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# Influencing factors of air-quality perception in China: What is constructed? What is hidden?

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China is known to be widely concerned about the air quality of its major cities. Nevertheless, the factors that influence air-quality perception (AQP) are still a matter of discussion. On the basis of one idea that AQP is constructed by media contact, this study assesses the effects of quantitative approach to compare the effect of constructionism and realism on AQP, that is media contact, individualism, and health condition on AQP. Based on data of the Chinese General Social Survey (CGSS) in 2010, we build an ordered logistic regression model and introduce urban/rural dual structure and urbanization as control variables. The results show that media contact, health condition, and individualization affect AQP. The effect of media contact, however, varies depending on the media type, and the relationships between media contact and AQP change according to region when adding control variables. Health condition is significant only when it affects work and activities as well as when mental health (MH) occurs. Additionally, the function of health effect (HE) and MH on AQP only becomes obvious in some areas after adding control variables. Moreover, in most places, the effect of some individualization variables on AQP disappear after adding control variables, whereas they continue to be obvious in others. Therefore, the effect of control variables, which are urbanization level and urban/rural dual structure, is hidden. Furthermore, there is a need to pursue economic and environmental justice between developed and undeveloped areas. The study replies with the effect of constructionism and realism on AQP. And it also sheds light on both the constructed and hidden functions of media contact.

## KEYWORDS

air-quality perception, media contact, individualism, social constructionism, urbanization, social realism

## 1 Introduction

AQP is the process occurring in people whereby sensory stimulation based on air quality is translated into organized experience. Previous study classified AQP into perception of the intensity and the harmfulness, and discovered both were influenced by environmental knowledge, socio-economic status, health experience, among others (Li et al., 2016). In this paper, AQP is defined as the joint product of the stimulation from air quality and of the process itself. Research on AQP is of importance in China, when the

COVID-19 pandemic has profoundly affected and changed the global and regional environmental issues, and strengthened individuals' awareness of air-quality indoor and outdoor (Wang and Su, 2020; Abdel-Salam, 2022). Moreover, the energy consumption and the industrial structure, which result from economic activity, traffic transportation, and urbanization, are still major concerns worldwide (Wang and Su, 2020; Zhang L. et al., 2022; Chen et al., 2022). Furthermore, the effects of China's coal consumption control policy are diverse across regions (Zhao et al., 2022).

During the past 10 years, many studies have concerned AQP in China (Shi, 2015; Guo et al., 2016; Brimblecombe and Zong, 2019; Zhang and Zhao, 2019). Numerous factors are found to be correlated with AQP, including multiple stakeholders, industrial facilities, vehicles and city constructions, among others (Liu, 2022). Moreover, AQP has influences on destination image, tourists, urban settlement intentions, and health effects and concerns (Lan et al., 2016; Becken et al., 2017; Reames and Bravo, 2019; Yao et al., 2022) and, moreover, influences self-protection demands and migration, among other factors (Li and Tilt, 2018; Tu and Zhao, 2021). However, little research has investigated the effect from the perspective of social constructionism and social reality, which was one of the important concern in environmental sociology (Shi et al., 2022). In this study, we seek to compare the effects of social constructionism and social reality on AQP.

From the theoretical framework of this paper, AQP is influenced by two aspect of factors. One is the particles harmful to the health in the air, which influence human experience. Particulate materials, such as  $PM_{10}$  and  $SO_2$  are the main causes of rates of hospital admission due to asthma in Northeast China (Zhang and Zhao, 2019). The influence of  $PM_{2.5}$  on the mortality related to urogenital diseases is greater than that of cardiovascular and respiratory diseases, and the influence of  $NO_2$  and black carbon (BC) on the mortality related to cancer is greater than that of respiratory diseases (Ho et al., 2020). Individuals acquit with environmental knowledge would evaluate the air condition and take action like restricting outdoor activities and increasing expenditure for risks (Li and Folmer, 2022). Therefore, both the exposure to polluted air and the hazard of pollutants negatively and significantly influences individuals' happiness (Li et al., 2014). And the deteriorating air condition has caused people's AQP to worsen (Tu and Zhao, 2021). Moreover, it is found that AQP influences tourist arrival into China (Becken et al., 2017) and migration intention and residential satisfaction in urban areas (Yao et al., 2022). Another factor originated from the need of individuals, which is a social constructed phenomenon. With the purpose of protecting public health, the Chinese government has expended great efforts toward improving air quality. And the air pollution is gradually controlled, consequently, although it is heterogeneous in different regions (Lv et al., 2022; Yan et al., 2022). In September 2021, there were 7.9% days with mild

pollution, 0.5% days with moderate pollution, and above 0.1% days with severe pollution. However, the public remain skeptical, believing that the solutions to air-pollution problems are only short term (Brimblecombe and Zong, 2019). The reason is that the energy use and greenhouse gas exceed after the event of the coronavirus disease COVID-19, although the outbreak of the coronavirus disease COVID-19 has greatly decreased the economic activities of China and restricted the traffic (Wang and Zhang, 2021). It also led to changes of the energy consumption of China, and blocked the environment deteriorate (Wang and Su, 2020). Therefore, the perception of air quality remains low particularly in some areas (Shi, 2015; Guo et al., 2016).

The process of haze presentation has shown that the process of stimulation, which is influenced by environmental policies and media contact, among others, also affects AQP. Most of the Chinese people are not supposed to be aware of  $PM_{2.5}$  because lacked of knowledge and it was not incorporated in the Air-Quality Index of China until 2012, or not freely available (Liu and Anbumozhi, 2009; Li et al., 2016; Hong et al., 2021). Moreover, there are few reports on haze in China before 2010, with data from China National Knowledge Internet (CNKI) showing that the number of reports in 2010 was 64 (cumulative number 228). In 2011, the number was 111 (cumulative number 339), and 99 in 2012 (cumulative number 448). It then increased abruptly to 1861 in 2013 (cumulative number 2309). Thus,  $PM_{2.5}$  has been gradually attracting attention after the US Embassy announced the hourly data of  $PM_{2.5}$  on 8 April 2008, which caused dispute between the US Embassy and the Environmental Protection Bureau of Beijing (Hong et al., 2021). On 22 October 2011, Pan Shiyi, one of the most successful real estate developers in China, forwarded the  $PM_{2.5}$  data of the US Embassy on his microblog, and attracted the attention of some microblog users. In 2012, the Ministry of Environmental Protection of China revised and formulated a new standard, which added  $PM_{2.5}$ . At 19:00 to 19:30 on 18 January 2013, the national news broadcast of China Central Television (CCTV1) consumed 3 min and 30 s to report the serious haze problem in central and eastern China for the first time. Later in 2015, the documentary Under the Dome had more than 200 million views in 48 h in China, and has a long-term effect (Tu et al., 2020). Due to increasing debate about haze in media, such as on Microblog and in news media reports, researchers have concluded that media contact plays an important role in the appearance of  $PM_{2.5}$  and caused people to become familiar with the haze problem.

The process of haze presentation has triggered a dispute between social constructionism and social realism. Due to the effect of media, there is an idea in the literature that AQP is constructed by media contact and other social cultural factors rather than physiological feelings on air pollution (Huang and Yang, 2020; Tu et al., 2020; Hong et al., 2021; Shi et al., 2022). As a result, the social characteristics and social impacts of environmental problems of China are ignored. In addition, the connection between

environment and society, which is the object of environmental sociology, is neglected. However, media content may be hiding something that is more important to AQP. It is found that the smog in London has been a reference point when journalists talk about smog problem in China, which justifies air pollution and naturalizes the problems (Li and Svarverud, 2018). When talking about the data of PM<sub>2.5</sub> announced by the US Embassy, it is found the media preferred to compare the action of the US Embassy in China with silence of the US Embassy in India, Pakistan, and Bangladesh. Thus, some Chinese researches lead to the illusion that transforming the haze problem in China into a conflicting politicized framework (Xiaosu, 2014; Minghua et al., 2020). Therefore, the realism of the haze problem becomes hidden, although there is an opportunity to use a global perspective to combat the haze problem (Zhang and Samet, 2015).

The purpose of this article is to compare the effects of social constructionism and social reality on AQP. Media contact is used to measure the effect of social constructionism. Health condition is used to measure the effect of social reality. Individualism, which is constructed by the culture and social condition, is used to measure both the effects of constructionism and social reality. Nationally representative data are used to understand relationship between AQP and influencing factors. The data were collected in 2010, when most Chinese residents were not aware of PM<sub>2.5</sub>. Otherwise, it is harder for us to compare which factor is more important, particularly when knowledge about PM<sub>2.5</sub> spread in China since 2011 and media contact play a more important role. Media contact, health condition, individualism, urbanization, and urban/rural dual structure are selected as possible influencing factors. The subjective perception of air quality near residences, which is selected as the dependent variable. By analyzing the relations of AQP and influencing factors, our study aims to compare the effects of social constructionism and social reality on AQP. This objective is achieved by exploring the following questions: (A) How does media contact affect AQP? (B) How does health affect AQP? (C) How does individualism affect AQP? (D) What is the role of urbanization and urban/rural dual structure?

## 2 Data source and methods

### 2.1 Data source

This article uses data from the 2010 version of the Chinese General Social Survey (CGSS), which was officially implemented by the National Survey Research Center (NSRC) of China Renmin University in 2003. The CGSS is a national representative survey conducted annually on more than 10,000 households in 31 province-level administrative units in China. The 2010 CGSS adopted a three-stage stratified

sampling design. The first step is selecting the primary sampling unit (PSU), which is divided into two categories. In category 1, the PSU is the sub-district office in five cities. Otherwise, the sample would be overly concentrated in distribution and lose representation. Included are the households in the selected five large and developed cities, which are Shanghai, Beijing, Guangzhou, Shenzhen, and Tianjin, which were selected from 36 possible cities (including municipalities directly under the central government, provincial capitals, and sub-province cities of China) based on the gross domestic product (GDP), total number of teachers, and foreign direct investment (FDI). Category 2 includes all families in the country except the five cities. The PSU is county-level units and districts. In the second step, community level units are selected, which are urban and rural communities. The last step is the selection of households.

Due to worldwide cooperation, the 2010 CGSS includes core content, a class consciousness module, a social stratification module, an income and consumption module, a religion module, an environment module, which is also conducted as part of the International Social Survey Program (ISSP), and a health module, which is conducted as part of the East Asian Social Survey (EASS). The number of valid respondents of the 2010 CGSS was 11,783, and 3,866 of these who were born in January, April, June, and August were selected to answer questions of the health module.

### 2.2 Data exploration

Before employing descriptive and comparative statistics, the root mean square error of approximation (RMSEA) was introduced (McDonald and Ho, 2002), due to the large sample size, for the purpose of assessing the level of significance between AQP and variables related with media contact, health condition, individualism, urbanization, and urban/rural dual structure (see Table 1). This was conducted using the following equation. It is suggested that an RMSEA value of about 0.08 or less is a reasonable error of approximation, whereas a model with RMSEA greater than 0.1 should not be employed (Browne and Cudeck, 1992).

$$RMSEA = \sqrt{\frac{\hat{F}_0}{df_{test}}}$$

where

$$\hat{F}_0 = \frac{\chi^2_{test} - df_{test}}{N}$$

Based on the RMSEA value, we classify *urbanization* and *urban/rural dual structure* as control variables, and *media contact*, *health condition*, *individualism* as independent variables.

TABLE 1 Chi-square results and RMSEA value.

	Pearson chi-square	Df	Sig.	N	RMSEA
AQP-newspaper	241.69	12	0.000	3,838	0.07
AQP-magazine	231.04	12	0.000	3,836	0.07
AQP-radio	158.07	12	0.000	3,827	0.06
AQP-TV	33.90	12	0.001	3,846	0.02
AQP-Internet	248.78	12	0.000	3,835	0.07
AQP-SMS	120.52	12	0.000	3,835	0.05
AQP-health	62.69	12	0.000	3,844	0.03
AQP-HE	58.06	12	0.000	3,831	0.03
AQP-MH	40.63	12	0.000	3,834	0.02
AQP-OASRBSS	45.89	12	0.000	3,813	0.03
AQP-OASROTMP	40.50	12	0.000	3,823	0.02
AQP-OASRBM	72.47	12	0.000	3,821	0.04
AQP-ELDCOST	34.06	9	0.000	3,829	0.03
AQP-GENDIV	151.07	12	0.000	3,844	0.05
AQP-HOUSWKDV	28.51	12	0.005	3,840	0.02
AQP-FREESPECH	95.23	12	0.000	3,824	0.04
AQP-FREEBIRTH	70.99	12	0.000	3,835	0.04
AQP-FREEWRK	42.72	12	0.000	3,831	0.03
AQP-urbanization	166.93	6	0.000	3,849	0.08
AQP-Urban/rural	558.44	3	0.000	3,849	0.22

HE, Health effect; MH, Mental health; OASRBSS, Opinion about sexual realtions between adults of the same sex; OASROTMP, Opinion about married person having sexual realtions with someone other than the marriage partner; OASRBM, Opinion about sexual relation between two adults of the same sex), among others, are abbreviation. The variable name, measurement level, variable value could be seen in the following part 2.3.

## 2.3 Variables and measures

### 2.3.1 Dependent variable

#### 2.3.1.1 AQP

AQP concerns the judgment and assessment of the risks when we are faced with ambiguous and contradictory information about the air conditions. Air-pollution exposure has both physical and psychological effects. It is suggested that psychological effects might have a more significant influence than physical effects (Meertens and Swaen, 1997). Moreover, because the psychological effect is difficult to measure, researchers have introduced subjective indicators as an alternative (Deguen et al., 2012; Chiarini et al., 2020; Zhang Y. et al., 2022). We do not attempt to develop a new tool to measure AQP but instead use an existing question in the questionnaire, “How serious is the air pollution problem in your area?”, to which there are four responses, namely 1) most severe, 2) more severe, 3) less severe, and 4) not severe.

### 2.3.2 Independent variables

#### 2.3.2.1 Media contact

Previous study found that social networks transmit channel rather than media contact is more important for enhance awareness and perception (Tang et al., 2013). The CGSS proposes six questions measuring media contact that concern frequency. They are (A) “How often do you read newspapers?” (B) “How often do you read magazines?” (C) “How often do you listen to radio?” (D) “How often do you watch TV?” (E) “How often do you surf the Internet?” (F) “How often do you use short message service (SMS)?” There are five responses, namely 1) never, 2) several times a year or less often, 3) several times a month, 4) several times a week, and 5) daily.

#### 2.3.2.2 Individualism

The relationship of individual and society influences environmental action and perception. Measurement of the relationship between individual and society has previously involved the concept of cultural worldview, which includes

individualism, hierarchy, egalitarian, and fatalism (Kim and Kim, 2019). Individualization is also another important concept. This means, firstly, that individuals have discarded all embracing social categories in industrial society, such as family, kinship, gender, and class. Individualization indicates the increasing awareness about emotions and desires, particularly sexual knowledge and rights, which have been controlled or stigmatized in traditional and socialist Chinese culture (Yan, 2010). It also indicates an attempt by individuals to remove the estrangement between the two sexes that was once characteristic of the basic traditional relationship in China (Qiu Zeqi, 2014). Additionally, studies have shown that the more acceptance there is of individualization, the more likely there is to be acceptance of premarital sex (Lo et al., 2010; Twenge et al., 2015).

Based on the measurements of a previous study (Qiu Zeqi, 2014), we use nine variables to measure individualism. (A) “What is your opinion about a man and a woman have sex relations before marriage (OASRBM)?” (B) “What is your opinion about a married person having sexual relations with someone other than the marriage partner (OASROTMP)?” (C) “What is your opinion about sexual relations between two adults of the same sex (OASRBSS)?” The responses are 1) always wrong (2) almost always wrong, 3) not sure whether it is wrong, 4) wrong only sometimes, and 5) not wrong at all. (D) “Do you think who should primarily be responsible for supporting elderly people who with children? 1) The government, 2) the children, 3) the elderly themselves, or 4) both (ELDSPT).” (E) “To what extent do you agree or disagree, a man’s job is to earn money; a woman’s job is to look after the home and family (HUBBYWK).” (F) “Both the man and woman should contribute to the housework (HOUSWKDV).” (G) “If a person makes a speech criticize government, the government should not interfere (FREESPECH).” (H) “The number of children one wants to give birth to is his or her own business. The government should not interfere (FREEBIRTH).” (I) “It is personal freedom to choose working and living place, the government should not interfere (FREEWRK).” The responses of (E-I) are 1) absolutely disagree, 2) disagree, 3) not sure whether I disagree or agree, 4) agree, and 5) absolutely agree.

The variables OASRBM, OASROTMP, and OASRBSS, which are related to questions (A-C), are used to measure whether individuals have cast off the shackles of traditional gender relations. The variable ELDSPT, which is related to question (D), is used to answer whether individuals have cast off the shackles of traditional generation relations. The variables HUBBYWK and HOUSWKDV, which are related to questions (E-F), are used to answer whether individuals have cast off the shackles of traditional family division of labor. The variables FREESPECH, FREEBIRTH, and FREEWRK, which are related to questions (G-I), are used to answer whether individuals have cast off the shackles of the government.

### 2.3.2.3 Health condition

Air-pollution exposure has both physical and psychological effects (Deguen et al., 2012). However, the relationship between air pollution and health mainly depends on the perception, which is related to health condition, other individual and environmental factors (Elliott et al., 1999; Veloz et al., 2020). AQP reflects human perception of odor and dustiness, although there is no sensory organ for air-quality index in humans (Wolkoff, 2018). In this study, we consider both physical and psychological health conditions based on three questions, (A) “Would you say your own health, in general, is excellent, good, fair, or poor (health)?” The responses are 1) poor, 2) fair, 3) neither good nor fair, 4) good, and 5) excellent B) “Would you say your own health affect your work and activity during the past 30 days (HE)?” (C) “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good (MH)?” The responses are 1) always, 2) almost always, 3) sometimes, 4) seldom, and 5) never.

### 2.3.3 Control variables

#### 2.3.3.1 Urbanization

Urbanization as a fundamental feature of economic development has major impacts on the environment, although the impact is relatively small when compared with economic growth and the energy structure (Li et al., 2021). Some study shows that air quality was related to the urbanization stages and policies in China (Liu et al., 2022). Urban land use is particularly negative for air quality unless the energy consumption, industrial, transportation structure and education levels are upgraded (Narducci et al., 2019; Chiarini et al., 2020; Gan et al., 2020). Based on the economic conditions of the 31 province-level administrative units, we classified those units into three types of urbanization. They are 1) developed regions, which include Beijing, Shanghai, Tianjin, Shandong province, Jiangsu province, Zhejiang province, Fujian province, and Guangdong province; 2) developing regions, which include Chongqing, Inner Mongolia, Shanxi province, Hainan province, Hunan province, Liaoning province, Anhui province, Henan province, Hubei province, and Shaanxi province; and 3) undeveloped regions, which include the remaining province-level administrative units.

#### 2.3.3.2 Urban/rural dual structure

Urban/rural dual structure originates from the household registration (Hannum, 1999). The household registration regulations were promulgated by the PRC in 1958 (Wu and Treiman, 2004) for the purpose of controlling movement. However, this led to inequality regarding resources supply and differences in development opportunities between urban and rural residents (Cheng and Selden, 1994; Chan and Buckingham, 2008). It is found that a household registration in the cities have

**TABLE 2 Responses recorded for AQP and their corresponding percentages according to various categories.**

	Urbanization			Dual structure		Gender		Total	Age			Total
	Deve- loped	Deve- loping	Undeve- loped	Urban	Rural	Male	Female		17–35	36–60	>60	
Most severe	9.33	6.89	6.90	9.67	4.79	7.66	7.77	7.72	7.66	8.57	5.52	7.72
More severe	29.30	17.04	17.67	28.50	10.75	20.73	22.00	21.38	23.09	21.46	19.07	21.36
Less severe	46.72	45.40	42.17	48.72	38.86	45.42	44.15	44.76	49.79	43.25	42.91	44.78
Not severe	14.65	30.67	33.26	13.10	45.60	26.19	26.08	26.14	19.47	26.72	32.50	26.14
%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Count	1,297	1,262	1,290	2305	1,544	1867	1982	3,849	940	2111	797	3,848
Percent	33.70	32.79	33.52	59.89	40.11	48.51	51.49	100.00	24.43	54.86	20.71	100.00

impacts on residential satisfaction (Ren and Folmer, 2017). Moreover, PM<sub>2.5</sub> is more highly concentrated in dense urban areas than in rural areas (Lu et al., 2019), although air pollution in urban areas contributes to disease both in urban and rural areas (Gong et al., 2012). Due to these reasons, this study introduces the survey location as a variable to measure the impact urban/rural dual structure. The responses are 1) urban area, 2) rural area.

## 2.4 Descriptive and comparative method

In the descriptive part, the frequency statistics is used. It helps to describe the general condition of the respondent properties and their attitudes on AQP, media contact, health condition and individualism. In the comparative part, the ordered logistic regression (OLR) is used. The reason is that the purpose of this study is finding and comparing the influencing factors. Moreover, the dependent and the independent variables are ordinal measurement, which means that higher numbers mean either “more” or “less”, and control variables are nominal measurement. OLR is good at comparing the more important influencing factors, although it limits in detecting the casual links when compared with structure equation model (SEM). Meanwhile, SEM can handle latent and observable variables simultaneously (Tang et al., 2020). With the purpose comparing the effect of social constructionism and realism, we introduced the control variable to overcome the limits of OLR. We compare the functions of different types of media, health condition, and individualism on AQP, and consider it based on urban/rural dual structure and urbanization.

Relationships between AQP and media contact, AQP and health condition, AQP and individualism are compared by STATA. First, AQP is selected as a dependent variable, and

media contact, health condition, and individualism are selected as independent variables batch by batch. Secondly, the OLR is repeated by introducing urbanization and dual structure in grouping variables separately. Finally,  $\beta$  and  $p$  are integrated into one table.

## 2.5 Descriptive statistics of responses and variables

Table 2 presents the percentages of respondents regarding their responses related to AQP. It shows that around 33.70% of the respondents are in developed areas, 32.79% in developing areas, and 33.52% in undeveloped areas. 59.89% of respondents are in urban areas and 40.11% are in rural areas. Around 48.51% of the respondents are male and 51.49% female. The average age of the respondents is 47.12, and 24.43% of them are aged 17–35 years old, 54.86% are aged 36–60 years old, and 20.71% are more than 60 years old. The proportion of respondents who hold an AQP of air pollution as most severe is lowest, at 7.72%, whereas 21.38% of the respondents hold the AQP view that air pollution is more severe, 44.76% as less severe, and 26.14% as not severe. It can also be seen in Table 2 that the AQP of respondents varies substantially depending on differences in urbanization levels, regions, and ages. Respondents living in developed and urban areas are more likely to have an AQP that air pollution is most severe or more severe. Older respondents are more likely to hold an AQP that air pollution is not severe.

Table 3 shows data for the respondents’ media contact, health condition, and individualism. It shows that TV is the most popular media type, with newspaper second and Internet third. The proportion of respondents who always had contact through newspapers, magazines, radio, TV, Internet, and SMS

TABLE 3 Percentages of media contact, health condition, and individualism.

	Never	Seldom	Sometimes	Often	Always	N
Newspaper	41.97	20.48	15.91	14.77	6.88	3,853
Magazine	49.81	24.88	15.24	8.80	1.27	3,851
Radio	56.86	19.04	10.94	8.52	4.64	3,839
TV	2.23	6.37	11.62	39.22	40.56	3,863
Internet	66.20	6.50	6.78	11.02	9.51	3,849
SMS	75.60	10.11	6.11	4.83	3.35	3,849
	poor	Fair	Neither good nor fair	Good	Excellent	N
Health	4.04	14.22	23.80	33.15	24.79	3,861
	Always	Almost always	Sometimes	Seldom	Never	N
HE	3.98	10.34	15.44	26.56	43.69	3,848
MH	2.05	9.35	24.23	32.94	31.43	3,850
	Always wrong	Almost always wrong	Not sure	Wrong sometimes	Not wrong at all	N
OASRBMB	56.34	14.27	19.69	6.94	2.76	3,834
OASROTMP	83.08	8.63	6.39	1.41	0.50	3,835
OASRBSS	83.51	4.08	10.77	1.02	0.63	3,826
	Government	Children	Elder themselves	Both	---	N
ELDSPT	7.46	57.30	4.24	31.00	---	3,845
	Absolutely disagree	Disagree	Not disagree or agree	Agree	Absolutely agree	N
HUBBYWK	6.45	17.20	8.55	41.75	26.06	3,861
HOUSWKDV	3.11	10.87	12.50	41.44	32.08	3,856
FREESPECH	14.22	33.14	20.57	23.41	8.67	3,841
FREEBIRTH	29.01	41.13	9.87	14.31	5.69	3,851
FREEWRK	6.78	15.86	10.87	38.97	27.53	3,847

was 6.88%, 1.27%, 4.64%, 40.56%, 9.51%, and 3.35%. 14.77%, 8.80%, 8.52%, 39.32%, 11.02%, and 4.83%. The self-evaluation of health condition shows that 33.15% of respondents answered that their health was good and 24.79% excellent. The self-reported of health effect shows that 43.69% never experienced effects on work or activity, 26.56% seldom, 3.98% always, and 10.34% almost always. The mental health (MH) self-evaluation shows that 2.05% always feel effects on MH, 9.35% almost always, 32.94% seldom, and 31.43% never.

Table 3 also shows the extent of individualism. The statistics show that 56.34% of respondents believe OASRBMB is always wrong, 14.27% almost always wrong, 19.69% not sure, 6.94% wrong only sometimes, and 2.76% not wrong at all. Attitudes regarding OASRBSS and OASROTMP are similar, with respectively 0.63% and 0.50% considering it is not wrong at all, 1.02% and 1.41% wrong only sometimes, 10.77% and 6.39% not sure if it is wrong or not,

4.08% and 8.63% that it is almost always wrong, and 83.51% and 83.08% that it is always wrong.

Statistics for ELDSPT shows that 57.30% of individuals regard that children should be primarily responsible for supporting elderly people, 31.00% that it should be shared between the government, children, and elder themselves. When talking about the division of main duties for the family and responsibilities on housework, 67.81% of individuals agree or absolutely agree with the idea that it is a man's job to earn money, whereas it is a woman's job to look after the home and family, and 73.52% agree or absolute agree with the idea that both the man and woman should contribute to housework. It is shown that 32.08% of individuals agree or absolutely agree that the government should not interfere with a criticizer. Around 20.00% agree or absolutely agree that the government should not interfere with how many children one want to give birth, and 66.50% of individuals agree or

TABLE 4 Coef. of AQP and media contact.

AQP	Coef.	By (repeated command by groups)				
		Urban	Rural	Developed	Developing	Undeveloped
Newspaper	-0.18***	-0.06	-0.10	-0.07	-0.14*	-0.21***
Radio	-0.02	0.01	-0.07	-0.04	-0.03	0.01
Magazine	-0.05*	0.02	-0.11	-0.06	-0.23***	0.12*
TV	-0.06**	0.01	-0.12**	-0.02	0.02	-0.14***
Internet	-0.20***	-0.09***	-0.22***	-0.13	-0.11*	-0.31***
SMS	0.01	-0.01	0.01	0.04	-0.16**	0.10*
/cut1	-3.72	-2.55	-4.22	-3.04	-3.79	-3.79
/cut2	-2.09	-0.79	-2.91	-1.22	-2.31	-2.26
/cut3	-0.05	1.60	-0.99	1.05	-0.24	-0.31
Log likelihood	-4634.54	-2755.52	-1,689.06	-1,563.90	-1,357.22	-1,653.50
LR chi2(6)	261.27	22.55	51.94	31.37	83.13	91.89
<i>p</i>	0.000	0.001	0.000	0.000	0.000	0.000

\*, \*\* and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

TABLE 5 Coef. of AQP and health condition.

AQP	Coef.	By (repeated command by groups)				
		Urban	Rural	Developed	Developing	Undeveloped
Health	0.01	0.04	-0.05	0.08	-0.06	-0.04
HE	-0.17***	-0.07	-0.06	-0.06	-0.14	-0.17
MH	0.10***	0.18***	0.04	0.16***	0.14	0.10
/cut1	-2.77	-1.68	-3.36	-1.61	-2.87	-3.01
/cut2	-1.18	-0.07	-2.06	0.21	-1.43	-1.53
/cut3	0.76	2.46	-0.17	2.45	0.54	0.34
Log likelihood	-4717.22	-2742.49	-1,694.79	-1,565.08	-1,389.94	-1,673.18
LR chi2(3)	29.43	19.06	7.78	11.40	9.34	15.96
<i>p</i>	0.000	0.000	0.051	0.010	0.025	0.001

absolutely agree that the government should not interfere with working and living place.

### 3 Results and discussion

#### 3.1 The effect of media contact

Media communication plays an important role in the public perception of air problems, which is related with the risk source

and consequence of perception (Zhang Y. et al., 2022). However, the channel of information transmission is more important. Our study confirms the effects of media contact on AQP, but the level of media influence differs according to the type. Table 4 presents the relationship between AQP and media contact. Contact with newspaper ( $\beta = -0.18$ ,  $p < 0.01$ ), magazine ( $\beta = -0.05$ ,  $p < 0.10$ ), TV ( $\beta = -0.06$ ,  $p < 0.05$ ), and Internet ( $\beta = -0.20$ ,  $p < 0.01$ ) significantly affect AQP of air pollution in the living area. The  $\beta$  shows that AQP decreases or perception of air pollution is worse as media contact increases.



TABLE 6 Coef. of AQP and individualism.

AQP	Coef.	By (repeated command by groups)				
		Urban	Rural	Developed	Developing	Undeveloped
OASRBM	-0.07**	0.02	-0.08	-0.01	-0.02	-0.08
OASROTMP	-0.07	-0.06	-0.01	-0.17**	0.00	0.07
OASRBSS	-0.03	-0.07	0.04	-0.02	-0.16**	0.03
ELDSPT	-0.05*	-0.04	0.06	-0.07	-0.02	-0.02
GENDIV	0.19***	0.03	0.20***	0.08**	0.22***	0.19***
HOUSWKDV	0.00	-0.05	0.03	0.00	0.02	-0.01
FREESPECH	-0.16***	-0.15***	-0.13***	-0.18***	-0.10*	-0.19***
FREEBIRTH	0.01	-0.01	-0.05	0.00	-0.04	0.02
FREEWRK	-0.05**	-0.02	-0.04	0.07	-0.02	-0.09**
/cut1	-2.86	-3.14	-2.64	-2.74	-2.44	-2.81
/cut2	-1.26	-1.39	-1.33	-0.91	-1.00	-1.34
/cut3	0.75	1.02	0.59	1.37	1.04	0.54
Log likelihood	-4576.08	-2688.60	-1,651.40	-1,533.73	-1,479.66	-1,490.65
LR chi2(9)	146.24	35.68	37.38	35.03	35.40	51.20
p	0.000	0.000	0.000	0.000	0.000	0.000

The function of each type of media varies by location. Moreover, in regions with different levels of development, the roles of various media are not identical. Previous research has not examined regional differences (Brody et al., 2004; Tu et al., 2020; Hong et al., 2021). And found individuals living in cities with limited AQP media coverage are more likely to be unaware of the haze problem (Hong et al., 2021). The results of this study show that urbanization, urban/rural dual structure, and AQP are significantly associated. Moreover, in contrast with previous evidence that people in cities tend to assign AQP as worse or poor than rural areas (Brimblecombe and Zong, 2019), our study found that TV plays an important role in the difference between urban and rural areas. It is also found that the effect of TV is more significant in rural and undeveloped areas. In Table 4, some of the significance disappears or changes when classifying by the variable urban/rural dual structure and urbanization. It shows that contact with newspaper has significant effects in developing areas ( $\beta = -0.14$ ,  $p < 0.10$ ) and undeveloped areas ( $\beta = -0.21$ ,  $p < 0.01$ ). It is shown that newspapers have a reverse effect on AQP in undeveloped and developing areas. Furthermore, contact with magazines also affects those in developing areas ( $\beta = -0.23$ ,  $p < 0.01$ ) and undeveloped areas ( $\beta = 0.12$ ,  $p < 0.10$ ), which means the effect of magazine on AQP differs according to location. Thus, magazines have a reverse effect in developing areas and a promoting effect in undeveloped areas. Contact with TV significantly affects those in rural areas

( $\beta = -0.12$ ,  $p < 0.05$ ) and in undeveloped areas ( $\beta = -0.14$ ,  $p < 0.01$ ). Surfing the Internet significantly affects those in all the areas. TV has reverse effect both in rural areas and undeveloped areas. Internet has a reverse effect in all areas. Thus, the impact of newspaper, magazine, and SMS is more obvious in developing and undeveloped areas.

This result is in line with the findings that controlled media coverage of polluted air would limit the chance of concerns developing about the air quality (Hong et al., 2021). Nevertheless, individuals living in developing and undeveloped areas could also subscribe to magazines and receive customized SMS messages, which are vital for knowing the environmental condition. Moreover, the effect of Internet on AQP is more significant in rural and undeveloped areas than in urban and developing or developed areas. Individuals could instead access to information through the Internet, which is also critical for determining AQP. Therefore, the prosperity of mobile We Media may add some opportunities to bridge the gap.

From the consideration of different places, we conclude that: 1) Not all media have the function of construction. In general, the effect of radio and SMS on AQP is not significant. 2) The media types with a constructive function have different functions and degrees of influence in different areas. 3) Internet is one of the main sources involved in the construction of AQP. However, the effect differs according to area, being stronger in rural and

undeveloped areas. 4) There is a reduction in the relationship between AQP and media contact resulting from grouping variables. 5) Control variables, including urban/rural dual structure and urbanization, have significant effects during the regulation process.

### 3.2 The effect of health condition

The effect of health condition on AQP is a realistic factor that varies according to regional differences. Our study is in line with previous study that perceived hazardousness is influenced by health experience (Li et al., 2016). The result suggests that an effect on AQP will only be observed when health also affects work and activity. This relationship is significant in developing and undeveloped areas. Table 5 shows that when dividing by the variable urban/rural dual structure or urbanization, the significance of HE disappears in rural and urban areas and strengthens in developing ( $\beta = -0.14, p < 0.10$ ) and undeveloped areas ( $\beta = -0.17, p < 0.01$ ). Besides the effect of HE (health effect), we found MH (mental health) also has impact on AQP. Table 5 shows that HE ( $\beta = -0.17, p < 0.01$ ) and MH ( $\beta = 0.10, p < 0.01$ ) significantly affect AQP of air pollution in living areas. Thus, HE is significant in developing and undeveloped areas. It is consistent with the suggestion that respondents' AQP worsens as they become more concerned about the impact of pollution exposure on health (Reames and Bravo, 2019). Furthermore, the MH (mental health) is found to be significantly associated with AQP, except for in rural areas. Table 5 shows that MH significantly affects those in urban areas ( $\beta = 0.18, p < 0.01$ ) and also in developed ( $\beta = 0.16, p < 0.01$ ), developing ( $\beta = 0.14, p < 0.05$ ), and undeveloped ( $\beta = 0.10, p < 0.10$ ) areas. That is, on the one hand, AQP bring concerns about physical health and, on the other hand, MH problems will also affect people's evaluation of AQP.

From the coefficients and discussion, we conclude that 1) Health evaluation does not affect AQP. 2) When there is an HE happens or MH is poor, there will be a significant effect on AQP. 3) The effect of HE on AQP is more obvious in developing and undeveloped area. 4) MH effects are more frequent and serious in urban and developed areas. 5) Control variables, including urban/rural dual structure and urbanization level, have significant effects during the regulation process.

### 3.3 The effect of individualism

When asked how individualism affects AQP, our results indicate an obvious effect of individualism on AQP. Table 6 presents the relations between AQP and individualism.

OASRBM (opinion about sexual relations before marriage) ( $\beta = -0.07, p < 0.05$ ) significantly affects AQP. The data indicate a negative influence, that the higher the acceptance of OASRBM, the worse the AQP. ELDSPT ( $\beta = -0.05, p < 0.10$ ) significantly affects AQP. GENDIV ( $\beta = 0.19, p < 0.01$ ) significantly affects AQP. The significance of GENDIV is strengthened in rural ( $\beta = 0.20, p < 0.01$ ) and developing ( $\beta = 0.22, p < 0.01$ ) areas. It is also significant in developed ( $\beta = 0.08, p < 0.05$ ) and undeveloped ( $\beta = 0.19, p < 0.01$ ) areas. FREESPECH ( $\beta = -0.16, p < 0.01$ ) significantly affects AQP. It is shown that FREESPECH significantly affects those in both urban ( $\beta = -0.5, p < 0.01$ ) and rural ( $\beta = -0.13, p < 0.01$ ) areas and in developed ( $\beta = -0.18, p < 0.01$ ), developing ( $\beta = -0.10, p < 0.10$ ), and undeveloped ( $\beta = -0.19, p < 0.01$ ) areas. The FREEWRK ( $\beta = -0.05, p < 0.05$ ) significantly affects AQP. FREEWRK significantly affects in undeveloped areas ( $\beta = -0.09, p < 0.05$ ). OASROTMP, OASRBSS, HOUSWKDV, and FREEBIRTH are not significant.

This result is in line with the idea that social networks transmit channel is more important for enhance awareness and perception (Tang et al., 2013). Due to the access to information, instant messaging (IM) has gained popularity in the past 2 decades. It is attractive to younger generations because of its ease sharing information (Correa et al., 2010). QQ (an IM and social platform developed initially for PC and then extended to mobile users) was once the most widely used IM platform in China before WeChat (an IM and social platform for mobile users). Besides QQ, the Chinese government has invested in a project that aims to extend TV coverage, and also the use of Internet and smartphones, to remote villages. Nevertheless, friendlier interface designs are needed to facilitate access for the elderly and disabled (Blažun et al., 2014; Guner and Acarturk, 2020; Sankhi and Sandnes, 2020; Shagerdi et al., 2022). Table 3 shows a high degree of individualism because of the effect due to OASRBM, ELDSPT, GENDIV, FREESPECH, and FREEWRK. It is shown that 31.00% of individuals considered multiparty responsibility most appropriate for supporting an elder, 73.52% agreed with a man and woman completing housework together, and 66.50% agreed or absolutely agreed to free selection of work and living place. Thus, the increase in access to information would contribute to the extent of individualism.

From the coefficients and discussion, we conclude that 1) The effect of OASRBM, ELDSPT, GENDIV, FREESPECH, and FREEWRK on AQP are significant. 2) GENDIV has a promoting effect on AQP, which indicates there is higher acceptance of GENDIV and more positive the judgment of AQP. 3) OASRBM, ELDSPT, FREESPECH, and FREEWRK have a reverse effect on AQP, the higher acceptance OASRBM, FREESPECH, and FREEWRK, the worse the judgment of AQP. Furthermore, the more accepting one is of supporting an elder by themselves or through multiparty responsibility, the worse the judgment of AQP.

## 4 Conclusion

This study explores AQP in terms of the air-pollution problem in living areas, examining its relationship with media contact, health condition, and individualism. The OLR method is used. Two control variables, urban/rural dual structure and urbanization, are introduced.

The analysis replies with the dispute between social constructionism and social realism. It reveals the basic relationship between media contact, health condition, individualism, and AQP. In addition, the study sheds light on both the constructed and hidden functions of media contact. It is suggested that the difference in AQP is constructed due to the selective development of certain types of media in different regions. Furthermore, MH and HE are realistic factors that affect AQP in different areas. These results indicate AQP of air pollution is a concern among people living in all regions, although it is constructed in some areas and hidden in others. This indicates the demand for justice on air quality. Therefore, there is a need to reduce regional socioeconomic gaps, to popularize the application of Internet and smartphones, and to prevent the transfer of pollution from developed to undeveloped areas.

There are two methodological innovations in this study. One is the adoption of a quantitative approach in comparing constructionism and realism. The other is that the functions of different types of media, health condition, and individualism are considered based on urban/rural dual structure and urbanization. Compared with previous research, which found that media contact, health condition, as well as discussions in social groups are vital for the public perception of fog turning into haze in China, this study shows another shielding function. That is, the kind of media adopted in different regions can be crucial to further studying the regional differences in AQP. It is also crucial to protect people who live in these areas from air pollution. Furthermore, this study is limited regarding consideration of the contribution of education in different

areas, although education may be a practical way to improve AQP.

The results can help individuals and policymakers better understand the function of each type of media aimed at air quality disclosure, evaluate the relationship between health risks and air quality accurately, and search for protection measures properly.

## Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: <http://www.cnsda.org/>.

## Author contributions

GY contributes by providing technical support. The corresponding author is responsible for all aspects of the study and its publication.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## References

- Abdel-Salam, M. M. M. (2022). Assessment of children's exposure to air pollutants in urban residences during the Covid-19 pandemic. *Front. Environ. Sci.* 10, 2176. doi:10.3389/fenvs.2022.1050623
- Becken, S., Jin, X., Zhang, C., and Gao, J. (2017). Urban air pollution in China: Destination image and risk perceptions. *J. Sustain. Tour.* 25, 130–147. doi:10.1080/09669582.2016.1177067
- Blažun, H., Vošner, J., Kokol, P., Saranto, K., and Rissanen, S. (2014). "Elderly people's interaction with advanced technology," in *Nursing informatics 2014* (IOS Press), 1–10.
- Brimblecombe, P., and Zong, H. (2019). Citizen perception of apec blue and air pollution management. *Atmos. Environ.* 214, 116853. doi:10.1016/j.atmosenv.2019.116853
- Brody, S. D., Peck, B. M., and Highfield, W. E. (2004). Examining localized patterns of air quality perception in Texas: A spatial and statistical analysis. *Risk Anal.* 24, 1561–1574. doi:10.1111/j.0272-4332.2004.00550.x
- Browne, M. W., and Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociol. methods & Res.* 21, 230–258. doi:10.1177/004912419201002005
- Chan, K. W., and Buckingham, W. (2008). Is China abolishing the hukou system? *China Q.* 195, 582–606. doi:10.1017/s0305741008000787
- Chen, W.-T., Chang, I., Li, Z., et al. (2022). Weighting analysis on air pollution among recent years in China via grey theory models. *Front. Environ. Sci.* 10, 1568. doi:10.3389/fenvs.2022.871839
- Cheng, T., and Selden, M. (1994). The origins and social consequences of China's hukou system. *China Q.* 139, 644–668. doi:10.1017/s0305741000043083
- Chiarini, B., D'Agostino, A., Marzano, E., and Regoli, A. (2020). The perception of air pollution and noise in urban environments: A subjective indicator across European countries. *J. Environ. Manag.* 263, 110272. doi:10.1016/j.jenvman.2020.110272
- Correa, T., Hinsley, A. W., and De Zuniga, H. G. (2010). Who interacts on the web?: The intersection of users' personality and social media use. *Comput. Hum. Behav.* 26, 247–253. doi:10.1016/j.chb.2009.09.003

- Deguen, S., Ségala, C., Pédrone, G., and Mesbah, M. (2012). A new air quality perception scale for global assessment of air pollution health effects. *Risk Anal.* 32, 2043–2054. doi:10.1111/j.1539-6924.2012.01862.x
- Elliott, S. J., Cole, D. C., Krueger, P., Voorberg, N., and Wakefield, S. (1999). The power of perception: Health risk attributed to air pollution in an urban industrial neighbourhood. *Risk Anal.* 19, 621–634. doi:10.1111/j.1539-6924.1999.tb00433.x
- Gan, T., Liang, W., Yang, H., and Liao, X. (2020). The effect of economic development on haze pollution (pm<sub>2.5</sub>) based on a spatial perspective: Urbanization as a mediating variable. *J. Clean. Prod.* 266, 121880. doi:10.1016/j.jclepro.2020.121880
- Gong, P., Liang, S., Carlton, E. J., Jiang, Q., Wu, J., Wang, L., et al. (2012). Urbanisation and health in China. *Lancet* 379, 843–852. doi:10.1016/s0140-6736(11)61878-3
- Guner, H., and Acarturk, C. (2020). The use and acceptance of ict by senior citizens: A comparison of technology acceptance model (tam) for elderly and young adults. *Univers. Access Inf. Soc.* 19, 311–330. doi:10.1007/s10209-018-0642-4
- Guo, Y., Liu, F., Lu, Y., Mao, Z., Lu, H., Wu, Y., et al. (2016). Factors affecting parent's perception on air quality—from the individual to the community level. *Int. J. Environ. Res. Public Health* 13, 493. doi:10.3390/ijerph13050493
- Hannum, E. (1999). Political change and the urban-rural gap in basic education in China, 1949–1990. *Comp. Educ. Rev.* 43, 193–211. doi:10.1086/447554
- Ho, H. C., Wong, M. S., and Chan, T.-C. (2020). Spatially differentiating the effects of long-term air pollution on specific causes of death from cardiovascular and respiratory mortality in Hong Kong: A territory-wide register-based study. *Air Qual. Atmos. Health* 13, 721–730. doi:10.1007/s11869-020-00828-4
- Hong, W., Wei, Y., and Wang, S. (2021). Left behind in perception of air pollution? A hidden form of spatial injustice in China. *Environ. Plan. C Polit. Space* 40, 666–684. doi:10.1177/23996544211036145
- Huang, J., and Yang, J. Z. (2020). Beyond under the dome: An environmental documentary amplified public risk perception about air pollution in China. *J. Risk Res.* 23, 227–241. doi:10.1080/13669877.2019.1569090
- Kim, H. K., and Kim, Y. (2019). Risk information seeking and processing about particulate air pollution in South Korea: The roles of cultural worldview. *Risk Anal.* 39, 1071–1087. doi:10.1111/risa.13231
- Lan, G.-l., Yuan, Z.-k., Maddock, J. E., Cook, A., Chu, Y.-y., Pan, B.-b., et al. (2016). Public perception of air pollution and health effects in nanchang, China. *Air Qual. Atmos. Health* 9, 951–959. doi:10.1007/s11869-016-0397-0
- Li, H., and Svarverud, R. (2018). When London hit the headlines: Historical analogy and the Chinese media discourse on air pollution. *China Q.* 234, 357–376. doi:10.1017/s0305741017001400
- Li, R., Wang, Q., Liu, Y., and Jiang, R. (2021). Per-capita carbon emissions in 147 countries: The effect of economic, energy, social, and trade structural changes. *Sustain. Prod. Consum.* 27, 1149–1164. doi:10.1016/j.spc.2021.02.031
- Li, X., and Tilt, B. (2018). Perceptions of quality of life and pollution among China's urban middle class: The case of smog in tangshan. *China Q.* 234, 340–356. doi:10.1017/s0305741017001382
- Li, Z., and Folmer, H. (2022). Air pollution and perception-based averting behaviour in the jinchuan mining area, China. *Ann. Reg. Sci.*, 1–29. doi:10.1007/s00168-022-01157-3
- Li, Z., Folmer, H., and Xue, J. (2016). Perception of air pollution in the jinchuan mining area, China: A structural equation modeling approach. *Int. J. Environ. Res. Public Health* 13, 735. doi:10.3390/ijerph13070735
- Li, Z., Folmer, H., and Xue, J. (2014). To what extent does air pollution affect happiness? The case of the jinchuan mining area, China. *Ecol. Econ.* 99, 88–99. doi:10.1016/j.ecolecon.2013.12.014
- Liu, H., Cui, W., and Zhang, M. (2022). Exploring the causal relationship between urbanization and air pollution: Evidence from China. *Sustain. Cities Soc.* 80, 103783. doi:10.1016/j.scs.2022.103783
- Liu, H. (2022). How to improve environment performance? The comparison of stakeholder perceptions on how to improve air quality in China. *Front. Environ. Sci.* 478. doi:10.3389/fenvs.2022.889588
- Liu, X., and Anbumozhi, V. (2009). Determinant factors of corporate environmental information disclosure: An empirical study of Chinese listed companies. *J. Clean. Prod.* 17, 593–600. doi:10.1016/j.jclepro.2008.10.001
- Lo, V.-h., So, C. Y., and Zhang, G. (2010). The influence of individualism and collectivism on internet pornography exposure, sexual attitudes, and sexual behavior among college students. *Chin. J. Commun.* 3, 10–27. doi:10.1080/17544750903528724
- Lu, X., Lin, C., Li, W., Chen, Y., Huang, Y., Fung, J. C., et al. (2019). Analysis of the adverse health effects of pm<sub>2.5</sub> from 2001 to 2017 in China and the role of urbanization in aggravating the health burden. *Sci. Total Environ.* 652, 683–695. doi:10.1016/j.scitotenv.2018.10.140
- Lv, Y., Fan, T., Zhao, B., Zhang, J., Zheng, Y., and Zhang, Z. (2022). How do government environmental concerns affect haze pollution? *Front. Environ. Sci.* 10. doi:10.3389/fenvs.2022.945226
- McDonald, R. P., and Ho, M.-H. R. (2002). Principles and practice in reporting structural equation analyses. *Psychol. methods* 7, 64–82. doi:10.1037/1082-989x.7.1.64
- Meertens, R., and Swaen, G. (1997). Psychological factors in air pollution epidemiology. *Socioecon. Cult. Factors Air Pollut. Epidemiol. EC Air Pollut. Epidemiol. Rep. Ser.* 8, 105–112.
- Minghua, X., Danni, L., and Zhongzi, W. (2020). Different others”: Differences in the construction of environmental images of eastern countries in the wWesternperspective—comparative perspectives on haze issues in CChinaand IIndiabased on gGooglenews. *Journalism Commun.* 27, 68–85.
- Narducci, J., Quintas-Soriano, C., Castro, A., Som-Castellano, R., and Brandt, J. S. (2019). Implications of urban growth and farmland loss for ecosystem services in the Western United States. *Land Use Policy* 86, 1–11. doi:10.1016/j.landusepol.2019.04.029
- Qiu Zeqi, B. Z. (2014). *Who are the Chinese striving for? Forum of famous sociologists*, 3. Beijing: China Social Sciences Press, 103–132.
- Reames, T. G., and Bravo, M. A. (2019). People, place and pollution: Investigating relationships between air quality perceptions, health concerns, exposure, and individual-and area-level characteristics. *Environ. Int.* 122, 244–255. doi:10.1016/j.envint.2018.11.013
- Ren, H., and Folmer, H. (2017). Determinants of residential satisfaction in urban China: A multi-group structural equation analysis. *Urban Stud.* 54, 1407–1425. doi:10.1177/0042098015627112
- Sankhi, P., and Sandnes, F. E. (2020). A glimpse into smartphone screen reader use among blind teenagers in rural Nepal. *Disabil. Rehabilitation Assistive Technol.* 1–7, 875–881. doi:10.1080/17483107.2020.1818298
- Shagerdi, G., Ayatollahi, H., and Hemmat, M. (2022). Opportunities for using health information technology for elderly care in the emergency departments: A qualitative study. *Perspect. Health Inf. Manag.* 19, 1h.
- Shi, X. (2015). Factors influencing the environmental satisfaction of local residents in the coal mining area, China. *Soc. Indic. Res.* 120, 67–77. doi:10.1007/s11205-014-0584-z
- Shi, X., Li, X., Chen, X., and Zhang, L. (2022). Objective air quality index versus subjective perception: Which has a greater impact on life satisfaction? *Environ. Dev. Sustain.* 24, 6860–6877. doi:10.1007/s10668-021-01730-4
- Tang, J., Folmer, H., and Xue, J. (2013). Estimation of awareness and perception of water scarcity among farmers in the guanzhong plain, China, by means of a structural equation model. *J. Environ. Manag.* 126, 55–62. doi:10.1016/j.jenvman.2013.03.051
- Tang, J., Ren, H., and Folmer, H. (2020). “Subjective wellbeing as valuation system of environmental quality: An environmental social sciences approach,” in *Handbook on wellbeing, happiness and the environment* (Edward Elgar Publishing), 85–103.
- Tu, L., and Zhao, Y. (2021). Air pollution and the public perception level and self-protection demand in three cities of China: Fractional grey modelling analysis. *J. Math.* 2021, 1–15. doi:10.1155/2021/4951714
- Tu, M., Zhang, B., Xu, J., and Lu, F. (2020). Mass media, information and demand for environmental quality: Evidence from the “under the dome”. *J. Dev. Econ.* 143, 102402. doi:10.1016/j.jdeveco.2019.102402
- Twenge, J. M., Sherman, R. A., and Wells, B. E. (2015). Changes in American adults' sexual behavior and attitudes. *Arch. Sex. Behav.* 44, 2273–2285. doi:10.1007/s10508-015-0540-2
- Veloz, D., Gonzalez, M., Brown, P., Gharibi, H., and Cisneros, R. (2020). Perceptions about air quality of individuals who work outdoors in the san joaquin valley, California. *Atmos. Pollut. Res.* 11, 825–830. doi:10.1016/j.apr.2020.01.010
- Wang, Q., and Su, M. (2020). A preliminary assessment of the impact of Covid-19 on environment—a case study of China. *Sci. total Environ.* 728, 138915. doi:10.1016/j.scitotenv.2020.138915
- Wang, Q., and Zhang, F. (2021). What does the China's economic recovery after Covid-19 pandemic mean for the economic growth and energy consumption of other countries? *J. Clean. Prod.* 295, 126265. doi:10.1016/j.jclepro.2021.126265
- Wolkoff, P. (2018). Indoor air humidity, air quality, and health—an overview. *Int. J. Hyg. Environ. Health* 221, 376–390. doi:10.1016/j.ijheh.2018.01.015

- Wu, X., and Treiman, D. J. (2004). The household registration system and social stratification in China: 1955–1996. *Demography* 41, 363–384. doi:10.1353/dem.2004.0010
- Xiaosu, H. (2014). The characteristics of the New York times' report on China's haze and its response to publicity. *Extern. Commun.* 213, 37–38.
- Yan, D., Zhou, M., Diao, Y., and Yang, M. (2022). Air pollution in China: Spatial patterns and spatial coupling with population and economy. *Front. Environ. Sci.* 10, 2000. doi:10.3389/fenvs.2022.1040131
- Yan, Y. (2010). The Chinese path to individualization. *Br. J. Sociol.* 61, 489–512. doi:10.1111/j.1468-4446.2010.01323.x
- Yao, L., Li, X., Zheng, R., and Zhang, Y. (2022). The impact of air pollution perception on urban settlement intentions of young talent in China. *Int. J. Environ. Res. Public Health* 19, 1080. doi:10.3390/ijerph19031080
- Zhang, H., and Zhao, Y. (2019). Land use regression for spatial distribution of urban particulate matter (pm10) and sulfur dioxide (so2) in a heavily polluted city in northeast China. *Environ. Monit. Assess.* 191, 712–714. doi:10.1007/s10661-019-7905-2
- Zhang, J. J., and Samet, J. M. (2015). Chinese haze versus Western smog: Lessons learned. *J. Thorac. Dis.* 7, 3–13. doi:10.3978/j.issn.2072-1439.2014.12.06
- Zhang, L., You, S., Zhang, S., Yi, S., and Zhou, B. (2022a). The effects of urbanization on air pollution based on a spatial perspective: Evidence from China. *Front. Environ. Sci.* 10, 2280. doi:10.3389/fenvs.2022.1058009
- Zhang, Y., Chen, J., Wei, X., and Wu, X. (2022b). Development and validation of the haze risk perception scale and influencing factor scale—a study based on college students in Beijing. *Int. J. Environ. Res. Public Health* 19, 4510. doi:10.3390/ijerph19084510
- Zhao, W., Chang, M., Huangfu, J., and Yu, L. (2022). Revealing effectiveness and heterogeneity of the impact of China's coal consumption control policy on air quality. *Front. Environ. Sci.* 10, 2073. doi:10.3389/fenvs.2022.1050736