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Article

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Posted Date: August 19th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-55816/v1>

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Geological Environmental and Socioeconomic Factors of Disease Spectrum in Chinese Population

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Abstract Through the correlation analysis of statistical data of provinces and autonomous regions, this paper has comprehensively, systematically and quantitatively studied the natural geography, geological environment, socioeconomic, geochemical and hydrogeological constraints of endemic diseases, cancer and common diseases in mainland China. In order to prevent the rational design of medical experimental plan, provide a scientific basis. The results show that, the occurrence of different human diseases is subject to different environmental conditions. Keshan disease, Kashin-Beck disease, endemic goiter and fluorosis, in addition to soil selenium, groundwater iodine and fluoride, but also by a variety of environmental factors; Total nitrogen in soil has an promote effect to gastric cancer and liver cancer. The amount of nitrogen fertilizer has an effect to rectal cancer, pancreatic cancer and lymphatic cancer, and soil arsenic has significant inhibitory effect to lung cancer, pancreatic cancer and lymphatic cancer. River water hardness, salinity and soil calcium, magnesium and other elements for a variety of cancers may also have inhibitory effect. Cerebrovascular disease and myocardial infarction have shown the features of urban population in cold and droughts in the north; Chronic obstructive pulmonary disease and respiratory tract infections show the features of the population in the mountain mining and smelting industries; Chronic nephropathy reflects the characteristics of arsenic and sulfur poisoning in plateau areas; Alzheimer disease shows the characteristics of people in farming areas. The average content of elements in sediments of water system, the county territory of 26 longevity counties in China are relatively high compared with the national average, and the human beneficial elements are relatively high; while the harmful elements in human bodies are relatively low. If we make full use of soil (stream sediment) geochemical measurement data, combined with the results of this study, it is possible to greatly refine the spatial distribution prediction maps of population diseases in mainland China. The author believes that by improving the climatic and geographical conditions of residence and increasing the intake of certain chemical elements in an appropriate form (Especially the food chain diet structure), it will certainly play an important role in reducing the occurrence and development of diseases and improving human health.

Keywords: disease lineage; natural geography; hydrogeology; soil geochemistry; mainland China

1.A Review of the Research on the Relationship between Environment and Health

Since 1954, British J of Cancer has published articles on the relationship between soil and cancer ^{[1][2][3]} (Griffith, G.,1955; Tromp S W,1955; STOCKS, P,1960).

In 1960, Legon, Stocks, and David noticed that residents of North Wales and Cheshire, living in areas with high organic matter content, had a higher incidence of gastric cancer. Stocks and David believe there is a positive correlation between gastric cancer incidence and zinc, chromium, and cobalt in soil^[4](Stocks,1964).

In 1980, Marjanen discussed that soil manganese concentrations in Finland seemed to have a strong anticancer effect, and high concentrations of zinc and copper also seemed to be associated with higher cancer mortality. Norie and Foster study finds that digestive system cancers occur less frequently in hard water areas in Canada.

From the 1970s to the 1980s, many studies in China suggested that the high incidence of nasopharyngeal cancer in Sihui County, Guangdong was related to higher nickel content and lower selenium content in the local area. In Shunde, the content of copper, molybdenum and zinc in soil and water is higher in the severely ill area than in the mildly ill area, while the content of manganese, barium and strontium is lower in the severely ill area than in the mildly ill area.

30 counties in Jiangxi, analysis of the relationship between lung cancer, colon cancer, rectal cancer and soil dose-response, negative correlation between selenium and malignant tumors; Co / Se, Mn / Se values are positively correlated with rectal cancer; Bi / Se positively correlated with colon cancer; When selenium and molybdenum are both low, malignant tumor mortality is high^[5] (Liu Yanfang, *et al.*1987) .

From the late 1990s to the present, people have paid more attention to the relationship between soil and human cancer, and pollutants with clear cancer risk.

Based on relative risk, dose-effect, and multivariate analysis results, negative correlation between soil selenium content and digestive system cancer in Jiangxi Province ^[6](Liu Yanfang, *et al.*1994). Correlation and comparative analysis show that, negative correlation between zinc content in soil and rice and digestive system cancer in Jiangxi Province^[7] (Fan Guangqin.1997) .

The high-low incidence areas of gastric, esophageal and liver cancer in China have regional distribution characteristics and unique geological environments, Some elements in soil, drinking water, food and human body are significantly positively or negatively correlated with incidence^{[8][9]} (Wang Xiaomei.1999; ZENG Zhao-hua, *et al.*2000) .

There is a correlation between cancer mortality and soil mercury, grade correlation coefficient: gastric cancer -0.4443, liver cancer 0.5099, cervical cancer—0.3613, leukemia 0.3376, Nasopharyngeal carcinoma 0.7425, breast cancer 0.4567^[10](Zeng Zhaohua, *et al.*1999). zinc content in esophageal cancer tissue is significantly lower than normal esophageal tissue adjacent to the cancer^[11] (Song Guangmin, *et al.*2000) .

In Mainland China, cancer mortality is related to iodine in the soil,among them gastric cancer -0.3308, esophageal cancer -0.5217,liver cancer 0.3145, cervical cancer -0.3968, nasopharyngeal carcinoma 0.6283^[12] (Zeng Zhaohua, *et al.*2000) .

Grade correlation coefficient between cancer mortality and vanadium in soil, respectively, gastric cancer -0.4769,colorectal cancer -0.3179^[13](Zeng Zhaohua,*et al.*2002).Comprehensive analysis shows that the death rate of various cancers is related to the abundance and deficiency of many trace elements in the soil^[14] (Qin Junfa,*et al.*2004) .

High incidence of gastric cancer in Zanhuang County, Hebei Province, contamination of benzopyrene, nitrosamines, aflatoxins B1, and G1 in residents' drinking water can be detected, nitrate and nitrite content are significantly higher than in low-incidence areas^[15] (Zhang Xiulan, *et al.*2002) . The contents of nitrate nitrogen

and nitrite nitrogen in drinking water, serum and saliva of residents with high incidence of gastric cancer were significantly higher than those in low incidence areas^[16] (Zhao Shuqing.2005) . Arsenic content in soil, drinking water, and human hair in low-incidence areas of gastric cancer in Fujian is higher than in high-incidence areas, indicating that moderate arsenic can inhibit cancer^[17] (Chen Boyang.2008) . Gastric cancer was positively correlated with soil Pb and negatively correlated with Mo and Se. The circulation of chemical elements in the environment through the ecosystem leads to a lack of Mo and Se and an increase in the Cu / Zn ratio, may be an important risk factor for gastric cancer in Xianyou County, Fujian^[18] (Li Hongtu.2008) .

Numerous studies have proven that compound contamination and viral infection are two important causes of cancer. Compound-compound,compound-viral combination increase the risk of cancer. Mutation test results become positive when the two are combined^[19] (Wang Xiaomeng.2013) .

Nitrosamines,molds,aflatoxins, human papillomavirus infection, occupational environment, air radon pollution, indoor coal-fired air pollution are the causes of the high incidence of cancer in parts of China^[20] (Zou Xiaonong. 2014) .Lung cancer in eastern Yunnan is related to its special geographical environment and coal resources, indoor combustion of coal,pollution exposure, family aggregation and genetic susceptibility are the main factors for the higher incidence of lung cancer^[21] (Li Jihua.2014) .

The geographical distribution of cancer villages in China is consistent with the distribution of water pollution and air pollution, there is a positive correlation between the number of cancer villages in each province and the total GDP of each province^[22] (Liu Tongshan. 2016) .

Based on the data of China's tumor registration area from 2005 to 2012, Zhang Calculated the comprehensive correlation degree, The death latency of gastric nitrogen, liver cancer, and esophageal cancer caused by ammonia nitrogen emissions is 1 year, the incubation period for colorectal cancer deaths is 1 year in men and 0 years in women^[23] (Zhang Rongyan, *et al.*2016) .

The incubation periods of male lung cancer caused by atmospheric pollutants sulfur dioxide, nitrogen oxides and smoke and dust are 5 years, 3 years, and 5 years, respectively;the incubation period that causes female lung cancer is 5 years, 4 years, and 5 years, respectively^[24] (Zhang Rongyan, *et al.*2016) .

Big data clearly states again that the main causes of human cancer are acquired environment and lifestyle. Pollution of air, soil and drinking water means that China's population is still exposed to many environmental carcinogens^{[25][26]} (American Cancer Society.2015; Chen W, *et al.*2016) .

Through a large number of epidemiological statistical analysis and clinical experimental research, scholars have initially identified the geographic distribution and risk factors of various cancers and common fatal diseases in the Chinese population, such as gastric cancer^{[27][28][29][30][31][32]} (Duell, *et al.* 2011;Zhiyong Zhang,*et al.* 2011; L. D.Elia, *et al.*2012; Zou Xiaonong,*et al.*2012; Zuo Tingting, *et al.*2017; LI Daojuan, *et, al.*2017;S M Dawsey, *et al.*2019), bowel cancer^{[33][34][35][36][37][38][39]} (Qin Huanlong, *et al.*2001; Chen Kun.2003; Chen Qiong, *et al.*2012; Daojuan L I , *et al.*2015; Zuo Tingting, *et al.*2015; Feng Yajing, *et al.*2016; Fan Chunsun,*et al.*2018),primary liver cancer^{[40][41][42]} (Guan Chentao,*et al.*2015; Lu Guishuai, *et al.*2015), lung cancer^{[43][44][45][46][47]}(Fan Ruolan.1993; Ettinger DS.2012; Yao Xiaojun, *et al.*2014; Chen Wanqing *et al.*2016; Han Baohui.2018), bladder Cancer^{[48][49][50][51][52]}(Wang Junyong, *et al.*2012; Zheng Rongshou, *et al.*2012; Wen Denggui, *et al.*2012; Han Sujun, *et al.*2013; Wen Denggui.2013),pancreatic cancer^{[53][54][55][56]} (Xiang Yongbing.2002; Amaral AF,*et al.* 2012;Zeng Hongmei,*et al.*2013; Tian Ming, *et al.*2016),esophageal cancer^{[57][58][59][60]} (Wang Lidong,2002; Zou

Xiaonong.2006; HeJie, *et al.*2011; Qiao Youlin.2016),lymphoma^{[61][62]}(Xu Liangzhong.2002; Zhang Yuling.2013),nasopharyngeal carcinoma^[63] (Deng Wei, *et al.*2012),leukemia^[64] (Jiang Hao,*et al.*2014), breast cancer^{[65][66][67][68]} (Yang Ling, *et al.*2006; Zheng Ying, *et al.*2013; Chen Wanqing, 2015;Jouybari L, *et al.*2018), cerebrovascular disease^{[69][70]}(Chang Yiming.1989; Wang Wenzhi.2011),myocardial infarction^{[71][72]} (Wu Dong,*et al.*2008; Su Shi, *et al.*2012) ,chronic obstructive pulmonary disease^{[73][74][75][76][77]} (Zhou Yumin, *et al.*2004; Zhong Nanshan.2011; Wang Cuiru, *et al.*2011; Zhao Yanni,*et al.*2012; Ding Ning, *et al.*2016) , chronic kidney disease^{[78][79][80][81]} (Wang Haiyan.2010; Expert group,2017;JinweiWang,*et al.*2018; Richard J. Johnson, *et al.*2019) , respiratory infections^[82](Xiao Jianping.2019), Alzheimer's disease^{[83][84]} (Cheng Yinmei,*et al.*1999; Zhou Yumiao, *et al.*2006).

Diabetes is related to geographic climate, lifestyle, diet structure, race and virus, and aging population. Minerals, vitamins and trace element preparations can be used as diagnostic markers for diabetes. The content of various elements in the body has significant differences in comparative studies^{[85][86][87][88][89][90][91][92][93][94]} (Mei Yuehua, *et al.*1990;Qin Junfa.2000;Chen Yu, *et al.*2002; W.Y.Yang, *et al.*2010; Siddiqui K, *et al.*2014; Chinese Medical Association Diabetes Branch.2014;Liu Gang.2015;Tiange Wang, *et al.*2019;B. B Finlay,*et al.*2020) .

Table 1 Natural Environment and Socioeconomic Factors of Chinese Population Diseases in Literature Reports

<i>Disease</i>	<i>Epidemic distribution</i>	<i>Socioeconomic factors</i>	<i>Positive correlation factors in environment</i>	<i>Negative correlation factors in environment</i>
<i>Gastric cancer</i>	Northwest China as the high-incidence area, followed by the southeast coast and Liaodong Peninsula. Gradual decline from north to south,low incidence areas in South China and Yunnan-Guizhou Plateau	People who eat smoked, salted food for a long time. <i>Helicobacter pylori</i>	Ammonia nitrogen emissions, surface water, benzopyrene, nitro samine, aflatoxin B1, GI,nitrate, nitrite,Ca,Mg, K, Na,P,Ba,As,Cd,in drinking water, human tissue Fe, V, Ti, B, Cr,Ni, soil Pb,Co, Cu, diet sodium	Deep ground water, soil F, Be, Sn, Mo, Se, I, V; Drinking water Zn, Fe, Co; Soil, drinking water and human hair As, hair Ca, Ma, Fe, Cu; Serum Zn, Fe, high quality protein, garlic
<i>Lung cancer</i>	Northeast China, Shanxi, Hebei, Anhui, and Zhejiang have relatively high incidence, and the northwest is relatively low. Male over female	Industrially developed, smoking, occupational exposure, ethnicity, familial clustering and genetic susceptibility	Iron and steel coal resources, indoor coal combustion, sulfur dioxide, nitrogen oxides and smoke and dust, soil Pb,As,K, Rh,Cr,Ni,Ba,F,Hair Mn; Air benzopyrene, PAHs, lung Se	Soil Se,Mo; Hair Al, Ca, Cu, Ni, Zn, Sr, Ba; serum Se, hair Mn, Sr, β-carotene
<i>Liver cancer</i>	Coastal areas are higher than inland, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong and Guangxi form high - incidence belts.	Viral HBV and HCV infections, alcohol, cirrhosis, sex hormones, aflatoxins in grains and oils.	Humid climate zone, ammonia nitrogen emissions, nitros - amines, drinking water organic chlorine, benzopy -rene; soil Hg, I, Cu, Ca; Hair Fe, In.	Soil Sn,As,Se; Hair Al, B, Cr, La, Sr, Zn, P, Mg,tea
<i>Esophag eal cancer</i>	The high-incidence area is centered on the Taihang Mountains, with the highest incidence in Henan, Shaanxi, and Shanxi. Gradually decrease towards the	Rural is about 16 times more urban. age, sex, occupation, race, region, dietary structure, lifestyle, genetic susceptibility, etc	Drought erodes low mountains and hills.Drying index, evaporation; ammonia nitrogen emissions, Soil Ca, Mg, Co, hair Pb, Cr,Sr,Si.	Hydrothermal index, soil organic carbon, precipitation, average annual temperature, Soil Cu, Mo; water and soil Mg,Mn,Cu,Mo,

	periphery.			Se,Zn,I; human tissue Zn, hair Ca, Mg, Fe, Cu, Ni,Zn, Mn,Ni,Pb, P, S; Coffee, Vitamin A, B ₂
Bowel cancer	Total male and female incidence is highest in Shanghai, Followed by Zhejiang, Sichuan, and Fujian, and Shandong, and Tibet lowest	Male is higher than female, urban is higher than rural. Economically developed, animal fats and proteins are too high, and dietary fiber intake is insufficient	Ammonia nitrogen emissions, soil Cr, Co, V, Ni, Cu, Ti, Hg, Mn, Bi, Mg,Ba.	Soil Mo,Sn,Be,Se,V; Dietary fiber
Leukemia	Eastern coastal areas, the middle and lower reaches of the Yangtze River, Zhejiang, Jiangsu, Fujian, and Shanghai are the highest, Gansu, Tibet lowest	Industry is developed, old people and children are more common	Benzene and its derivatives, Pesticides, herbicides; high-dose radiation, petroleum hydrocarbons, formaldehyde, soil Pb, As,K, Hg; blood Cu,Ni	Diet Fe, Zn, Se, Cu; blood Zn, Fe, Ca,Mn; serum and hair Se, Zn,Ge,Co,V, drug As ₂ O ₃ .
Nasopharyngeal carcinoma	From southeast coastal Guangdong, Guangxi and Hunan to northwest Gansu, Tibet, the incidence gradually decreased	Family aggregation, ethnic susceptibility, regional concentration, susceptibility genes, virus infection	Soil Ni, Hg, I; soil and water Cu,Mo,Zn,As; Hair Ni, Cr, Cd	SoilSe,Mn,Ba,Sr, Co, Cr; Hair Mo, Se, Zn
Bladder Cancer	Total incidence is highest in Ningxia, followed by Zhejiang and Jiangsu, and lowest in Tibet. 3~4 times higher for men than female	Smoking and occupational exposure to aromatic amines - Aluminum products, coal tar, asphalt, dyes, rubber, coal gasification, etc., the incidence increases with age.	Urine Fe	Blood Fe,Zn,Cu, Mg,Se
Lymphoma	The highest incidence was in Shanghai, followed by Beijing and Zhejiang; Tibet was the lowest. Male over female	Eastern developed areas, infection, decreased immune function, occupational and genetic factors, individuals over 70	Serum Cu; air benzenes, petroleum hydrocarbons	Blood Zn,Se
Pancreatic cancer	Total male and female morbidity rates are highest in Shanghai, followed by Jiangsu and Beijing, lower to the west, and lowest in Xinjiang and Tibet.	Age, occupation, smoking, drinking, high-fat and high-protein diet, excessive coffee consumption, genetics, etc.	Soil Sr, human tissue Pb,As,Cd	Mg intake, human tissue Ni, Se
Breast cancer	The eastern coastal areas, the middle and lower reaches of the Yangtze River and the industrially developed areas in the Northeast have relatively high incidence.	Long-term use of exogenous estrogen, postmenopausal obesity, excessive drinking and related mutant genes	Soil As,Hg, Ba; human tissue Cd, Ni; Hair Cr, Ni	Human tissue Se,I, Zn, Cu, Mn, Hair Zn, Cu, Mn, Sr, Ca; Vitamin D
Cancer villages Quantity	Regional distribution is consistent with water pollution and air pollution distribution	The total GDP of each province is positively correlated	Ash powder, soot, soil Cd,As; hydrogen sulfide in river water, dioxin; permanganate index and ammonia nitrogen, volatile phenol, nitrite nitrogen, Fe, Mn, Hg, Cr ⁶⁺ , Benzene and toluene concentrations exceeded	

			standards; pesticides, Cr, Cd, Pb in food exceeded standards	
<i>Cerebrovascular disease</i>	The prevalence is higher in the north than in the south, inland than in the coast, highest in the north and northeast, and lowest in the south and southwest	Hypertension, hyperlipidemia and hypercholesterolemia, overweight and obesity, diabetes, lifestyle, psychosocial factors	Cold weather, soil Pb,Cd,Cd V, Ni; hair Cu	Drinking hardness, Ca, Mg, K, Cl, Se, Cr, Mn,Zn; hair Cr, Se,Mn, Mg, Zn; Salvia miltiorrhiza
<i>Heart disease</i>	The incidence is highest in the northeast and northwest, and gradually decreases towards the southeast coast	Sociopsychological factors -mental strain, stress state; obesity, smoking, increasing age, heavy drinking	Cold stimulation, Diet Na+, Whole blood Pb, Zn, Cd, As, Co	Diet K ⁺ ,Ca ²⁺ ; human tissue Zn, Se; hair blood urine Mg; Whole blood Cu, Si, Se, Li, Mg, Rb, Sr, Ni, Ba, K / Na, Mg / Ca; Hair Sr, Ca, Aspirin, beans, sea fish, soybean
<i>COPD</i>	Male incidence is highest in Guizhou, followed by Yunnan, Gansu, Sichuan, and Qinghai, while Jilin, Beijing, and Tianjin are the lowest.	Smoking, respiratory infections and low socioeconomic status	Inhalation of dust and chemicals in the air, nitriles, amines in tobacco,As,Hg,Cd,Ni	Diet Zn, Fe,Ca, Vitamin E
<i>Chronic kidney disease</i>	The prevalence rate for males is highest in Hunan, followed by Tibet, Guizhou, Qinghai, and Yunnan, while lowest in Beijing, Shanghai, and Tianjin.	Increased age, family history of CKD, diabetes, hypertension, metabolic immunity, infection, stone tumor, cardiovascular disease, anemia, low economic and educational level	Climate change, combinations of toxins and infections; Pb exposure; soil Cd,As; respiratory contact SiO ₂ and many more	Human tissue Se, Zn; Serum and hair Fe, Zn, Ca
<i>Alzheimer's disease</i>	The male incidence rate is highest in Shandong, followed by Zhejiang, Hebei, Guangdong, and Shanghai; Shanxi is the lowest	Family history, head trauma, low education level, viral infection, etc., long-term alcohol abuse, sweets, sedentary, rarely use the brain	Drinking water Al; Hair P Mn,Pb,Cd; Cerebrospinal fluid Fe, Al, Cu	Diet Cu; drinking water Li; Human tissue Zn, Se, Mg, K, Ca; serumCa,Zn,Al; Hair Ba, Sr, Ca, Mg, Co, Cr, Cu, Ni, Ti, Mn, Zn
<i>Diabetes</i>	Overall trend gradually decreased from the eastern plain to the western plateau. Beijing was the highest, followed by Tianjin, Shanghai, Jilin, and Hebei; Yunnan, Ningxia, Tibet lowest.	High-speed economic development, industrialization process, lifestyle, diet structure, obesity, race, genetic genes, viral infection, population aging	Geography, climate, human tissue V, Cu;urine Ni,Plasma ferritin	Human tissue Ca,Mg, Na,Cr, Co, I, Zn,Mn, Se; serum Mg, P, Zn, Fe, Cr,Se, Metformin, Mediterranean diet, flaxseed, vitamin D

Health and longevity is an important indicator of human happiness, but also a goal of the people persistent pursuit, and disease disasters is the biggest enemy of health and longevity. Human health and longevity are related to social culture, living habits, dietary nutrition, etc., and are more directly related to the regional geographical environment. The local climate, soil, water, air and vegetation are the main factors affecting people's health and longevity.

Since the 1990s, people began to use geochemical methods to study the relationship between longevity and the environment, believing that the content of life elements in the longevity area is different. The one of the environmental elements, soil is at the center position. It directly affects the

water nature and crops quality, through physiological and biochemical functions of life elements, Affect human health. The combined effect of excellent water and soil ecology and environment and the good eating habits make the inhabitants' physical fitness gradually increase in some areas and form a world famous longevity area. If some trace elements in the soil are high or low, local people may get endemic through the food chain.

2.Methods and techniques

Restrictions on human health and longevity factors include social, environmental and personal three aspects. Human life in a certain natural environment, its health status, longevity level will inevitably be a variety of natural factors. How the geographical environment affects human life and mental condition is still a weak link ^[95].

The author has collected a large number of Chinese provinces and municipalities disease statistics, including 1959-1982 incidence of Keshan disease, Kashin-Beck disease, endemic goiter, dental fluorosis, fluorosis, 2015 incidence of diabetes, incidence in 2008 of nasopharyngeal cancer, esophageal cancer, stomach cancer, liver cancer, lung cancer, bladder cancer, leukemia, Lymphoma, colorectal cancer, data on causes of death from 1990 to 2013, the proportion of centenarians in longevity township, corresponding altitude Alt / m, annual average temperature Tat / °C, precipitation Pre / mm, per capita income Pci, soil pH, organic carbon OrC, Total nitrogen TN, total S and Se, effective sulfur efS, effective manganese efMn, effective molybdenum efMo^[96] ^[97], elemental concentrations of water system sediments^[98], river water hardness Rwh, river water salinity Rws, groundwater fluorine content GwF, drinking water iodine content DwI^[99]. Through the correlation analysis, studied the natural geography, geological environment, socioeconomic, geochemical and hydrogeological factors of the disease lineage, and provide a scientific basis for the rational design of preventive medical experimental plan.

A statement

All materials used in this article have been published publicly and are listed as references. That all experiments on humans were approved by the corresponding agencies.

All experiments and methods in this article were carried out in accordance with relevant guidelines and regulations.

This article belong personal amateur research. All experimental schemes do not require the approval of a designated institution.

This study is public and transparent in nature and has obtained sufficient informed consent from all participants.

Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

3.Endemic disease's geological environment factors

China's diverse terrain, climate, soil and biome organic combination become different nature character ecological landscape. Due to the abnormal ecological environment or people's own special living habits, the balance between the human body and the ecological environment is destroyed,

which affects health and causes endemic diseases.

Keshan disease and Kashin-Beck disease in China are mainly distributed in the area of northeast Sanjiang to the southwestern Sanjiang area, mainly in the area of brown-colored soil series. This is a form of endemic cardiomyopathy, predominantly for children under 10 and women of childbearing age. The study found that a variety of environmental factors and the occurrence of Keshan disease have different degrees of correlation^[100].

This study shows that the incidence of Keshan disease is positively correlated with soil organic carbon OrC0.6863, stream sediment phosphorus P 0.5139, effective molybdenum efMo0.4207, manganese Mn0.3868, aluminum Al0.3641, iron Fe 0.3191, significantly negative correlation with Se-0.4602, Tat-0.4290, Pes-0.3653, Si-0.3542, S-0.3469 and B-0.3073.

Kashin-Beck disease ecological environment survey showed that ward soil, food and dietary selenium levels were significantly lower, in addition there are other environmental factors and selenium deficiency compound cause disease^[100].

This study showed that the incidence of Kashin-Beck disease was significantly positively correlated with soil organic carbon OrC0.7789, phosphorus P0.41462, manganese Mn0.3349, aluminum Al0.3203, sodium Na0.3130, and negatively correlated with the annual average temperature Tat -0.5418, selenium Se-0.4054, boron B-0.4030, effective sulfur efS-0.3055 and so on.

Iodine deficiency disease in almost all parts of China have varying degrees distribution of the disease, in the mountains more than plains, inland more than the coast, especially in the grasslands and plateau areas more serious^[100].

This study showed that the incidence of endemic goiter was significantly positively correlated with altitude Alt0.5763, soil effective sulfur efS0.4773, total sulfur S0.4073, arsenic As0.3869, calcium Ca0.3813, and significant negative correlation with per capita income Pci-0.4046, life expectancy Ale-0.3797, potassium K-0.3409 in sediments, nitrogen fertilization Nf-0.3076, groundwater fluorine RwF-0.2754, drinking water iodine DwI-0.2648.

The clinical manifestations of endemic fluorosis are dental fluorosis and skeletal fluorosis. Disease areas in China from Heilongjiang in the northeast to Xinjiang in the northwest, showing an inhomogeneous stove-like distribution. The groundwater fluoride the higher, the longer the drinking time, the more serious the disease. Children aged between 7 and 8 years old were susceptible to fluorosis, and the prevalence of skeletal fluorosis increased in adults over 20 years old. The prevalence of the disease is also affected by other factors, such as dietary nutrition, calcium content and hardness in drinking water^[100].

This research shows that, there was a significant positive correlation between dental fluorosis and groundwater fluorine content GwF0.6264, river water hardness Rwh0.5124, soil pH0.4651, phosphorus P0.3904, calcium Ca0.3852, magnesium Mg0.3780, degree of mineralization of river water Rws0.3746, strontium Sr0.3318 and iodine DwI0.3144; Significant negative correlation with the amount of pesticide applied Pes-0.4269, nitrogen fertilizer application amount Nf-0.4005, soil effective manganese efMn-0.3941, temperature Tat-0.3570, soil silicon Si-0.3365, etc. Fluorosis of bone incidence significantly positively correlated with soil phosphorus P0.5273, strontium

Sr0.4628, life expectancy Ale0.4083, soil magnesium Mg0.3934, pH0.3399, groundwater fluorine GwF0.3360, soil calcium Ca0.3262, river water hardness Rws0.3258, and significant negative correlation with soil Se-0.4398, silicon Si-0.3861, U-0.3595, effective manganese efMn-0.3475 and so on.

The background values of fluorine in soil and sediments in northern China were lower than those in the south, but the mineralization of groundwater increased due to the transpiration enrichment. The F, Ca, Mg concentrations are relatively high, Fe and Al ion concentrations are relatively reduced, the antagonism of various elements together determine the body's ability to absorb fluorine, exacerbated the degree of harm to human body fluoride^[101].

In recent years, the incidence of diabetes showed a significant trend of increasing with time, at the same time there are obvious differences in spatial distribution^{[102][103]}. Correlation analysis showed that there was a significant positive correlation between the disease and per capita income Pci0.6912, life expectancy Ale0.5445, soil potassium K0.5256, drinking water iodine DwI0.4489, nitrogen fertilizer Nf0.3218, soil aluminum Al0.3190, significantly negative correlation was observed with soil As-0.6621, Alt-0.4991, soil B-0.4784, Ni-0.4140, effective sulfur efS-0.3880, Cr-0.3132 and effective zinc efZn-0.3493.

Table 2 Related factors list of endemic diseases incidences in 1959-1980 China

<i>Diseases</i>	<i>Positive correlation factors</i>	<i>Negative correlation factors</i>
<i>Keshan disease</i>	OrC0.6863,P0.5139,eM0.4337,Mn0.3868,Al0.3641,Fe0.3191	Se-0.4603,Tat-0.4290,Pes-0.4053,Si-0.3542,N-0.3469,B-0.3073
<i>Kashin-Beck</i>	OrC0.7789,P0.4462,Mn0.3349,Al0.3203,Na0.3130	Tat-0.5318,Se-0.4053,B-0.4030,ePS-0.3055
<i>Endemic goiter</i>	Al0.5763,ePS0.4773,S0.4073,As0.3869,Ca0.3813	Pci-0.4046,Ale-0.3797,K-0.3409,Nf-0.3076,RwF-0.2754,13e1-0.2648
<i>Dental fluorosis</i>	GwF0.6260,Rwh0.5124,pH0.4651,P0.3909,Ca0.3852,Mg0.3780,Rw0.3746,S0.3318,DwI0.3144	Pes-0.4269,Nf-0.4005,eMn-0.3941,Tat-0.3570,Si-0.3365
<i>Fluorosis of bone</i>	P0.5273,Sr0.4628,Ale0.4083,Mg0.3934,pH0.3399,GwF0.3360,Ca0.3262,Rw0.3228	Se-0.4398,Si-0.3861,U-0.3595,efMn-0.3475
<i>Diabetes</i>	Pci0.6912,Ale0.5445,K0.5256,DwI0.4489,Nf0.3218,Al0.3190	As-0.6621,Alt-0.4991,B-0.4784,Ni-0.4140,efS-0.3880,Cr-0.3132,efZn-0.3493

Disease lineage related equations:

$$\text{Keshan disease } y_1 = 0.0345x_1^3 + 0.0959x_1^2 + 0.3114x_1 - 0.3297$$

$$x_1 = \lg[(\text{OrC} \times \text{P} \times \text{efMn} \times \text{Mn}) / (\text{Se} \times \text{Tat} \times \text{Pes} \times \text{Si})], \quad R^2 = 0.5667$$

$$\text{Kashin-Beck disease } y_2 = -0.207x_2^3 + 2.8987x_2^2 - 11.559x_2 + 14.097$$

$$x_2 = \lg[(\text{OrC} \times \text{P} \times \text{Mn} \times \text{Al}) / (\text{Tat} \times \text{Se} \times \text{B} \times \text{efS})], \quad R^2 = 0.8112$$

$$\text{Endemic goiter } y_3 = 0.376x_3^3 + 2.8956x_3^2 + 7.1452x_3 + 8.3092$$

$$x_3 = \lg[(\text{Alt} \times \text{efS} \times \text{As} \times \text{Ca}) / (\text{Pci} \times \text{Ale} \times \text{K} \times \text{Tat})] \quad R^2 = 0.4515$$

$$\text{Dental fluorosis } y_4 = 1.0235x_4^3 - 4.4277x_4^2 + 5.4993x_4 + 5.7656$$

$$x_4 = \lg[(\text{GwF} \times \text{Rwh} \times \text{pH} \times \text{P}) / (\text{Pes} \times \text{Nf} \times \text{efMn} \times \text{Tat})] \quad R^2 = 0.5787$$

$$\text{Fluorosis of bone } y_5 = 0.2008x_5^3 - 2.7329x_5^2 + 12.403x_5 - 18.665$$

$$X_5 = \lg[(P \times Sr \times Al \times Mg) / (Se \times Si \times U \times fMn)] \quad R^2 = 0.3999$$

$$\text{Diabetes } y_6 = -1.7989x_6^3 + 4.3306x_6^2 + 1.9714x_6 + 7.8711$$

$$X_6 = \lg[(Pci \times Al \times K \times DwI) / (B \times Ni \times fS \times Cr)] \quad R^2 = 0.6223$$

4. The geological environment factors of cancer incidences

A retrospective survey of death causes in the 1990s showed that the mortality rate of malignant tumors in Chinese residents showed a clear upward trend and became the second leading cause of death among residents. Various malignancies have their own spatial distribution characteristics, There is a clear correlation between the mortality rates of most malignancies. Lung cancer, breast cancer, colon cancer and leukemia are relatively high in the eastern coastal areas, the middle and lower reaches of the Yangtze River and the industrialized areas in northeast China. Gastric cancer and esophageal cancer are relatively high in the hinterland and the coastal mountainous areas. The mortality rates of liver cancer and nasopharyngeal cancer gradually increase from the southeast coast to the northwest reduces. The stepwise correlation analysis showed that most of the malignant tumors that were clustered together had most commonly associated soil micronutrients. Correlation analysis also showed that the contents of Fe, Cu, Co, Se, Mo, Mn and other elements in human hair were negatively correlated with the local mortality of malignant tumors. Pb, K, As, Cr, Ca and other elements were positively correlated with the mortality of local malignant tumors^[104].

The distribution of cancer villages in China is closely related to rivers. Environmental pollution, especially water pollution, is the chief culprit in the cancer village^[105]. J.Z.Gong (2019) 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)^[106].

According to the incidence rate data of each province and city, the disease related lineage is counted. The results show that the anatomically similar organs and viscera, its incidence rate has geographical spatial aggregation.

Chinese male cancer related lineage map

Chinese female cancer related lineage map

Uses the data on various cancer rates in mainland China in 2008^[10], the author carried out the relevant analysis, come to different human diseases environmental constraints pedigree. All kinds of cancer male and female with environmental factors are generally the same, but there are also some differences. For different diseases, the same indicator may be the opposite effect. In many disease factors, we can find the shadows of the altitude elevation.

According the field survey data, J.Z. Gong has established a dose - response function between groundwater NO_3^- content and the incidence of cancer^[107].

The above shows that soil total nitrogen on gastric cancer, liver cancer has a promoting effect, the amount of nitrogen fertilizer on pancreatic cancer, lymphoma has a promoting effect, soil As has obvious inhibitory effect on lung cancer, pancreatic cancer and lymphoma. River water hardness, degree of mineralization and soil Ca, Mg, for many cancers also have inhibitory effect.

Table 3 Relevant factors list of cancer incidence in 2008 China

Cancer	Male		Female	
	Positive correlation	Negative correlation	Positive correlation	Negative correlation
Nasopharyngeal	Pre0.6667,U0.6633,Ta0.5866,Pb0.3350,efZn0.5409,Sa0.5395,Pes0.4511,Hg0.3730	Si-0.6120,pH-0.5974,Na-0.5826,Mg-0.5083,Ca-0.4423,Rws-0.4137	Pre0.6689,U0.6546,Ta0.5903,efZn0.5372,Pb0.5351,Sa0.5173,Pes0.4523,efMo0.3987,B0.3905,Zn0.3751,Hg0.3714	Si-0.6136,pH-0.6062,Na-0.5990,Mg-0.5006,Ca-0.4468,Rws-0.4460
Oesophageal	pH0.2627,Rws0.2619	efMn-0.3829,GwC-0.3604	Co0.3106	
Stomach	Al0.6945,pH0.4240,Sr0.4029,Rwh0.3946,TN0.3762,Na0.3725,S0.3473	Al-0.4530,Ti-0.4361,Pci-0.4142,efZn-0.3950	Al0.6945,Ca0.4896,pH0.4874,S0.4224,Na0.3986,Rwh0.3946,Sr0.3661,TN0.3480,GwF0.3214	Ta-0.6557,Pre-0.6226,Al-0.5983,Ti-0.4995,Fe-0.4415,Pci-0.4239
Liver	U0.3804,S0.3150,TN0.2980,Pb0.2674	Mg-0.5065,Pci-0.4797,P-0.4518,Dwl-0.4434,Rws-0.4006,pH-0.3678	Al0.2240,TN0.2315	Pci-0.5858,Dwl-0.4930,Rws-0.3558,P-0.2756,efMo-0.2754,Mg-0.2503
Lung	Al0.4691,K0.3942,Pes0.2444	Rwh-0.6508,As-0.4818,Ca-0.4705,efS-0.4020,Al-0.3696,Ni-0.3633	Al0.4831,K0.4384,Als0.3566	As-0.5988,Rwh-0.5922,Se-0.4819,Ni-0.4313,Al-0.4123

Bladder	Pci0.4796, Ale0.4629, GwF0.4212, KO.3680, NI0.3094	Alt-0.6033, As-0.5595, efMo-0.3979, Ni-0.3799, efZn-0.3710, U-0.3614	GwI0.4620, Sr-0.3929, pH0.3330	U-0.4554, Alt-0.3937, Se-0.3667, efZn-0.3582, As-0.3382
Pancreatic	NI 0.8105, Pci 0.8046, Pes0.6844, Ale0.5750, DwI 0.5052, Tat 0.3688, KO.3351, Si0.3216, Pre0.3020	As-0.5247, Alt-0.4470, Rwh-0.3893, S-0.3754, Ca-0.3235, efS-0.3102	Pci0.7999, NI0.7464, Pes0.6298, Ale0.5632, DwI0.5218, Tat0.3113	As-0.4978, Alt-0.4444, Rwh-0.3983, S-0.3305
Lymphoma	NI0.8105, Pci0.8046, Ale0.5750, DwI0.5052	As-0.5247, Alt-0.4470, Rwh-0.3893, S-0.3754, Ca-0.3235	NI0.6928, Pci0.6532, Pes0.6083, Ale0.4481, Tat0.3710, DwI0.3481, Pre0.3335	Alt-0.5126, Si0.3960, As-0.3817, Rwh-0.3903, Ca-0.3412, Na-0.3199
Rectum	NI0.6833, Pes0.6327, Pci0.4550, Per0.4158, Tat0.3964, KO.3563, Si0.3453	Rwh-0.4193, Ca-0.3834, Sr-0.3539, As-0.3485, pH-0.3438, efS-0.3434, Alt-0.3387, Na-0.3160	NI0.5629, Pci0.5308, KO.4572, Pes0.4572, DwI0.3787	efS-0.3753, Alt-0.3608, Rwh-0.2823

Altitude Alt/m, Temperature Tat/°C, Precipitation Pre/mm, Per capita income Pci Yuan / year, soil pH, Organic carbon OrC, Total nitrogen TN, effective ef, River water hardness Rwh, River water salinity Rws, Groundwater fluorine content GwF, Drinking water iodine content DwI

Disease spectrum related equation:

$$\text{Male Nasopharyngeal cancer } y_7 = 0.0782x_7^3 - 0.2153x_7^2 + 0.0598x_7 + 0.5325 \quad R^2 = 0.6117$$

$$X_7 = \lg[(\text{Pre} \times \text{U} \times \text{Tat} \times \text{Pb}) / (\text{Sr} \times \text{pH} \times \text{Na} \times \text{Mg})]$$

$$\text{Female Nasopharyngeal cancer } y_8 = 0.0261x_8^3 + 0.0311x_8^2 - 0.045x_8 + 0.1609 \quad R^2 = 0.5958$$

$$X_8 = \lg[(\text{Pre} \times \text{U} \times \text{Tat} \times \text{efZn}) / (\text{Sr} \times \text{pH} \times \text{Na} \times \text{Mg})]$$

$$\text{Male Stomach cancer } y_9 = 1.3311x_9^3 + 17.849x_9^2 + 79.379x_9 + 137.28 \quad R^2 = 0.4766$$

$$X_9 = \lg[(\text{Alt} \times \text{pH} \times \text{Sr} \times \text{Rwh}) / (\text{Al} \times \text{Ti} \times \text{Pci} \times \text{efZn})]$$

$$\text{Female Stomach cancer } y_{10} = -0.1344x_{10}^3 + 0.2238x_{10}^2 + 6.8114x_{10} + 23.196$$

$$R^2 = 0.6397 \quad X_{10} = \lg[(\text{Alt} \times \text{Ca} \times \text{pH} \times \text{S}) / (\text{Tat} \times \text{Pre} \times \text{Al} \times \text{Ti})]$$

$$\text{Male Liver cancer } y_{11} = 2.9861x_{11}^3 + 41.026x_{11}^2 + 190.2x_{11} + 328.1 \quad R^2 = 0.6341$$

$$X_{11} = \lg[(\text{U} \times \text{Si} \times \text{TN} \times \text{Pb}) / (\text{Mg} \times \text{Pci} \times \text{P} \times \text{DwI})]$$

$$\text{Female Liver cancer } y_{12} = 0.2431x_{12}^3 + 4.427x_{12}^2 + 27.497x_{12} + 67.692 \quad R^2 = 0.3039$$

$$X_{12} = \lg[(\text{Alt} \times \text{TN}) / (\text{Pci} \times \text{DwI} \times \text{RwI})]$$

$$\text{Male Lung cancer } y_{13} = -0.1242x_{13}^3 - 1.1841x_{13}^2 + 1.1842x_{13} + 32.102 \quad R^2 = 0.4478$$

$$X_{13} = \lg[(\text{Al} \times \text{K} \times \text{Pes}) / (\text{Rwh} \times \text{As} \times \text{Ca} \times \text{efS})]$$

$$\text{Female Lung cancer } y_{14} = -3.0746x_{14}^3 + 11.942x_{14}^2 - 8.4412x_{14} + 10.52 \quad R^2 = 0.8123$$

$$X_{14} = \lg[(\text{Al} \times \text{K} \times \text{Ale}) / (\text{As} \times \text{Rwh} \times \text{Sex} \times \text{Ni})]$$

$$\text{Male Bladder Cancer} \quad y_{15} = -0.0255x_{15}^3 + 0.0527x_{15}^2 + 0.4252x_{15} + 0.6839 \quad R^2 = 0.6329$$

$$X_{15} = \lg[(Pci \times Ale \times GwF \times K) / (Alt \times As \times efMoxNi)]$$

$$\text{Female Bladder Cancer} \quad y_{16} = -0.0484x_{16}^3 + 0.0485x_{16}^2 + 0.1439x_{16} + 0.3358 \quad R^2 = 0.4222$$

$$X_{16} = \lg[(GwF \times Sr \times pH) / (U \times Alt \times Sex \times efZn)]$$

$$\text{Male Pancreatic cancer} \quad y_{17} = 0.0436x_{17}^3 + 0.0779x_{17}^2 + 0.2073x_{17} + 1.9547 \quad R^2 = 0.7506$$

$$X_{17} = \lg[(Nf \times Pci \times Pes \times Ale) / (As \times Alt \times Rwh \times S)]$$

$$\text{Female Pancreatic cancer} \quad y_{18} = 0.03x_{18}^3 + 0.0504x_{18}^2 + 0.132x_{18} + 1.3619 \quad R^2 = 0.6848$$

$$X_{18} = \lg[(Pci \times Nf \times Pes \times Ale) / (AS \times Alt \times Rwh \times S)]$$

$$\text{Male Lymphoma} \quad y_{19} = 0.0307x_{19}^3 + 0.0046x_{19}^2 + 0.1582x_{19} + 1.6874 \quad R^2 = 0.6844$$

$$X_{19} = \lg[(Nf \times Pci \times Ale \times DwI) / (As \times Alt \times Rwh \times S)]$$

$$\text{Female Lymphoma} \quad y_{20} = 0.0099x_{20}^3 + 0.0149x_{20}^2 + 0.1293x_{20} + 0.9608 \quad R^2 = 0.5594$$

$$X_{20} = \lg[(Nf \times Pci \times Pes \times Ale) / (Alt \times S \times As \times Rwh)]$$

$$\text{Male rectum cancer} \quad y_{21} = -0.006x_{21}^3 + 0.0818x_{21}^2 + 0.1267x_{21} + 4.8088 \quad R^2 = 0.3371$$

$$X_{21} = \lg[(Nf \times Pes \times Pci \times Per) / (Rwh \times Ca \times Sr \times As)]$$

$$\text{Female rectum cancer} \quad y_{22} = 0.1284x_{22}^3 - 0.1216x_{22}^2 - 0.2088x_{22} + 4.0523 \quad R^2 = 0.5211$$

$$X_{22} = \lg[(Nf \times Pci \times K \times Pes) / (efS \times Alt \times Rwh)]$$

5. The lineages of geological environmental factors of the death cause

As a result of the Global Burden of Disease Project jointly funded by scholars from China and the United States, in a sense, the rapid development of China is also reflected in the changes in the disease spectrum in all provinces. The gulf between China's health-care regions still exists, and the huge heterogeneity of mortality rates in various regions is a concentrated manifestation of this. The differences in regional development and the imbalance in the supply of health resources are the great challenges facing China's health system^[108].

We can also find some common trends in the relevant factors from the correlation analysis of the related factors of population mortality in mainland China from 1990 to 2013.

Chinese male disease related lineage map

Chinese female disease related lineage map

The mortality of cerebrovascular disease shows the characteristics of the population in the cold and dry northern town. Chronic obstructive pulmonary disease (COPD) Mortality shows the demographic characteristics of the mountain mining and smelting industry. Chronic kidney disease reflects the characteristics of arsenic and sulfur poisoning in the plateau. Mortality in Alzheimer's disease, showing population characteristics in farming areas.

Table 4 Population mortality related factors list in 1990-2013 Chinese

Diseases	Male		Female	
	Positive correlation	Negative correlation	Positive correlation	Negative correlation
cbv	Na0.3821,OrC0.3570,Mn0.3530,Air0.2713,Sr0.2671,FO.2544	Pcl-0.5740,Per-0.4889,NI-0.4741,Tar-0.4164,Dwl-0.3407,Pre-0.2926,Sr-0.2850	Air0.6479,Na0.4361,S0.3720,zf80.3411,As0.3001,Sr0.2623	Per-0.4941,NI-0.4480,Tar-0.4456,Pre-0.4236,Air-0.4073,Dwl-0.3262,Sr-0.26

				97
<i>ihd</i>	Se0.6473,Na0.5123,GwF0.4434,P0.4303,pH0.4271,Rwh0.3638,OrC0.2788,Ca0.2528	Tat-0.3032,Pes-0.5643,Ni-0.5503,Pre-0.5496,B-0.4599,Pb-0.4296,Si-0.4279,efZn-0.3979,Ca-0.3787,U-0.3784,Pci-0.3389,efMn-0.2982	Si0.4963,Na0.4172,GwF0.4365,pH0.2768,OrC0.2845	Tat-0.5312,Pes-0.5100,Ni-0.5024,efZn-0.4524,Pre-0.4191,Pb-0.3948,Se-0.3800,U-0.3773,Cd-0.3211,B-0.3113,Pci-0.2907
<i>copd</i>	efZn0.5646,Cd0.5281,34g0.4876,As0.4605,Se0.4569,efMn0.4036,V0.3892,Ti0.3838,U0.3717,Pb0.3522,B0.3466,efMo0.3446,Na0.3459,Co0.3231,Mn0.3101,Cr0.3035	Pci-0.4598,Sr-0.4308,pH-0.3250,Na-0.3216,K-0.3123,Ale-0.2999,Rws-0.2817,Dwl-0.2603	Cd0.4928,As0.4822,efZn0.4232,Al0.3994,Rwh0.3808,efMn0.3472,Mo0.3352,Se0.3082,Mn0.3055,V0.2916,Cr0.2863,B0.2832	Pci-0.4893,Ale-0.3264,K-0.3213,Sr-0.2599
<i>luc</i>	Al0.5426,Ale0.4462,Pre0.4350,efMn0.4068,K0.3819,Pes0.3129,Ti0.3054,Ta0.3008,Pci0.2653	Al-0.6518,Ca-0.6110,Rwh-0.4699,efS-0.4336,pH-0.3732,S-0.3671,As-0.3543,Mg-0.3528,Rws-0.2604	Ale0.5529,Al0.4297,P0.4060,K0.4006,B-0.2675	Al-0.4863,S-0.4322,As-0.3975,Se-0.3268,efZn-0.2814,Ca-0.2813,B-0.2675
<i>lic</i>	U0.6056,Pre0.5547,Pb0.4258,Al0.4075,Ta0.3464,Si0.3442,Zn0.3413,Ti0.3114,efMn0.2980,Pes0.2949,efZn0.2932,Mo0.2897	Mg-0.6493,Ca-0.5778,Rws-0.4797,Rwh-0.4509,efS-0.3545,Na-0.3454,F-0.2658	Al0.2595,U0.2568,OrC0.2501	Pci-0.5061,Mg-0.3197,F-0.2872,K-0.2487
<i>stc</i>	Rwh0.5288,pH0.3226,Alr0.2793,Na0.2726	Fe-0.4140,efMn-0.3752,Cd-0.3750,Mn-0.3732,Mo-0.3650,Ti-0.3643,P-0.3604,Pci-0.3600,efZn-0.3549,Hg-0.3316,F-0.3296,Pb-0.3216,efMo-0.3086,Cr-0.3009,U-0.2950,Al-0.2944	Al0.6226,S0.4902,pH0.4133,Rwh0.4024,Ca0.3366	Al-0.4778,Pci-0.4299,Ale-0.3932,Pre-0.3924,K-0.3658,Ta-0.3329,Mn-0.3413,Ti-0.3318,Fe-0.3293,Ma-0.3177,P-0.3135,Zn-0.2947
<i>oec</i>	Na0.2704,Rws0.2625,Ale0.2496	efZn-0.4548,As-0.4495,Cd-0.4015,Hg-0.3999,Zn-0.3733,F-0.3418,OrC-0.3318,Mn-0.3293,Mo-0.3246,P-0.3010,efMn-0.2948		
<i>hhd</i>	Al0.6840,As0.4596,S0.3528,Ca0.3143	Ale-0.5239,Pci-0.4853,K-0.3935,Dwl-0.3613,Se-0.2908,GwF-0.2627	Al0.7219,As0.4506,S0.3260,Ca0.2591	Ale-0.4915,Pci-0.4254,K-0.3796,Dwl-0.3417,GwF-0.3417,Al-0.2604
<i>alz</i>	Pes0.4315,S0.3308,N0.2846,Pre0.2603,Ta0.2592	Mg-0.4715,Rwh-0.3855,Ca-0.3842,Rws-0.3714,Cr-0.3667,Ni-0.3635,S-0.3540,P-0.2974	Pes0.3798,N0.3013	S-0.4730,Fe-0.3543,Cr-0.3896,Ni-0.3742,V-0.3427,Mg-0.3256,Ti-0.3096,Ma-0.2956
<i>rti</i>	As0.7771,Al0.5243,Cd0.5272,Hg0.5270,Pb0.4446,U0.4276,Zn0.4244,S0.3910,V0.3897,Ni0.3897,Mn0.3724,Cr0.3370,Ti0.3449,Mo0.3225,Fs0.2970	Ale-0.5630,K-0.5515,Ni-0.4695,Dwl-0.4481,Pci-0.4346,Pes-0.3634	As0.7942,Hg0.5851,Al0.5838,efZn0.5753,Cd0.5747,S0.4677,Pb0.4380,Zn0.4253,U0.4272,Ni0.3884,Mo0.3811,V0.3769	Ale-0.6106,K-0.5951,Pci-0.4500,Dwl-0.4409,Ni-0.4405,pes-0.3440
<i>ckd</i>	As0.5837,Al0.5049,S0.4113,efZn0.4754,B0.3763,Hg0.3749,V0.3574,Cd0.3311,Ni0.3122,Zn0.3006	Pci-0.6396,Ale-0.5750,Dwl-0.5096,K-0.4439,GwF-0.3788,Rws-0.3294	Al0.5728,As0.4520,S0.3617,B0.3058	Pci-0.6031,Ale-0.4381,Dwl-0.4003,Ni-0.3464,K-0.3443
<i>crc</i>	Pre0.6214,Pes0.5948,N0.5540,Al0.5060,Pci0.4829,Ta0.4811,efMo0.4287,s0.4226,efMn0.4052,Ti0.3943,efZn0.3707,Pb0.3597,Alr0.3148	Na-0.6046,ca-0.5245,GwF-0.4771,Sr-0.4660,Rwh-0.4632,Alr-0.3809,Rws-0.3117	Pes0.5518,Ni0.5498,Pci0.5320,Pre0.4346,K0.4047,Al0.3890,Mo0.3593,Ta0.3473,Se0.3236,Ale0.3190	GwF-0.3971,Alr-0.3915,Ca-0.3895,As-0.3738,Si-0.2983,Rwh-0.2955,pH-0.2931
<i>bc</i>			Al0.4488,P0.4177,Ale0.4091,Fe0.2688,K0.2648	Al-0.4641,As-0.3643,TN-0.2600

cbv- Cerebrovascular disease, ihd -Ischaemic heart disease, COPD -Chronic obstructive pulmonary disease, luc-Lung cancer, lic-Liver cancer, stc-Stomach cancer, oec- Oesophageal cancer, crc- Colon and rectum cancer, hhd-Hypertensive heart disease , alz-Alzheimer's disease , rti-Respiratory tract infections, ckd-Chronic kidney disease, bc-Breast cancer

Disease spectrum related equation:

$$\text{Male Cerebrovascular disease} \quad y_{23} = 1.6094x_{23}^3 - 5.3015x_{23}^2 + 6.2507x_{23} + 197.72$$

$$R^2 = 0.3713, X_{23} = \lg[(Na \times Orc \times Mn \times Alt)/(Pci \times Pes \times Nf \times Tat)]$$

$$\text{Female Cerebrovascular disease } y_{24} = 1.2817x_{24}^3 - 8.9716x_{24}^2 + 18.856x_{24} + 118.23$$

$$R^2 = 0.3851, X_{24} = \lg[(Alt \times Na \times S \times As)/(Pes \times Nf \times Tat \times Pre)]$$

$$\text{Male ischaemic heart disease } y_{25} = 0.8296x_{25}^4 - 4.5409x_{25}^3 + 0.467x_{25}^2 + 30.754x_{25} + 125.29$$

$$R^2 = 0.4433, X_{25} = \lg[(Sr \times Na \times Gw \times P)/(Tat \times Pes \times Nf \times Pre)]$$

$$\text{Female ischaemic heart disease } y_{26} = 1.0724x_{26}^4 - 4.1389x_{26}^3 - 3.3991x_{26}^2 + 24.913x_{26} + 93.315$$

$$R^2 = 0.4149, X_{26} = (Sr \times Na \times Gw \times F)/(Tat \times Pes \times Nf \times efZn)$$

$$\text{Male COPD } y_{27} = 2.4256x_{27}^4 + 43.863x_{27}^3 + 286.81x_{27}^2 + 818.39x_{27} + 986.49$$

$$R^2 = 0.3862, X_{27} = \lg[(efZn \times Cd \times Hg \times As)/(Pci \times Sr \times pH \times Na)]$$

$$\text{Female COPD } y_{28} = -10.016x_{28}^3 - 72.316x_{28}^2 - 128.5x_{28} + 34.581$$

$$R^2 = 0.5311, X_{28} = (Cd \times As \times efZn \times Alt)/(Pci \times Alex \times K)$$

$$\text{Male Hypertensive heart disease } y_{29} = 2.8187x_{29}^3 + 13.523x_{29}^2 + 18.993x_{29} + 27.121$$

$$R^2 = 0.7161, X_{29} = \lg[(Alt \times As \times S \times Ca)/(Alex \times Pci \times K \times DwI)]$$

$$\text{Female Hypertensive heart disease } y_{30} = 3.6584x_{30}^3 + 22.804x_{30}^2 + 43.694x_{30} + 41.105$$

$$R^2 = 0.7028, X_{30} = \lg[(Alt \times As \times S)/(Alex \times Pci \times K \times DwF)]$$

$$\text{Male Alzheimer's disease } y_{31} = -0.0728x_{31}^3 - 0.2891x_{31}^2 + 1.2653x_{31} + 25.017$$

$$R^2 = 0.2766, X_{31} = \lg[(Pes \times Si \times Nf)/(Mg \times Rwh \times Ca \times rws)]$$

$$\text{Female Alzheimer's disease } y_{32} = 0.0448x_{32}^4 + 0.8376x_{32}^3 + 4.8273x_{32}^2 + 7.5941x_{32} + 12.794$$

$$R^2 = 0.3014, X_{32} = \lg[(Pes \times Nf)/(S \times Fe \times Cr \times Ni)]$$

$$\text{Male Respiratory tract infections } y_{33} = 0.4431x_{33}^3 - 0.7135x_{33}^2 + 3.6985x_{33} + 15.498$$

$$R^2 = 0.7533, X_{33} = \lg[(As \times Alt \times Cd \times Hg)/(Alex \times K \times Nf \times DwI)]$$

$$\text{Female Respiratory tract infections } y_{34} = 0.4108x_{34}^3 + 4.3302x_{34}^2 + 17.919x_{34} + 37.384$$

$$R^2 = 0.7936, X_{34} = \lg[(As \times Hg \times Alt \times efZn)/(Alex \times K \times Pci \times DwI)]$$

$$\text{Male Chronic kidney disease } y_{35} = -0.1275x_{35}^3 - 0.2182x_{35}^2 + 3.8741x_{35} + 18.726$$

$$R^2 = 0.6230, X_{35} = \lg[(As \times Alt \times S \times efZn)/(Pci \times Alex \times DwI \times K)]$$

$$\text{Female Chronic kidney disease } y_{36} = -0.1089x_{36}^3 + 0.0007x_{36}^2 + 2.3899x_{36} + 10.066$$

$$R^2 = 0.4841, \quad X_{36} = I[g (Alt \times As \times S \times B) / (Pci \times Ale \times DwI \times K)]$$

6. The geological environmental factors of the longevity townships

Researchers through Rugao and Ningling County, the geological background and soil, water, atmospheric environmental quality survey shows that, one of the secrets of these longevity towns lies in the good environment. The experts conducted a test and analysis of soil in four townships, namely Zhongxiang City in Hubei province, Baipu Town in Rugao City in Jiangsu province and Ningling County in Henan province. The results showed that, the average content of iodine, zinc and selenium in soils in these areas is obviously higher than other areas. More importantly, the elements content in these area is relatively high, but not too high, just to fit the needs of the body. The survey also showed that arsenic, mercury, cadmium, lead and other toxic heavy metals in Rugao stream sediments were significantly lower. Longevity elderly hair and soil elements have similar characteristics. Guangxi Bama longevity hair has high manganese low copper characteristics. The soil in longevity area of Hubei province is characterized by rich calcium, magnesium, strontium and fluorine, and the selenium content is 2-3 times higher than that of the general area. Centenarian hair with relatively rich in manganese, selenium and low cadmium characteristics. Grain is characterized by rich selenium iron and low cadmium^[95].

The spatial distribution of longevity population over the age of 90 in Rugao, Jiangsu province, is characterized by geographical agglomeration, with soil effective state B, F, Se, Zn and Ni to achieve a significant positive correlation^[109].

The author has counted the arithmetic average of the elemental contents in sediments of 26 longevity counties in China, Compared with the national average, Se1.1515, Ni1.0629, B1.0599, Si1.0440, Co1.0367, Zn1.0310, Fe1.0144 and Ti1.0122 are relatively high, most of which are beneficial to human body; yet Cd0.5976, Na0.6796, As0.7025, Hg0.7441, Sr0.7679, Ca0.7966, Pb0.8920, Mg0.8929, K0.8969, Cu0.9234, U0.9271, F0.9407 relatively Low, many of which are harmful elements of the human body.

Related analysis results, the relationship between various indicators and the proportion of centenarians, the average annual precipitation Pre0.5909, temperature Tat0.5010, soil organic carbon OrC0.4557, Se0.3298, stream sediments Ti0.5862, P0.5254, Fe0.3977, Si0.3270, Mo0.3156, Mn0.3147 significantly positive correlation, mainly warm and humid climate conditions and neutral - basic rocks; significant negative correlation with stream sediments F -0.4707, pH -0.4630, Mg -0.4073, Na -0.3690, Ca -0.3553, TN -0.3539 and K -0.3348, reflects mainly limestone, dolomite marine carbonates and alkaline volcanic geological environment.

Table 5 Geological and ecological factors of longevity townships in China

Longevity Township	Centenarians /10 ⁻⁵	Pre	Ti	P	Tem	F	Soil pH	MgO	Na ₂ O	x ₃₇	lgx ₃₇
Rugao ,Jiangsu	18.58	1100	4520	615	15.0	525	7.1	2.01	1.53	4001219	6.60
Xiayi, Henan	10.50	750	4105	595	15.0	535	8.1	2.16	1.51	1944076	6.29
Zhongxiang ,Hubei	7.33	800	5165	690	15.5	650	6.5	1.65	0.83	7637520	6.88
Mayang, Hunan	12.00	1500	4150	605	16.0	445	5.1	1.26	0.82	25698048	7.41
Yongfu ,Guangxi	13.30	1600	4650	655	21.0	565	5.5	1.24	0.39	68098273	7.83
Bama ,Guangxi	30.00	1600	5165	695	19.0	515	5.5	1.21	0.39	81641094	7.91
Sanshui, Guangdong	21.40	1800	4105	495	22.0	512	5.1	0.86	0.35	102378064	8.01
Chengmai ,Hainan	38.39	2000	6050	815	22.0	230	5.5	0.82	0.41	510125960	8.71
Pengshan, Sichuan	4.67	1000	4650	405	18.0	585	7.1	1.65	0.83	5959423	6.78
Dujiangyan, Sichuan	14.08	1300	4650	690	13.5	635	6.5	2.01	1.45	4680886	6.67
YutianRiesh, Xinjiang	7.00	100	3530	490	12.0	520	8.5	2.34	2.65	75730	4.88
Laizhou ,Shandong	10.10	650	4105	485	11.9	515	6.8	1.65	2.42	1101285	6.04
Fei County, Shandong	14.80	880	4635	595	13.0	510	7.1	1.65	2.32	2276105	6.36
Fengnan , Henan	13.69	650	3950	490	14.0	550	8.0	2.01	1.55	1284855	6.11
Ningling, Henan	10.50	700	3950	490	14.3	450	8.0	2.01	1.85	1447295	6.16
Yongcheng, Henan	12.32	730	3950	595	14.5	440	8.0	2.02	1.42	2463897	6.39
SuYang, Jiangsu	13.70	1000	4105	489	15.1	445	7.0	0.91	0.83	12883131	7.11
Tonggu,Jiangxi	9.40	1400	4650	491	15.8	460	6.5	1.24	0.82	16611653	7.22
Quanzhou, Fujian	10.54	1200	3530	405	21.5	380	5.4	0.67	0.83	32323560	7.51
Jiaoling, Guangdong	19.00	1800	4250	456	22.1	450	5.4	0.65	0.39	125150997	8.10
Lingyun, Guangxi	15.00	1000	3620	800	21.0	440	5.5	1.25	0.67	30006661	7.48
Fengshan, Guangxi	33.03	1000	4650	800	21.0	512	6.5	1.24	0.68	27838660	7.44
Dongxing ,Guangxi	10.34	1200	4650	800	21.0	516	6.5	1.23	0.66	34429552	7.54
Cenxi Guangxi	13.00	1500	3530	403	21.5	390	6.5	0.67	0.39	69261533	7.84
Rong County, Guangxi	11.05	1600	3510	403	21.5	392	6.5	0.67	0.39	73085592	7.86
Wanning Hainan	32.00	2200	5125	650	23.5	331	5.4	0.67	0.83	173269898	8.24

Related equations: $y_{37} = 2.1943x_{37}^3 - 41.594x_{37}^2 + 261.81x_{37} - 535.2$

$$R^2 = 0.5515, \quad x_{37} = \lg[(Pre \times Ti \times P \times Tat) / (F \times pH \times Mg \times Na)]$$

7. Conclusion and discussion

The results of this study are basically consistent with previous results. There are also some differences due to different data ages, regional scopes, and indicator systems. The author comprehensively, systematically and

quantitatively considered various physical geography and socio-economic factors, but failed to involve elemental data in human tissues; The previous conclusions about the effects of selenium on human health are less reproducible here. It may be that the two are not a simple linear dose-response relationship, but a threshold-effect relationship. If we make full use of soil (stream sediment) geochemical measurement data (1 point / km²), combined with the results of this study, it is possible to greatly refine the spatial distribution prediction maps of population diseases in mainland China.

In short, the statistical relationship between human disease lineages and natural geography and hydro-soil geochemistry revealed in this paper, it is worthy of further study its experimental mechanism of medical physiology. The author believes that by improving the climatic conditions of living places and increasing the intake of certain chemical elements in appropriate forms (Especially the food chain diet structure), it will certainly play an important role in reducing the occurrence and development of diseases and improving human health.

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Keshan disease

Kaschin-Beck disease

Endemic goiter

Dental fluorosis

Skeletal Fluorosis

Diabetes

Male Nasopharyngeal

Female Nasopharyngeal cancer

Male Stomach cancer

Female Stomach cancer

Male Liver cancer

Female Liver cancer

Male Lung cancer

Female Lung cancer

Male Bladder Cancer

Female Bladder Cancer

Male Pancreatic cancer

Female Pancreatic cancer

Male Lymphoma

Female Lymphoma

Male rectum cancer

Female rectum cancer

Male Cerebrovascular disease

Female Cerebrovascular disease

Male Ischaemic heart disease

Female Ischaemic heart disease

Male Chronic obstructive pulmonary disease COPD

Female Chronic obstructive pulmonary disease COPD

Male Hypertensive heart disease

Female Hypertensive heart disease

Male Alzheimer's disease

Female Alzheimer's disease

Male Respiratory tract infections

Female Respiratory tract infections

Male Chronic kidney disease

Female Chronic kidney disease

Centenarian Ratios of Longevity Township

Figure1 Correlation analysis scatter plots of Chinese population disease lineage and geological eco-environment

Table 1 Natural Geography, Social and Economic Factors of Endemic Diseases in China

Disease category	Altitude/m	Temperature	Precipitation	PCI 2011	life expectancy	Rwh	Rws	GWF	DWI	Pesticide kg/hm ²	Nitrogen fertilizer T/hm ²
Keshan disease		-0.4290	-0.2364							-0.3653	-0.2955
Kashin-Beck		-0.5418	-0.2803				-0.2302			-0.3329	-0.3022
Endemic goiter	0.5763	-0.3152	-0.2593	-0.4046	-0.3797			-0.2754	-0.2648	-0.2696	-0.3076
Dental fluorosis		-0.3570				0.5124	0.3746	0.6264	0.3144	-0.4269	-0.4005
Skeletal fluorosis			-0.3344	0.2523	0.4083	0.3258	0.2655	0.3360		-0.3294	-0.2514
Diabetes	-0.4991			0.6912	0.5445	-0.2819	0.2728		0.4489	0.2765	0.3218

Table 2 Soil geochemical factors of endemic diseases in China

Disea se	pH	Or C	TN	S	ef S	Ca	Mg	P	K	Na	Fe	Zn	ef Zn	Cr	Mn	ef Mn	Co	F	V	Ti	Ni	ef Mo	Sr	Si	B	Se	Al	U	As	Cd	Pb
Kes		0083			0349			0513	0282	0265	0391			0246	0388					0249		0437		0352	0303	0402	0261				
Kasb		0789	0201		0305			0442	0280	0310			0242		0349							0293	0201	0289	0400	0454	0318				
Eg				0403	0473	0383			0349	0265																	0293		0389		
Def	0461				0257	0352	0380	0304		0304						0341		0250					0318	0335				0318			
Skf	0339		0326			0332	0384	0523	0293	0282			0369			0345							0428	0361	0320	0498		0395	0287		
Dia					0380			0240	0526			0259	0348	0312		0247	0263	0281	0302		0440		0280		0484	0267	0390		0621	0393	0295

Kes- Keshan disease, Kasb -Kashin-Beck disease、Eg -Endemic goiter, Information from 1959 -1982, Def -Dental fluorosis, Skf -Skeletal fluorosis Information from 1980-1984, Dia -diabetes 2015 data

Table 3a Natural Geography Socioeconomic Factors of the Incidence of Cancer among Chinese male in 2008

Disease category	Alt	Tp	Pre	PCI 2011	ALE	Rwh	RWS	GWF	DWI	pes	Nf
Nasopharyngeal cancer		0.5866	0.6667			-0.3201	-0.4137	-0.3204		0.4511	0.3103
Nasopharyngeal cancer			-0.2069				0.2619				
Stomach cancer	0.4843	-0.6560	-0.5760	-0.4142	-0.2428	0.3205		0.3436		-0.3723	-0.3188
Stomach cancer			0.2565	-0.4797		-0.2487	-0.4006		-0.4434		
Lung cancer	-0.3696					-0.6508	-0.3579			0.2444	
Bladder Cancer	-0.6033			0.4796	0.4629			0.4212	0.2639	0.2397	0.3094
Leukemia				-0.2555					-0.2885		
Pancreatic cancer	-0.4470	0.3688	0.3020	0.8046	0.5750	-0.3892			0.5052	0.6844	0.8105
Lymphoma	-0.6082	0.3616	0.3655	0.7079	0.4733	-0.4149			-0.3656	0.6392	0.6884
Rectum cancer	-0.3387	0.3964	0.4158	0.4550	0.3080	-0.4193		-0.3083		0.6327	0.6833

Table 3b Natural Geography Socioeconomic Factors of the Incidence of Cancer among Chinese Female in 2008

Disease category	Alt	Tp	Pre	PCI 2011	ALE	RWH	RWS	GW _F	DW _I	Pes	NF
Nasopharyngeal cancer		0.5903	0.6689			-0.3301	-0.4460	-0.3234		0.4523	0.3097
Nasopharyngeal cancer				-0.2156							
Stomach cancer	0.6945	-0.6557	-0.6226	-0.4239	-0.3526	0.3946	0.2715	0.3214		-0.4179	-0.3753
Stomach cancer	0.2240			-0.5858	-0.2451		-0.3558		-0.4930		
Lung cancer	-0.4123				0.3566	-0.5922	-0.3078				
Bladder Cancer	-0.3937		-0.2769					0.4620			
Leukemia									-0.2628		
Pancreatic cancer	-0.4444	0.3113	0.2659	0.7999	0.5632	-0.3983	0.2554		0.5218	0.6298	0.7464
Lymphoma	-0.5126	0.3710	0.3335	0.6532	0.4481	-0.3903			0.3481	0.6083	0.6928
Rectum cancer	-0.3608			0.5306		-0.2823			0.3787	0.4529	0.5629

Table 4a Soil geochemical factors in the incidence of cancer in Chinese male in 2008

Cancer	pH	OrC	TN	S	Ef S	Ca	Mg	P	K	Na	Fe	Zn	Ef Zn	Cr	Mn	Ef Mn	Co	F	V	Ti	Ni	Mo	Ef Mo	Sr	Si	B	Se	Al	U	As	Hg	Cd	Pb
Nas	0874				0257	0423	0803	0285		0836		0842	0849			0249				0274		0343	0432	0612	0352	0382	0595		0663	0262	0370		0550
Oes	0327	0804											0265			0329							0273					0286	0242	0280			
Sto	0400		0362	0343		0343				0325	0396	0348	0380		0202	0299	0340		0332	0461	0250		0397	0409				0450	0348		0387		0409
Liver	0368		0280		0311	0381	0306	0458	0251															0343	0350				0304				0264
Lung	0246				0400	0405	0274		0342									0297			0363						0263	0251	0491		0488		
Bla				0346					0360		0201	0344	0370	0354	0200		0288		0329	0329	0399		0399			0246	0246		0364	0395	0244	0287	
Leuke						0284	0342	0474						0346							0341				0366		0280						
Pan				0354	0302	0325			0351																0326					0527			
Lym				0409	0282	0430			0403	0331				0354							0396				0357			0262	0484				
Rect	0348				0364	0334		0249	0383	0360														0359	0363					0345			

Table 4b Soil geochemical factors in the incidence of cancer in Chinese Female in 2008

Cancer	pH	TN	S	Ef S	Ca	Mg	P	K	Na	Fe	Zn	ef Zn	Cr	Mn	Ef Mn	Co	F	V	Ti	Ni	Mo	Ef Mo	Sr	Si	B	Se	Al	U	As	Hg	Pb	
Nas	0062			0252	0448	0506	0286		0590		0351	0532			0280				0278		0348	0387	0636	0307	0345	0573		0546	0291	0374	0351	
Oes																0306										0249						
Sto	0454	0348	0424	0246	0486	0254		0257	0386	0445	0409	0306		0307	0389	0344		0362	0495				0361				0383	0348		0342	0400	
Liver		0215				0253	0256															0254										
Lung			0287	0396	0396			0384			0261	0359					03123			0463						0325	0489	0431		0388	0256	0283
Bla	0330					0236						0382										0289	0329			0367		0454	0382			
leuke				0264		0295	0345						0284																			
Pan			0305	0280	0280			0289																	0290					0478		
Lym			0366		0342			0299	0369															0372						0387		
Rect				0353				0452																								

Table 5a Natural Geography, Social and Economic Factors of Male disease Mortality in China from 1990-2013

Disease category	Alt	Tp	Pre	PCI 2011	ALE	RWH	RWS	GWF	DWI	Pes	NF
Cerebrovascular disease	0.2713	-0.4164	-0.2969	-0.5740					-0.3407	-0.4889	-0.4741
Ischaemic heart disease		-0.6032	-0.5496	-0.3389		0.3038		0.4434		-0.5644	-0.5503
Chronic obstructive pulmonary disease	0.2811		0.2599	-0.4598	-0.2999		-0.2817		-0.2603		
Lung cancer	-0.6518	0.3008	0.4350	0.2653	0.4462	-0.4699	-0.2604			0.3129	
Liver cancer		0.3464	0.5547			-0.4509	-0.4797			0.2949	
Road injuries	0.4624	-0.3295	-0.4421	-0.7309	-0.6119	0.5067		0.2794	-0.2549	-0.4590	-0.4612
Stomach cancer	0.2793		-0.2814	-0.3600		0.3288					
Oesophageal cancer					0.2496		0.2625				
Hypertensive heart disease	0.6840			-0.4853	-0.5239			-0.2627	-0.3613		
Alzheimer's disease		0.2592	0.2603			-0.3855	-0.3714			0.4115	0.2846
Respiratory tract infections	0.5243			-0.4346	-0.5630	0.2724			-0.4481	-0.3634	-0.4695
Chronic kidney disease	0.5049			-0.6396	-0.5750		-0.3294	-0.3788	-0.5096		-0.2893
Colon and rectum cancer	-0.3809	0.4811	0.6214	0.4829	0.3148	-0.4632	-0.3117	-0.4771		0.5948	0.5540
Self-harm			0.2720	-0.4722							
Falling		0.5812	0.5830				-0.3767	-0.4460	-0.3269	0.3113	

Table 5b Natural Geography, Social and Economic Factors of Female disease Mortality in China from 1990-2013

Disease category	Alt	TP	Pre	PCI 2011	ALE	RWH	RWS	GWF	DWI	Pes	NF
Cerebrovascular disease	0.6479	-0.4456	-0.4236	-0.6560	-0.4073				-0.3262	-0.4941	-0.4480
Ischaemic heart disease		-0.5312	-0.4191	-0.2907				0.4365		-0.5100	-0.5024
Chronic obstructive pulmonary disease	0.3994			-0.4893	-0.3264	0.3808					
Lung cancer	-0.4863				0.5529						
Hypertensive heart disease	0.7219			-0.4254	-0.4915			-0.3417	-0.3417		
Alzheimer's disease						-0.2769				0.3798	0.3013
Respiratory tract infections	0.5838			-0.4500	-0.6106	0.3453			-0.4409	-0.3440	-0.4405
Stomach cancer	0.6226	-0.3329	-0.3924	-0.4299	-0.3932	0.4024					
Liver cancer	0.2595			-0.5061							
Road injuries	0.6673		-0.2886	-0.5805	-0.6308	0.3264			-0.2780		-0.2715
Chronic kidney disease	0.5728			-0.6031	-0.4381				-0.4003	-0.2578	-0.3464
Diabetes	-0.2529			0.3385	0.3767				0.3940	0.2688	0.3676
Colon and rectum cancer	-0.3915	0.3473	0.4346	0.5320	0.3190	-0.2955		-0.3971		0.5518	0.5498
Self-harm				-0.3931							
Breast cancer	-0.4641				0.4091						

Table 6a Soil geochemical factors of male disease mortality in China from 1990 -2013

Disease	pH	Or C	S	ef S	Ca	Mg	P	K	Na	Fe	Zn	ef Zn	Cr	Mn	ef Mn	Co	F	V	Ti	Ni	Mo	ef Mo	Sr	Si	B	Se	Al	U	As	Hg	Cd	Pb
Cbv		0.357 0					0.280 2		0.382 1					0.353 0			0.254 4						0.2671			-0.285 0						
Ihd	0.427 1	0.278 8			0.252 8		0.430 3		0.512 3			-0.397 9											0.6473	-0.42 79	-0.459 9			-0.37 84		-0.289 5	-0.378 7	-0.42 96
COP D	-0.32 50							-0.312 3	-0.32 16	0.253 2	0.300 5	0.564 6	0.303 5	0.310 1	0.403 6	0.323 1		0.389 2	0.383 8	0.345 9		0.344 6	-0.430 8		0.346 6	0.456 9		0.371 7	0.460 5	0.487 6	0.528 1	0.352 2
Luc	-0.37 32		-0.367 1	-0.43 36	-0.61 10	-0.35 28		0.3819							0.406 8				0.305 4								0.542 6		-0.354 3			
Lic	-0.61 27			-0.35 45	-0.57 78	-0.64 93			-0.34 54		0.341 3	0.293 2		0.295 0	0.298 0		-0.26 58		0.3114		0.289 7	0.275 3	-0.461 2	0.344 2			0.407 5	0.605 6				0.425 8
Ri	0.298 2		0.359 9	0.435 4	0.331 6			-0.282 5	0.358 8	-0.29 26													0.3067				-0.55 26					
Stc	0.322 6	-0.26 71					-0.36 04		0.272 6	-0.41 40	-0.395 5	-0.354 9	-0.277 8	-0.373 2	-0.375 2	-0.30 09	-0.32 96	-0.291 5	-0.364 3	-0.287 0	-0.36 50	-0.30 86					-0.29 44	-0.29 50		-0.331 6	-0.375 0	-0.32 16
Dec		-0.33 18					-0.30 10		0.270 4	-0.27 66	-0.373 3	-0.454 8		-0.329 3	-0.294 8		-0.34 18		-0.281 1		-0.32 46								-0.449 5	-0.399 9	-0.401 5	
Hhd			0.352 8	0.275 5	0.314 3			-0.393 5																		-0.290 8			0.439 6			
Ald	-0.27 07		-0.354 0		-0.38 42	-0.47 15	-0.29 74			-0.25 48			-0.366 7							-0.363 5			0.330 8									
Rti			0.391 0	0.290 7				-0.551 5		0.297 0	0.424 4	0.538 5	0.337 0	0.372 4		0.272 5		0.389 7	0.344 9	0.389 7	0.322 5				0.261 6			0.427 6	0.777 1	0.527 0	0.527 2	0.444 6
Ckd			0.41 13					-0.44 39			0.30 06	0.47 54	0.26 50	0.27 81	0.26 42			0.35 74	0.27 90	0.31 22			-0.26 71		0.37 63	0.29 45			0.58 37	0.37 49	0.33 11	
Crc	-0.47 73			-0.29 53	-0.52 45				-0.60 46	0.282 4	0.333 0	0.370 7			0.405 2				0.394 3			0.428 7	-0.466 0				0.506 9	0.422 6		-0.310 9		0.339 7
Seh	-0.39 29				-0.29 12										0.4117	0.255 9		0.299 2	0.317 6				-0.281 9	0.294 5							0.285 2	
Fall	-0.59 14		0.299 4		-0.33 10	-0.31 71	-0.31 62	-0.264 3	-0.66 15	0.314 5	0.525 4	0.693 1		0.290 3	0.420 4	0.305 5	0.279 2	0.394 5	0.489 7	0.312 5	0.341 4		-0.693 2		0.361 5	0.421 9		0.621 0	0.353 5	0.486 1	0.513 5	0.737 6

Table 6b Soil geochemical factors of Female disease mortality in China from 1990 -2013

Disease	pH	Or C	TN	S	ef S	Ca	Mg	P	K	Na	Fe	Zn	ef Zn	Cr	Mn	ef Mn	Co	F	V	Ti	Ni	Mo	ef Mo	Sr	Si	B	Se	Al	U	As	Hg	Cd	Pb
Cbv				0.37 20	0.34 11					0.43 61														0.26 25			-0.2 697			0.30 01			
Ihd	0.27 68	0.28 45						0.32 85		0.41 72			-0.4 586					-0.2 605						0.49 63		-0.3 113	-0.3 800		-0.3 773		-0.2 725	-0.3 211	-0.3 948
COP D									-0.3 213				0.42 32	0.28 63		0.34 22	0.25 30		0.29 66	0.25 49	0.30 55	0.33 52		-0.2 599		0.28 32	0.30 82			0.48 22	0.41 81	0.49 28	
Lc				-0.4 322		-0.2 813		0.40 60	0.40 06				-0.2 814													-0.2 675	-0.3 268	0.42 97		-0.3 975			
Hhd				0.32 60		0.25 91			-0.3 796																			-0.2 604		0.45 06			
Ald				-0.4 730			-0.3 256				-0.3 543			-0.3 896	-0.2 956		-0.2 816		-0.3 427	-0.3 096	-0.3 742										-0.2 833		
Rti				0.46 77	0.35 14				-0.5 951		0.26 17	0.42 53	0.57 45	0.31 92	0.36 54			0.29 04	0.37 69	0.32 76	0.38 84	0.38 11	0.27 61			0.31 50	0.26 62		0.42 72	0.79 42	0.58 51	0.57 47	0.43 80
Stc	0.41 33			0.45 02		0.33 66		-0.3 135	-0.3 658		-0.3 293	-0.2 947	-0.2 607		-0.2 667	-0.3 413				-0.3 318		-0.3 177						-0.4 778					
Lic		0.25 01					-0.3 197		-0.2 487									-0.2 872											0.25 68				
Ri				0.36 94	0.28 81			-0.4 093	-0.3 370		-0.3 695									-0.3 029				-0.2 543				-0.5 520		0.30 19			
Ckd				0.36 17					-0.3 443																	0.30 58				0.45 20			
Crc	-0.2 931				-0.2 559	-0.3 895			0.40 47	-0.3 612													0.35 95		-0.2 983		0.32 36	0.38 90		-0.3 738			
Seh				0.32 06	0.31 50										0.31 91												0.25 62					0.29 99	
Brc			-0.2 690					0.41 77	0.26 48		0.26 88									0.26 00								0.44 88		-0.3 643			

Figures

Chinese male cancer related lineage map

Chinese female cancer related lineage map

Figure 1

Chinese male and female cancer related lineage map

Figure 2

Chinese male and female disease related lineage map