GAVIN PUBLISHERS

Advances in Preventive Medicine and Health Care

Research Article

Gong JZ. Adv Prev Med Health Care 2: 1013.

DOI: 10.29011/APMHC-1013.001013

Relationship Between Residents Cancer Distribution and Water Soil Pollution-Evidence from Langfang City, Hebei Province

Jin-zhong Gong*

Hebei Institute of Geophysical Exploration, Langfang, China

***Corresponding author:** Jin-zhong Gong, Hebei Institute of Geophysical Exploration, Langfang 065000, China. Email: gjz212@tom.com

Citation: Gong JZ (2019) Relationship Between Residents Cancer Distribution and Water Soil Pollution-Evidence from Langfang City, Hebei Province. Adv Prev Med Health Care 2: 1013. DOI: 10.29011/APMHC-1013.001013

Received Date: 02 March, 2019; **Accepted Date:** 01 April, 2019; **Published Date:** 09 April, 2019

Abstract

Langfang City, Hebei Province is known as the "Pearl on the Beijing-Tianjin Corridor", it is an important city in the Bohai Economic Circle. In the process of land use information collection for key enterprises in soil pollution, by interviewing local residents on site, the authors have obtained information on cancer morbidity and mortality 45 groups that by the village as a unit. The Cancer distribution map was drawn using the Geographic Information System MapGIS operating platform. According to urban environmental geochemical surveys and multi-target geochemical survey data, the author conducted a related analysis. The results show that the residents cancer morbidity and mortality are negatively correlated with the depth of shallow groundwater table, γ = -0.5271, (n = 45, $\gamma_{0.05}$ = 0.2040), significant positive correlation indicators: deep soil Hg0.8885, surface soil Pb0.8572, shallow groundwater Cr0.8290, deep soil N0.7106, surface soil effective Zn0.7027, surface soil Cd0.6931, Hg0.6751, shallow ground water NH_4-N0.6441, surface water Zn0.6288, shallow ground water As0.6206, NO_3-N0.6130, Pb0.5284, Cd0.5028, NO_2-N, 0.4958. According to the characteristic pollutant frequency table of 340 key industries in Langfang area, these organic matters significantly related to mercury: benzopyrene 0.4723, pyridine 0.1551, formaldehyde 0.1371, dioxin 0.1138.According to the results of this research, the authors established a map of the relationship between water soil geochemical anomalies (contamination sources) and geotechnical hydrological conditions (migration pathways) and resident cancer distribution (sensitive receptors).

Keywords: Cancer distribution map; Environmental pollution; Hebei; Langfang; relationship model; Water and soil

Research Progress on the Relationship Between Cancer and Ecological Environment

With the rapid development of the economy and society and the improvement of the living standards of urban and rural residents, the age structure, eating habits, lifestyles, and environmental conditions of the Chinese population have undergone major changes, and the disease epidemic pattern has undergone a major transformation. In 2006, chronic non-communicable diseases such as cerebrovascular diseases and malignant tumors have become the main cause of death in urban and rural residents. From the crude mortality rate of malignant tumors, the city is 16.7% higher than the rural area, the eastern city is 24.9 higher than the western city, and the eastern rural area is 43.7% higher than the western rural area. The gross mortality rate of malignant tumors in 39 high-incidence counties (cities) was 84.85/100,000-300.87/100,000, accounting for 14.58%-43.56% of all causes of death. Some cancer deaths have a phenomenon of village aggregation. In some areas, the mortality rate of cancer is at a national low or normal level. The cancer spectrum of urban and rural residents is changing, and it is increasingly becoming the model of cancer death in developed countries. There are significant differences in the level of malignant tumor death and lineage structure in different regions [1].

As the population ages trend is getting worse, the environment and lifestyle changes, cancer has become one of the major diseases that seriously endanger the health and social development of Chinese residents. The incidence and mortality of malignant tumors in China have continued to increase since the 1970s [2].

Chen W, et al. estimated that there were 4292,000 new cancer cases and 2814,000 cancer deaths in 2015, the morbidity and mortality rates for lung cancer is the highest. The incidence and mortality of gastric cancer, esophageal cancer and liver cancer are also high [3]. Due to the increase in the elderly population, the burden of cancer in the digestive tract in China is still serious, and cancers such as lung cancer and breast cancer, closely related

to the environment and lifestyle have increased significantly in recent years. It is expected that in the next few decades, China's cancer morbidity and mortality will continue to rise as a whole [4]. China's health industry has made tremendous progress, but the gap between regions still exists, and the heterogeneity of mortality in various regions is a concentrated expression of this. Maigeng Zhou, et al. divided the regions of mainland China into five grades [5].

In 2014, the incidence rate of malignant tumors in Hebei Province was 224.98/100,000, and the mortality rate was 149.42/100,000. The task of cancer prevention and treatment in the future is still arduous, and measures still need to be taken to continue to strengthen the prevention and control of malignant tumors in the province [6]. The distribution of cancer villages in China is closely related to rivers. Nearly 60% of cancer villages are distributed within 3 km of rivers, and 81% of cancer villages are distributed within 5 km of rivers; The generate of cancer villages in China, its 95.16% is caused by chemical carcinogens. Environmental pollution, especially water pollution, is the chief culprit in the cancer village [7].

J Z Gong analyzed the influence mechanism of mine tailings reservoir on the hydrogeological environment of adjacent areas, established a conceptual model of local groundwater system and the dose-response function relationship between groundwater NO_3-content and cancer incidence [8]. The occurrence of many cancers in China is regionally different. The difference in living environment hidden behind the region is the real cause of the difference in cancer incidence. Using the data of regional differences as a clue to further investigate and discover the hidden risk factors, this is the significance of investigating the difference in incidence rates in different regions.

Natural Geographical Background

Langfang City is located in the core area of the Bohai Economic Circle. It is known as the "Pearl on the Beijing-Tianjin Corridor". Its urban planning area is located at 116°31′-116°48′ east longitude and 39°27′-39°37′ north latitude. The total area is about 355 km^2, including the urban area, the development zone, the Jianta Town, the North Shijiawu Township, and the majority of Wanzhuang Town, Jiuzhou Town and Beiwang Township, with a total population of 450,000.

The area is located in the northern part of the Hebei Plain between Taihang Mountain, Yanshan Mountain and Bohai Bay. The terrain is flat and wide, and the terrain is slightly inclined from northwest to southeast. The elevation of the ground is 9~21 meters, and the slope of the ground is 0.3%-0.5%. The area is formed by the Yong ding River alluvium and flooding accumulation. The landforms include sand hills, sand ridge, sand hillock, wavy sand ground and rivers, as well as water ditch, pit and sand excavation pits formed by human activities. The Huaying and Pengzhuang have a small amount of fixed semi-fixed aeolian sandy soil, and the rest are mostly tidal soil. According to the physical and chemical properties, the fluvo-aquic soil is further divided into sandy fluvo-aquic soil, sandy loam tidal soil, light loess fluvo-aquic soil and clayey tidal soil, which are regularly distributed from the river channel to the inter-river depression. In the southeast of Huangdaowu and Puzhaoying, there are sporadic saline-alkali soils along the sides of the ditch, which are distributed the strip areas. The vegetation in different soil types is not the same.

According to the lithology characteristics of the stratum, the Quaternary system of this area is divided into four water-bearing groups, corresponding to the Holocene (the bottom boundary 20-30 m), the Upper Pleistocene (80-150 m), the Middle Pleistocene (340-360 m) and the lower Pleistocene (500-520 m). According to the latest results, the shallow groundwater level is buried from 1.3 meters in the urban area to 25 meters in the suburbs, forming an anti-funnel; the depth of deep groundwater is from 90 meters in the urban area to 25 meters in the suburbs, forming a falling funnel.

Ecological Environment Assessment

In 2005, our institute conducted an environmental geochemical survey in the area, and the results showed that the water and soil pollution in this area is very serious [9].

Soil Environmental Quality Assessment

From the sand dunes, the gentle hills, the slopes, the depressions to the lakes, the area presents a combination of sandy fluvo-aquic soil, sandy loam tidal soil, light loam tidal soil, medium-altitude fluvo-aquic soil, clay tidal soil and marsh soil. Mg, Fe, F, N, B, Cr, Co, Cu, Pb, Zn, Mo, Cd, As, Hg, Se and other elements tend to increase, only the pH value decreases.

Compared with deep soil, the geochemical regional distribution pattern of arable soil mainly presents two characteristics:

- Inheritance of abundance background, the ratio of the element average value of the plough layer/deep soil is close to 1.
- The newness of human elements: N, Hg, Se, Cd, P, Pb and other elements related to human industrial and agricultural production are significantly increased, and the content of elements such as Mn and Co is decreased. It is the collective effect result of the Quaternary climate change and human activities.

Using the sequence comprehensive weighted average method to calculate the regional distribution of soil environmental quality in this area, the northwestern environment is better, and the southeast is worse. From Xiwu, Daguanzhuang, Zhougezhuang to Pengzhuang and Dazaolin, along the north side of the Jingshan Railway, the environmental quality is the worst.

Surface Water Quality Evaluation

Compared with shallow groundwater, many indicators of surface water in this area are significantly increased, such as chromaticity, turbidity, visible to the naked eye, chemical oxygen demand, Fe, Zn, Ag, Hg, cyanide, volatile phenol, nitrous acid nitrogen, ammonia nitrogen, F, coliforms, etc. the overall quality is extremely poor. The detection rate of pollutants: cyanide 28%, volatile phenol 48%, nitrite nitrogen 72%, nitrate nitrogen 72%, and ammonia nitrogen 92%.

Based on the drinking water standard GB5749-85, surface water in this area average excess multiple: total coliform 2168, ammonia nitrogen 51.9, oxygen consumption 25.37, turbidity 6.8, nitrite nitrogen 4.5, mercury 3.72, volatile phenol 3.60, manganese 2.33, iron 1.86, chromaticity and fluorine 1.77. Geochemical distribution of pollutants: The degree of surface water pollution corresponds to urban areas, development zones and major towns. Among them, the development zone and Xiguandi in the eastern half have the highest F value and the worst environmental quality. Among them, the high content of Fe, Mn, Cu, Zn, As, Pb is related to industrial enterprises. Volatile phenol, oxygen consumption, and nitrate nitrogen are high in the development zone, which is related to the dense distribution of the chemical industry. The increase in total coliforms is closely related to population density.

Shallow Groundwater Quality Evaluation

Compared to the deep groundwater, the total hardness and salinity and other indicators of shallow groundwater in this area are significantly increased, the quality is significantly reduced, and the overall is poor, chemical oxygen demand, Fe, Mn, NO_2-N, NH_4^+, F, turbidity, total Hardness, total dissolved solids, etc. exceeded the standard. The detection rate of harmful substances has been increased: total cyanide 3.48%, nitrous nitrogen 29.57%, nitrate nitrogen 38.26%, ammonia nitrogen 19.13%.

Based on the background of natural geological evolution, hydro geochemical field states superimposed the interference of human activities:

- The average F value is higher in the area of from Moqiying and the urban area to Menggezhuang, and basically presents the north west direction belt distribution.
- The pH value is higher in the ancient river channel with higher oxidation environment and lower in the river zone.
- The total hardness, Cl^-, COD and other southeastern parts are higher, and the northwestern part is lower, which is related to the continental salinization caused by Quaternary transgression activities.
- The high content of fluorine is concentrated in the inter-river depression.
- Fe, Mn, Cu, and Zn are higher along the modern Wuding River and the Hunhe River.
- The heavy metals such as As, Pb and Cd are higher in the urban area and the southeastern part of the development zone, and are subject to the duality of aquifer lithology and human activities.

Dust Heavy Metal Distribution Characteristics

Yuan Haiyan et al collected the dust samples in the planning area of Langfang City, quantitatively analyzed the contents of heavy metal elements in As, Cd, Hg and Pb, and compiled geochemical maps, anomaly maps and combined anomaly maps using GIS. The results show that the initial pollution area of heavy metals in this area accounts for 21% of the total area. The main pollution elements are Hg and Pb, followed by Cd and As. On the basis of the survey of the planning area, the encryption sampling is carried out in the main urban area. The both maps elements geochemical characteristics are similar and the anomalies are basically reappeared, but the abnormal acreage is reduced, the mean and the extreme value are increased, and several local details are present [10].

Resident Cancer Distribution Characteristics

By the end of 2015, the number and coverage of the Chinese Cancer Registry had increased significantly, reaching a higher level in the world, but the quality of registration data needs to be improved [11]. What we urgently need to do is to regularly publish cancer-related information, on a regular basis release relevant data of tumor registration, cause of death monitoring, and geographic information, and compile national cancer maps.

Acquisition of the Morbidity Data

Through on-site interviews with local residents, the author obtained data on 2017-2018 cancer incidence and mortality at the village level. Ask a question: What is the total number of cancer patients and population in your village in recent years? Interviewees: simple and kind-hearted, concerned about public affairs, 50-65-year-old male farmers and industrial workers, a small number of 40-50-year-old rural cadres and rural medical workers. Sometimes 2-3 people are required to verify the statistical accuracy.

Data Analysis

The number of cancer patients/the current population was calculated from each group of data, and the latest cancer crude mortality + incidence ($\times 10^{-4}$) data 45 groups in recent years was obtained. Among them, the rural areas are based on natural (administrative) villages, and the urban areas are based on communities. The data density is 1 point/6.7 km^2, which is equivalent to a 2.6 km × 2.6 km grid Figure 1 and Figure 2.

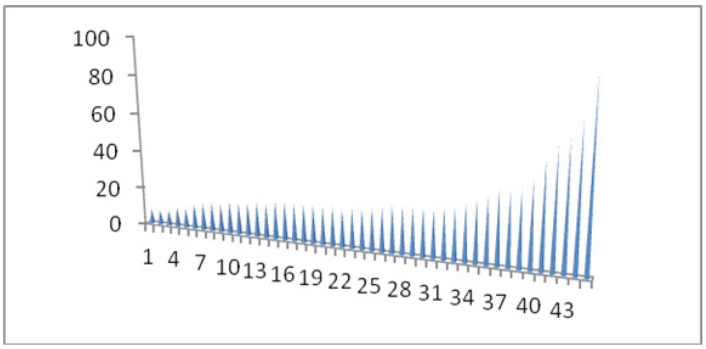

Figure 1: Sequence diagram of resident's cancer incidence and mortality in Langfang City, Hebei Province.

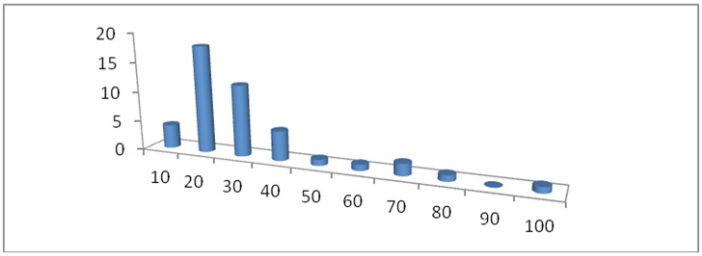

Figure 2: Probability distribution histogram of resident's cancer incidence and mortality in Langfang City, Hebei Province

The data set varies from 7.5-94.3, its mode 20, median 21, geometric mean 22.98, arithmetic mean 27.19, and standard deviation 18.11. The probability distribution is a superposition of 2 normally distributed parent population.

Drawing Production

On the geographic information system MapGIS operation platform, with the base map as the background, the cancer data is marked according to the village, and the equal-line is drawn by hand, and the partition is filled with color tone. The cool color indicates a low value area, and the warm color indicates a high value area.

Geographical Spatial Distribution Characteristics of Residents' Cancer

Distribution characteristics of resident's cancer incidence+ mortality: from 10×10^{-4}-30×10^{-4} in the outskirts to 50×10^{-4}-90×10^{-4} in the urban areas, and the highest in the central area, and Wanzhuang North China Petroleum mining area is also higher, up to 50×10^{-4}.

Correlation Analysis Pedigree

According to the results of 2005 environmental geochemical survey and 2008 multi-target geochemical survey in the Hebei Plain, the authors conducted a correlation analysis, found that the residents cancer incidence + mortality rate is negatively correlated with the shallow depth of groundwater table Hw γ = -0.5271 (n = 45, γ0.05 = 0.2040) significant positive correlation indicators: deep soil Hg0.8885, surface soil Pb0.8572, shallow groundwater Cr0.8290, deep soil N0.7106, surface soil effective Zn0.7027, surface soil Cd0.6931, Hg0.6751, shallow groundwater NH_4-N0.6441, surface water Zn0.6288, shallow groundwater As0.6206, NO_3-N0.6130, Pb0.5284, Cd0.5028, NO_2-N, 0.4958. In addition to the buried depth of the water level, they are harmful or excessive harmful elements, directly or indirectly indicating the presence of carcinogens (such as benzo pyrene, dioxins, etc.) Figure 3.

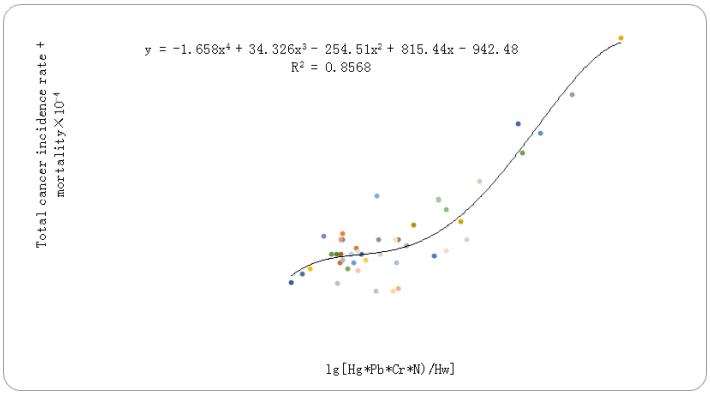

Figure 3: Scatter plot of correlation between resident's cancer crude morbidity + mortality and water soil geochemistry in Langfang City, Hebei Province.

We can establish an equation between the resident's cancer crude morbidity and mortality and the water soil geochemistry.

$y = -1.658x^4 + 34.326x^3 - 254.51x^2 + 815.44x - 942.48$

$R^2 = 0.8568$, $\gamma = 0.9256$, $\gamma 0.05 = 0.261$

$X = \lg[(Hg^*Pb^*Cr^*N)/Hw]$

In addition, there was a significant positive correlation between 48 pieces of dust heavy metal content data and cancer distribution: Pb0.8439, As0.8150, Hg0.7950, Cd 0.5847.

According to the characteristic pollutant frequency table of 340 key industries in Langfang area, these organic matters significantly related to mercury: benzopyrene 0.4723, pyridine 0.1551, formaldehyde 0.1371, dioxin 0.1138(n=340, γ0.05=0.1056). These are carcinogens.

Geological Environment Model of Cancer Distribution

According to the results of this research, the author established a pattern map of mutual relationship, between geochemical anomalies of soil waters in this area (contamination sources)-geotechnical hydrological conditions (migration pathways)-resident cancer distribution (sensitive receptors) Figure 4 and Figure 5.

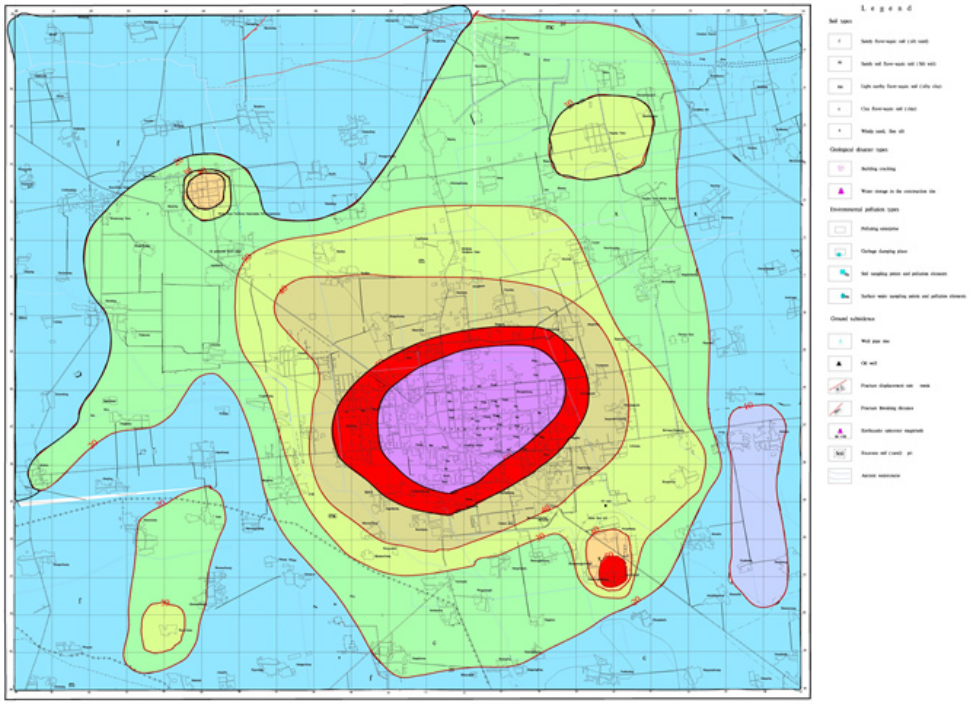

Figure 4: Residents' Cancer distribution map of in Langfang City, Hebei Province, 2017-2018 The value is malignant tumor total crude morbidity + mortality, unit 10^{-4}.

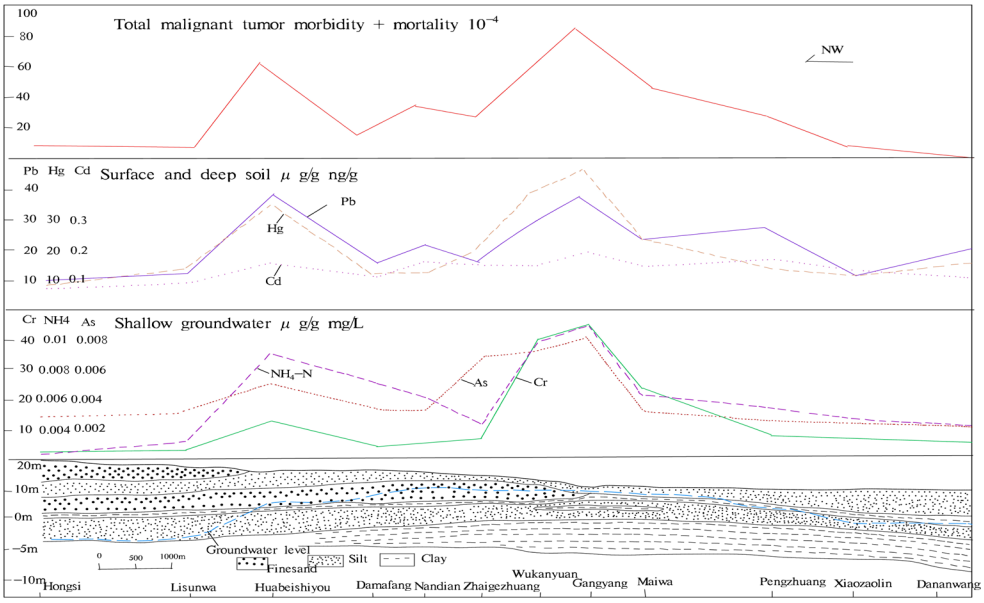

Figure 5: Geological environment model map of resident's cancer distribution in Langfang City, Hebei Province.

Synopsis of the Author

Jin-Zhong GONG (1962-), male, 1983 graduated from the China University of Geosciences (Wuhan) geochemical exploration professional, now as a professor, 50 papers published articles and published 5 books. Email: Gjz212@tom.com; 2548180918@qq.com

Fund Project

China Ministry of Ecology and Environment Land use survey of key industry enterprises in environmental pollution Environmental Affairs Office Soil letter [2018] No. 924.

References

1. Zhu C (2008) The third national death cause retrospective sampling survey report [M], Beijing: China Union Medical University Press: 1-51.
2. Wanqing C, Rongshou Z, Siwei Z (2014) Cancer Incidence, Mortality and Trend in China: 65-71.
3. Chen W, Zheng R, Baade PD, et al. (2016) Cancer statistics in China, 2015. CA Cancer J Clin 66: 115-132.
4. Hongmei Z, Wanqing C (2013) Cancer Epidemiology and Control in China: State of the Art,Progress in Chemistry 25: 1415-1420.
5. Zhou M, Wang H, Zhu J, Chen W, Wang L, Liu S, et al. (2016) Cause-specific mortality for 240 causes in China during 1990-2013: a systematic subnational analysis for the Global Burden of Disease Study 2013. The Lancet: 00551-00556.
6. Jin S (2017) The current status and prediction of malignant tumor incidence and death in Hebei Province in 2014[R]. Graduate School of Hebei Medical University: 1-10.
7. Sheng-sheng G, Tao Z (2013) Temporal-Spatial Distribution Changes of Cancer Villages in China[J]. China Population, Resources and Environment 23: 156-161.
8. Gong JZ (2016) Environmental impact analysis of mine tailing reservoir International Conference on Water Resource and Environment 2016 (WRE2016), IOP Conf. Series: Earth and Environmental Science 39: 012014.
9. Shu-juan SHI, Jin-zhong G, Si-chao J (2008) Geochemical Assessment of Soil Contamination in the Planning area of Langfang City. Geophysical & Geochemical Exploration 32: 571-573.
10. Haiyan Y, Jinzhong G, Chunshan C (2015) Causes of dust heavy metal pollution and its prevention and control measures in Langfang City Planning District. Anhui Agricultural Sciences: 233-236.
11. Wanqing C, Zhiheng L, Huishan Y (2016) Status and development of Chinese oncology registration. Chinese Journal of the Frontier Medicine science 8: 1-5.