Impacts of perceived environmental pollution on urban and rural residents' health - China national study

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Research article

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Abstract

Background: The emergence of a quantity of mega cities accompanying China's economic boom has led to enormous increases in resource consumption and a variety of pollution especially emissions of air pollutants. Pressure-based government assessment mechanism is the driving force for the transfer of environmental pollution from urban to rural areas. Methods: Descriptive and analytical statistics were used for the data analyses based on a national survey The 3rd Survey on the Status of Chinese Women in 2010 jointly conducted by the All China Women's Federation and the China Statistical Bureau in 2010 and 24741 samples were selected. Results: Among urban residents, 67.21% of them reported their total health was good, 1.35% lower than the rate of rural counterparts; 25.88% reported their total health was general, nearly 3% higher than the rate of rural counterparts; 6.91% reported their total health was poor, 1.63% lower than the rate of rural counterparts. The study also found the rate of urban residents perceiving air pollution (35.67%), water pollution (17.96%), garbage pollution (25.05%), noise pollution (32.05%) was higher than that of rural counterparts, respectively. Perceived air, garbage and noise pollution all had a significantly negative impact on urban residents' health while none of perceived pollution had a significant impact on rural residents' health. Conclusions: Rural residents perceived little about impacts of environmental pollution on health, which may create risks and vulnerability of the rural environment and the livelihood of these residents. Great attention should be paid to the impacts of environmental pollution on health for not only urban residents but also rural residents, which will highly improve the support of "green development" among the public in China.

Background

The emergence of a quantity of mega cities accompanying China's economic boom has led to enormous increases in resource consumption and a variety of pollution. Environmental pollution has become one of China's pinnacle environmental concerns[1]. Air pollutants, such as carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NOx), volatile organic compounds (VOCs), ozone (O_3), heavy metals, and respirable particulate matter (PM2.5 and PM10), vary in their chemical composition, reaction properties, emission, disintegration time and potential to diffuse over long or short distances[2]. Air pollution has negative effects on a wide variety of human systems and bodies, causing worsening respiratory symptoms, more frequent use of medication, decreased lung function, recurrent use of health care and accelerated mortality[3]. The World Health Organization ranked air pollution world's 13th leading motive of mortality as the pollution from particulate matter (PM) contributes to about 800,000 premature deaths every year[3]. Water quality issues are a primary challenge facing humanity in the 21st century[4]. The foremost sources of water pollution included chemical pollution, specifically on inorganic and organic micropollutants consisting of toxic metals and metalloids as well as a range of synthetic organic chemicals[4]. The quantity of wastewater produced expanded unexpectedly due to the developing volume of industrial chemicals, heavy metals, and algal toxins alongside with the economic increase in China and were linked to unfavourable health effects such as deaths from liver and stomach cancer [5]. A study in 2001 confirmed 30 billion tons of urban sewage were discharged into China's rivers lakes and seas

annually, with 2.7%-10% receiving no prior treatment[6]. The Ministry of Water Resources had monitored 532 rivers in China and found that 436 rivers were polluted at varying degrees; Among the 15 major urban rivers flowing through the seven major rivers of China (the Yangtze River, the Yellow River, the Huaihe River, the Pearl River, the Liaohe River, the Haihe River, and the Songhua River), 13 rivers had serious water pollution, accounting for 87%[7]. Rapid, unregulated industrial increase and urbanization besides sufficient investment in water supply exacerbated waterborne infections and parasitic diseases[6]. Industrial pollution and wastewater was the main source of water pollution. Large household garbage produced due to populous residents was piled on the ground, producing bacteria and polluting air and groundwater. Fertilizers and pesticide residues produced in agricultural production caused pollution to soil and groundwater as well. The garbage production in China is highest worldwide and nonetheless increases at the speed of 8%-10% every year[8]. China had tried to enforce the policy of classifying household garbage in eight cities including Beijing, Shanghai, Guangzhou, Shenzhen, Hangzhou, Nanjing, Xiamen, Guilin since 2000 and none of the cities succeeded due to various factors such as related policies, residents' attitudes and values[8]. And the components of the garbage became increasingly complex, ranging from formerly perishable leaves, fruits peels and papers to lately plastics, polyfoam, glass, discarded batteries, concrete and other non-degradable garbage, which increased the challenge of the garbage disposal[9]. A report published by Chinese ministry of environmental protection showed in 2015, the domestic garbage production of 246 large and medium-sized cities was 185.64 million tons; the disposal rate and the harmless treatment rate was 97.3% [10], 92.5%[11], respectively. Among them, the largest amount of household garbage generated was Beijing, with a production of 7.903 million tons, followed by Shanghai, Chongqing, Shenzhen[10]. Household garbage production in rural areas amounted to 0.3t billion every year, accounting for 75% of the garbage production in urban areas [9]. And China's township domestic garbage disposal rate and harmless treatment rate was 50%, 13.96%[12], respectively. With insufficient environmental awareness, rural residents dump garbage in a mess, adding difficulty to garbage collection and treatment. This was partly due to insufficient investment in waste pollution technology and lagging legislation and policies[13]. The majority of waste disposal facilities in rural areas have not been built until the last few years. The increasing unclassified rural household waste not only polluted the earth but also the air and water. An essential public health problem, noise can lead to hearing loss, sleep disruption, cardiovascular disease, social handicaps, reduced productivity, impaired educating and learning, absenteeism, accelerated drug use, and accidents[13], it has often been considered less harmful than other pollutants [15] although noise exposures in rural and urban areas are prevalent in everyday life. The busy traffic with a variety of vehicles day and night and construction sites can be the offenders of a quiet living environment everywhere[16]. With the strong implementation of the urbanization strategy over the last 10 years, centralized residence in villages and towns has been very common. Meanwhile, road building has also been greatly encouraged[17]. Labor-intensive industry, processing factories and enterprises of agricultural products are emerging in the countryside.

Sustainable development as a basic national strategy has been set down since 1992 in China. However, environmental pollution and ecological degradation have continued to grow and have inflicted superb damage on the economy and quality of life[14]. China starts from a point of grave pollution, and

prioritizes progress in urban environment during its current stages of development. Pressure-based government assessment mechanism is the driving force for transferring environmental pollution from urban to rural areas[15]. Economic growth remains the primary mission of rural development and industrialization is the foremost way to achieve this. Peasants prefer to earn money and the government is willing to have political achievements. Under this pressure, villages permit heavily polluting enterprises to produce there. Openness, ambiguity and publicity of environmental rights of peasants make environmental degradation in rural areas particularly serious[16]. Rural residents can't rationally judge the harm of environmental pollution as they benefited from immoderate use of noticeably cheap natural resources and continuous transfer of environmental pollution due to loose environmental policies there.

China's governments recognized that environmental protection, rather than being a drag on the economy, can ensure long-term sustainable economic development. "Green development " has been laid down as one of the five key drivers for development in the 13th Five-Year Plan(2016-2020)[17]. Currently, a very limited number of studies have been conducted to evaluate Chinese residents' attitudes towards the health impacts of environmental pollution despite the objective levels of environmental pollution are severe. Therefore, the study aims to investigate urban and rural residents' perceived environmental pollution and its harmful effects on health.

Method

Data source

The data were from *The 3rd Survey on the Status of Chinese Women in 2010* (SSCW3) jointly conducted by the All China Women's Federation(ACWF) and the China Statistical Bureau in 2010. The sampling of this survey is conducted in four stages. The first stage of sampling is based on the districts of cities above the prefecture level and the county and county-level cities. The primary sampling units of the three municipalities of Beijing, Tianjin and Shanghai are townships, towns and streets. The second stage of sampling is to draw 5 resident(urban) or village(rural) committees based on the level of urbanization in each of the districts and counties (township streets) that are selected. The sample districts and counties (township streets) and the resident or village committees are selected by the sampling expert group of the National Investigation Leading Group Office according to the sampling plan and sampling frame data. The third stage is sample selection of the households in the resident or village committee, which adopts equal probability sampling of random starting points, that is, equidistant sampling. A fixed number of 15 households are selected for each resident or village committee. The fourth stage is to select samples in the household. Specifically, the number of family members in the household is taken, and the respondents are determined by random selection. The third and fourth stages are conducted by the investigator. The cross-sectional data were collected from nationally representative samples through self-administered surveys. The questionnaires used in the SSCW3 covered a major and an additional questionnaire. Female and male adults aged at 18-65 years old with *hukou* information in the major questionnaire were selected. Finally, 24741 samples were kept.

Questionnaire

A structured questionnaire was developed and used for the investigation. The questionnaire was anonymous and measured the participants' attitudes subjectively. The questionnaire used in this study were part of the primary questionnaire and consisted of the questions: (1) respondents' general demographic characteristics, (2) perceived environmental pollution, (3) self-rated health. The demographic questions in section 1 included their gender, age, hometown or places they were brought up(rural versus urban), marital status(never married, married, divorced, widowed), education level(primary school or below, junior or senior high school, postsecondary or above), the father's education level.

The participants were asked four questions about environmental pollution: Did you perceive air pollution/water pollution/garbage pollution/noise pollution in your daily life? (Yes versus No). The participants were also asked their health status measured using a Likert scale with five levels, from very good or good versus general versus poor or very poor. Self-rated health has been shown to be a reliable and valid measure of general health status[28] and has been reported to be associated with various objective health measures and strongly predicts future onset of mortality[29, 30].

Data analysis

Stata software version 15 (Stata Corp., College Station, Texas, USA) was utilized for the data examinations. The analyses consisted of three parts. First, descriptive statistics were used to present the demographic characteristics, perceived environmental pollution and health status of the participants. These data were presented as "percentages".

Second, univariate examinations were performed by cross-tabulations, utilizing Likelihood-ratio Chi-square tests, to determine relationships between perceived air pollution, water pollution, garbage pollution, noise pollution (independent variables) and health status (dependent variables).

Third, multivariate examinations were directed to additionally determine connections between the independent variables and dependent variables. For the dependent variable, health status was set as a categorical variable (0=general health, 1=good health, 2=poor health). Hence, multinomial regression examinations were directed eventually. In model 1 perceived environmental pollution's impacts on health status were assessed for urban residents. In Model 2 perceived environmental pollution's impacts on health status were assessed for rural residents. A p-value less than 0.05 was defined as statistically significant.

Results

Descriptive statistics

Among the urban residents, 67.21% of them reported their total health was good, 1.35% lower than the rate of rural counterparts; 25.88% reported their total health was general, nearly 3% higher than the rate of

rural counterparts; 6.91% reported their total health was poor, 1.63% lower than the rate of rural counterparts.

Demographic characteristics

Table 1 presented the residents' demographic characteristics. Among the urban residents, 47.94% were male; the rate of rural counterparts was 49.37%. 15.69% were 29 years old or below, 7.31% were 60 years old or above; the rate of rural counterparts was 17.26%, 7.90%, respectively. 8.51% had completed education through primary school or below, more than five thirds (61.20%) had completed education through junior or senior high school, about 30% had completed postsecondary or above; the rate of rural counterparts was 42.32%, 55.78%, 1.90%, respectively. 10.86% were never married, 81.94% were married; the rate of rural counterparts was 9.03%, 85.82%, respectively. More than half (51.53%) of their father had completed primary school or below, 41.56% of their father had completed junior or senior high school, 6.91% of their father had completed postsecondary or above; the rate of rural counterparts was 78.39%, 21.23%, 0.38%, respectively.

Perceived environmental pollution

Table 2 presents the summary of residents' perceived environmental pollution. 35.67% of urban residents perceived air pollution in their daily life, 18.91% higher than the rate of rural counterparts; 17.96% of them perceived water pollution, 5.5% higher than the rate of rural counterparts; 25.05% perceived garbage pollution, 6.86% higher than the rate of rural counterparts; 32.05% perceived noise pollution, 18.56% higher than the rate of rural counterparts.

Inferential statistic

All the factors associated with health among urban and rural residents were displayed in Table 1, 2 respectively.

After the multinomial logit regression analyses, the following findings were further observed. Factors significantly associated with health among urban residents included perceived air pollution, garbage pollution and noise pollution, gender, age, marital status, education, the father's education; these were displayed in Table 3. Model 1a showed that perceived air pollution had a negative effect on urban residents' good health ($B=-0.14$, $p<0.05$). Perceived noise pollution had a similar effect ($B=-0.23$, $p<0.001$). Females were less likely to have good health than males ($B=-0.38$, $p<0.001$). Urban residents aged at 30-39, 40-49, 50-59 were more likely to have good health than those aged at 29 years old or below ($B=1.44$, 0.89, 0.47, $p<0.001$, respectively). Never married and married residents were more likely to have good health than the widowed ($B=0.60$, $p<0.001$; $B=0.35$, $p<0.01$, respectively). Urban residents whose education level was primary school or below were less likely to have good health than those with a higher education. Urban residents whose father's education level was junior or senior high school were more likely to have good health than those whose father's education was primary school or below($B=0.12$, $p<0.05$). Model1b showed perceived garbage pollution had a positive effect on residents' poor health

(B=0.33, p<0.01). Urban residents aged at 30-39 years old were less likely to have poor health (B=-1.40, p<0.001) while residents aged at 50-59 years old were more likely to have poor health (B=0.42, p<0.01) than those aged at 29 years old or below. Never married residents were more likely to have poor health (B=0.89, p<0.01) while the married were less likely to have poor health(B=-0.47, p<0.01) than the widowed. Urban residents whose education level was primary school or below were more likely to have poor health than those with a higher education.

In addition, factors significantly associated with health among rural residents included gender, age, marital status, education level. Model 2a showed that females were less likely to have good health than males(B=-0.38, p<0.001). Rural residents aged at 29 years old or below were less likely to have good health than the older ones. Rural residents whose education level was primary school or below were less likely to have good health than those whose education level was higher. Rural residents whose father's education level was junior or senior high school were more likely to have good health than those whose father's education was primary school or below (B=0.14, P<0.05). Model 2b showed rural residents aged at 29 years old or below were more likely to have poor health than the older ones. Never married residents were more likely to have poor health than the widowed (B=0.56, p<0.05). Rural residents whose education level was junior or senior high school were less likely to have poor health than those whose education level was primary school or below (B=-0.56, p<0.001).

Discussion

The study was conducted to evaluate impacts of perceived environmental pollution on health, which analyzed impacts of rural and urban residents' perceived environmental pollution on health.

Perceived environmental pollution

This study highlighted the impacts of perceived environment pollution on health especially among urban residents. The study found that the rate of urban residents perceiving air pollution(35.67%), water pollution(17.96%), garbage pollution(25.05%), noise pollution(32.05%) was higher than that of rural counterparts, respectively, which means urban residents perceived more environmental pollution than rural counterparts. This was similar to the results of a local study on environmental awareness using the data from a national survey *Chinese General Social Survey*(CGSS) in 2010[18]. A western study also found urban residents are assumed to be more environmentally concerned than rural counterparts[19]. Perceived air pollution, garbage pollution and noise pollution all had a significant negative impact on urban residents' health while none of the perceived pollution had a significant impact on rural residents' health. China's environmental pollution is severe in both cities and villages in recent years. In spite of measures such as limiting cars on the road to reduce exhaust emissions and the technical development of air purification in recent years, China's large-scale air pollution continues to spread from north to south. Some developed cities can use gas to protect the environment completely, while less developed cities still choose coal and gas as fuels in China. Due to the attribute of rapid spread, air pollution quickly transmitted to neighborhood cities. This has resulted in worse and worse air pollution in both cities and

villages in China. In rural China, the rates of stomach and liver cancer are 50% higher than that in the major cities of the country [27]. In part, this may be due to the lack of protection of water quality in rural areas. One of the goals published on Nov 8, 2018 by the Ministry of Ecology and the Environment and by the Ministry of Agriculture and Rural Affairs, by 2020, the utilization rate of fertilizers and pesticides in the country's major crops will reach more than 40%; the coverage rate of soil testing and formula fertilization technology will reach more than 90%; the overall utilization rate of livestock and poultry fungi will exceed 75%; the corresponding rate of equipment for sewage treatment plants in large farms will be over 95% [30]. This further emphasizes that water pollution in Chinese rural areas has become a major hazard [31]. Moreover, garbage collection and treatment in rural areas has not been talked about until recent years. Still little attention has been paid to noise pollution in these areas in China. Relative to the urban areas, environmental protection infrastructure, pollution supervision and environmental protection technology in rural areas have greatly lagged behind. In addition, due to the pressure of strict environmental policies in cities, some heavily polluting enterprises are transferred to the villages in order to weaken the risk of environmental protection departments ' punishment and also to reduce penalty costs [25]. However, rural residents still perceived little about the impacts of environmental pollution on health due to inadequate policies aiming at controlling environmental pollution in rural areas.

Individual Factors

The rate of good health among rural residents (68.08%) was higher than that of urban counterparts (66.64%). And the rate of poor health among rural residents (8.69%) was higher than that of urban residents (7.14%).

Gender

In this study, males were more likely to have a positive attitude towards their health status than females. The results are consistent with a study based on the first wave of the European Social Survey in 2003 conducted in 22 countries and in all countries men report a better health than women[20]. The study based on CGSS in 2010 also presented the similar results among both urban and rural residents[21]. Some studies also found women suffer from more nonfatal chronic conditions, and greater likelihood of functional limitations[22] although they live longer than men[23].

Age

Residents aged at 30 years old or above were more likely to have a positive attitude towards their health status than the younger ones, which applied to both urban and rural residents. This may because greater socioeconomic status(SES) will promote residents to take advantage of new mechanisms that protect and promote better health and reduce their mortality risk[24] and young residents aged at 29 years old or below are more likely to be lack of SES compared with the older ones. However, a contradictory findings revealed by a local study conducted in China showed rural or urban residents aged at 30 years old or above both had a negative attitude towards health than the younger ones(29 years or below)[21] as a

great deal of evidence has suggested that young people are more energetic and do more physical exercise[25, 26].

Education level

Residents whose education level was primary school or below were more likely to have a negative attitude towards health than those with a higher education level among both urban and rural residents, which is similar to the results of local studies showed years of schooling had a positive impact on residents' self-rated health[21, 27]. Education level is an indicator of SES, correlated with income and occupation, as well as working and living conditions[28]. Residents with low education are more likely to be influenced by disease and have no access to medical interventions. A western study also found the education level mediates the health differences between Japanese and Chinese compared with Hawaiian and a higher level of education is positively associated with longer life and better health throughout the lifespan[29].

Marital status

Most studies have showed married adults enjoyed better physical and mental health than the unmarried [30]and have longer life expectancies than the divorced[31]. In this study, compared with the widowed, never married residents are more likely to be good or poor health compared to general health. In a universal marriage system, tradition of marriage coexisted with modern culture of being single in China. Young residents enjoying the single status may have good health while others who can't get married at marriageable age have poor health compared with individuals who ever married even they lost the spouse but they are more successful in the society based on the marriage tradition. And married or ever married residents were more likely to have a positive attitude towards their health than others[21].

Family factors

In this study, the father's education level had a positive impact on urban and rural residents' good health. The father's education level is an important factor with regard to the family's SES. Higher father's education level means the family's income and occupation may be better, which creates better nutrition during the residents' childhood and more medical resources when they face some health risks.

Implications

The study has several implications. First, more advocate on environmental pollution should be provided especially for rural residents and make them notice the seriousness of air, water, garbage and noise pollution. This helps residents build an awareness of environmental protection and participate more in their daily life. Second, more official report on the impact of environmental pollution on health in China should be published. The State of Environment(SOE) Report played an important role in acknowledging the development made in enhancing its environment by the government in China. However, so little attention has been paid to these reports by the rural residents and they still lack environmental awareness. Third, measures to increase the protection of rural environment should be given greater

attention. For instance, some highly polluting enterprises should not be allowed to produce in villages. These enterprises continue to transfer to rural areas currently, which add risks and vulnerability of rural environment. This may create risk for agricultural production and make the peasants lose their livelihood. More research is needed to determine the factors that influence rural residents' health and their environmental awareness as environmental rights inequality may create more health inequality between urban and rural residents.

Limitations

First, as a cross-sectional study, it can solely exhibit a static picture that cannot thoroughly describe the changes between the actual impacts of perceived environmental pollution on residents' health. Second, the study captured some demographic factors and environmental factors in residents' health and could not take all the individual differences into consideration, such as nutrition, physical exercise. Third, the results of this study were based on measurement of self-rated health. This may not reflect the real status of their physical health. In the following study, some objective assessment needs to be added, such as some chronic diseases. Finally, the huge differences in awareness of environmental pollution's impacts on health between urban and rural residents partly are due to the priority of environmental protection policies in cities. The study did not involve the impacts of environmental policies.

Conclusions

Rural residents perceived little about impacts of environmental pollution on health, which may create risks and vulnerability of rural environment and the livelihood of these residents. Suitable measures ought to be executed to more readily accomplish the supportable improvement of urban and rural regions together. Great attention should be paid to the impacts of environmental pollution on health for not only urban residents but also rural ones, which will highly improve the support of "green development" among the public in China.

Abbreviations

SSCW3: The 3rd Survey on the Status of Chinese Women in 2010; CGSS: Chinese General Social Survey; ACWF: All China Women's Federation; SOE: The State of Environment; SES: Socioeconomic status

Declarations

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Authors' Contributions

TY analyzed the data and drafted the manuscript. The author read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable. The data were from *The 3rd Survey on the Status of Chinese Women in 2010* conducted by the All China Women's Federation and the China Statistical Bureau. All participants consented the interviews.

Consent to publish

Not applicable.

Competing interests

The author declares that she has no competing interests

References

1. Chan, C. K., & Yao, X. (2008). Air pollution in mega cities in China. *Atmospheric environment, 42*(1), 1-42.
2. Kampa, M., & Castanas, E. (2008). Human health effects of air pollution. *Environmental pollution, 151*(2), 362-367.
3. Anderson, J. O., & Stolbach, A. (2012). Clearing the Air: A Review of the Effects of Particulate Matter Air Pollution on Human Health. *J Med Toxicol, 8*(2), 166-175.
4. Schwarzenbach, R. P., Egli, T., Hofstetter, T. B., Gunten, U. V., & Wehrli, B. (2010). Global Water Pollution and Human Health. *Social Science Electronic Publishing, 35*(1), 109-136.
5. Wu, C., Maurer, C., Wang, Y., Xue, S., & Davis, D. L. (1999). Water pollution and human health in China. *Environmental Health Perspectives, 107*(4), 251-256.
6. Beach, M. (2001). Water, pollution, and public health in China. *The Lancet, 358*(9283), 735-735.
7. Gao R.W.(2018). Current status of water pollution in China and countermeasure analysis. *Resources and Habitant Environment*, (11), 44-51.(in Chinese)
8. Xu L., Ling M.L., Lu Y.J.(2017). Key Determinants of Urban Household Solid Waste Recycling Behavior.*Journal of Public Management*, (1), 142-153. (in Chinese)

9. Du, L. Z., Chen, X., Sun, X. M., Shang, A. Y., & Cao, M. (2014). Analysis on Current Situation and Countermeasures of Rural Household Garbage in China. *Trans Tech Publ*.(955-959), 2640-2643.
10. Ministry of Environmental Protection. Annual Report on Environmental Pollution Prevention and Control of Solid Wastes in Large and Medium Cities in China in 2016. 2016.(in Chinese)
11. National Bureau of Statistics. *Statistical Communique on National Economic and Social Development in 2015.* http://www.stats.gov.cn/tjsj/zxfb/201602/t20160229_1323991.html, 2016.(in Chinese)
12. Ministry of Housing and Urban-Rural Development. *China Urban and Rural Construction Statistical Yearbook.*(in Chinese)
13. Goines, L., & Hagler, L. (2007). Noise pollution: a modern plague. *Southern Medical Journal-Birmingham Alabama-, 100*(3), 287-294.
14. Zhang, K.-m., & Wen, Z.-g. (2008). Review and challenges of policies of environmental protection and sustainable development in China. *Journal of Environmental Management, 88*(4), 1249-1261.
15. Zhang Y.L.(2006). The integrating mechanism of Political and economic development and rural China Environmental conflict. *Exploration and Free Views*, 1(5), 28-30. (in Chinese)
16. Ma D.M.(2018). An endogenous Analysis of the Continuous Deterioration of Rural Environment under the Background of Urbanization—Based on the investigation of Q town in southern Jiangsu. *Academia Bimestrie*, (4), 53-58. (in Chinese)
17. Bo, Z., Cong, C., Hughes, R. M., & Davis, W. S. (2017). China's new environmental protection regulatory regime: Effects and gaps. *Journal of Environmental Management, 187*, 464-469.
18. Zhang F.N.(2018). Regional Differences in Environmental Concern among Urban and Rural Residents in China. *Social Sciences Digest*,(9). 58-60. (in Chinese)
19. Fransson, N., & Gärling, T. (1999). Environmental concern: Conceptual definitions, measurement methods, and research findings. *Journal of Environmental Psychology, 19*(4), 369-382.
20. Von, d. K. O., & Geyer, S. (2007). Emotional support, education and self-rated health in 22 European countries. *BMC Public Health, 7*(1), 1-7.
21. Ren G.Q., Wang F.Z. & Luo Y.H.(2016). The Impact of Income□Individual Income Deprivation on Health of Urban and Rural Residents in China□An Analysis Based on CGSS2010. *NanKai Economics Studies*,(6), 3-22. (in Chinese)
22. Read, J. N. G., & Gorman, B. K. (2010). Gender and Health Inequality. *Annual Review of Sociology, 36*(1), 371-386.
23. Almeling, R. (2008). *Gender and Health: The Effects of Constrained Choices and Social Policies*. New York: Cambridge University Press.
24. Pavalko, E. K., & Caputo, J. (2013). Social inequality and health across the life course. *American Behavioral Scientist, 57*(8), 1040-1056.
25. Dannefer, D. (2003). Cumulative Advantage/Disadvantage and the Life Course: Cross-Fertilizing Age and Social Science Theory. *J Gerontol B Psychol Sci Soc Sci, 58*(6), S327.

26. Andrea , E. W., Kim , M. S., & Glen H. Elder, Jr. (2007). Cumulative Advantage Processes as Mechanisms of Inequality in Life Course Health. *American Journal of Sociology, 112*(6), 1886-1924.
27. Wu F.(2018). Rural-urban Migration and Self-rated Health Among Chinese Population Using Anchoring Vignette Method to Examine the Effects of Response Heterogeneity. *Northwest Population Journal*, 39(5), 1-10. (in Chinese)
28. Pincus, T., & Callahan, L. F. (1994). Associations of low formal education level and poor health status: behavioral, in addition to demographic and medical, explanations? *Journal of Clinical Epidemiology, 47*(4), 355-361.
29. Zhang, W., McCubbin, H., McCubbin, L., Chen, Q., Foley, S., Strom, I., & Kehl, L. (2010). Education and self-rated health: An individual and neighborhood level analysis of Asian Americans, Hawaiians, and Caucasians in Hawaii. *Social Science & Medicine, 70*(4), 561-569.
30. Schoenborn, C. A. (2004). Marital status and health: United States, 1999-2002. *Adv Data, 351*(351), 1-32.
31. Kaplan, R. M., & Kronick, R. G. (2006). Marital status and longevity in the United States population. *Journal of Epidemiology & Community Health, 60*(9), 760-765.

Tables

Table 1 Demographic characteristics of residents (N=24741)

variable	Urban residents(N=11416)					Rural residents(N=13325)					p-value
	Good	General	Poor	p-value		Good	General	Poor	p-value		
Total	67.21	25.88	6.91			68.56	22.90	8.54			***
Gender											
Male	47.94	71.37	22.58	6.05	***	49.37	72.77	20.42	6.81	***	*
Female	52.06	63.39	28.91	7.71		50.63	64.44	25.33	10.23		
Age											
≤29 years old	15.69	87.72	11.22	1.06	***	17.26	87.83	10.48	1.70	***	***
30-39 years old	25.23	75.66	20.58	3.78		22.97	77.95	18.03	4.02		
40-49 years old	29.67	63.09	27.34	9.57		29.37	67.35	24.55	8.10		
50-59 years old	22.10	53.82	36.46	9.71		22.49	54.92	30.53	14.55		
≥60 years old	7.31	51.26	37.72	11.02		7.90	42.45	36.37	21.18		
Education level											
Primary school or below	8.51	48.30	35.63	16.07	***	42.32	57.76	28.04	14.20	***	***
Junior or senior high school	61.20	64.78	27.31	7.91		55.78	76.19	19.36	4.45		
Postsecondary or above	30.29	77.44	20.24	2.31		1.90	84.98	12.65	2.37		
Marital status											
Never married	10.86	85.89	10.89	3.23	***	9.03	82.38	12.47	5.15	***	***
Married	81.94	66.26	27.11	6.63		85.82	68.19	23.45	8.36		
Divorced	4.21	54.89	30.98	14.14		1.45	63.21	27.46	9.33		
Widowed	2.99	42.82	39.30	17.89		3.71	45.34	34.01	20.65		
Father's education level											
Primary school or below	51.53	60.77	30.02	9.21	***	78.39	65.60	24.73	9.67	***	***
Junior or senior high school	41.56	74.14	21.27	4.60		21.23	79.32	16.26	4.42		
Postsecondary or above	6.91	73.64	22.69	3.68		0.38	76.00	18.00	6.00		

Table 2 Perceived environmental pollution among urban and rural residents

variable		Urban residents(n=11416)			Rural residents(n=13325)			p-value
		Good	General	Poor	P-value	Good	General	Poor	p-value	
Air pollution										
Yes	35.67	62.84	29.17	7.98	***	16.76	69.10	24.23	6.67	***	***
No	64.33	69.64	24.05	6.32		83.24	68.45	22.64	8.92		
Water pollution											
Yes	17.96	61.32	30.63	8.05	***	12.46	67.23	25.18	7.59	*	***
No	82.04	68.50	24.83	6.66		87.54	68.74	22.58	8.68		
Garbage pollution											
Yes	25.05	61.40	29.48	9.13	***	18.19	68.19	24.71	7.10	**	***
No	74.95	69.16	24.67	6.17		81.81	68.64	22.50	8.86		
Noise pollution											
Yes	32.05	62.18	30.01	7.82	***	13.49	68.21	22.87	8.93	***	***
No	67.95	69.59	23.93	6.48		86.51	70.78	23.15	6.07		

Table 3 Multinomial regression models of perceived environmental pollution's impacts on health

	Urban residents		Rural residents	
	Model 1a	Model 1b	Model 2a	Model 2b
	Good vs General	Poor vs General	Good vs General	Poor vs General
	B(95%CI)	B(95%CI)	B(95%CI)	B(95%CI)
Air pollution(No)				
Yes	-0.14* (-0.26,-0.02)	0.09 (-0.12,0.31)	-0.12 (-0.26,0.02)	-0.11 (-0.35,0.14)
Water pollution(No)				
Yes	-0.10 (-0.25,0.04)	-0.18 (-0.42,0.07)	-0.06 (-0.22,0.09)	-0.03 (-0.28,0.23)
Garbage pollution(No)				
Yes	-0.04 (-0.18,0.09)	0.33** (0.10,0.56)	-0.08 (-0.21,0.05)	-0.17 (-0.40,0.06)
Noise pollution(No)				
Yes	-0.23*** (-0.35,-0.11)	-0.19 (-0.40,0.03)	-0.06 (-0.21,0.09)	-0.10 (-0.36,0.16)
Gender(male)				
Female	-0.38*** (-0.47,-0.29)	-0.08 (-0.24,0.08)	-0.38*** (0.47,-0.29)	(0.03,0.32)
Age(≤29 years old)				
30-39 years old	1.44*** (1.18,1.69)	-1.40*** (-2.04,-0.76)	1.81*** (1.59,2.04)	-1.22*** (-1.66,-0.77)
40-49 years old	0.89*** (0.71,1.07)	-0.10 (-0.44,0.23)	1.20*** (1.02,1.38)	-0.73*** (-1.00,-0.45)
50-59 years old	0.47*** (0.30,0.64)	0.42** (0.13,0.70)	0.76*** (0.59,0.92)	-0.36** (-0.58,-0.13)
≥60 years old	0.05 (-0.12,0.23)	0.00 (-0.28,0.28)	0.37*** (0.21,0.53)	-0.10 (-0.31,0.10)
Marital status(Widowed)				
Never married	0.60*** (0.25,0.94)	0.89** (0.33,1.45)	0.11 (-0.19,0.41)	0.56* (0.12,1.00)
Married	0.35** (0.10,0.60)	-0.47** (-0.80,-0.14)	0.21 (-0.01,0.42)	-0.17 (-0.44,0.10)
Divorced	0.08 (-0.24,0.39)	0.08 (-0.35,0.51)	-0.17 (-0.56,0.23)	-0.13 (-0.73,0.47)
Education(primary schools or below)				
Junior or senior high school	0.26** (0.10,0.41)	-0.45*** (-0.68,-0.23)	0.24*** (0.15,0.33)	-0.56*** (-0.72,-0.40)
Postsecondary and above	0.39*** (0.21,0.57)	-1.27*** (-1.60,-0.95)	0.43* (0.04,0.82)	-0.62 (-1.52,0.27)
Father's education(primary schools or below)				
Junior or senior high school	0.12* (0.02,0.22)	-0.15 (-0.34,0.04)	0.14* (0.02,0.26)	0.02 (-0.20,0.25)
Postsecondary and above	-0.01 (-0.20,0.18)	-0.21 (-0.62,0.21)	0.13 (-0.62,0.88)	0.10 (-1.22,1.43)
_cons	0.09(-0.21,0.38)	-0.47*(-0.87,-0.07)	0.14(-0.09,0.38)	-0.38**(-0.67,-0.09)
N	11416		13325	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$