PLoS Med 2009;6: e1000100. doi :10.1371/journal.pmed.1000100

52. Utba NM. The prevalence of hepatitis E virus in Al-Sadr City - Baghdad. Clin Lab 2013;59: 115-20. doi: 10.7754/Clin.Lab.2012.120124

53. Al-Nasrawi KK, Al Diwan JK, Al-Hadithi TS, Saleh AM. Viral hepatitis E outbreak in Al-Sadr city, Baghdad, Iraq. East Mediterr Health J 2010;16: 1128-32.

54. Lankarani KB, Alavian SM, Peymani P. Health in the Islamic Republic of Iran, challenges and progresses. Med J Islam Repub Iran 2013;27: 42-9.