Cause of Death among Young-old, Old-old and Oldest-old Patients in a Single Center During 15 Years

Wu-X Zhang, W Zhou, Z-Q Zhang, B-Yi Shi

ABSTRACT

Objective: The purpose of this study is to identify the cause of death in elderly patients stratified by age in a general hospital during 15 years.

Methods: The authors retrospectively analyzed the cause of death in a cohort of deceased patients aged 65 years and over, who were divided into three groups as young-old (65-74 yrs, n=1050), old-old (75-84 yrs, n=944), and oldest-old (≥85 yrs, n=344), and who were admitted to a general hospital in Beijing from May 1996 till May 2011.

Results: There are totally 2338 patients (1409 male, 929 female) aged 65 years and older admitted to and eventually died in our hospital in this period. The 5 major cause of death by the order were neoplasm (777, 33.2%), circulatory (648, 27.7%), respiratory (541, 23.1%), digestive (163, 7.0%) diseases and injuries (70, 3.0%). However, in the oldest old group, they were respiratory (126, 36.6%), circulatory (95, 27.6%), neoplasm (61, 17.7%), digestive (28, 8.1%) diseases and injuries (26, 7.6%). The proportion of patients died by neoplasm is significantly lower, while that of respiratory system diseases and injuries significantly higher in the older groups than in the younger groups ($P<0.01$). The proportion of patients died by neoplasm is negatively correlated with age ($r=-0.938$, $P=0.000$), while that by respiratory diseases was positively correlated with age ($r=0.785$, $P=0.000$).

Conclusion: More attention should be paid to the prevention and management of neoplasm for younger group, while of respiratory system diseases for older group of elderly to fulfill their longevity.

Keywords: Age, cause of death, Chinese, elderly patients, in-hospital

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INTRODUCTION

With improved living-conditions and advances in public health and medical care, life expectancy is increasing around most of the world (1). The global life expectancy has increased from 46.5 years in 1950-1955 to 70years in 2011 (2). Meanwhile, there is also a general decline in fertility rates in much of the world. The world's total fertility rate (TFR) has dropped by about a half, from 5.0 children per woman in 1950-1955 to 2.5 children per woman in 2010-2015 (3). On average, global life expectancies have been increasing and birth rates declining, resulting in global aging. The global population of those 65 years and older more than quadrupled, from 128.4 million in 1950 to 551 million in 2010, and projected to reach 1964 million in 2050 (4, 5). The challenge posed to health and social care providers and commissioners is to respond to the increasing numbers of the elderly and extreme elderly in the population and to meet their changing needs for end of life care.

Similar to other parts of the world, the Chinese population is also in a rapidly aging, due to a lower mortality rate and the one child policy. In 2013, Life expectancy in China has reached 76 years old (6). The number of people over 65 years old in China has reached 119 million, accounting for 8.87% of the total population at this time (7). China is presently the only country in the world with more than 100 million elderly people (8). By 2020, over 23 percent of China's citizenry is expected to be over age 65, resulting in a major challenge to China's medical and social insurance system (9). In China, 30.4% of hospitalized patients are elderly (10). Significant portion of them never return alive despite intensified medical management. The information of their cause of death is important to the hospital and public in assisting the clinical decision and fulfilling the patients' longevity. However, the data on

the cause of death in hospitalized elderly patients in China is scarce.

Although people aged 65 and older are categorized as “elderly”, elderly people have a wide range of age and are heterogeneous in many aspects (11). In the gerontological field, dividing elderly patients into three age strata is commonly done, that is, young-old (65-74 yrs), old-old (75-84 yrs), and oldest-old (≥85 yrs) (12-14). In USA, the primary cause of death in people younger than age 85 was cancer, while in those older than 85, the primary cause of death was heart disease (15). In England, the proportion of deaths from pneumonia increased with increasing age, from 3.6% of deaths in males aged 75-79 yeas and 4.3% in females, compared with 12.1% of deaths in males aged 90 and over and 11.7% of deaths in females (16). It is not known whether there is a difference among different age strata of elderly in the cause of death in China. The aim of the current study was therefore to analyze the cause of death in elderly patients in one general hospital in China, and special attention was also paid to the differences among various age strata of elderly patients.

PATIENTS AND METHODS

Study population: A retrospective study was conducted in PLA 309th hospital, which is a general hospital with a 1700-bed capacity that offers tertiary care in Beijing, China. This study was approved by the hospital’s institutional Ethics Committee, and was undertaken conformed to the provisions of the Declaration of Helsinki (as revised in Tokyo 2004). All deceased patients admitted from May 1996 till May 2011and with the age of 65 years old and over when die were included. The subjects and their relatives have given their informed consent to the hospital for statistical using their medical records before admission and patient

anonymity has been preserved. These patients were grouped into three age strata: the young old group (65 to 74 years), the old old group (75 to 84 years) and the oldest old group (85 years and older). Medical records and related materials were thoroughly reviewed by an experienced doctor team. The single disease or injury considered to be the underlying cause of death based on clinical presentation, clinical course, and postmortem findings was recorded for each patient. All diseases and injuries were classified according to Tenth Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (17).

Cause of death: In the TICD-10 (17), WHO presents definitions of terms concerning cause of death and instructions for mortality statistics. The immediate cause of death is defined as the final disease, injury, or complication directly causing death. The underlying cause of death is the disease, injury, or corresponding circumstance that initiated the chain of events (i.e. intermediate causes of death) ultimately leading to death. Contributory causes are all other conditions which to some extent contributed to the fatal outcome, but were not part of the main causal sequence leading to death. According to WHO, the underlying cause of death is the piece of information to be used in mortality statistics.

Statistical analysis: The primary data was collected using Excel software (Microsoft, Redmond, WA, USA) and statistical analyses were performed using SPSS software version 13.0 (SPSS inc., Chicago, IL, USA). The data are expressed as means ± SD. Differences in cause of death among patients of young old, old old, and oldest old in the study population

were examined using the chi-square test (or Exact test, when appropriate). $P<0.05$ was considered statistically significant.

RESULTS

Patient demographics: There are totally 2338 patients (1409 male, 929 female) aged 65 years and older admitted to and eventually died in our hospital in the investigated period. Number of patients, age, and gender for the total cohort and each group was given in Table 1.

5 major causes of death in different age groups: As shown in table 2, the 5 major cause of death of overall deceased patients by the order were neoplasm (777, 33.2%), circulatory system diseases (648, 27.7%), respiratory system diseases (541, 23.1%), digestive system diseases (163, 7.0%) and injuries (70, 3.0%). In young old patients, the 5 major cause of death were neoplasm (432, 41.1%), circulatory system diseases (275, 25.9%), respiratory system diseases (162, 15.4%), digestive system diseases (73, 7.0%) and end-stage renal disease (30, 2.9%). In old old patients, those were neoplasm (284, 30.0%), circulatory system diseases (281, 29.8%), respiratory system diseases (253, 26.8%), digestive system diseases (62, 6.6%) and injuries (24, 2.5%). However, in oldest old patients, those were respiratory system disease (126, 36.6%), circulatory system disease (95, 27.6%), neoplasm (61, 17.7%), digestive system disease (28, 8.1%), and injuries (26, 7.6%).

Proportion of death by neoplasm, respiratory, circulatory diseases, and injuries among different age groups: The proportion of patients died of neoplasm was significantly higher in younger groups than in older groups ($P=0.000$). However, the proportion of patients dead

of respiratory system diseases especially bronchopneumonia was significantly higher in older groups than in younger groups (P=0.000). For circulatory system diseases, the proportion of patients was similar among the three groups (P=0.157). The proportion of patients dead of injuries especially incident falls was significantly higher in older groups than in younger groups (P=0.000). The data were shown in Table 2.

The relationship of proportion of death by neoplasm, respiratory and circulatory diseases with age: The proportion of patients died by neoplasm, circulatory diseases and respiratory diseases according to each year of age in old patients (≥65 yrs) was shown in Figure 1. The proportion of patients died by neoplasm decreased with age, while that of those died by respiratory diseases increased with age. The proportion of patients died by circulatory diseases remained similar across the age span. The proportion of patients died by neoplasm is negatively correlated with age (r=-0.938, P=0.000) (Figure 2), while that by respiratory diseases was positively correlated with age (r=0.785, P=0.000) (Figure 3). Stepped decrease of the proportion of neoplasm and increase of that of respiratory diseases among young-old, old-old and oldest-old groups were observed in all three temporal windows (1996-2001, 2002-2006, 2007-2011) (Figure 4 A, B, C).

DISCUSSION

In this study, we described the age-stratified cause of death in elderly patients in our hospital over a period of 15 years. Our study indicates that there were apparent differences in the cause of death among young-old, old-old and oldest-old patients. The first leading cause of

death in young-old and old-old was neoplasm; while in oldest-old patients it was respiratory diseases. The proportion of patients dead of neoplasm decreased with age, while those of respiratory system diseases and accident falls increased with age.

According to vital statistics available for 13 cities in China, respiratory diseases, acute infectious diseases, and tuberculosis were the leading causes of death in 1957, while diseases of heart, cerebrovascular disease, and malignant neoplasm were the fifth, sixth, and seventh leading causes of death (18). However, in 2005, He et al. reported the major causes of death in China, which indicates that diseases of the heart, malignant neoplasms, and cerebrovascular disease account for approximately two thirds of the total deaths in the Chinese population 40 years of age and older (19). Respiratory disease would also be a leading cause of death if chronic pulmonary heart disease were included in it (20). In another study, the causes of death of 2226 patients 60 years and older from 2000 to 2008 in a hospital were investigated (21). Their results showed that the top three death causes in order of frequency were tumor, cardiovascular disease and respiratory disease, accounting for 77.72% of total death (21). Our results showed that neoplasm, circulatory system diseases, and respiratory system diseases accounts for 84% death in patients 65 years and older. The results of these studies and ours are similar. All those studies support the notion that a transition in disease burden has occurred in China. In the United States, the top three leading causes of death among persons 65 and older were heart diseases, cancer and stroke in 2002 (22). These studies indicates that the pattern of death cause has changed to being similar to western countries, which call for serious attention to be given to the consequences of chronic diseases in developing countries.

Our study also indicates that the cause of death differences in different age-strata of elderly patients. Few previous studies have reported age-specific cause of death in elderly patients. Since 1999, cancer has surpassed heart disease as the primary cause of death in people in USA younger than age 85 (15). However, in people aged 85 and older, heart disease accounted for three times as many deaths as did cancer in 2002 (15). The study of Ahmad S showed that deaths due to cancer in the 65-74 years, 75-84 years, and over 85 years were 25%, 17.1%, and 9.1% in 1981, and 35.7%, 25.2% and 13.1% in 2001, respectively (23). This is conform to our findings that neoplasm was the primary cause of death in young old (41.1%) and old old (30.0%), but not in oldest old (17.7%). The reason why older people die less for cancer and more for circulatory and respiratory diseases is not clear.

Our findings have important public health implications. According to our results, more attention should be paid to the prevention and management of neoplasm in elderly patients of younger group, while that of respiratory system diseases and accident falls in those of older group, in order to fulfill and improve their longevity.

The study's limitations include a retrospective, single-center design; a relatively small patient population; and lack of documentation of details of inpatient care. The accuracy of hospital medical records-based cause of death is debatable. At advanced ages, it is difficult to identify the initial cause of death. We have refined the diagnosis with expert review of hospital records to minimize this limitation. The composition and distribution of hospital cause of death may not be representative of deaths occurring in the community. The finding of this study is therefore more applicable to a similar general hospital than abroad public population.

In conclusion, our study indicates that the top 5 major cause of death in elderly patients in our hospital by the order were neoplasm, circulatory system diseases, respiratory system diseases, digestive system diseases and injuries. However, in the oldest old group, unlike that of young old and old old, the 5 major cause of death by the order were respiratory system diseases, circulatory system diseases, neoplasm, digestive system diseases and injuries. The proportion of patients died by neoplasm is significantly lower, while that of respiratory system diseases and injuries significantly higher in the older groups than in the younger groups. The proportion of patients died by neoplasm is negatively correlated with age, while that by respiratory diseases was positively correlated with age. The underlying reason and meaning of these findings to the public health need to be further investigated.

CONFLICT OF INTEREST

All authors have no conflict of interest regarding this paper.

REFERENCES

1. Huhtaniemi I. Life expectancy of humans is increasing. Best Pract Res Clin Endocrinol Metab 2013; **27:** 465.
2. WHO. World Health Statistics 2013. Geneva: World Health Organization. 2013.
3. United Nations, Department of Economic and Social Affairs, Population Division. World Population Ageing 2013. ST/ESA/SER.A/348. 2013.
4. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2012 Revision, Highlights and Advance Tables. Working Paper No. ESA/P/WP.228. 2013.
5. Lunenfeld B, Stratton P. The clinical consequences of an ageing world and preventive strategies. Best Pract Res Clin Obstet Gynaecol 2013; **27:** 643-59.
6. Xu Y, Zhang W, Yang R, Zou C, Zhao Z. Infant mortality and life expectancy in China. Med Sci Monit 2014; **20:** 379-85.
7. Chao J, Wang Y, Xu H, Yu Q, Jiang L, Tian L et al. The effect of community-based health management on the health of the elderly: a randomized controlled trial from China. BMC Health Serv Res 2012; **12:** 449.
8. Liu J, Wang LN, Tan JP. Dementia in China: current status. Neurology 2013; **81:** 1077-8.
9. Jiang Y, Huang S, Fu X, Liu H, Ran X, Lu S et al. Epidemiology of chronic cutaneous wounds in China. Wound Repair Regen 2011; **19:** 181-8.
10. Xiao D, Shen J, Wu H, Ding F, He X, Zhu Y. An innovative continuing nursing education program targeting key geriatric conditions for hospitalized older people in China. Educational Gerontology 2013; **39:** 585-98.

11. Hu KC, Chang WH, Chu CH, Wang HY, Lin SC, Wang TE et al. Findings and risk factors of early mortality of endoscopic retrograde cholangiopancreatography in different cohorts of elderly patients. J Am Geriatr Soc 2009; **57:** 1839-43.
12. Suzman R, Riley MW. Introducing the "oldest old". Milbank Mem Fund Q Health Soc 1985; **63:** 177-86.
13. Fries BE, Morris JN, Skarupski KA, Blaum CS, Galecki A, Bookstein F et al. Accelerated dysfunction among the very oldest-old in nursing homes. J Gerontol A Biol Sci Med Sci 2000; **55:** M336-41.
14. Volkert D, Kreuel K, Heseker H, Stehle P. Energy and nutrient intake of young-old, old-old and very-old elderly in Germany. Eur J Clin Nutr 2004; **58:** 1190-200.
15. Twombly R. Cancer surpasses heart disease as leading cause of death for all but the very elderly. J Natl Cancer Inst 2005; **97:** 330-1.
16. Ruth K, Verne J. Deaths in older adults in England. London: National End of Life Care Intelligence Network. 2010.
17. World Health Organization. The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision. Geneva: WHO. 1992.
18. Lian Z, Xie Y, Lu Y, Huang D, Shi H. Trends in the major causes of death in China, 1982-2010. Chin Med J (Engl) 2014; **127:** 777-81.
19. He J, Gu D, Wu X, Reynolds K, Duan X, Yao C et al. Major causes of death among men and women in China. N Engl J Med 2005; **353:** 1124-34.
20. Wagner PD, Viegi G, Luna CM, Fukuchi Y, Kvale PA, El Sony A. Major causes of death in China. N Engl J Med 2006; **354:** 874-6.

21. He ML, Peng CW. The analysis on death causes of 2226 elderly inpatients. Chinese Medical Record 2009; **10:** 43-4.
22. Gorina Y, Hoyert D, Lentzner H, Goulding M. Trends in causes of death among older persons in the United States. Aging Trends 2005; **(6):** 1-12.
23. Ahmad S, O'Mahony MS. Shift in the burden of cancer towards older people--a retrospective population-based study. Int J Clin Pract 2007; **61:** 931-6.

Table 1. Patients characteristics

	Young	Old	Oldest	P-Value	Total
Number	1050(44.9%)	944(40.4%)	344(14.7%)		2338
Age (years)	70.0±3.0	79.1±3.0	88.6±3.5		76.4±7.3
Male	648(61.7%)	569(60.3%)	192(55.8%)	0.152	1409(60.3%)

Table 2. Cause of death among young-old, old-old and oldest-old

	Young-old	Old-old	Oldest-old	P-Value	Total
Neoplasm	432(41.1%)	284(30.0%)	61(17.7%)	0.000	777(33.2%)
Circulatory system disease	272(25.9%)	281(29.8%)	95(27.6%)	0.157	648(27.7%)
Ischaemic heart disease	113(10.8%)	109(11.5%)	37(10.8%)	0.839	259(11.1%)
Cerebrovascular disease	142(13.5%)	154(16.3%)	53(15.4%)	0.210	349(14.9%)
Pulmonary embolism	4(0.4%)	3(3.2%)	2(5.8%)	0.795	9(0.4%)
Other circulatory system disease	13(1.2%)	15(1.6%)	3(0.9%)	0.576	31(1.3%)
Respiratory system disease	162(15.4%)	253(26.8%)	126(36.6%)	0.000	541(23.1%)
Bronchopneumonia	113(10.8%)	182(19.3%)	101(29.4%)	0.000	396(16.9%)
COPD	28(2.7%)	57(6.0%)	22(6.4%)	0.000	107(4.6%)
Other respiratory system disease	21(2.0%)	14(1.5%)	3(0.9%)	0.323	38(1.6%)
Digestive system disease	73(7.0%)	62(6.6%)	28(8.1%)	0.618	163(7.0%)
Liver cirrhosis	33(3.1%)	12(1.3%)	0	0.000	45(1.9%)
Gastrointestinal Haemorrhage	6(0.6%)	19(2.0%)	5(1.5%)	0.016	30(1.3%)
Gall bladder infection	13(1.2%)	7(0.7%)	8(2.3%)	0.068	28(1.2%)
Other	6(0.6%)	10(1.1%)	7(2.0%)	0.055	23(1.0%)
Obstruction	4(0.4%)	3(0.3%)	4(1.2%)	0.124	11(0.5%)
Intestion infection	6(0.6%)	8(0.8%)	2(0.6%)	0.733	16(0.7%)
Pancrea infeciton	5(0.5%)	3(0.3%)	2(0.6%)	0.772	10(0.4%)
Blood system disease	6(0.6%)	5(0.5%)	0	0.382	11(0.5%)
Endocrine, nutritional and metabolic diseases	17(1.6%)	6(0.6%)	0	0.011	23(1.0%)
End-stage renal disease	30(2.9%)	16(1.7%)	2(0.6%)	0.021	48(2.1%)
Nervous system disease	7(0.7%)	4(0.4%)	0	0.282	11(0.5%)
Tuberculosis	19(1.8%)	6(0.6%)	0	0.004	25(1.1%)
Injuries	20(1.9%)	24(2.5%)	26(7.6%)	0.000	70(3.0%)
Traffic accident	13(1.2%)	4(0.4%)	2(0.6%)	0.113	19(0.8%)
Accident falls	7(0.7%)	20(2.1%)	24(7.0%)	0.000	51(2.2%)
Poison	3(0.3%)	0	1(0.3%)	0.257	4(0.2%)
Unkown	9(0.9%)	3(0.3%)	5(1.5%)	0.084	17(0.7%)

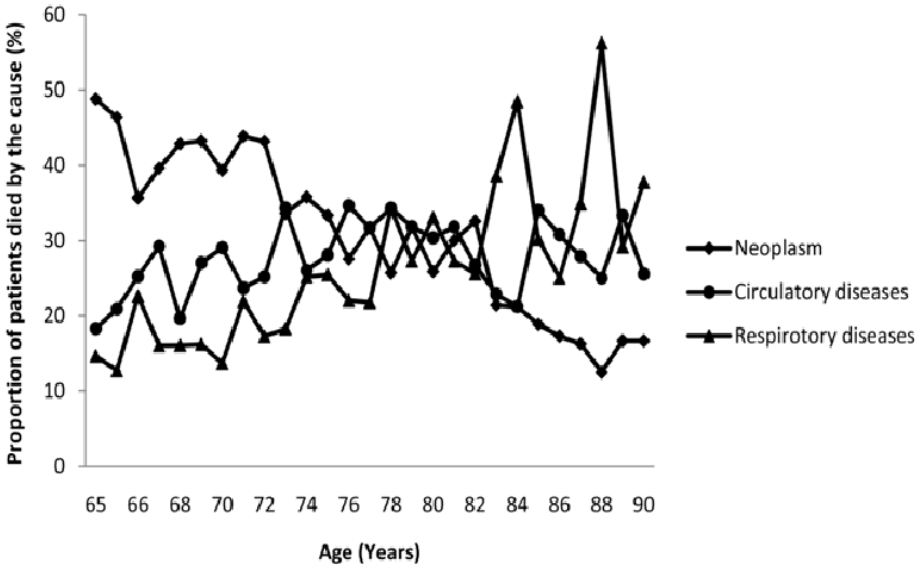

Figure 1 Proportion of patients died by neoplasm, circulatory diseases and respiratory diseases according to each year of age in old patients (≥65 yrs). The proportion of patients died by neoplasm decreased, while by respiratory diseases increased along with age.

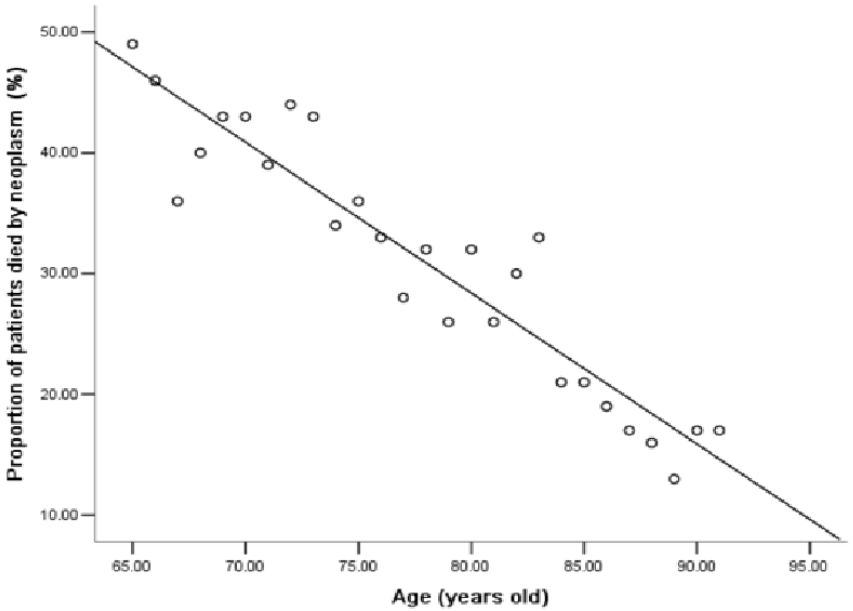

Figure 2. The correlation between proportions of patients died by neoplasm with age (r=-0.938, *P*=0.000).

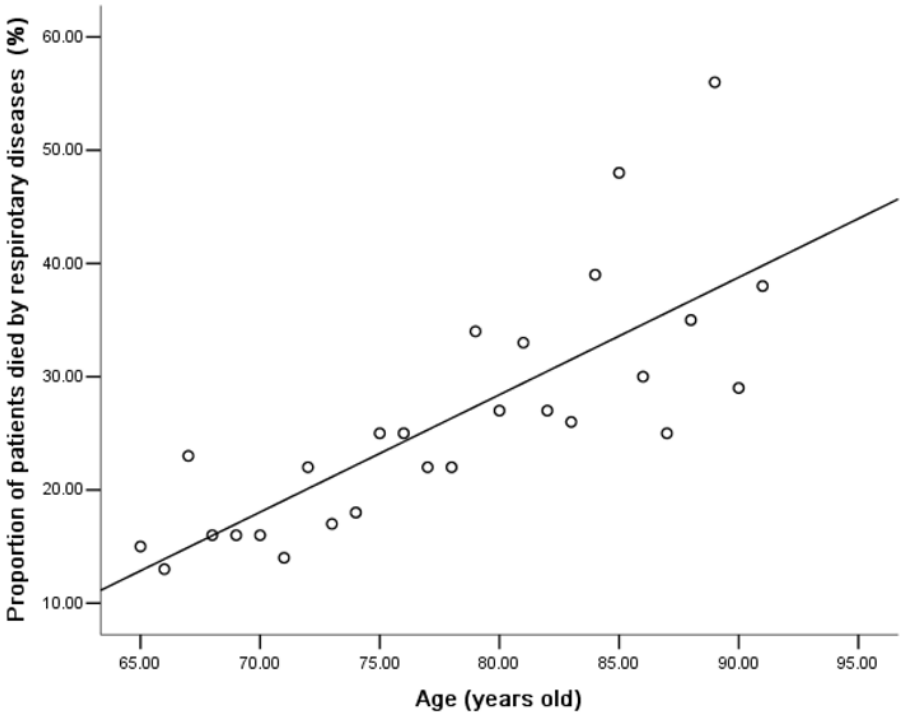

Figure 3. The correlation between proportions of patients died by respiratory diseases with age (r=0.785, *P*=0.000).

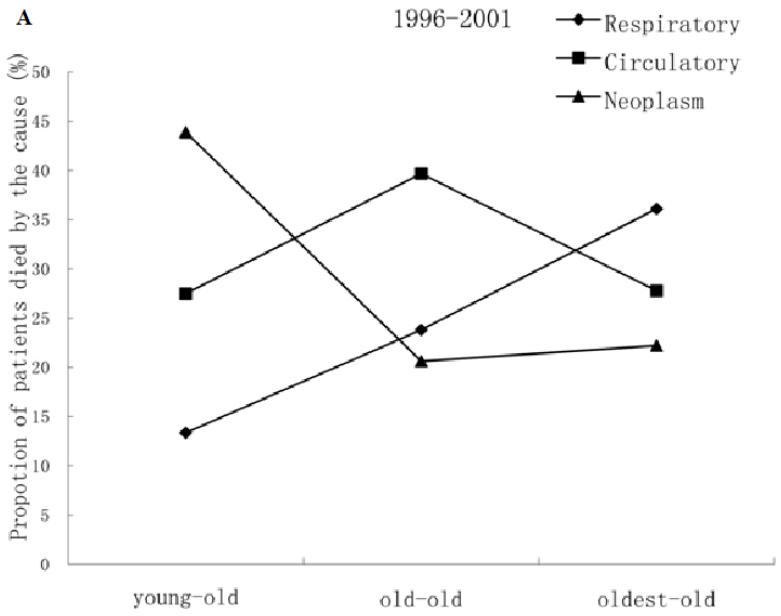

Figure 4a

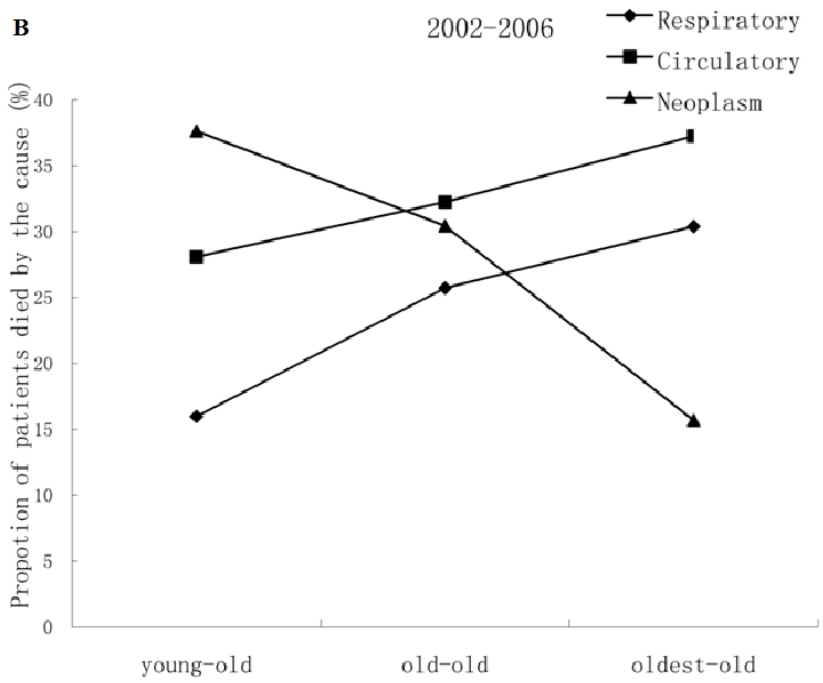

Figure 4b

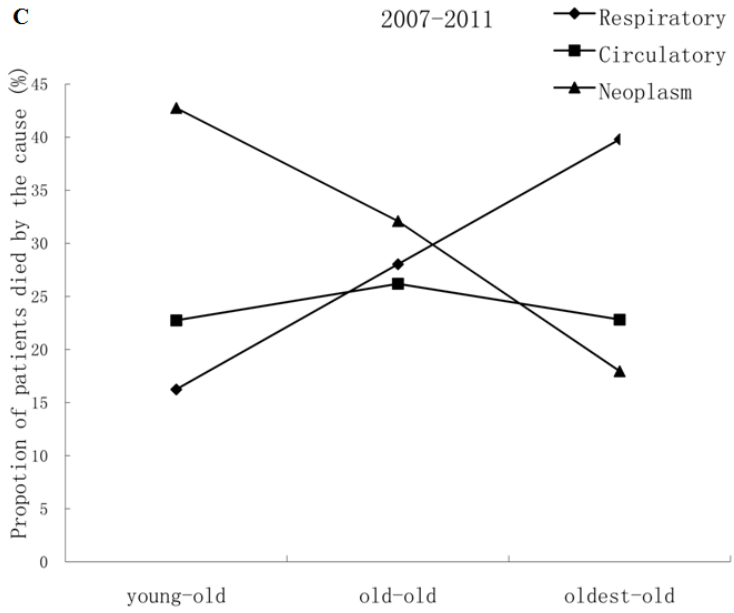

Figure 4c

Fig.4: Proportion of patients died by neoplasm, circulatory diseases and respiratory diseases in young old, old old, and oldest old in the year of: A. 1996-2001; B. 2002-2006; C. 2007-2011. Stepped decrease of the proportion of neoplasm and increase of that of respiratory diseases among young old, old old and oldest old groups were observed in all three temporal windows.