Geographical disparities in child mortality in the rural areas of Iran: 16-years trend

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ABSTRACT
Purpose We performed this study to assess the trend of geographical disparities between rural areas located in the catchment areas of 41 medical universities in Iran from 1993 to 2008. We evaluated four indicators including rates for neonatal mortality (NMR), infant mortality (IMR), under-5 mortality (USMR) and crude death (CDR).

Methods We got about 656 university-year data points for each of the indicators (missing data <0.5%). The people under assessment were between 16.7 (in 1993) to 20.1 million (in 2008). We measured disparities through the calculation of index of disparities (IDisp) and assessed the trends using the Cuzick non-parametric test for trend.

Findings Except for the increasing trend of CDR (Z=+2.83, p=0.005), the others had decreasing trends: NMR (Z=−3.23, p=0.001), IMR (Z=−3.84, p<0.001) and USMR (Z=−3.84, p<0.001). The IDisp trends of IMR (Z=−2.2, p=0.027) and USMR (Z=−2.84, p=0.005) were decreasing, while the IDisp trends for NMR (Z=+2.19, p=0.028) and CDR (Z=+2.39, p=0.017) were increasing.

Conclusions The results show that at least for IMR and USMR, in addition to improvement in average national levels, the geographical disparities have decreased. In the cases of NMR and CDR, inspite of the improvements in national levels, the trends of health disparities are not as good. We need to use strategies to provide more specialised care fairly in addition to primary healthcare to reduce disparities in CDR and NMR and influence them more.

BACKGROUND
Unnecessary, avoidable, unfair and unjust difference in health is defined as inequity and is a synonym for disparity.1 For practical purposes, the absence of systematic disparities in health or its social determinants between different social groups is considered as health equity.2 Although average levels of health indicators are important, determinants describing the distribution of health which emphasise on disparity and inequity are also important.3 Many reports have shown improvement of health indicators at national or provincial levels in Iran, but the reports on health inequities are limited.4–6 There are reports which show a decreasing trend in the urban-rural gap of some health indicators at the national level.7 Also, a previous report from Iran compared the geographical inequities in health between the rural areas of different provinces during two time periods (1996 to 2000 vs 2001 to 2005) but the authors did not use quantitative indices to assess the sequential trend and suggested more studies about the health inequity.8

Iran is located in the Middle East and as per 2010 estimates, is the 17th country in the world in terms of population and 18th in terms of land area. In the last national census report published in September 2011, about 28.5% of its 75.1 million people were rural residents.9 After the global strategy of Health for All suggested in 1978 in the Alma-Ata sessions, Iran started the implementation of the Primary Health Care (PHC) network in the early 1980s; after pilot testing the project in West Azerbaijan province and scaling it up, it achieved almost complete coverage of the rural areas in the early 1990s.10 11

The rural part of the PHC network included two levels for service provision; the health houses (HH) as the most peripheral unit of healthcare, and the rural health centres as the second level of population referral. Each HH has a standard list of resources and services and covers at least one main village and sometimes some satellite villages.10 12

The community health workers (named ‘Behvarz’ in the Persian language) are selected from the young local candidates; they subsequently undergo training in a 2-year educational programme.11 12 More than 27 000 Behvarz work at more than 18 000 HH in the rural areas of Iran. Each province is covered by at least one state ‘university of medical sciences and health services’ whose chancellor is the steward of the health system in its catchment areas.13

Although it was the universal standard for all parts of the country, a study showed a 3.7-fold difference between the provinces with the highest and the lowest ratios of rural HH per 1000 population in 2009; it could be related to different population densities and other factors for installing HH in villages except than population (such as distance with urban area and adjacent villages). Beyond the structural indices, there are interprovincial dissimilarities even in outcome indicators such as mortality.14

We performed this study to see the 16-years trend of health disparities between the rural areas covered by the provinces (the state universities of medical sciences (UMS) and health services as surrogates) in Iran and to assess whether or not the interprovincial disparities in mortality indicators had decreased after the setting-up of the PHC system in Iran. In the last few years, a new programme of ‘family physician’ was introduced and was implemented as the alternative for the previous PHC network.15 So, we limited the study time period from 1993 to 2008 to avoid overlapping with this new intervention.
METHODS

Study design
In this secular-trend observational study, we used the nationally representative data extracted from vital horoscopes or ‘Zij’ of rural areas (a national tool for registration of key health data) from the catchment areas of 41 Iranian ‘UMS and health services’. Since the number of universities had increased during the study reference period, we re-estimated the indicators for all universities according to the last classification of catchments areas. We entered the data for the years from 1373 to 1388 of the Persian calendar and for ease of understanding, used them as equivalent to 1993 to 2008 respectively; in reality, a Persian calendar starts on 20th March and ends on 19th March of the next year.

Data extraction tool (vital horoscope or Zij)
Zij is a nationally developed and up-to-date tool to account for the aggregated data of births and deaths, and also some other important health data such as family-planning and children health in the catchment area of a HH. It is a standard paper sheet (50×70 cm) filled daily in every HH by Behvarzes. Our interest variables were indices of mortality which account for mortality of new borns, infants or children. We estimated the annual neonatal death rate (NMR), infant death rate (IMR), under-5 death rate (USMR) and crude death rate (CDR) based on the catchment areas of state universities in 2008 and got about 656 university-year point data for each of the four indices (less than 0.5% missing data).

Measuring geographical disparities
The index of disparity (IDisp) is a simple, acceptable and quantitative measure of disparity across population groups. The IDisp can be used to compare inequity trends. We estimated IDisp for each of the four mortality indices in each of the 16 years.

IDisp is the average of the absolute differences between the rates for specific groups within a population and the overall population rate, divided by the rate for the overall population, and is expressed as a percentage.

The following formula was used to calculate IDisp:

$$ID_{disp} = \left( \frac{1}{J} \sum_{j=1}^{J} |r_j - r_{ref}| / J \right) / r_{ref} \times 100$$

Where \( r_j \) indicates the measure of health status in the jth group, \( r_{ref} \) is the measure of indicator in the total population or reference group and J shows the number of groups. A decreasing trend in the annual IDisp indicates reduction of health disparity and shows an improvement in between-groups equality. We assessed the statistical significance of trends using the statistical software STATA, V9.1.

Ethics
The study was approved by the research and ethical councils of the Iran University of Medical Sciences.

RESULTS

The total rural population covered by vital horoscopes had increased from 16.7 to 20.1 million during the 16 years reference period.

We assessed the national level trends of death rate indicators (NMR, IMR, USMR and CDR) which have been shown in figure 1. The ranges of national level indicators were between 12.5(2008) and 19.3(1997) for NMR, between 17.9(2008) and 37.2(1993) for IMR, between 21.6(2008) and 46.3(1993) for USMR and between 4.2(1998) and 5.1(2003) for CDR. Except for the increasing trend of crude death rate (Z=+2.83, p=0.005), the other indicators had statistically significant decreasing trends: NMR (Z=−3.23, p=0.001), IMR (Z=−3.84, p<0.001) and USMR (Z=−3.84, p<0.001). Details of university-year data points of NMR, IMR, USMR and CDR are seen in figures 2–5 respectively. Each province is covered by one to three UMS. Data points show downward shifting slopes for NMR, IMR and USMR during the study period (figures 2–4, respectively), while there is an upward shifting slope for CDR (figure 5). The density of data points which simply shows the similarity of outcomes between provinces has increased for IMR and USMR, while it has decreased for NMR and CDR.

The ranges for provincial level indicators were between 3.1 (Tehran province, Southern part, 2007) and 28.8 (Kurdestan province, 1999) per 1000 live births for NMR, between 5.4 (Tehran province, Southern part, 2008) and 61.5 (Sistan-and-Balouchestan province, Balouchestan, 1993) per 1000 live births for IMR, between 7.8 (Tehran province, Southern part, 2003) and 80.2 (Sistan and Balouchestan province, Balouchestan, 1993) per 1000 live births for USMR and between 2.2 (Tehran province, Southern part, 2000) and 8.7 (Kermanshah province in which Bam had been struck by an earthquake in 2003) per 1000 residents for CDR.

Figure 6 demonstrates the IDisp trends of death rate indicators. The ranges of disparity indices were 16.3–23.4% for
NMR IDisp (in 1993 and 2006, respectively), 17.6–26.5% for IMR IDisp (in 2005 and 1995, respectively), between 17.6–24.4% for USMR IDisp (in 2007 and 1995, respectively) and 11.9–21.0% for CDR IDisp (in 1994 and 2006, respectively). Although the IDisp trends for IMR (Z=−2.2, p=0.027) and USMR (Z=−2.84, p=0.005) were decreasing, the IDisp trends for NMR (Z=+2.19, p=0.028) and CDR (Z=+2.39, p=0.017) were increasing.

The trend for infant deaths after the neonatal period (postneonatal infant deaths) was also decreasing (Z=−3.85, p<0.001). About 64.8% of infant deaths in the reference period occurred during the neonatal age; the ratio of neonatal to postneonatal infant deaths had an increasing trend (Z=+3.34, p=0.001).

DISCUSSION

In addition to the decreasing trends for NMR, IMR and USMR and the increasing trend for CDR at the national levels, this study showed decreasing trends in geographical disparities for IMR and USMR and increasing trends for disparities of NMR and CDR. While the trends for the national levels were expected based on previous studies, the findings on trends for disparities were new dimensions of the health system performance in the rural areas of Iran.

The IMR and USMR levels are among the indicators of the fourth Millennium Development Goal (MDG 4) and Iran is expected to achieve the MDG4 targets before 2015. However, comparing some countries with similar or not-better economic levels and good welfare systems such as Cuba, Costa Rica, Sri Lanka or Thailand, there are many things to do with IMR and USMR in Iran. Although about two thirds of infant deaths were neonatal deaths, the reduction in postneonatal infant deaths was more prominent. Geographical disparities in IMR and USMR had decreased during the reference period. A relatively similar coverage of PHC services in rural areas is a logical probable cause for this. However, access to health facilities is not equal in the different areas of Iran. Previous studies have shown that the largest contributors in inequalities in infant mortality in Iran are household economic status and mother education. In the last few decades, the female illiteracy rate has decreased in Iran and the average level of education has increased; this has probably played an important role in decreasing the disparities between IMR and USMR.

The result of this study supports a previous study which analysed the geographical inequities based on the standard deviation of some important health indicators in the two time bands: 1996 to 2000 and 2001 to 2005. In that study, the standard deviation of the provincial levels of IMR and NMR decreased and increased, respectively, in the second time period.

The slope of the decreasing NMR was lower than that of IMR and USMR; it seems that prevention of neonatal deaths in the present situation in Iran does not respond to the current interventions and needs new strategies. Preventing newborn
What is already known on this subject

- Many reports have shown improvements in health indicators at national or provincial levels after implementation of Primary Health Care in the rural areas of Iran, but the reports on health disparities and their trends are limited.

What this study adds

- This study shows that at least for infant death rate and USMR, in addition to an improvement in the average national levels, the geographical disparities have decreased. In the cases of crude death rate (CDR) and also neonatal death rate (NMR) (in spite of the improvement in its national levels), the trends of health disparities are not as good. We need to use strategies to provide more specialised care fairly in addition to Primary Health Care to reduce disparities in CDR and NMR and influence them more.

We need to use strategies to provide more specialised care fairly in addition to PHC to reduce disparities in CDR and NMR and influence them more.

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Contributors All authors had substantial contribution in conception and design, acquisition of data, or analysis and interpretation of data: MM-L, BB, A-RO and AK developed the proposal for the project. BB was involved with data collection. MM-L, BB and NN analysed the data. MM-L, NN and BB wrote the draft of the manuscript and A-RO and AK commented on and contributed towards finalising the manuscript. All authors have read and approved the final version.

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