Anemia Related Mortality in Inner Mongolia in 2008–2012

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Abstract

Objective: This study aimed to assess the characteristics of anemia-related deaths and the relationship between socio-demographic status and mortality risk of anemia in Inner Mongolia from 2008 to 2012.

Methods: We obtained our data for 2008–2012 from the Death Registry System of Inner Mongolia. We calculated the mortality, percentage, and potential years of life lost (PYLL) of anemia in diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (DBDIM). We collected socio-demographic status of case and control, including marital status, education level, area of residence, and occupation. Logistic regression models were employed to analyze which factor has effect to mortality risk of anemia.

Results: The total mortality from anemia was $0.66/10^5$, and the mortality rates in male and female were $0.74/10^5$ and $0.57/10^5$, respectively ($\chi^2 = 1.270$, P = 0.260). No significant differences in the mortality of anemia were observed from 2008 to 2012 ($\chi^2 = 6.003$, P = 0.199). In DBDIM approximately 80% of these deaths were caused by anemia. Among the various types of anemia, aplastic and other anemias (AOA) showed the highest PYLL and mortality. The age-specific mortality of anemia increased with age. Moreover, a high education level increased the mortality risk of anemia.

Conclusion: Among the various types of anemia, AOA showed the highest PYLL and mortality, and the burden of premature death resulting from AOA is possibly more serious than other anemia. Moreover, high education level increased the mortality risk of anemia.

Keywords: anemia, mortality, socio-demographic status

1. Introduction

Anemia is a condition characterized by a low number of red blood cells or low oxygen-carrying capacity that insufficiently meets physiologic needs. This disorder varies by age, sex, altitude, smoking, and pregnancy status (WHO, 2015a). Anemia indicates both poor nutrition and poor health (World Health Organization and United Nations Children's Fund, 2004) and is a public health problem affecting populations in both rich and poor countries (Bruno, Erin, Ines, & Mary, 2008). Anemia is the world's second leading cause of disability and thus is one of the most serious global public health concerns (WHO, 2015b). The staggering number of anemic people worldwide is estimated by the World Health Organization (WHO) to be 2 billion (WHO/UNICEF/UNU, 2011).

The incidence of anemia increases with age (Guralnik et al., 2004; Patel, 2008). Over half and at least 30%–40% of pre-school children and pregnant women in developing countries and in industrialized countries, respectively, are anemic (WHO, 2015b). In addition, up to 25% of older people in the United States and in other Western countries are anemic based on WHO criteria (Chalmers et al., 2012), indicating that anemia is also highly prevalent in older people (Milward, 1999; Challand et al., 1990).

Approximately 50% of all anemia cases can be attributed to iron deficiency (WHO/UNICEF/UNU, 2011). Other important causes of anemia worldwide include infections, other nutritional deficiencies (especially folate and vitamins B12, A and C) and genetic conditions (including sickle cell disease, thalassaemia – an inherited blood

disorder – and chronic inflammation) (WHO, 2014). Anemia is common in severe malaria and may be associated with secondary bacterial infection (WHO, 2014).

Anemia is associated with increased mortality from cardiovascular diseases (Collins et al., 2001; Weiner et al., 2005), dementia (Atti et al., 2006), and poor quality of life (Moreno, Aracil, Perez, & Valderrabano, 1996). Averages of 40% patients with congestive heart failure are anemic (Wexler et al., 2005). Moreover, the type of anemia affects survival of old patients, wherein patients with nutritional anemia (NA) or anemia caused by chronic renal disease show higher mortality risk compared with non-anemic old patients (Shavelle, MacKenzie, & Paculdo, 2012).

The prevalence of anemia has been extensively reported (WHO, 2015a; Bruno, Erin, Ines, & Mary, 2008). The prevalence of anemia was highest in south Asia and central and west Africa Stevens (Stevens et al., 2013). We reside and live in Inner Mongolia, so we choose Inner Mongolia as region of research. There is lack of relevant research about anemia death cause in the world due to deaths caused by anemia is very few. In the light of this, we choose anemia related death. Our study reflects some characteristics in anemia-related deaths, the effect to life expectancy and evaluated the mortality risk of anemia in Inner Mongolia. Our epidemiological analyses will provide a reference for relevant future research and to provide insights into the preventive measures for disease.

2. Materials and Methods

2.1 Data Source

We obtained the data for 2008–2012 from death certificates retrieved from the Death Registry System (DRS) of eight monitoring points, five of which were established by the Chinese Ministry of Health and three by the Center for Disease Control (CDC) of Inner Mongolia (Xin et al., 2014). The DRS uses a multistage cluster probability sampling strategy with stratification according to eastern, central and western China; the local gross domestic product and proportion of rural dwellers; and the total population of local areas (Xin et al., 2014). This study divided these eight monitoring points into three regions: the Eastern region (including Yakeshi City, Kailu County, and Bairin Youqi), the Middle region (including Sonid Youqi, Muslims District, and Tumd Youqi), and the West region (including Ejin Horo Qi, and Linhe District). The annual average population of the eight monitoring points was 2.4 million, accounting for approximately 10% of the total population of Inner Mongolia (Xin et al., 2014). The diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism DBDIM (D50-D89) were categorized based on the 10th revision of the International Classification of Diseases (ICD-10), as follows: nutritional anaemias (NA, D50-D53); hemolytic anemias (HA, D55-D59); aplastic and other anemias (AOA, D60-D64); coagulation defects, purpura, and other hemorrhagic conditions (CDPHC, D65-D69); other diseases of blood and blood-forming organs (DB, D70-D77); and certain disorders involving the immune mechanism (CDIM, D80-D89). The external cause deaths were categorized based on ICD-10, including V01-Y98. Anemia was diagnosed based on blood hemoglobin levels using both the WHO criteria (WHO, 2008).

A case–control study is done by using data of death on the base of statistical description. The case–control study included a control group consisting of deaths randomly selected from among the external cause deaths. Anemia and external cause deaths were matched by sex, age, and region at a case–control ratio of 1:1.

We collected case and control of socio-demographic status, including marital status, education level, area of residence, and occupation. Education level was divided into illiterate and primary school and middle school and higher. The illiterate is the person who can't read and literacy. Primary school is a person who accepts formal education of initial stage, length of schooling is six years. Occupation was divided into light manual labor (including student, clerical support workers, professionals and technicians) and extensive manual labor. Data on population were obtained from the CDC of Inner Mongolia (Xin et al., 2014).

2.2 Statistical Analyses

We calculated the mortality, percentages, and potential years of life lost (PYLL) of each categorize in DBDIM in both genders. Anemia-related mortality (per 100 000) was calculated. Mortality: number of deaths/ number of midyear population. We calculated the percentages of each categorize in DBDIM. Percentages: the number of each categorize in DBDIM / the total number of DBDIM *100%. PYLL was specifically calculated as $PYLL = \Sigma(ai \times di)$, where ai=loss of life-years for a certain age group, i, and di = the number of deaths in that particular age group (Xin et al., 2014). In addition, we calculated the age-specific (0-, 25-, 45-, 65-. 85-) mortality of anemia, the logarithm graph was used to show change speed of mortality for both genders, and chi-squared test was used to determine the difference in mortality of anemia between both genders, five years, three regions, P-value of < 0.05 indicated significant difference. Unconditional logistic regression models were employed to

analyze which factor has effect to mortality risk of anemia. The odds ratio (OR) and 95% confidence interval (CI) were also calculated.

Microsoft Excel and SPSS 13.0 were used for data management and statistical analysis.

3. Result

A total of 76 death cases caused by anemia were recorded in the three regions of Inner Mongolia from 2008 to 2012 (male was 44, female was 32). The median age in these death cases was 66 years old (aged 3–101 years old). The total mortality for anemia was $0.66/10^5$, and the mortality in male and in female was $0.74/10^5$ and $0.57/10^5$, respectively. There was no statistical difference for both genders ($\chi^2 = 1.270$, P = 0.260).

No significant differences in the mortality of anemia were observed from 2008 to 2012 ($\chi^2 = 6.003$, P = 0.199). The mortality of anemia was $0.58/10^5$ in the East region, $0.83/10^5$ in the Middle region, and $0.61/10^5$ in the West region. There was no statistical difference in the mortality of anemia in three regions ($\chi^2 = 2.025$, P = 0.363) we then merged the data on deaths in the three regions for 2008–2012 for further analysis.

Table 1 shows the mortality, percentage, and PYLL each categorize in DBDIM. Up to 83.03% of the death cases were caused by various types of anemia in DBDIM. In both genders, AOA was the leading cause of death at a mortality rate of $0.29/10^5$ followed by HA at $0.25/10^5$ and then by CDPHC and NA. The total PYLL was 2026.99 person-years and the PYLL of the DBDIM in female was 1.17-fold than that in male. The PYLL of anemia was 72.32% in DBDIM. Among the various types of anemia, AOA showed the highest PYLL for both genders, wherein the PYLL of AOA was 496.62 person-years in female and 398.98 person-years in male.

Table 1. Mortality, percentages and potential years of life lost (PYLL) of each categorize in DBDIM in Inner Mongolia from 2008 to 2012

Types	Male			Female			Total		
	mortality (1/10^5)	percentages (%)	PYLL (person-years)	mortality (1/10^5)	percentages (%)	PYLL (person-years)	mortality (1/10^5)	percentages (%)	PYLL (person-years)
Total	0.89	100.00	944.06	0.75	100.00	1106.80	0.82	100.00	2026.99
Anemia (D50-D64)	0.74	83.02	695.88	0.57	76.19	784.10	0.66	80.00	1465.89
HA	0.34	37.74	262.52	0.16	21.43	158.56	0.25	30.53	430.76
AOA	0.29	32.07	398.98	0.30	40.48	496.62	0.29	35.79	881.36
NA	0.12	13.21	34.38	0.11	14.28	128.92	0.11	13.68	153.77
CDPHC (D65-D69)	0.12	13.21	173.76	0.14	19.05	288.06	0.13	15.79	452.04
CDIM (D80-D89)	0.03	3.77	74.42	0.00	0.00	0.00	0.02	2.10	74.42
DB (D70-D77)	0.00	0.00	0.00	0.04	4.76	34.64	0.02	2.11	34.64

Figure 1 shows the age-specific mortality of anemia. The changes in the curve of age-specific mortality, which increases with age. The mortality was low before the age of 45 and obviously increased after 45 and then peaked at the age of 85. The mortality was $0.22/10^5$ at the age of 0 and $27.49/10^5$ at the age of 85.
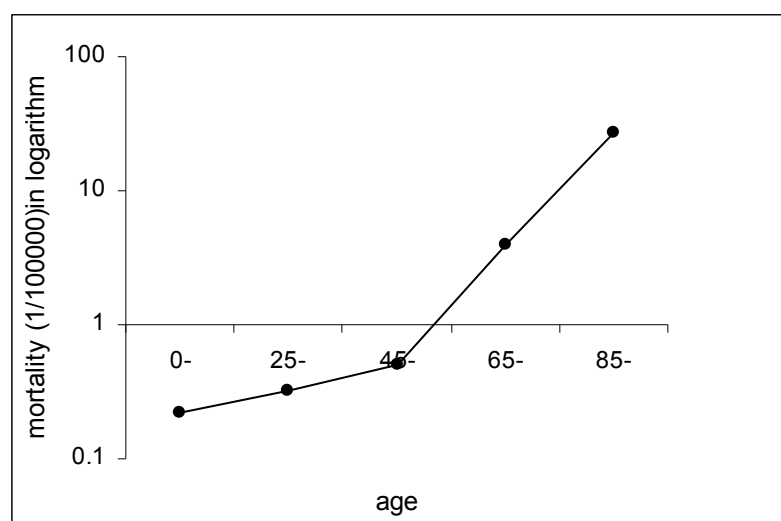
Figure 1. Age-specific mortality of anemia in Inner Mongolia, 2008-2012

Table 2 shows the results of multivariate analyses of the socio-demographic status. A high education level increased the mortality risk of anemia. By contrast, occupation, area of residence, and marital status were not significantly related to anemia death cases.

Table 2. Logistic regression analysis of socio-demographic characteristics for anemia-related deaths in Inner Mongolia from 2008 to 2012

Socio-demographic status	P	OR	95%CI
Education level	0.040		
Illiterate and primary school		1	
Middle school and higher		2.246	1.039-4.852
Occupation	0.946		
Extensive manual labor		1	
Light manual labor		0.964	0.333-2.792
Area of residence	0.092		
Urban		1	
Rural		0.54	0.264-1.106
Marital	0.607		
Married		1	
Unmarried		0.829	0.406-1.694

4. Discussion

The mortality of anemia in Inner Mongolia was lower than that in South Africa with $21.9/10^5$ and in United States America with $2/10^5$ but higher in Singapore with $0.3/10^5$ in 2013 (WHO, 2016). Mortality and PYLL are all representative measures of the burden from disease. Mortality rates show the risk for a person dying from disease while PYLL reflects by how many years earlier than the expected age the person died. Among the various types of anemia, AOA showed the highest PYLL and mortality and is the leading cause of death among female and second in male. In addition, the burden of premature death caused by AOA is possibly more serious than other anemia in Inner Mongolia. By contrast, HA is the leading cause of mortality in male and second in female. Some HA cases are also clearly related to hemolytic–uremic syndrome (Schwartz, Krause, Offermann, & Keller, 1991).

Moreover, our results showed that mortality caused by anemia was high in highly educated population. This finding is consistent with most existing studies. It is maybe these studies reported that the prevalence of anemia is high amongst population with highly education (Ndukwu et al., 2012; Gautam et al, 2002). Some studies also reported that high education level increased the mortality risk of some diseases (Xin et al., 2014; Fujino et al., 2005) for both genders, which is associated with shorter sleeping hours (Anzai et al., 2000) and high body mass indices (Martikainen et al., 2001). By contrast, a study suggested that the risk for diseases is partly caused by the inequalities in education in some countries or is partly a result of differences in the socioeconomic status of different countries (Fujino et al., 2005). Further studies are needed to assess the relationship between education and mortality risk of anemia.

Our results showed that mortality caused by anemia was no difference in area of residence and difference occupation, this suggests area of residence and occupation was no influence to the mortality of anemia.

Our study has a limitation, due to death is relatively less, so we only analyze mortality of five age groups with increments of 20 years.

5. Conclusion

In summary, the mortality from anemia was $0.66/10^5$, and up to 80% of these deaths in DBDIM were caused by anemia. Among the various types of anemia, AOA showed the highest PYLL and mortality, and the burden of premature death resulting from AOA is possibly more serious than other anemia in Inner Mongolia. Related department should pay attention to AOA occurred and take effective measure to reduce the mortality of AOA. Moreover, high education level increased the mortality risk of anemia. Therefore more attention should be paid to the prevention of anemia in people with high education level.

Competing Interests Statement

The authors declare that there is no conflict of interests regarding the publication of this paper.

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