AIR POLLUTION IN CHINA: A STUDY OF PUBLIC PERCEPTION

by

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A REPORT

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Abstract

Air pollution is a serious health and environmental problem. In fact, poor air quality has been linked to numerous diseases and is a significant public health issue related to urban planning. These problems can be clearly seen in urban Chinese cities, most recently with the first ever Red Alert in Beijing China in 2015. In 2015, director Chai Jing developed a documentary depicting the bad effects on health of air pollution in China. However, soon after the release of the film, it was banned. One important finding in the film was the misperception the Chinese people had about the kinds of pollution and the health impacts. Therefore, this study aims to investigate the extent to which Chinese people understand the causes of air pollution and their related health effects. Accordingly, a survey was produced and delivered via Chinese social medium. The survey had three objectives: study the perception of 1) Air quality and the source of air pollution, 2) Health effects if air pollution, and 3) Air pollution and Environmental policies. The results show that 44% Chinese people feel air quality is worse now than a year before, and 72% people feel air pollution has affected their health. One main finding in this study was that younger people took the survey more than older people, as perhaps because they may have started to have a family or become a family; this is significant because air pollution is harmful for children. The other main finding was that 52% people did not know a China Air Pollution and Prevention Law exists.

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Dedication

This report is dedicated to my parents, Ying Yan and Jing Fan; thank you for supporting me in finishing the program. I love you both!

This report also dedicated to my boyfriend, Thomas Allen Theis; without his encouragement and help, I could not have finished this report. He saved me when I got depressed! I love you!

1 Introduction

Environmental pollution is one of the world's biggest problems (Dunlap & Jorgenson, 2012), with air pollution (in particular, carbon dioxide) being of particular concern because of its negative impacts on human health (McAllister, 1998). More than 150 published sources address how air pollution influences public health (Pope, 2000), in particular respiratory diseases, including lung cancer and emphysema (Santos, 1973), and cardiovascular disease (Franchini & Mannucci, 2012) such that about 750,000 people per year die prematurely from pollution-related diseases in China (Kahn & Yardley, 2007). Moreover, 20% of the U.S population suffers from asthma, emphysema, and diabetes due to air pollution (Curtis et al., 2006), especially children who are susceptible to respiratory illness (Pope & Dockery, 1992). Air pollution has also been known to adversely affect the bloodstream, which could induce the inflammatory process, causing lung cancer and cardiovascular disease risks (Peters et al 1997). For example, London experienced a great smog in 1952, when over 4000 people died, and life expectancy was threatened by air pollution (Brunekree & Holgate, 2002). Another study in Philadelphia, Pennsylvania from 1973 to 1980 showed that the mortality rate increased because of air pollution (Schwartz & Dockery, 2000), while a short term study from 1991 to 1995 in Greater Paris showed increased hospital admissions during air pollution, and a relative risk of asthma also increased (Medina et al., 1997).

However, effective policy-making could improve public health by improving the community environment (Frumkin, 2002), an issue connected to due to urban planning (Hoehner et al., 2003) Specifically, the health of the community is linked to transportation planning in part and its effect on population health (Northridge & Sclar, 2002). However, transportation has started to become a leading source of air pollution (Frumkin, 2002). For example, a study conducted in Austria, France, and Switzerland found that mortality and morbidity rates correlated with traffic-related air pollution (Kunzli, et al., 2000). Moreover, transport polices have had significant consequences for public health because the varied choices of transportation mode have affected air quality (Dora, 1999). Given that people walk public streets, and that many types of

transportation are available, harmful emissions are an important issue in urban planning (Horowitz, 1982).

1.1 Air Pollution in China

In addition to transportation policies, energy policies in developing countries also should be considered (Campbell-Lendrum & Corvalan, 2007) because increased energy consumption correlates with decreased air quality (Wang et al., 2012). One major example of this is that energy consumption and production in China are major contributors to pollution (Zhang &Cheng, 2009). In 2003, China was the world's second largest energy consumer behind only the United States (Crompton & Wu, 2004). Likely, this is because China has had tremendous economic growth since economic reform in the late 1970s (Wu, 2000), which increased the country's GDP (Laffont & Qian, 1999). While energy consumption decreased because of sustainable development from 1978 to 1996, however, it has increased since 1996 (Fisher-Vanden et al., 2004). In the rural area, energy and industry sectors are the main contributors for air pollution, while transportation is the major source of emissions due to urbanization (Song, 2014). The components of vehicle emissions include nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) (Liu, et al., 2007), all contributors to particular matter (PM).The increase in pollution is associated with the recent economic boom in China (Kahn & Yardley, 2007), which is also largely associated with increase vehicular use. For instance, during the 1970s, black smoke from stacks was evident in several major industrialized cities (He et al., 2002), while some southern cities in China experienced acid rain in the 1980s (He et al., 2002). Even though the Chinese government implemented some policies to control the emissions, the situation got worse (Hao et al., 2007). For example, in 2013, the New York Times reported that Beijing's air quality had reached the level of pollution that is "Crazy Bad" (Wong, 2013) (Figure 1.1).

Air quality is measured using the Air Quality Index (AQI) (Air Quality Index, 2014), which ranges from 0-500+. Any level above 500 would be considered hazardous and

very unhealthy for the public (Air Quality Index, 2014). The index takes into account the many different pollutant levels of dangerous particulates in the air (Air Quality Index, 2014). By 2013, Beijing had reached unprecedented levels of poor air quality measuring 755 on the AQI scale, which is regarded as very unhealthy for the public (Wong, 2013). However, China had used a different AQI scale, specifically a PM10 test ("particles with an aerodynamic diameter of 10 μm or less") as its national air quality standard until 1996 (Zheng, et al., 2005). Later, like the U.S, China then adopted the PM2.5 because it measures smaller size particles(2.5 μm upper limit) in the air, which means the test is more rigorous than the PM10 (Cao, et al., 2013). After proving that air quality and energy emissions are related in negatively affecting public health, China's State Council approved the PM2.5 test as the national ambient air quality standard (Cao, et al., 2013). Moreover, China Daily reported that air quality was the worst in December 2013, when more than 80% of the seventy-four cities could not meet national standards for most days in that month (Zhang & Crooks, 2012). A recent study, showed that only 25 of 100 Chinese cities could meet the National Ambient Air Quality Standards; with particular problems in the winter due to people using biomass and fossil fuel for heating their homes (Zhang & Cao, 2015). Additionally, based on a 2012 Asian Development Bank report, few of China's largest cities meet the WHO's air quality standards (Zhang & Crooks, 2012).

In part, China's pollution problems are caused by coal production. As the world's biggest coal producer and responsible for almost half of global consumption (Lin & Liu, 2010), China has coal production emissions that are the main cause of severe air pollution (Daly, 1959). This is because coal is a major source of sulfur dioxide and particulate emissions (Schmalensee et al., 1998). Thus, ultimately, China contributes to two thirds of the world's carbon dioxide emissions (Chen & Zhang, 2010), However, a more recent study recalculated carbon emission and found out that China's contribution to world's carbon dioxide was 10% lower than 2013 (Liu, et al., 2015). Fortunately, in recent years, the Internet has facilitated greater information transparency (Mclvor et al., 2002); for example, the U.S. embassy in Beijing has issued pollution readings via a Twitter feed for Americans who live in other Chinese cities (Xu, 2014). Clearly, if policy were not consistently implemented, a thriving

environmental NGO community would push the government to stay on track (Xu, 2014). Therefore, the Chinese government has invested $290 billion to clean the air (Daly, 2013).

Figure 1.1: During Air Pollution and After Air Pollution in Downtown Beijing in 2013

(Source: Photo by Bill Bishop, *The Washington Post*.)

1.1.1 Public Awareness of Air Pollution

Not only has China invested money in air pollution mitigation, but the government has learned from other countries' policies to restrict driving (Wang & Xu & Qin, 2014). Therefore, one of the first steps since 2007 to control air pollution (i.e. carbon dioxide emission) in Beijing was to limit traffic flow by restricting even or odd tag number vehicles on the road (Wang & Xu & Qin, 2014). However, some researchers surveyed the public and found out that public acceptance of the policy was very low, unfortunately, so they suggested increasing public education about the benefit of the policy (Chen & Zhao, 2013). Despite such measures, many Chinese citizens may not understand what kind of effects air pollution causes, yet public awareness is

significant in studying air pollution because public attitudes could help spur the government to make effective policies (Groot, 1967). Also the community comprises citizens, and their actions could cause environmental harm, but most Chinese have little knowledge about what behavior affects air pollution (Harris, 2006). Munro studied public awareness of air pollution across 28 provinces in China, sending a survey to the public asking whether or not they felt harmed environmental pollution, but only 6% people answered "YES"; however, those provinces are experiencing severe air pollution (Munro, 2014). Awareness of environmental protection clearly is important to help the Chinese government make good public policy (Wang et al., 2013). Thus, in pursuit of expanding public education, in March 2015, Chinese journalist, Chai Jing, released a documentary called Under the Dome, purporting to tell the truth to Chinese citizens about China's air pollution (Chai, 2015).

1.2 Research Question and Project Objectives

Because air pollution can cause varied diseases, and public awareness can help government make effective policy, many research projects have started to investigate the public's perception of health and air pollution policy. For instance, a project about public perception of health risk affected by air pollution utilized a survey to study an urban industrial neighborhood in Hamilton, Ontario, Canada (Elliot et al., 1999). As a result, the researchers used survey results to persuade local government to create a local environmental health policy (Elliot, et al., 1999). South of that border in 1970s, air quality became a major concern of the public in the United States. Based on many public meetings about air pollution, the government started to make policy to deal with environmental issues (Lester, 1995). Clearly, public opinion is significant to make policy; however, all people do not share the same political views and interests, so when China made policies, the government would consider only the most popular opinions (Tang, 2005). Thus, the more people started to voice concern about air pollution, the more it caught the government's attention and invited policy change. Following in this tradition, this study will be guided by the following research question:

To what extent is the Chinese public aware of the causes of air pollution and the subsequent health effects?

Based on the research question, the ***purpose*** of this research study is to investigate the perception of public health in China and individuals' reactions to air pollution. The main methodology was to create a survey and target citizens of the Beijing Metropolitan Area. However, the scope was not to limit the geographical area, so people from other places were welcome to take the survey as well. First, literature was consulted to provide evidence about the composition of air pollution (Holman, 1999); however, the project focuses primarily on public opinion about the sources of air pollution. As stated, air pollution harms public health; therefore, the survey asked respondents how they feel living in their city. Even though public opinion may not be able to influence environmental policy, significantly, the survey results showed how the Chinese think about their air pollution policy and what they think their government can do to improve air quality. Therefore, the study pursues the following three primary objectives:

1. Identify the perceptions of which sources cause air pollution;
2. Determine the extent to which people experienced health effects due to air pollution; and,
3. Understand citizens' perception and knowledge of Chinese environmental policies.

1.3 Study Context and Area

Chai Jing's documentary gave the Chinese a lot of information about public awareness regrading air pollution and its harm to public health. However, only a few months after Chai Jing's documentary was released, the video was banned by the Chinese government. The main reason was unknown, but the continuing air pollution problems induced China gradually to begin to pay attention to its harmful effects, and the Chinese government now wants to make changes. The following three big events in 2015 in China showed the world that China wants to deal with air pollution problems.

1.3.1 Tianjin Warehouse Explosion

Tianjin, the third most populated city in China, experienced a massive factory explosion (Tan, Li, Xie & Lu, 2004), killing 173 people, hospitalizing 674 people and especially impacting the nearest 17,000 homes and 170 businesses (Tianjin chemical clean-up after explosion, 2015) (Figure 1.2). The explosion occurred at a warehouse containing 40 types of harmful chemicals, that spread into the air (Tianjin chemical clean-up after explosion, 2015); afterwards, many people started to think about moving out of the area (Will, Jiang & Mullen, 2015). What exacerbated the problem was the proximity of the chemical storage site to residential areas (Figure 1.3) (Wong & Fung, 2015). Had the government placed stricter controls on zoning with regard to industry and residential zones, the direct damage to the nearby neighborhoods might not have been as extensive or consequential.

Figure 1.2: After Chemical Explosion in Tianjin

(Source: Photo was taken by Yue YueWei, Xinhua) (*New China*, 2015)

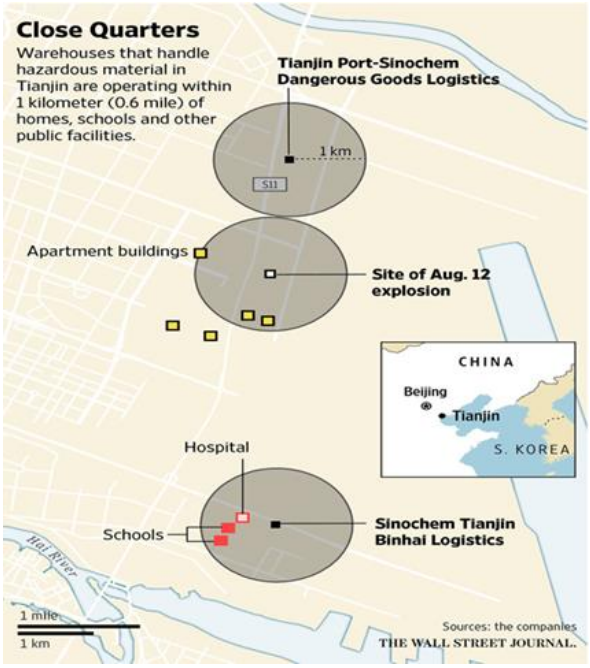

Figure 1.3: The Distance between Explosion Place and Residential Area

(Source: The companies) (*The Wall Street Journal*, 2015)

1.3.2 China's Red Alert for Air Pollution

Only four months after the Tianjin Warehouse explosion, China for first the time issued a red alert for pollution in Beijing on December 7, 2015 (Hunt & Lu, 2015) (Figure 1.4). A red alert is defined as the most severe air pollution of the four levels, and warns the public of the highest amount of hazardous particles in the air (This Is What China Looks Like When Its Cities Are on a 'Red Alert' for Smog, 2015). The alert is for when air quality gets worse over three consecutive days, whereupon the government would advise people to stay inside, shut down schools, and limit car use (This Is What China Looks Like When Its Cities Are on a 'Red Alert' for Smog, 2015). After 11 days, China issued another red alert for air pollution in Beijing on December 18. 2015 (China smog: Beijing issues second ever pollution red alert - BBC News, 2015) and then continued to issue red alerts in 10 additional cities close to Beijing: Tianjin, Puyang, Xinxiang, Dezhou, Handan (Hebei Province), Xintai, Langfang (Hebei Province), Hengshui (Hebei Province), Xinji (Hebei Province) and Anyang (This Is What China Looks Like When Its Cities Are on a 'Red Alert' for Smog, 2015) (Figure 1.5, Figure 1.6 &Figure 1.7). Figure 1.7 shows how extensively air pollution

spread in the North of China. This series of red alerts showed that the Chinese government for first time started to admit to severe air pollution and promised to take measures to deal with it. However, most Chinese citizens thought that the government announced the red alerts too late based on a study by Berkeley Earth, which reported that air pollution was killing about 4,400 Chinese people a day (This Is What China Looks Like When Its Cities Are on a 'Red Alert' for Smog, 2015). After these events, *China Daily*, which is a government run newspaper agency, reported that air pollution could cause lung cancer in more than 800,000 people a year by 2020 (This Is What China Looks Like When Its Cities Are on a 'Red Alert' for Smog, 2015). Based on these occurrences, most Chinese people started to wear a mask when they go outside (Figure 1.8). Finally, under the pressure of the public media, the Chinese government started to learn to co-operate with the United States to help China address air pollution.

Figure 1.4: Beijing in Pollution and On Blue Sky Day

(Source: The top half of the photo is from CNN's Beijing Bureau, showing the city in pollution on November 27, 2015, and the bottom half of the photo shows the blue sky the day before the pollution day) (*CNN News*, 2015)

Figure 1.5: Air Pollution in Shi Jiazhuang, Heibei Province

(Source: Photo by ChinaFotoPress/China FotoPress via Getty images)

Figure 1.6:Air Pollution in Hohot, Inner Mongolia on November 29

(Source: CNN News, 2016)

Figure 1.7: China Air Pollution Forecast for December 19-23, 2015

(Source: BBC News, 2015)

Figure 1.8: Chinese People Wearing Masks to Travel in Beijing
(Source: CNN News, 2015)

1.3.3 The United States and China Co-operate on Climate Change

In November, 2011, President Barack Obama and President Xi Jinping met and committed to an agreement that both these two countries would implement climate policies, decrease carbon consumption, and promote sustainable development (U.S.-China Joint Presidential Statement on Climate Change, 2015). The United States committed to decrease carbon dioxide emissions to 32% below 2005 levels by 2030, and China promised to reduce carbon dioxide emissions and increase forest land by about 4.5 billion cubic meters to the 2005 level by 2030 (U.S.-China Joint Presidential Statement on Climate Change, 2015). In reality, the cooperation had started earlier than 2014, when the United States Environmental Protection Agency (EPA) published progress of U.S co-operation with China since 2010 (EPA Collaboration with China, 2015). Indeed, the EPA helped China to reform environmental policies in a fifth meeting in November 2015 (EPA Collaboration with China, 2015).

Of these two countries, the United States has a longer history of dealing with air pollution than China. The U.S. Clean Air Act was established in 1930 and revised in 1977 and 1990 (EPA Collaboration with China, 2015). Meanwhile, China's current air pollution law only passed in 1987; however, the revision of 2000 did not address

the country's increasing economic growth (China drafts new law to fight air pollution: Xinhua, 2014). The newest version became operational on the first day of 2016, but it has only 129 regulations and policies in eight chapters, which is less than the content of the Clean Air Act (Legislative Affairs Office of the State Council P.R. China, 2016). Therefore, this research aims to study China's and other countries' air pollution policies and make some recommendations for the next version of China's air pollution law.

1.3.4 Study Site

This section introduces China, and particular the study site, Jing-Jin-Ji

1.3.4.1 China

China is officially called People's Republic of China (PRC), a one-party state governed by the Communist Party. It is located in East Asia, and the capital city is Beijing (Figure 1.9). The total population of China is about 1.41 billion (Worldmeters, 2016), while China's land area is about 9.6 million square kilometers, divided into 23 provinces, five autonomous regions, four direct-controlled municipalities (Beijing, Tianjin, Shanghai and Chongqing), two mostly self-governing special administrative regions (Hongkong and Macau), and Taiwan by claimed sovereignty (The State Council: The People's Republic of China, 2016), although this is a contentious political issue.

China's politics is different from that of other developed countries, and it is more complicated than capitalist-based politics. China was a capitalist country from 1912 to 1949 (Tien, 1991), but after 1949, Mao as the first president of PRC ruled as its one party governor (The Chinese people have stood up, 2009). In 1976, Deng Xiaoping took power and instituted a new measure called open market to stimulate the Chinese economy (Harding, 1990). The new policy has helped China develop a lot. However, with such a fast rate of growth, China has not had time to perfect any system to regulate industrial effects on the environment. Since China has such a large population, public meetings or diverse opinions such as those that western countries have are not functionally ideal. Instead, the government makes all the rules and laws,

so public participation is weaker than in developed countries, contributing to a lack of knowledge of environmental pollution.

Figure 1.9: Map of China

(Source: China, Operation World, 2016)

1.3.4.2 Jing-Jin-Ji (Beijing Metropolitan Area)

Since China's policy-making is different from that of other countries, and air pollution is a serious problem in China, the research area should focus on the entire country, but particularly the Beijing Metropolitan Area.

The Beijing Metropolitan Area is composed of the capital of Beijing, one of the four direct-controlled municipalities cities, Tianjin, and Hebei Province. Officially, the whole metropolitan area is called Jing-Jin-Ji. ("Jing" for Beijing, "Jin" for Tianjin and "Ji", the traditional name for Hebei Province) (Johnson, 2015) (Figure 1.10). The region is the national capital of China, as well as the biggest urbanized region in Northern China, along the coast of the Bohai Sea (Johnson, 2015). This emerging powerhouse is beginning to rival the Pearl River Delta in the south and the Yangtze River Delta in the east (Johnson, 2015). The total area is 82,000 square miles, about

the size of Kansas, and it contains more than a third of the population of the United States (Johnson, 2015), about 130 million (Johnson, 2015). As one of the most populous city in the world, Beijing has many cars, which would be one cause of air pollution. Next, Tianjin is a historical industry city in China, while Hebei Province is the center of one of two major industrial regions in China. The province developed from a modest industrial base from the late 19th century onward, chiefly in coal, iron, textiles, and indigenous goods (Hebei, 2015). Hebei's economy is largely dominated by iron and steel manufacturing, having consolidated the steel industry, and the economy is likely to increase its growth (Hebei, 2015). Clearly, overall, the region has many industries that would cause air pollution.

Figure 1.10: The Location of Jing-Jin-Ji
(Source: The New York Times, 2015)

2 Methodology

This chapter provides analysis methodology and discusses creation and distribution of the survey used to gather and examine Chinese public opinion of air pollution: The first section of this chapter addresses the details of the survey; the second section goes into depth about the social media-based method of distributing the survey; the third section covers the analysis techniques; and the last section clarifies how to use ArcGIS to analyze the spatial distribution of the survey (Figure 2.1).

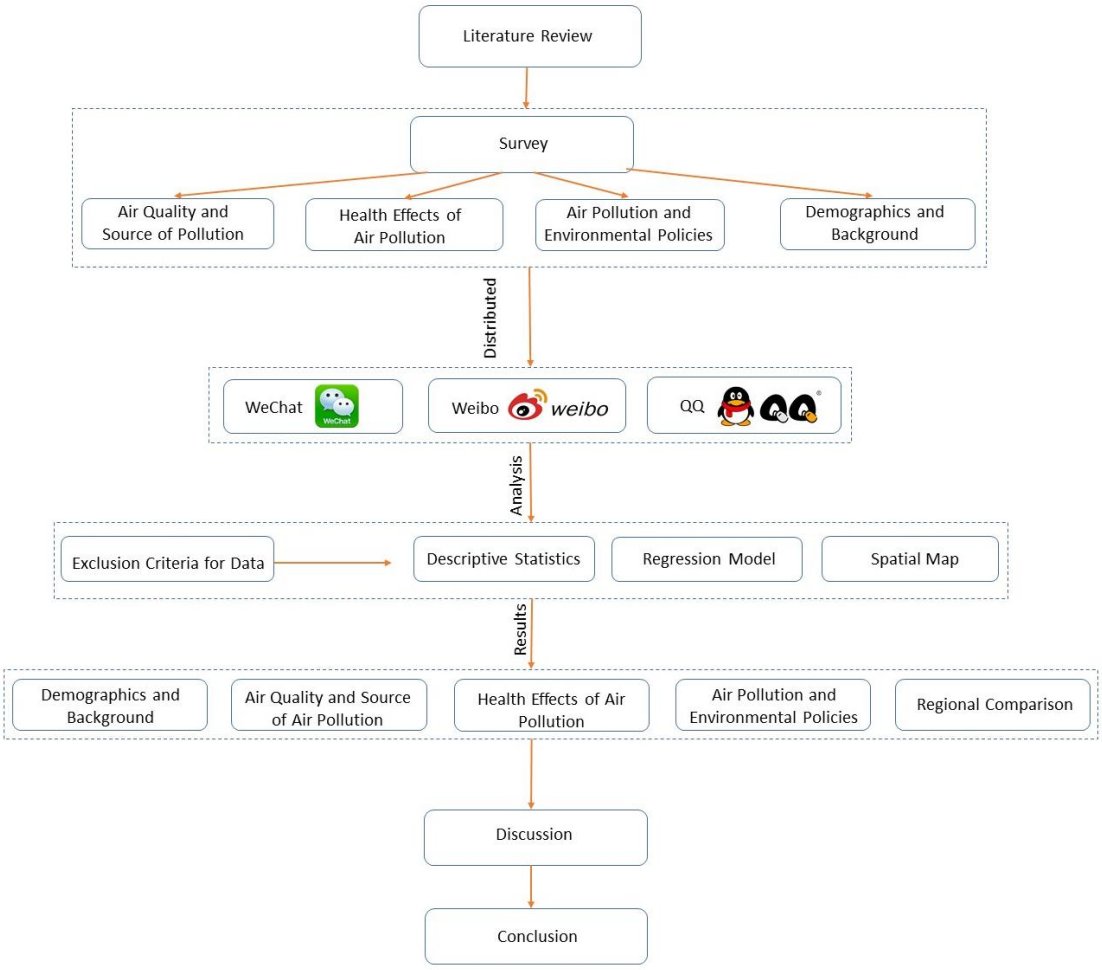

Figure 2.1: Flow Chart of Research Design

2.1 Survey

Public perspective regarding air pollution should represent local residents as they would be in the best position to experience it and judge the changing conditions (Birckerstaff & Walker, 2001). Because using them as participants would provide the most noteworthy data to add to the report, a survey of local people would be an excellent way to learn and understand their opinions (Bickerstaff & Walker, 2001). To support this approach, a study of environmental quality in Los Angeles County, by Pendleton, Martin and Webster used a survey to investigate local residents' opinions about local environment regarding both water and air quality (Pendleton, Martin & Webster, 2001). Also, in research in Northeast England, researchers carried out a survey of five neighborhoods to study the relationship between air pollution and public health because of the high population of these neighborhoods. In these cases, a survey made it easy to collect and analyze data about participants' personal information and their opinions (Howel et al., 2003). Thus, both of these research projects used a survey as their main methodology to study the perception of public health and air pollution. With the research being oriented toward similar topics, a survey would be the best method to gather information about the public's perspective on health and air pollution in the Beijing metropolitan area. The survey would benefit the proposed research greatly by clarifying the public's opinion about air pollution and local public health. The survey was created in English first then translated into Mandarin Chinese (the Appendix contains both English and Chinese versions), and then published online by Kansas State University's Qualtrics system. A consent form was translated into Chinese and attached to the beginning of the survey to offer the participants a general summary of the project. The survey was designed to be completed in only 10-15 minutes, encouraging more participation as well as a higher completion rate, making the data more valid and complete. However, a few responses gave feedback that the survey only needed 5-10 minutes to complete. The survey was anonymous to allow the participants to answer honestly without fear of scrutiny, yielding more valid demographics and background data. When participants completed the survey, they were allowed to skip any questions that they did not want to answer; for example, some people did not want to give personal information at the end of the

demographics and background section. This approach would help eliminate erroneous data that was only given because it was required. One criterion for inclusion in the survey was that participants be adults, which in China is 18 years or older. Thus, an exclusion criterion would be anyone under 18 and/or anyone who could not use a computer or smartphone to respond to the online survey.

The primary sample data was collected through an online survey, which yielded 889 completed responses between December of 2015 and January of 2016. The survey was composed of four different sections: Demographics and Background, Air Quality and source of Pollution, Health Effects of Air Pollution, and Air Pollution Environmental Policies. Each section had a different number of questions, and used a variety of question types, such as multiple choice, slider bars, check boxes, and open-ended questions. The sample population was drawn from residents of the Beijing Metropolitan area, but the survey could have been taken by anyone from any geographic location in China. The study focused on this particular area for it was one of the first to raise a "Red Alert" because of air pollution. Social media was used to distribute the survey to the participants via three outlets: WeChat, Weibo, and QQ. These particular social media are widely used by a diverse population in China. The contacts came from the researcher's friends and colleagues and spread to others using the sharing features of these social media networks.

The research collected participants' ratings of how they perceived air quality and what they believed to be the sources of air pollution. The study also collected respondents' ratings of how air pollution is affecting public health as well as the types of disease possible with such pollution levels. Moreover, the survey collected responses regarding the participants' perception of policies to reduce air pollution and their attitudes toward existing air pollution policies. In the last section of demographics and background, the survey asked for gender, age, income, home and work postal code, and employment status as well as employment type. However, the survey did not collect any names, IPs, IDs, or e-mail addresses that could possibly compromise the anonymity of the participants. Again, this was to ensure that the participants felt comfortable and secure in answering all questions fully and honestly.

2.1.1 Demographics and Background

The research survey strategically placed the demographics and background section at the end hoping to encourage people to feel comfortable answering questions honestly. However, analysis of this section began first to determine population characteristics. The demographics and background of survey participants are important to help the research avoid biased data that could compromise the results. It was also important to help the survey target a wide demographic group to ensure the data was diverse enough to more fully represent the actual population. Any populated area has a mix of different levels of income, education and employment, which means it was important to understand all of the participants to better analyze the results of the survey data. Thus, this section had 11 questions, and the following information assesses the importance of each question.

The first three questions asked the participants their age, gender, and annual household income to ensure a wide variety of participants; this would help avoid any biases arising from surveying only a narrow range of people. If the survey was completed by only one type or group of people, that data would be dismissed invalid and force a new distribution method. Also, getting a range of ages was very important to ensure data came from participants in all stages of life. For example, younger participants may not have been exposed to the effects of pollution for as long as some older participants. This information could also help clarify how different age groups view current policies and reveal the mindset toward pollution. Meanwhile, household income would show the various economic classes of participants. People with varied income levels may be affected in different ways by air pollution, depending on how they are able to cope with air pollution. Ultimately, these three questions, would ensure a wide variety of participants to well represent the actual Chinese population.

The next four questions asked for two postal codes, the number of cars per household, and transportation mode. The postal codes for home and work would facilitate a GIS map to study spatial relationships between the collected data and air pollution. Next, knowing the number of cars would help determine the relationship between the use of motor vehicles and air pollution. Finally, the transportation mode question would

elicit how many people drive a car to work or take public transportation. All this data would permit better understanding of the relationship between transportation variables and motor vehicle control policies.

The last four questions were about education and employment. The education question aimed to find out the educational background of participants, while employment status would show how many people were employed or unemployed; this data could be compared to the national unemployment rate to see if the data correlates with the current unemployment rate. Moreover, China has five different employer types, which could reveal the relationship between employer type and worker perception of air pollution. The project was useful for determining if different types of employment affect how people currently view air pollution. The last question was about area of expertise, which was important because the more people who participated in the survey from different fields, the better the research could yield information to represent what most Chinese people think of air pollution.

In summary, demographics and background information clearly was important to this survey's purpose to clarify public opinions as well as clarify how people were affected by air pollution. Finally, the survey's focus on transportation-based questions was intended to yield data possibly for future air pollutions studies.

2.1.2 Air Quality and Source of Pollution

With this set of questions, the research aimed to determine what the participants think of current air quality and the sources of most of the pollution. This data could also help to pinpoint where the participants may be more or less educated about the effects of air quality and about what sources are causing the most air pollution. Thus, this section had three to four questions. If people think motor vehicles are a source of air pollution, they would have needed to answer one more question about how they think motor vehicles affect air pollution. The following addresses each survey question and its justification.

In 2015, China was blighted by numerous new air pollution problems, so determining how the public perceives air pollution in their current city of residence compared to in 2014 was important. Therefore, the survey asked the following question: *How would you rate the overall air quality in your city now, compared with last year?* The purpose of this question was to evaluable if current residents of this area, and therefore the public at large, were seeing any significant change in a short amount of time. Also responses to the question possibly could be correlated with the many comments on social media about the effects of the growing population. From 1990 to 2003, the urban population increased 10%, which, for most cities in China could be considered to be urbanization, and consequently, energy consumption would also have increased (Hao & Wang, 2012). So, this data would enable thorough analysis of the public's opinions and permit tabulation of the public's complaints to determine if a majority of the public does see a decline in air quality over time because of air pollution.

Based on prior research of typical activities that increase air pollution, the following question was designed to gather specific responses to the opinion of pollution in the city: *How much do you believe each of the following activities affects air pollution in your city*? Since China has experienced economic growth, construction and industry likely would be factors affecting air pollution, especially construction materials as they impact the environment (Cole & Rousseau, 1992). Moreover, air pollution would be higher in an industrial town than a rural one, logically (Samet et al., 2000). Also, motor vehicles could be a major source of air pollution (Faiz et al., 1996). Next, heating systems in China are different from those in the U.S; some heating systems are burned by coal, and China is a major consumer, globally, of coal (Moriske, 1996). In addition, power plants generate energy for about one third of heating systems (Streets & Waldhoff, 2000) and so could emit air pollutants (Hao et al., 2005). Finally, burning waste would also be a source of air pollution because of emissions (Afroz et al., 2003).

This particular question had seven choices and used slider bars for respondents to rank their responses from none to very high (the scale was quantitative, ranging from

0 – 100; participants were not presented with specific values). People could choose more than one variable to respond to and drag slider bars to any point to rate them. Any of the seven choices might be typical sources of air pollution, and depending on the responses, the data could help determine which one the public perceives as most important.

Only If participants chose motor vehicles as one of the major air pollution sources would they then need to answer this question: *How much do you believe each of the following traffic-related circumstances affects air pollution in your city*? This was designed to ask why the participants believe motor vehicles are a major source of air pollution. Given that people are surrounded by any number of possible polluting mechanisms, giving respondents the chance to assemble such mechanisms would likely result in more dependable data. Nonetheless, vehicles in particular are known to cause pollution. According to a research paper, when motor vehicles aggregate in a traffic jam, the burning energy and emissions threaten human health and also increase concentrations of O_2, CO_2 and CO (Bari & Naser, 2005). However, not only traffic jams can cause air pollution; also, poor quality of fuel could decrease air quality, adding contaminants, and thereby increasing the concentration of air pollutants (Smith, 1993). Therefore, poor vehicle emissions control is another important factor influencing air quality. In support of this claim, Rank's research in Copenhagen found that if an old car's emission control was not updated that car would emit more air pollutants than would a newer vehicle (Rank, 2001), providing a good basis for assuming the same in China. In fact, based on the likelihood that vehicle fuel combustion contributes to climate change and global resource shortage (Kley, Lerch & Dallinger, 2011) as well as air pollution, the Chinese government did a lot of research on alternative energy cars and subsequently approved a ruling that 50% of cars on sale in 2010 had to run on alternative fuels (Gong, H. Wang, & M. Wang, 2012). Additionally, slow average travel speed can cause air pollution, and according to Wall Street Journal reports, Beijing's average travel speed was the lowest of that of other world cities; thus, when vehicles start and stop, they emit more gas which would decrease air quality (Guilford, 2014). Also, China had by then the largest automobile market in the world with 18 million automobiles sold in 2010 (Chen &

Zhao, 2013), undoubtedly increasing air pollution (Pucher et al., 2007). Again, then, as older vehicles would influence air quality, so testing them would be significant. Ultimately, these options might represent solutions to some of the major problems of motor vehicles as one air pollution source, but specifically, answers to this question could help supplement the research with information about the perception of the public's opinion on the subject.

The main study area, Jing-Jin-Ji, was established before the survey went out to the Chinese public. This is relevant as Hebei Province is a major industrial province in the area and the most polluted province in China. During the 2008 Olympic Games, for example, Hebei province emitted considerable air pollutants dispersed by sustained wind from the south to Beijing (Streets et al., 2007). Based on such research, this next question sought information on participants' perception of the geographic origination of the most prolific pollution: *Indicate where you believe most air pollution where you live is coming from.* This question also used slider bars and an invisible score range (From 0 to 100 with 0 representing a response totally from inside city and 100 representing a response totally from outside the city) to allow participants to judge. The advantage of the slider bar was that it supplied statistical data to analyze how many people think air pollution was not from inside or outside the city.

2.1.3 Health Effects of Air Pollution

This section focused on clarifying how the participants' health is being affected by the air quality and pollution levels. The purpose of the questions in this section was to get first-hand information on what kind of health effects were experienced in the last year due to air pollution. The three questions in the survey are followed by justification of these questions.

Many studies have investigated how air pollution influences public health (Brunekreef & Holgate, 2002) and how air pollutants in particular influence mortality and morbidity (Kunzli et al., 2000). Based on this reasoning, the research sought to clarify the effects of air pollution by asking this question: *Has air pollution affected*

your health in the last year? This question was designed to ask participants whether or not they feel air pollution has affected their health. Also, the question was set up to include a logic function; thus, if a participant chose "No" or "Unknown", meaning they did not feel air pollution had affected their health, they would not see the subsequent redundant two questions.

However, if respondents answered "Yes" to the first question, they would see this conditional question: *To what extent has air pollution affected your health in the last year?* The question used slider bars and an invisible score from 0 to 100 (with 0 representing very little effect, and 100 representing very significant effect) to allow the participant to register how much they feel air pollution has been harmful to their health.

Again, if people answered "Yes" to the first question, they would also see this conditional question: *In which of the following ways were you affected?* This question was followed by specific health effects for the participants to select. The question is rooted in finding out ailments and symptoms in China that have proven in the literature to correlate with air pollution. Some researchers connect air pollution with breathlessness, asthma, chest tightness or chronic cough (Zemp et al., 1999). Also, a study found children had asthma, wheezing, and breathlessness during the day of air pollution in Taiyuan, China (Zhao et al., 2008). Moreover, increasing rates of lung cancer might be associated with air pollutants (Cohen & Pope, 1995). Another study of the human brain showed that neurological impairment might be related to air pollution (Calderón-Garcidueñas et al., 2004). In addition to these ailments, participants also could choose from others and write about how they feel air pollution has harmed them. While the question may not fully represent every air pollution causing disease or the way disease compromises respondents, individually, responses would provide an idea of how participants feel regarding the danger of air pollution.

2.1.4 Air Pollution and Environmental Policies

This section had six short answer questions and one open-ended question, which aimed to determine public perception regarding air pollution policies. In the past few

years, China has taken some measures to deal with air pollution, so this section would provide data to evaluate what Chinese people think of these polices, especially China's Air Act, which was revised and instituted on Jan 1st, 2016.

The first question of this section attempted to assess how respondents reviewed government policies and civilian methods to reduce air pollution: *How much of a problem are each of the following for reducing air pollution?* The question used slider bars to easily generate descriptive statistics for future study and offered seven choices grounded in environmental protection, by both government and citizens. This is because many published policy sources suggest that the laws and policies for managing the environment are important for reducing air pollution (Chan et al., 1995) and to protect citizens as is citizen engagement. As the first chapter stated, China has already invested money in technologies to reduce air pollution (Fang, Chan &Yao, 2009); therefore, this question sought to determine whether or not the public knows about such government investment. Since China is growing more quickly than it was particularly, the structure of the national economy would be important, and as China has a one party government, oversight would be the party's responsibility. The nexus of what China is doing about air pollution and its citizens' understanding of such policy is evident in the newly issued red alerts. Clearly, the education of citizens and citizen engagement were significant in helping the country reduce air pollution, and of particular concern regarding citizen accountability is car ownership.

China is a rapidly growing, urbanizing country, and so the ownership of cars has increased a lot since economic reform (Feng & Li, 2013); specifically, the number of motor vehicles owned in Beijing in 2010 was 4.8 million (Chen & Zhao, 2013). In January 2011, Beijing began to restrict the ownership of cars, implementing the policy of buying a car through lottery to help the city reduce air pollution by restricting the number of people who could drive. In January 2014, the policy was extended to another three cities in China: Shanghai, Guangzhou, and Guiyang (Yang et al., 2014). Based on this trend, the survey asked this question: *Do you agree or disagree with the lottery purchasing policy to help reduce air pollution?* This question inquired about what the public thinks of the policy given that some people

would buy cars on the black market (Yang et al., 2014). For example, if people bought a car plate for about 120,000 yuan, it could sell at 200,000 yuan (Song, 2014). Based on responses to the question, then, if people generally disagree with the lottery, future research could address what kind of policy may instead be acceptable.

Digging deeper into the issue, the next question addressed the first driving restriction policy aimed to control traffic flow on the road that has helped Beijing reduce air pollution (Wang, Xu & Qin, 2014). The question sought the opinions of citizens about the policy: *Do you agree or disagree with the policy to use tag numbers to help reduce air pollution?* In addition to Jing-Jin-Ji, this survey went to the Beijing Metropolitan Area to generate results to compare with data from the last question to determine whether or not people like the policy.

The next question sought to determine public knowledge of and reaction to the Air Act: *China's Air Act began in 1987 and was revised in 2015. The current version will start to operate on Jan 1st, 2016. Do you think China's current Air Act needs to be revised further?* The question was designed to elicit a general idea about the public's knowledge of the law and if they know the law, what they think of it. The last choice of the question offered respondents the chance to write an open-ended response to how they feel about air pollution policy and why they may not think it is adequate.

Next, the survey addressed how seriously the public considers air pollution policy violation. This next question asked about the level of concern a respondent might have about policy violation: *If you saw a company or person violating policy and causing air pollution, would you report them to the government?* The question came from the Chinese government's survey about helping the government to revise the new air pollution Law. If respondents would report an air pollution violation, this would suggest how much people care about it. However, if people chose to report just because of rewards, this would mean they likely care about air pollution, not for any intrinsic value, but rather to be rewarded. Answers to this question would provide another perspective about the education of the public with respect to air pollution.

Since the 1980s, China has tried to deal with the balance between sustainable development and protecting the environment (Zhang & Wen, 2008). However, some people may think China should develop the economy first and then deal with environmental problems. However, since air pollution has become a serious and spreading problem, clearly, the government needs to do more to protect the environment. Therefore, this question asked for public perception of the situation: *Do you agree or disagree with the following statement: "develop the economy first, then deal with air pollution."*

This open-ended question allowed people to write at length about what they thought was really important to reduce air pollution. However, to reduce time to take the survey, the question offered only typical, selective, policy questions. The final question in this section encouraged the respondent to state additional obstacles to preventing pollution: *Are there any other problems that you believe limit the methods to reduce of air pollution?*

2.2 Distribution of Survey through Social Media

Technology, and especially social media, is a convenient method for distributing a survey. In China, WeChat, Weibo and QQ are popular social media, and have millions of users. This section discusses what these three social media are and how they were used to distribute the survey.

2.2.1 WeChat

WeChat is a popular Chinese mobile app that allows people to text message or voice message (Lien & Cao, 2014) (Figure 2.2). WeChat has 549 million users every month (Kosoff, 2015) and is widely used by Chinese people. Therefore, with a short description the survey was sent to a survey link WeChat via the researcher's contact list, which included friends and colleagues, who were then asked to take the survey and convey it to their friends and colleagues (Figure 2.3 and Figure 2.6). The following figures are screen captures showing how WeChat works for the survey; note that these figures use mosaics over the username to protect personal information.

Specifically, the survey went to a WeChat group of about 36 people. The contact list included the investigator's school classmates one of whom had a group of 36 people who received the survey (Figure 2.4 & Figure 2.5). This way, the survey was distributed. The content of the message was this: "The students and professors from Kansas State University are studying air pollution in China and the perception effect on public health. The purpose of the research is to help reduce air pollution in China by studying guidelines from the United States Clean Air Act. The survey only takes 10-15 minutes, and your response will be significant for the research. Thank you for your participation! After you finish the survey, please forward it to your family members, friends, and co-workers! Thanks again!" After reading this statement, the participant could click on the survey link.

Figure 2.2: WeChat App logo

(Source: logo design by Tencent Holdings Limited) (Business of Apps)

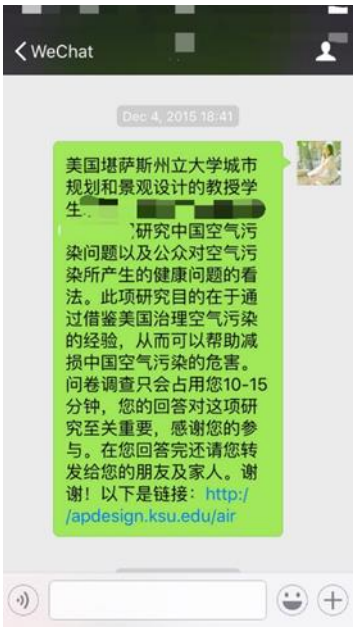

Figure 2.3: Sending the Link to Someone

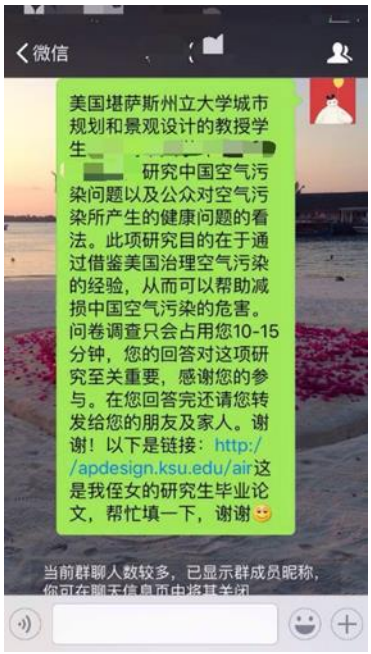

Figure 2.4: Someone Sending the Link to A

Individually

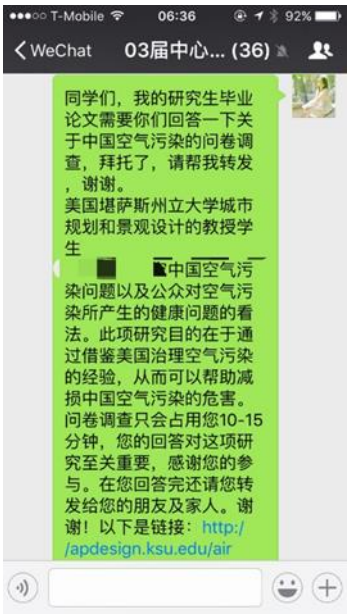

Figure 2.5: The Researcher Sending the Link to A Group Chat

Group Chat

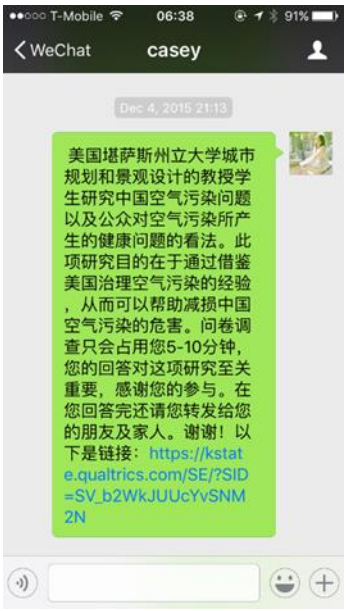

Figure 2.6: The Researcher Sending the Link to Someone Individually

2.2.2 Weibo

Weibo is another popular mobile app or site in China, and it looks like Facebook and Twitter (Figure 2.7). This approach first introduced the survey with a short statement and link posted in the author's account, and then posted it in two places: on some account pages of people who care about air pollution and in the author's personal account because it has 131 followers (before the researcher realized most of these followers are friends who might already have received the link via WeChat). Second, the investigator started to research "Beijing air pollution" in Weibo (Figure 2.11) to learn more about regional air pollution, and about air pollution in China overall (Figure 2.12 &Figure 2.11), and to see what many people had posted about the topic. When some opinions that had a lot of replies appeared, the investigator posted the statement about the survey and link to one of those replies. An interested person could then ask for information about the survey and be asked to forward the survey (Figure 2.8 &Figure 2.9). Weibo limits the number of words possible, so only a short introduction of the project was possible to clarify the survey was not spam: "Hello, I

am a master's student at Kansas State University. Our university's professors and students are studying air pollution in China and the perception of public health affected by air pollution. The survey needs only 5-10 minutes of your time, and your response is significant to our study. Thank you for participating! After you finish the survey, please forward it to others. Thanks again"! Figure 2.11 and Figure 2.12 show how many people read, discussed and followed the topic. #Beijing Air Pollution# had 220 million read about the topic, 141 thousand discuss it, and 4,448 follow it. Meanwhile, #Air Pollution# had 120 million read about the topic, 353 thousand discuss it and 190 follow it. Judging by these data, if the investigator wanted to find others really interested in the topic of air pollution, it would be easy to get more responses.

Figure 2.7: Weibo Logo

(Source: photo credit by bfishadow, Forbes Asia, 2014)

Figure 2.8: Someone Likes the Reply Post

Figure 2.9:Someone Replies to the Post and Gives Their Opinions

Figure 2.10: How to Search the Topic in Weibo

Figure 2.11: Search for "Beijing Air Pollution"

Figure 2.12: Search for "Air Pollution"

2.2.3 QQ

QQ is another popular social utility in China (Figure 2.13), equal to messenger in the U.S. In January 2015, there were 829 million QQ accounts (Tencent, 2014). However, even though QQ has many users, most of the investigator's contacts are the same as for WeChat. Therefore, the investigator sent the survey link to only a few friends who do not have WeChat or Weibo, but they have not replied yet (Figure 2.14). Then the investigator searched some group chats in QQ, restricting the criteria to people living in Beijing, Tianjin, and Hebei province. However, showing how to spread the survey was not possible because the investigator was removed from the group chat when some people thought the survey was an advertisement or spam. Ultimately, even though QQ might not offer a useful way to spread the survey because the investigator was blocked from the group, still, the posted message could be seen by others, and some of them could have been interested in taking the survey.

Figure 2.13: The QQ Logo and Frame
(Source: photo credit by Tom Clark, 2009)

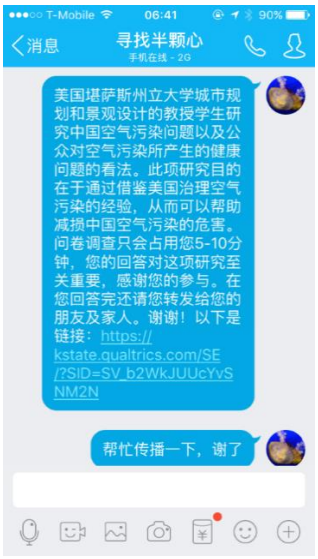

Figure 2.14: Researcher Sent Post to Someone On Contact List in QQ

2.3 Analysis Techniques

With the data collected from the survey, three analysis techniques were used: excluding data criteria, descriptive statistics, and regression model. The survey generated 889 responses; however, good analysis requires high quality data, so it was necessary to selectively exclude suspect data from the entire batch. After removing poor responses, we could use descriptive statistics to analyze remaining data in different ways, as well as make it easier to compare elements in each question. The following section addresses how criteria excluded responses to get at select data and also discusses how descriptive statistics works.

2.3.1 Exclusion Criteria for Data

Three exclusion criteria in particular help researchers to winnow all data to only select, representative data. First, if people took the survey in less than two minutes, their data is suspect. Second, if people did not answer the first two questions, this indicates people who may not have completed the survey. Third, when people chose more than five responses of 100 or 0 or left questions blank that had slider bars, that data reflects people perhaps not thinking of each choice carefully enough. Ultimately, removing any such suspect data would make the remaining data much more useful.

2.3.2 Descriptive Statistics

Next, the selected data was analyzed by various methods: population pyramid, bar chart, pie chart, histogram, and descriptive statistics. A population pyramid would show different ages of males and females by gender, while bar charts and pie charts would show the percentage of each element in the total population. Also, for the four questions that used slider bars from 0 to 100 to rate how much people were affected by air pollution, Microsoft Excel analyzed that data by way of descriptive statistics. The resulting table identifies mean, standard error, median, mode, standard deviation, sample variance, Kurtosis, Skewness, Range, Minimum, Maximum, Sum, Count, and Confidence Level (95.0%). After generating the descriptive table, Microsoft Excel used scatter plot and error bar to plot the error of mean in each choice, to elicit the most significant choice compared with the others.

2.3.3 Regression Model

To the results from descriptive statistics, Excel data analysis of regression was applied to test which two variables had the most significant relationship according to a simple regression model. The model consists of regression information and residuals. The significant F represents the test of hypothesis between two variables, in this case based on a set 95% confidence level, so if the significant F value was less than 0.05, this would mean that the two variables are significant; however, if the value of significant F was bigger than 0.05, this means the two variables are insignificant. Next, if one question used slider bars and had seven different variables, ANOVA would only consider one variable in that question and another variable in another question, for example, whether the number of cars owned correlated with driving alone. Therefore, the ANOVA table not only helps define the value of the result, but it also could generate questions for the discussion chapter.

2.3.4 Spatial Map

The study collected information about postal codes for the workplace and for the home in the section on demographics and background. This data was used to create a

map of where people lived and then to separate them into different regions for a comparative analysis. Basic geospatial information about postal codes in China is very difficult to acquire due to the country's security protocol, and because of lack of funding to purchase data. Thus, the study used the Google Maps API to lookup the spatial location for each postal code provided, which then returned the coordinates for each postal code. These coordinates were then converted to point data in ArcGIS. With this data, individual location and groups were easier to recognize and then cluster into different regions.

3 Results

Of the initial 889 responses, 473 were deleted for not meeting the three stated criteria, leaving 416 responses available for analysis. Of these responses, some did not complete all questions, but the data they did provide are still useful for analysis with respect to some of the earlier questions in the survey. In this chapter, where there are different sample sizes, the exclusion criteria and sample size are stated. The results are described in the following five sections: demographics and background, air quality and source of air pollution, health effects of air pollution, air pollution and environmental policies, regional comparison. The first four sections aggregate all responses together, while the fifth section analysis also uses geographic area to differentiate groups and then compares those groups according to how regions rated air quality and transportation policies.

3.1 Demographics and Background

This section presents data about gender, age, annual household income, education level, employment status, employer type, and area of expertise. Specifically, the section covers analysis of responses for each question related to these characteristics.

3.1.1.1 Gender and Age

Figure 3.1 shows the population pyramid for 384 participants who identified their gender orientation: 180 males and 204 females across all ages. The left side shows the age distribution of males, and the right shows females. The average age was 39, with a wide distribution across ages. Figure 3.3 shows that 184 people come from Tianjin, 32 people come from Beijing, 16 people live Hebei province, 12 from Shanghai, and 31 live in other cities in China. Currently, China's entire population comprises people mostly aged 24- 45 (China Age Structure, 2015) (Figure 3.2), which is fairly consistent with the age distribution in the sample from the survey. Compared to Figure 3.2, the sample population seems to correlate quite well with the entire population of China; however, in the sample, the number of people aged 40 to 49 is

larger than the number of people 25 to 35, perhaps because of the one child policy established in 1979, which curbed the population for ages 25-35 (Kuschk, 2011).

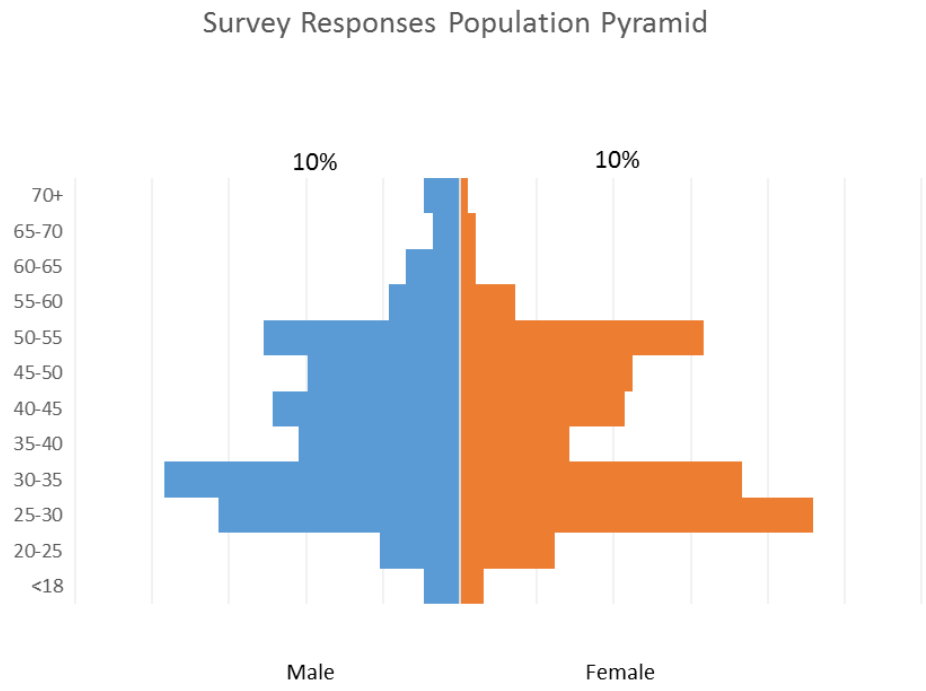

Figure 3.1: Survey Sample Population Pyramid

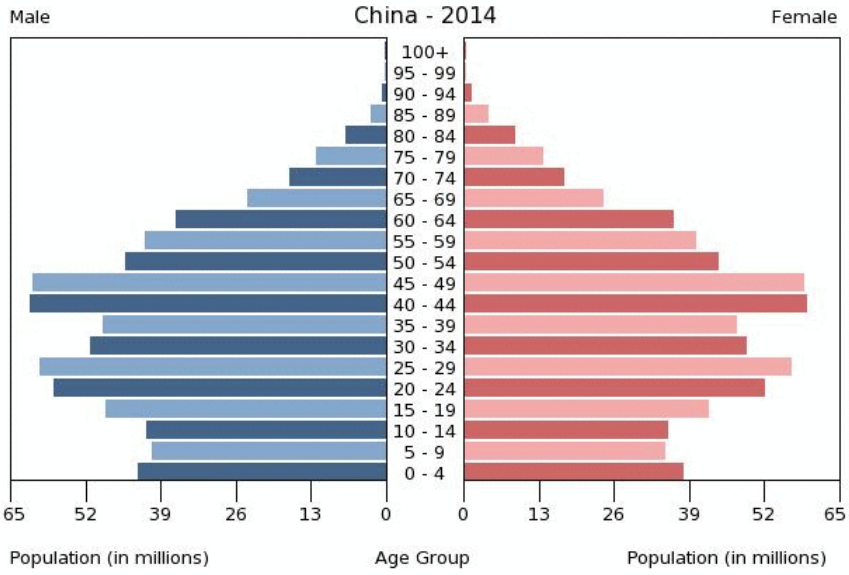

Figure 3.2: 2014 China's Total Population Pyramid

(Source: CIA World Factbook, 2015)

Figure 3.3: Spatial Map of the Survey Responses

3.1.1.2 Education

The total number of people in sample population who responded useful to the question regarding level of education was 381. Figure 3.4 shows 52% had a bachelor's degree; 19% had a masters/professional degree; 2% had a doctoral degree; 18% had an associate degree; 2% had primary education (up to grade 9), 3% had some high school; 3% completed high school; and 1% had trade/technical vocational training or a similar degree. It should be noted that China has a legal requirement of nine years of compulsory education resulting in is a high school diploma, and vocational school requires two or three years (Connelly & Zheng, 2003). The associate degree takes three years, and a bachelor degree requires four years while the master degree takes three years as does a PhD degree (Bauer et al., 1992). There is no official research to report the percentage of Chinese holding higher education diplomas; however, in 2013, TIME reported that 7 million college graduates would

seek jobs (Gu, 2013). Overall, Figure 3.4 shows that most people taking the survey had some sort of higher education.

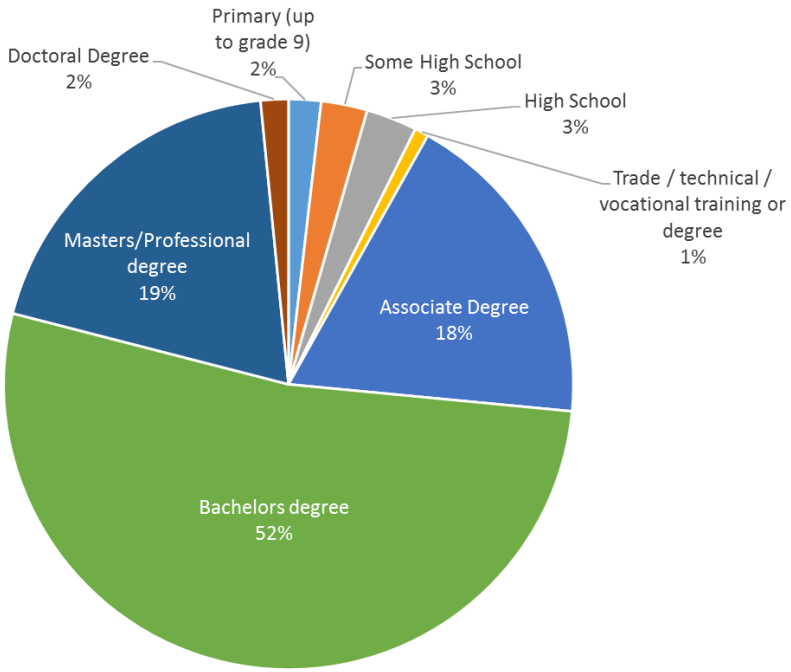

Figure 3.4: Education Pie Chart

3.1.1.3 Employment

The total population sample size for employment status, after exclusion criteria were applied, was 363 people (Figure 3.5). Of these, the three largest groups consist of the following: 70% employed for wages, 12% self-employed and 8% retired. Combined, all the responses indicated roughly a 6% unemployment rate, including students and those out of work but looking. This is similar to the reported unemployment rate of 4.7% for non-college graduates (Sharma, 2014).

Next, determining employer type helped determine what kind of organization respondents work for. For this question, 338 of the sample population were included in the analysis: 36.09% people were working in a private company; 6.21% people were working a foreign company; 3.55% people were working in government; 0.59% people were working in non-profit government; and 53.85% people were working in

a government company (Figure 3.6). Chinese firms can be divided into two basic types: first, there are international investment firms, called foreign companies; these international companies are usually run by other countries. Second, there are state-owned companies, such as those in the telecommunication, construction, and transportation sectors; largely private companies, some of them are run privately, but others are controlled by the Chinese government (Yu, 2012). Next to consider was area of expertise, occupation, and income. According to Figure 3.7 (the sample population was 363 after exclusion criteria), 30.11% people were working in construction, and 17.40% people were working in industry; this means most people who took the survey were certainly working in a state-owned company. A state-owned company can employ people in many sectors, but the majority of the respondents were working in construction, and 2.49% of people were working in transportation.

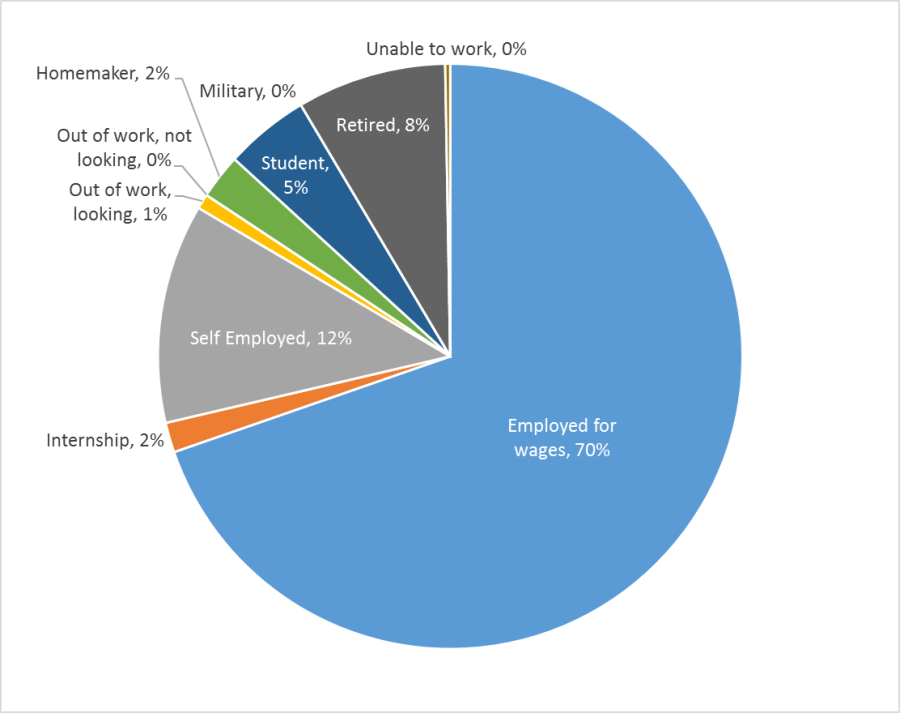

Figure 3.5: Employment Status Pie Chart

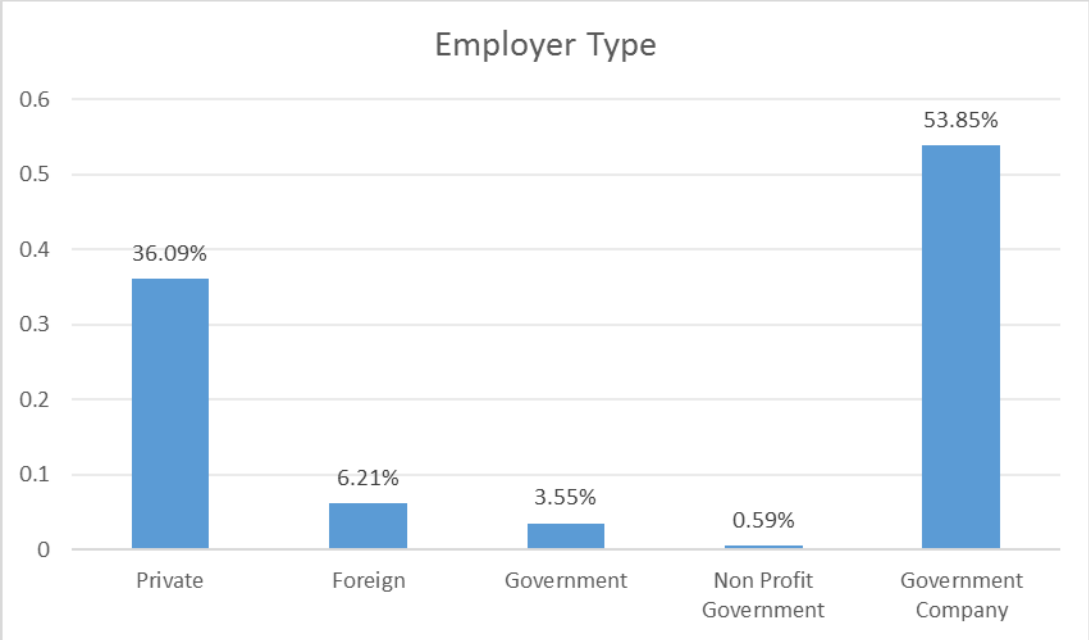

Figure 3.6: Employer Type

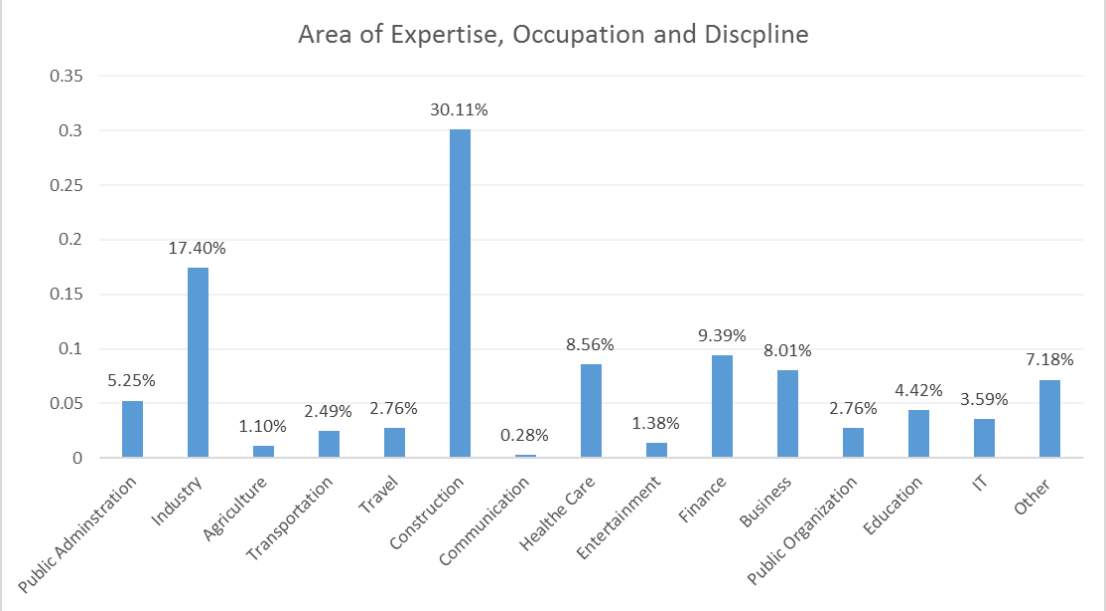

Figure 3.7: Area of Expertise, Occupation and Discipline

3.1.1.4 Income

The total sample population for this question, after exclusion criteria, was 379. The population was divided into seven different income levels and is shown in Figure 3.8 with yuan and the US dollar equivalent (all income is per year, per household). Specifically, less than 6% took in less than $3,000; 13% took in $3,000 to $6,000;

13% took in $6,000 to $9,000; 24% took in $9,000 to $15,000; 36% took in $15,000 to $77,000; 4% took in $77,000 to $154,000; and 4% took in more than $154,000. China's average annual income was $4,755 in 2012 (Kuo, 2014), and the upper middle class household income was $24,000 to $46,000 in 2015 (Wee, 2016). Therefore, compared with China's upper middle class income level, most respondents were in the middle-class or upper middle-class; moreover, only 6% of respondents had less than $3,000.

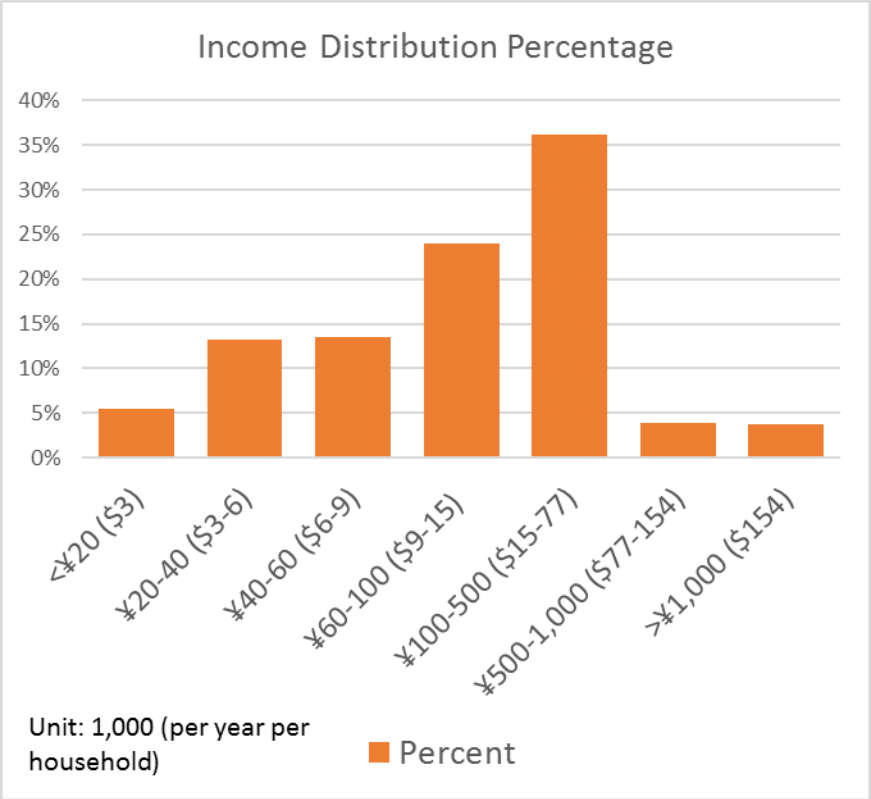

Figure 3.8: Income Distribution

3.2 Air Quality and Source of Air Pollution

Based on the results of the demographic data, most respondents had some higher education, were employed for wages, and lived an upper middle-class lifestyle. Thus, responses to questions about the perception of air quality and the source of air pollution in the following section may best represent the urban population. Moreover, the questions asked about the number of cars per household and transportation mode

are part of the traffic-related issue, which would show a relationship between motor vehicles and air pollution.

3.2.1 Air Quality and Source of Air Pollution

The total appropriate sample size for estimating the sources of air pollution was 411. This is one of the higher sample sizes, likely because it was the first question in the survey. Figure 3.9 shows that 26% of people believed air quality was much worse than in the previous year; 18% thought it was a little worse; and 33% felt it was the same. However, 22% felt conditions were a little better, and 1% thought they were much better. Overall, most people felt air quality was the same as for the previous year, but about 23% people felt air quality had improved. The distribution of results for and against changes in air pollution is fairly wide, but nearly ¾ of the sample indicated that pollution is the same or has gotten worse.

The next question related to air pollution asked respondents to indicate where they thought pollution was coming from (inside or outside their city). This a question yielded 336 good responses after exclusion criteria. Figure 3.10 shows that 28% of people agreed that about half of the source of air pollution comes from inside the city, and the half comes from outside the city. However, more than half of people believed that air pollution mainly came from inside the city. A regression model showed insignificant relationship between rated air quality and the source of air pollution, but these two variables both showed that most people do not believe air pollution comes totally from outside the city. Figure 3.9 showed 44% people felt air quality was worse than in the previous year, which suggests some realized that the city might have some polluted areas.

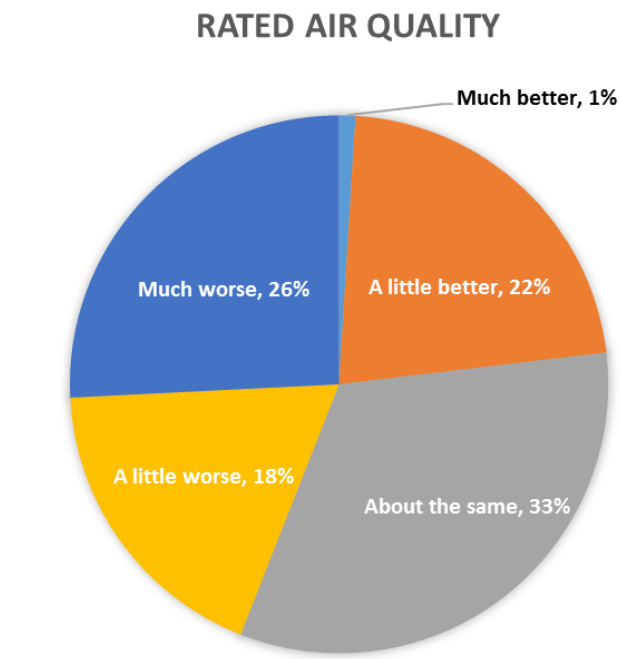

Figure 3.9: Rated Air Quality

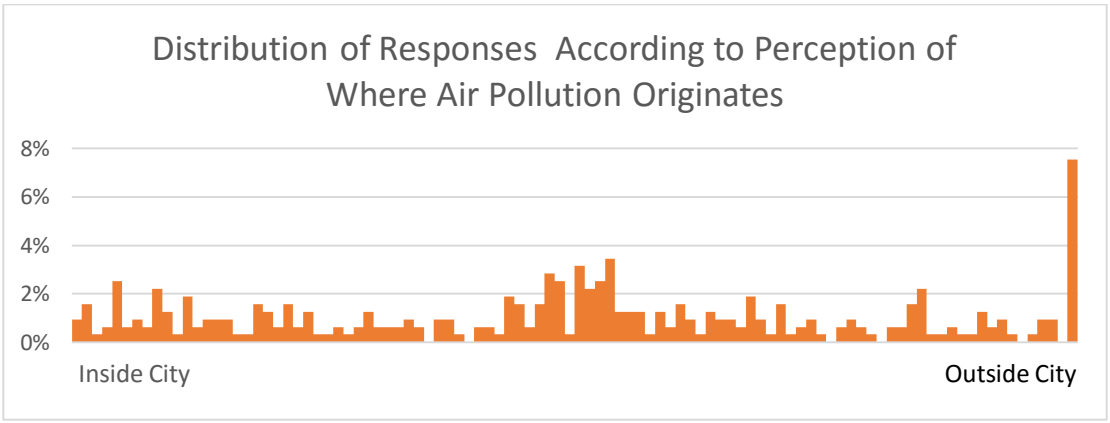

Figure 3.10: Perception of where Air Pollution Originates as Distribution

3.2.2 Activities That Affect Air Pollution

The number of people who responded appropriately to the question about the sources of air pollution was 416. Figure 3.11 shows the results with the confidence intervals (at 95%) for each source of pollution. The mean values are as follows: the mean for construction was 49.49; the mean for industrial manufacturing facilities was 57.27; the mean for motor vehicles was 59.37; the mean for general heating of homes was 35.70; the mean for burning waste was 37.86; the mean for dust and storms was 43.60; and the mean for power plants was 71.60 (see Table B.1). Apparently,

participants thought that power plants are the primary source of air pollution, followed by industrial manufacturing facilities and then motor vehicles (Figure 3.11). Participants thought that construction was the fourth most important factor in air pollution. Finally, general heating of home, burning of waste, and dust and sand storms were considered to be the least contributing factors affecting air pollution. In a research study conducted in Beijing, in 2008, the emissions of power plants affected air quality more than in 2000 (Hao et al., 2007). Moreover, from 2000 to 2005, the number of coal-fired power plants increased about 1.7 times (Zhao et al., 2008). Based on these two limited examples of research, the public's perception of the most significant cause of air pollution may be aligned with the measured cause of air pollution.

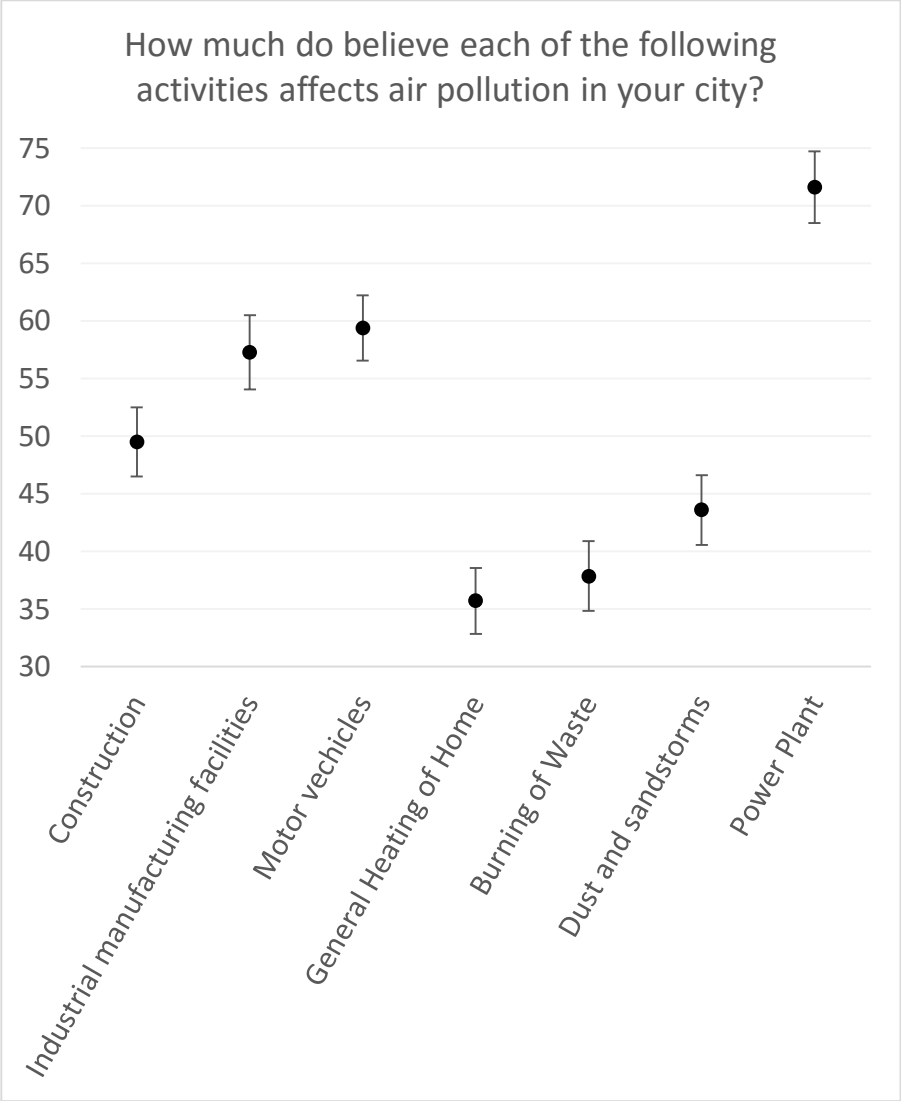

Figure 3.11: Activities' Influence on Air Pollution

3.2.3 Traffic-Related Circumstances that Affect Air Pollution

If respondents identified motor vehicles as a contributing factor to air pollution in the previous question, then they were asked a subsequent question related specifically to the aspects of motor vehicles that cause air pollution. The total number of appropriate respondents for this question was 366. Figure 3.12 shows respondent distribution with confidence intervals (at 95%). Several aspects were not indicated as strongly influencing air pollution: old cars that are not updated actively; it is not enough to advocate new energy cars; too much time is spent driving (number of kilometers); and weak testing for pollution from older vehicles. Respondents indicated that traffic

jams were the most significant cause of motor vehicle air pollution as well as poor quality of fuel, and weak emissions tests.

Figure 3.13 illustrates the number of cars respondents owned (*n* of 258). About half indicated that their household owns two cars; 20% of respondents have one car; no participant selected zero for number of cars in household. However, there were 152 missing responses in addition to the 258 respondents that did select the number of cars in their household. Therefore, it is possible that some or all of the 152 participants that did not select a value, chose so because they do not have a car in their household. Unfortunately, the question was not required on the survey, so these values cannot be determined. A study showed 58 vehicles per 1,000 persons in 2010, while the U.S had 804 vehicles per 1000 persons (Will China's Vehicle Population Grow Even Faster than Forecasted, 2012), and Wu's study predicted 200-300 vehicles per 1,000 persons in 2030 or later (Figure 3.14) (Wu, Zhao & Ou, 2014). This data did not align with the data collected in this survey even though the survey question asked how many cars there were per household, not per person. However, Figure 3.14 predicted there one car per household in future (Wu, Zhao & Ou, 2014). One might anticipate that a two-person household may thus own two cars. A regression model was conducted to determine any a relationship between the number of cars per household and the response to the belief that traffic jams were the largest contributor of air pollution for motor vehicles. The model yielded a significant relationship ($p < 0.00$, *see* Table 3.1).

Results indicated in Figure 3.12 also show most people think too many private cars is a major source of air pollution. Next, Figure 3.15 (*n* of 375) shows that most people either drive alone, use the subway, take the bus, or walk to work. A subsequent regression model revealed a statistically significant ($p < 0.00000$) effect of the relationship between the number of cars owned and the extent to which a person drives alone to work (Table 3.2). Some people indicated that they ride their bicycle to work, taxi or carpooled to work, and fewer indicated using the electric bicycle. Overall, most people indicated that they prefer driving alone or taking the bus to work.

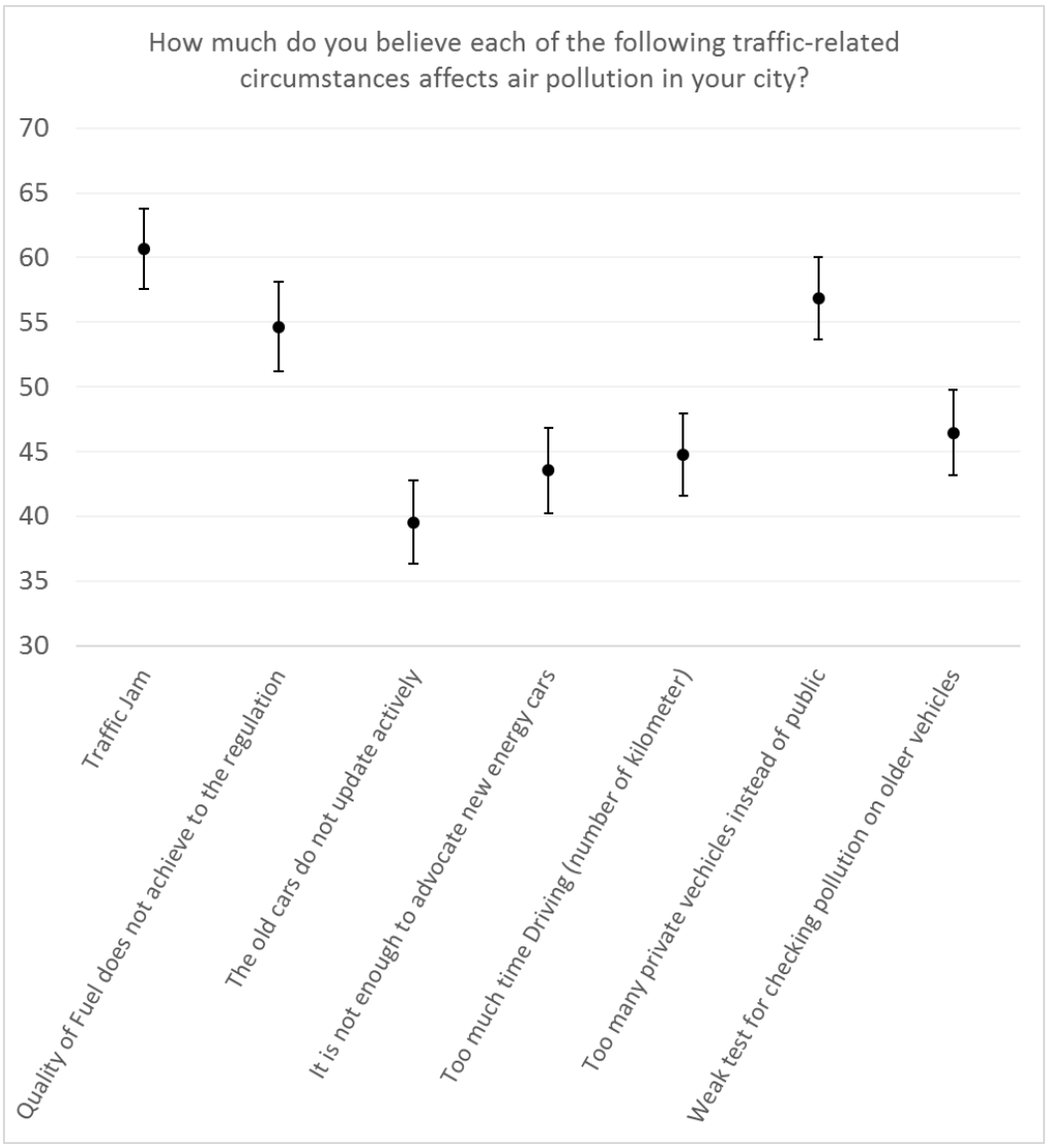

Figure 3.12: Motor Vehicles as Source of Air Pollution

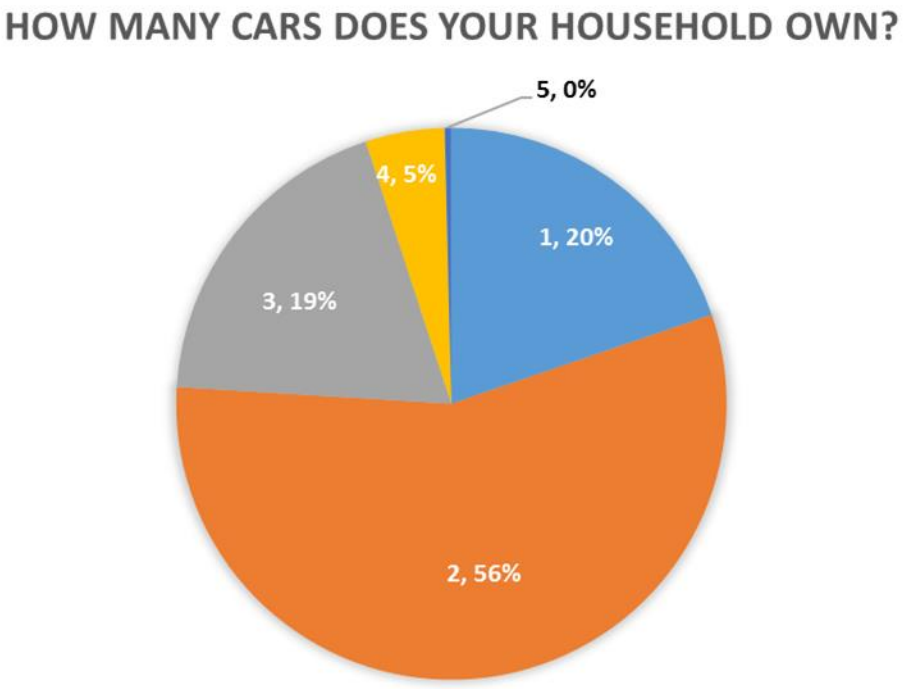

Figure 3.13: Number of Cars in Per Household

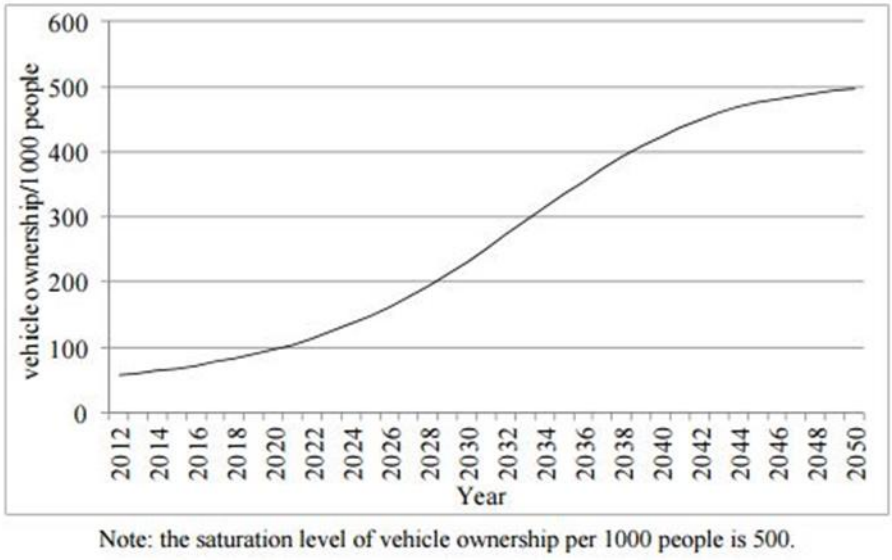

Figure 3.14: Annual Vehicle Ownership per 1000 in China (2012-2050)

(Source: Wu, Zhao & Ou, 2014)

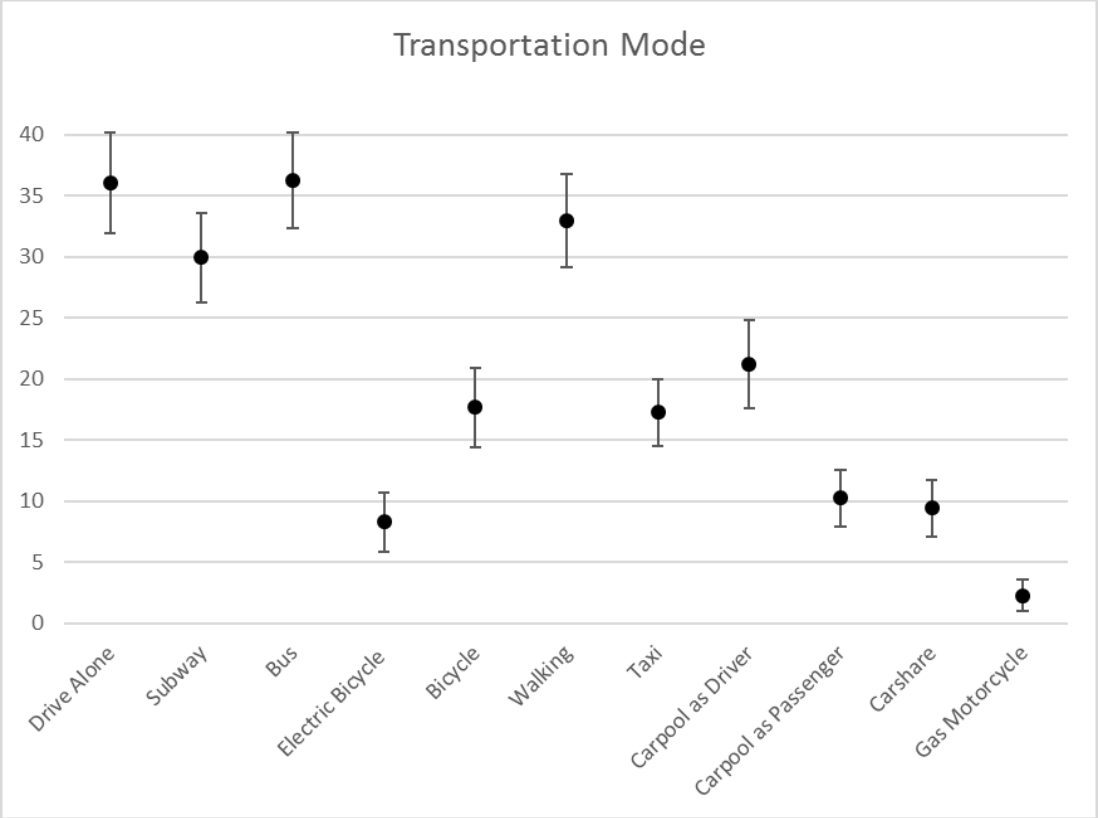

Figure 3.15: Transportation Mode to Go to Work

Table 3.1: The Number of Cars and Traffic Jams

	df	*SS*	*MS*	*F*	*P-value*
Regression	1	4.274044	4.274044	7.279943	0.007468
Residual	240	140.9036	0.587099		
Total	241	145.1777			

Table 3.2: The Number of Cars and Drive Alone

	df	*SS*	*MS*	*F*	*P-value*
Regression	1	9.768329	9.768329	21.19347	8.21861E-06
Residual	166	76.51143	0.460912		
Total	167	86.27976			

3.3 Health Effects of Air Pollution

The focus of this part of the survey was to determine if respondents felt that air pollution affected their health, and if so to what extent it was impacted. The following sub-sections address public health and air quality, and air pollution and public health.

3.3.1 Pulic Health and Air Quality

The total appropriate sample population for the first of the set of questions from this section of the survey was 404. This question asked simply if the individual felt that air pollution affected their health: 72% stated that air pollution affected their health; 22% did not know; and 7% people do not think so (Figure 3.16). Clearly, most people felt air pollution affected their health. To study the relationship between air pollution and public health requires analyzing data about air quality, based on the first question asking how people rated their city's air quality (see section 3.2.1), and then running a regression model between air quality and health. Table 3.3 shows the p-value is 0.0001, which, being less than 0.05, means a significant relationship between air quality and public health, as people rated air quality as being bad and public health as being adversely affected by air pollution. Although the sample survey data could not represent all of China, previous literature showed air pollution would influence public health. Moreover, this sample survey data showed that most people had a basic awareness that air pollution might have affected their health.

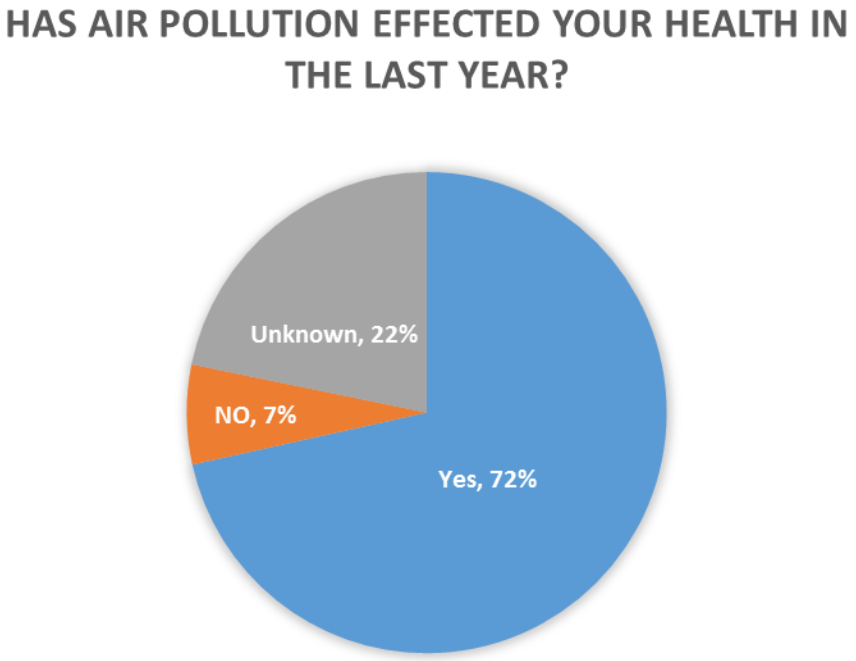

Figure 3.16: Air Pollution and Public Health

Table 3.3: The Relationship Between Air Quality and Health

	df	*SS*	*MS*	*F*	*P-value*
Regression	1	18.30077	18.30077	14.87978917	0.000133465
Residual	401	493.193	1.229908		
Total	402	511.4938			

3.3.2 Air Pollution and Public Health

Unfortunately, the public health data was not good data; when participants took the survey, some of them could not see the subsequent related health questions, which skewed the results for the air pollution impact question. The total sample population after using three exclusion criteria was 244, but Figure 3.17 addressed pollution impact on health by percentage; it didn't account for the population sampling exclusion criteria. All the same, the findings may be relevant to a degree, so they are worth discussing. While about 37.30% of those 244 people felt air pollution severely affected their health, more than half felt air pollution affected their health minimally. However, only 90 people answered the question about what kind of disease or activities affected them because of air pollution because some respondents could not see all the questions in survey (Figure 3.18). Apparently, 74.44% people acknowledged they had irritation affected by air pollution; 68.89% people indicated their children's outside activities were limited by air pollution; 67.78% people thought they had lost their opportunities to workout outside because of air pollution; 58.67% people felt breathless due to air pollution; and 52.22% people felt depression due to air pollution. These data showed most people felt they could not workout outside and that their children's outside activities were restricted because of air pollution. Again, because of issues in translation the English survey stressed the past tense, but the Chinese survey did not clarify past or future; thus, when people answered the question, they might have misunderstood it and so replied that air pollution may cause lung cancer in the future, rather than responding to whether pollution had already caused lung cancer. Therefore, the results should be interpreted with caution.

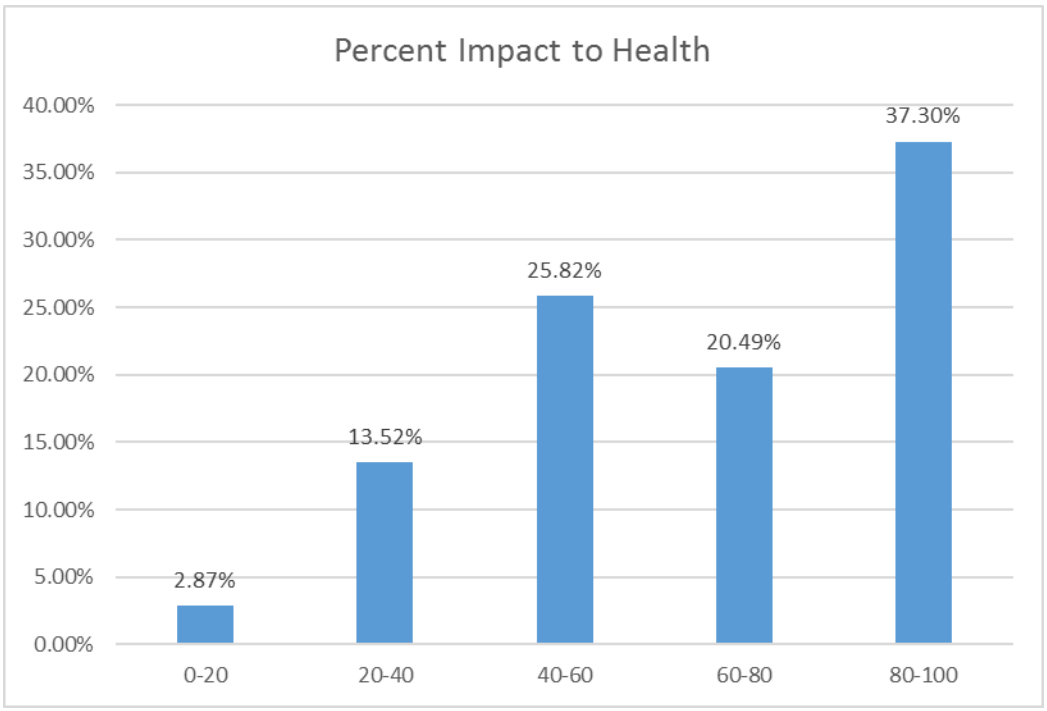

Figure 3.17: Percentage Rating of Effect of Air Pollution on Public Health

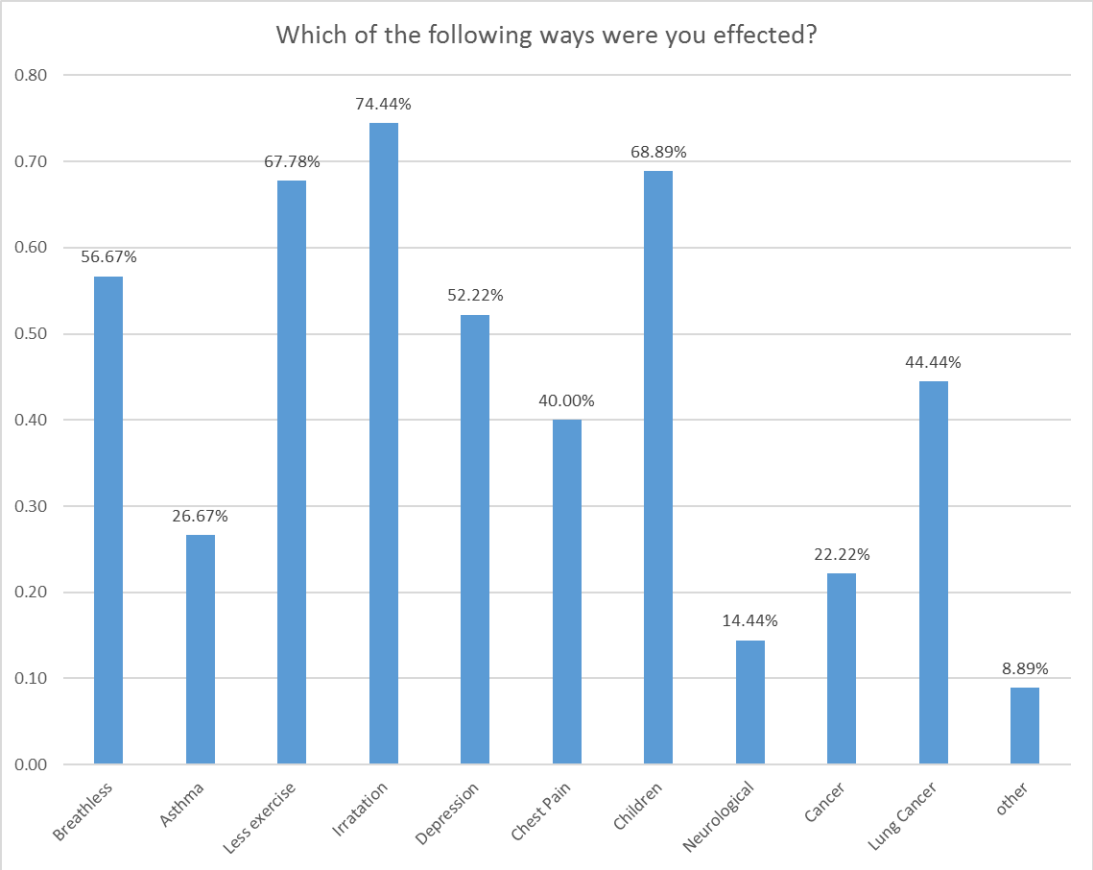

Figure 3.18: Identify in What Ways You Were Affected

3.4 Air Pollution and Environmental Policies

The results showed most respondents had a basic knowledge of air pollution and how it might affect their health. This section gives results about public opinion and knowledge of policy and governance related to air pollution. This section also focuses on activities to reduce air pollution and transportation policies.

3.4.1 Activities to Reduce Air Pollution

The total population sampled for Figure 3.19 (Table 3.4 explains Figure 3.19's axis) was 351 after applying three exclusion criteria. According to the results, laws and policies aimed at citizens were the least problematic factor of those listed, while those causes related to federal governance were rated as most problematic. The third important factor according to the results is lack of citizen education about air pollution, while citizen engagement and action was the second important factor to

affect air pollution. Respondents perceived lack of government oversight, too much focus on the national economy, insufficient environmental management, and insufficient financial investment in technologies as the most significant policy factors contributing to the air pollution problem. Overall, this means that people might think the government should take greater measures to reduce air pollution.

One of the more surprising results is that more than half of the participants did not know that China had an Air Pollution Act intended to help reduce pollution (Figure 3.20). The law, *China Air Pollution and Prevention Control Law*, was revised and released in January 2016. Considering Figure 3.19, possibly most people chose laws and policies for environmental management expressly because they do not know such a law exists. Based on this hypothesis, a regression was run to identify the relationship between knowledge of the China Air Pollution and Prevention Control Law and survey response to the laws and policies to help reduce air pollution. Table 3.5 shows that the relationship is significant ($p < 0.05$). However, as previous analysis showed most respondents have some form of higher education, yet notably 53% of those people did not know the law exists. So, a regression model was run between two variables, the level of education and whether respondents knew of the China Air Pollution and Prevention Control Law. Table 3.6 shows a significant relationship between these two variables, namely that people with higher education, likely would know about the China Air Pollution and Prevention Control Law. Conversely, the survey results did not show such a relationship; more than half of the people did not know of the Law. Therefore, based on survey results and comments from respondents, research suggests laws and policies for environmental management along with citizen education should be considered the most important factors to help reduce air pollution, especially as most people agreed government should enhance punishment for violating pollution laws. Appendix B, the report violation figure (Figure B.4.1), shows that more than half of people would report a violation no matter whether or not rewards were offered.

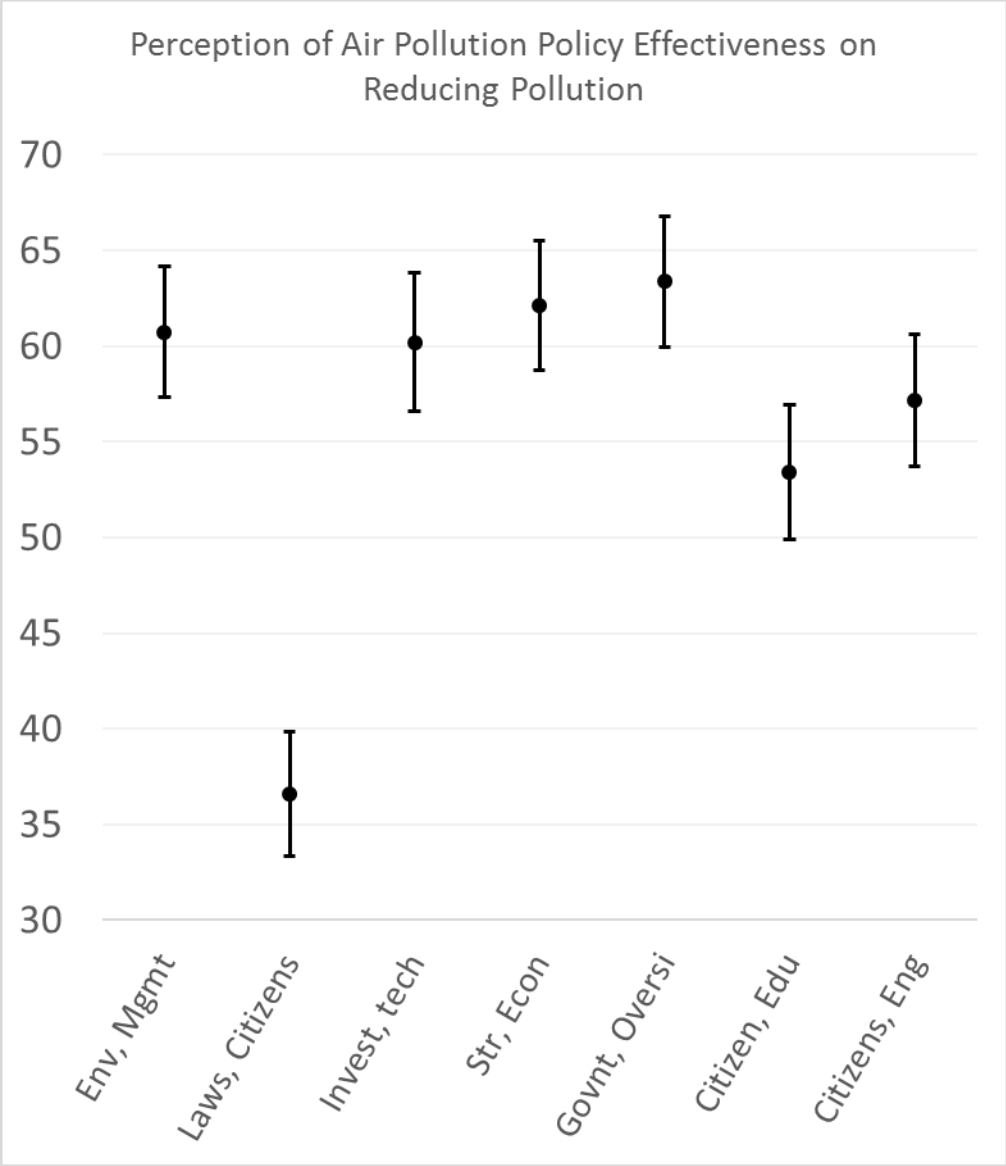

Figure 3.19: Options to Reduce Air Pollution

Table 3.4: Explanation of Figure 3.19

Axis Shortcut Title	Full Explanation
Env, Mgmt	Laws and policies for environmental management
Laws, Citizens	Laws and policies aimed at citizens reducing air pollution
Invest, tech	Finacial investment in technologies that reduce air pollution
Str, Econ	Structure of national economy (reliance on industry [steel])
Govnt, Oversi	Government oversight, policing and control of existing policies
Citizen, Edu	Citizens education about air pollution
Citizens Eng	Citizens engagement and action

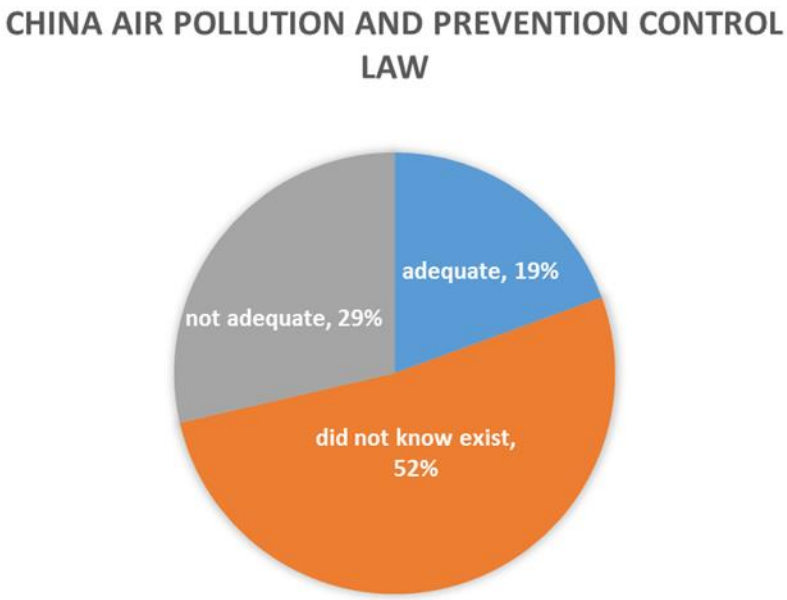

Figure 3.20: China Air Pollution and Prevention Control Law

Table 3.5: The Relationship Between China Air Act and Laws and Policies for Environmental Management

	df	*SS*	*MS*	*F*	*P-value*
Regression	1	2.570104	2.570104	5.573291944	0.018755808
Residual	369	170.163	0.461146		
Total	370	172.7332			

Table 3.6: The Relationship Between Education and China Air Act

	df	*SS*	*MS*	*F*	*P-value*
Regression	1	4.989945	4.989945	3.702788	0.055103077
Residual	363	489.1854	1.347618		
Total	364	494.1753			

3.4.2 Innovative Transportation Policies

In 2008, the government wanted to control the number of cars on the road per day during the 29th Olympic Games, so Beijing implemented a tag control policy based on odd and even numbers (Feng et al., 2016). In 2011 another policy was instituted, a lottery system that citizens would need to apply to for permission to buy a car. The intent was to better control vehicle ownership to mitigate major traffic problems. In 2014, three other large big cities (Shanghai, Guangdong and Guiyang) also implemented the lottery policy (Yang et al., 2014). Figure 3.21 shows that 54% of

people agreed with the lottery, and Figure 3.22 shows that less than half of people agreed with the tag control policy. This demonstrates that people agreed that ownership of cars should decrease, but they could not agree to restrict the number of cars on the road. Previous analysis revealed most respondents have two cars, which would not be typical throughout China; a subsequent regression model found no significance between the number of cars owned and these two policies. This result might that mean since most people already have one or two cars, they may not need to purchase another car, but policy would restrict their driving, which could explain why less than half of people agree with the tag control policy.

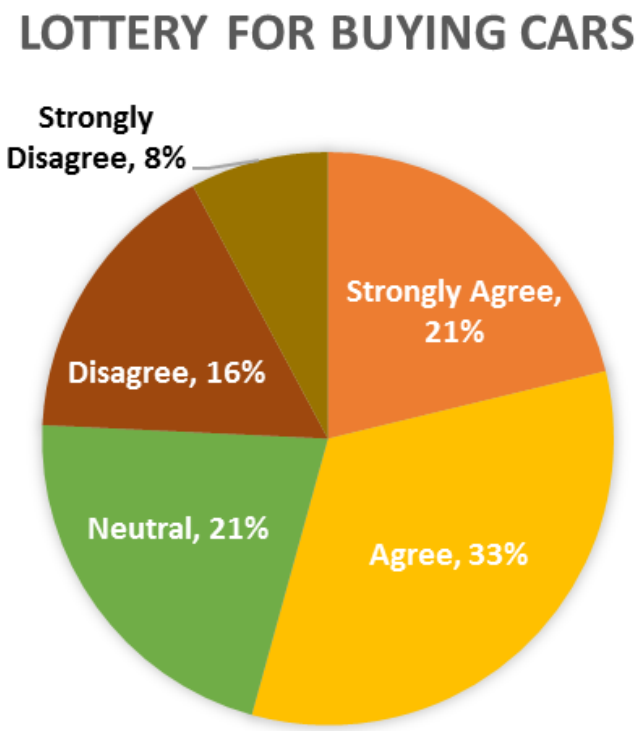

Figure 3.21: Acknowledge Whether You Agree or Disagree with the Lottery for Buying Cars

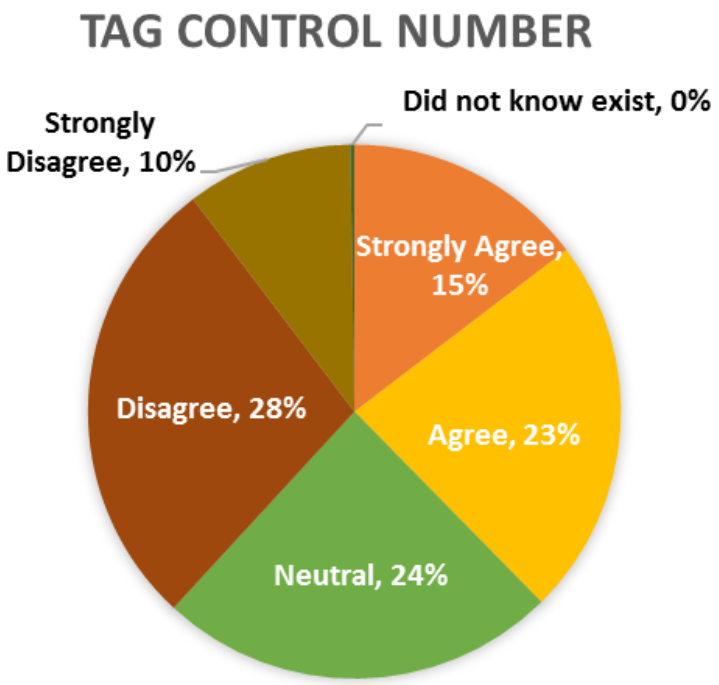

Figure 3.22: Tag Control Number Showing Policy Agreement and Disagreement

3.5 Regional Comparison Results

This section highlights differences among individuals living in different regions in China. In total, 275 people provided location information in the form of a postal code, which consists of six digits. The postal codes were mapped using Google API. The data revealed five distinct groups living in or near Beijing, Tianjin, Hebei Province, Shanghai, and others throughout the country. The following results compare four different regions (Beijing, Tianjin, Hebei Province and Shanghai) based on rated air quality and new transportation policies.

3.5.1 Different Region Rated Air Quality

Figure 3.23 shows that more Beijing people felt air quality had deteriorated significant than did people in Tianjin, Hebei Province and Shanghai. While, a few Tianjin people felt the air quality had got much better, nobody felt it was much better in Beijing, Shanghai, or in Hebei province. Moreover, nobody felt the air quality got a little worse in Shanghai, but some people from Beijing, Tianjin and Hebei province felt the air quality got a little worse, while, more people from Beijing than in other

two regions felt air quality got a little worse. Moreover, more Shanghai and Tianjin people felt the air quality got a little better than did response in Beijing and Hebei province; specifically, more Beijing people than Hebei province people felt the air quality got a little better. Therefore, these results show that the worst air quality may have been in Beijing, but in Hebei province, the air quality did not get better than that in Beijing. Also, the air quality in Tianjin got neither worse nor better, and while Shanghai's air quality stayed the same as usual, some thought it a little better now.

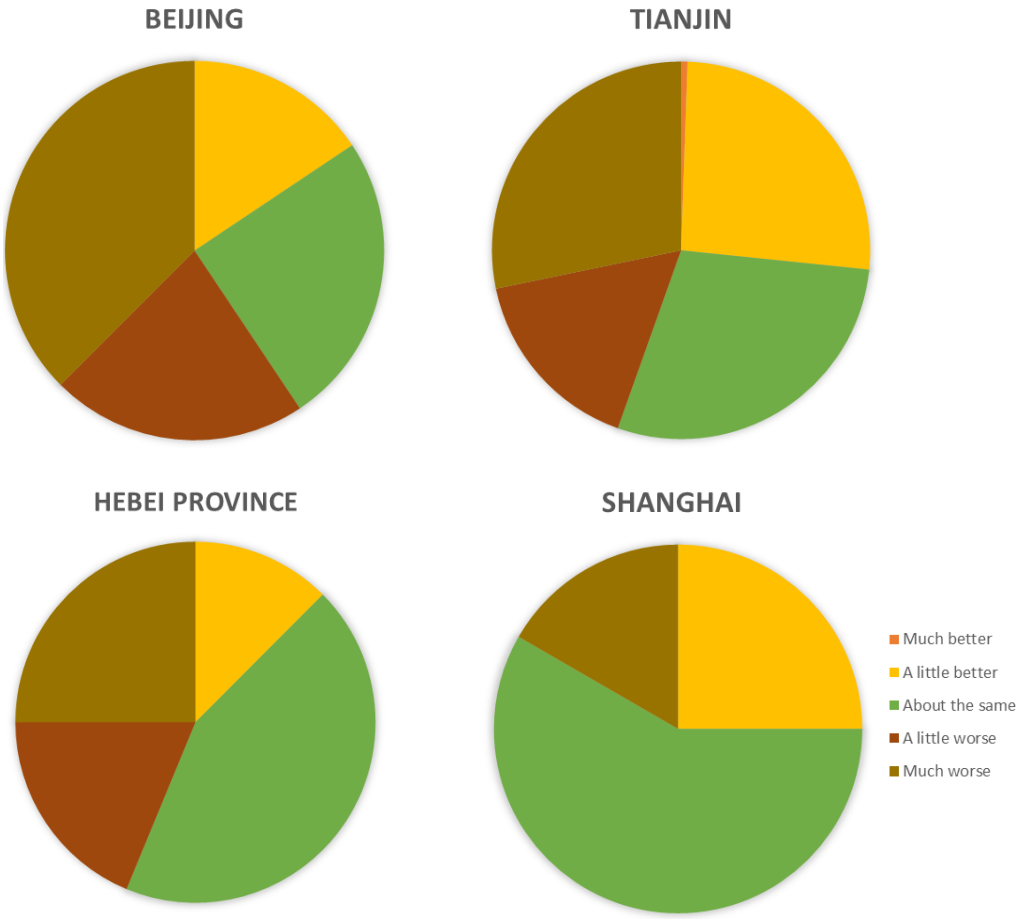

Figure 3.23: Rated Air Quality in Four Regions

3.5.2 Differences of Opinion About Transportation Policies

Figure 3.24 shows the differences among people in four regions who agreed or disagreed with the lottery policy in Beijing, Tianjin, Hebei province, and Shanghai. First, consistently large percentage of people who agreed with the policy come from Beijing, and then Hebei Province, and Tianjin. However, most people from Shanghai strongly agreed with the policy more than in the other these regions, and yet some people in Shanghai strongly disagreed with the policy, more than did people in the other three regions. All the same, a fair percentage of people in Shanghai did not overly strongly agree with the policy. Beijing and Hebei Province people disagreed with the policy more than people in Tianjin and Shanghai. Overall, Beijing and Hebei Province people both agreed and disagreed with the lottery, while more than half of people from Tianjin agreed with the lottery. Compared with Figure 3.24, Figure 3.25 shows that more than half of people from Beijing, Hebei, and Shanghai disagreed with the policy of tag control; however, even though a higher percentage of Tianjin people disagreed with the tag control policy, more people had neutral opinions about the policy than was true for the other three regions. However, a higher percentage of people supported tag control but less than the percentage of those who disagreed in Beijing, Tianjin and Hebei Province. Nevertheless, fewer people agreed with tag control policy than in the other three regions. Therefore, in Shanghai, the most interesting results were that more people agreed with the lottery, but a lot of people disagreed with tag control, and similar situations were true for Beijing, Tianjin, and Hebei Province. People from these four regions had various perceptions of the lottery policy, but they predominantly disagreed with the tag control policy.

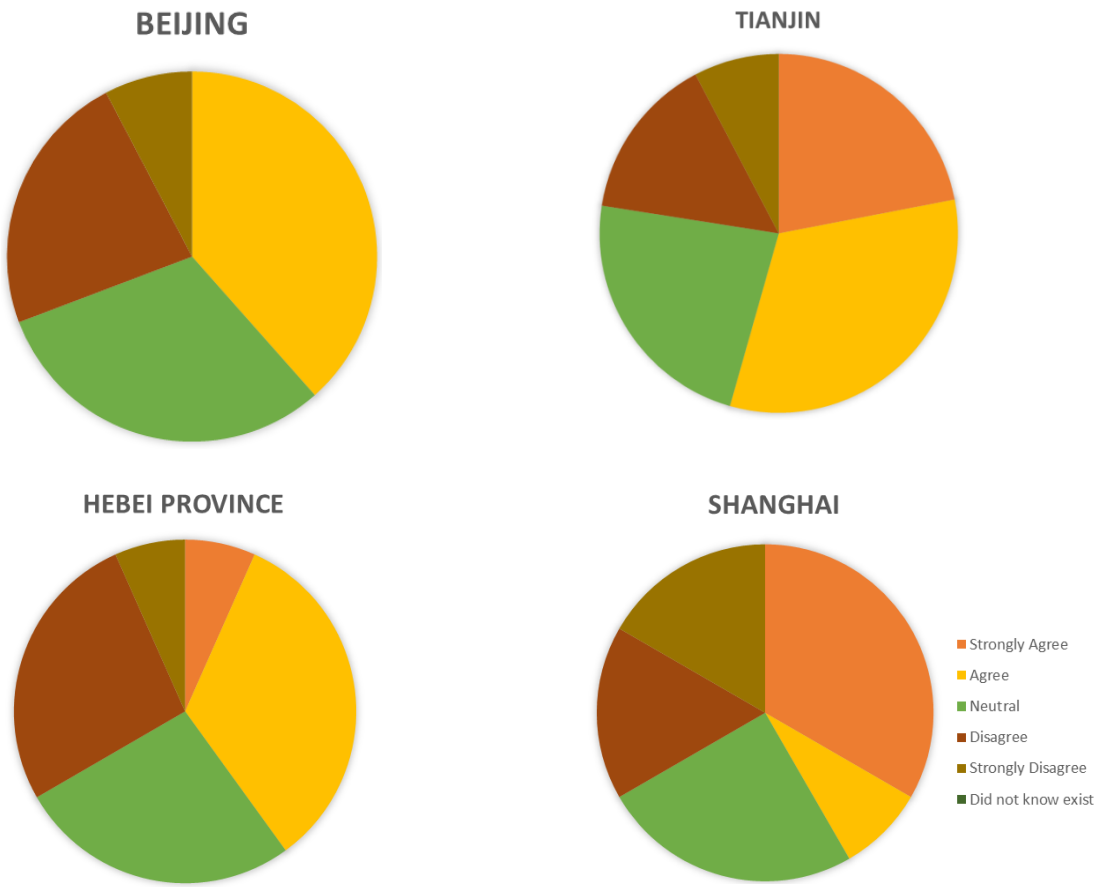

Figure 3.24: Respondents Lottery for Buying Cars in Four Regions

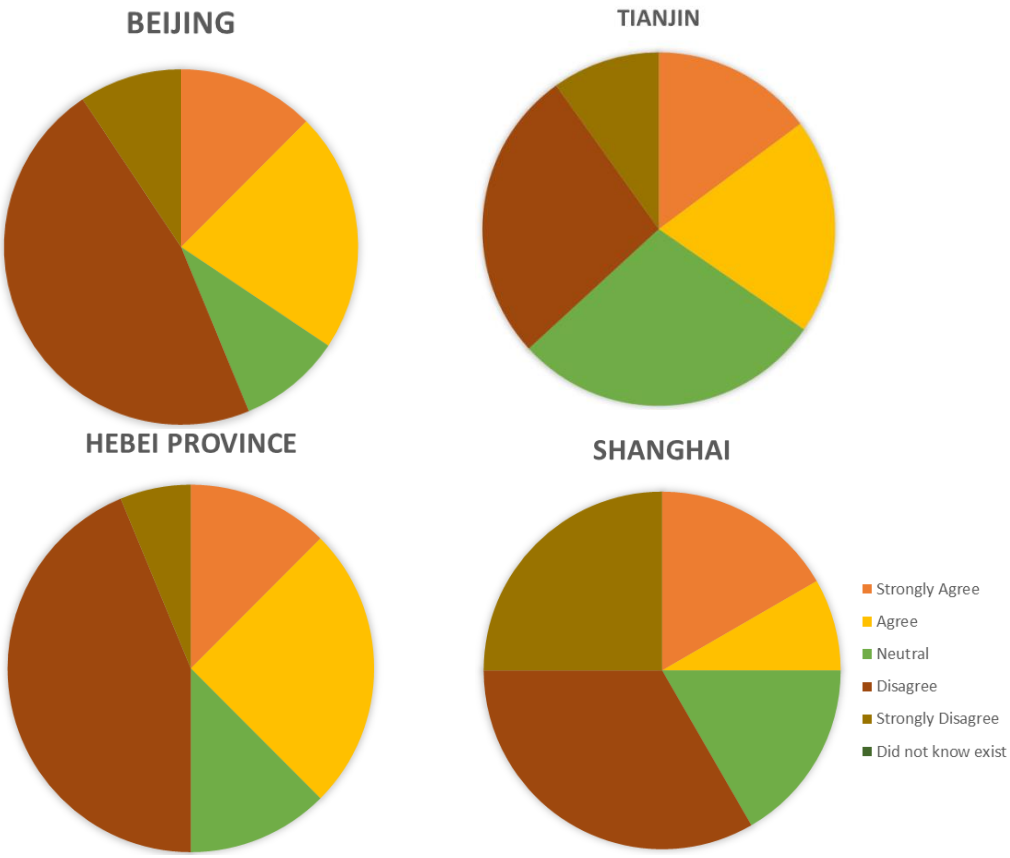

Figure 3.25: Tag Control Number in Four Regions

4 Discussion and Conclusion

This section further interprets the major results and limitations of the study and discusses the difference with other research. Finally, the report offers the conclusion.

4.1 Discussion

The main purpose of our study was to elicit perceptions about air pollution by Chinese citizens as well as how air pollution has affected their health. Previous studies determined that Chinese people might not have comprehensive knowledge about air pollution; however, our study was conducted after Chai Jing's Documentary (Chai, 2015), The Tianjin Warehouses Explosion, and the China red alerts, which warranted further investigation of air pollution. The results showed Chinese people to be more optimistic and specific about their opinions on air pollution and public health than they were before the recent pollution crises. Also, most of the survey went to urban areas in Jing-Jin-Ji, which had been issued red alerts for air pollution, and most respondents there have a higher education level; this means, this sample does not reflect the education of most Chinese. The sample also captured the opinions of younger people in particular who seemed to care more about government action to deal with air pollution than did previous generations.

This study was envisioned after a series of air pollution events occurred in China, soon after Chai Jing's documentary was banned. The documentary reported many illegal activities that were polluting the environment, and in particular pointed to some government sectors as the cause of the pollution. Making the documentary was a risky venture because China is different from other countries in that it might ban public speech that could negatively affect the stability of the country (Tang, 2005). The purpose of the documentary was to warn Chinese people of harmful effects of air pollution (Chai, 2015). Building on that documentary, our research project was to investigate public perception of air pollution after the documentary was released. After its online release, Chinese people started to talk more about air pollution (Tran,2015); however, social media had been reporting on such pollution since 2013 (Wong, 2013), although most social media reports were from foreign sources, for

instance, the New York Times (Wong,2013). This reporting was ongoing when in December, China released its first red alert for air pollution (Hunt & Lu, 2015). Historically, Chinese air quality data could be regarded as secret before 2008. Since 2012, after “airpocalypse” in 2011/2012, the Chinese government made a National Air Pollution Action Plan to try to make their air quality measures more transparent (BBC News, 2016). Thus the red alert from the “airpocalypse” represented a shift: that China had started to make a real progress to address with air pollution with their 2012 plan. Even though the government ostensibly wanted to make changes, local citizens thought it still was not doing enough (This Is What China Looks Like When Its Cities Are on a 'Red Alert' for Smog, 2015). Until the Tianjin warehouse explosion happened (Tan, Li, Xie & Lu, 2004) and a subsequent red alert was issued (Hunt & Lu, 2015), officially, the Chinese government seemed to want to make an effort to deal with air pollution, specifically by co-operating with the United States government (U.S.-China Joint Presidential Statement on Climate Change, 2015). Based on events in 2015, our study sought data revealing what the Chinese felt about air pollution, and whether or not they felt any danger of exposure as social media reported, or if they just felt the same about air pollution as they had the previous year.

4.1.1 Limitations

Unfortunately, the study methodology suffered some drawbacks. First, the survey was distributed using a convenience sample. The connections selected via social media were primarily oriented toward people in Tianjin, with the largest employment sector being construction. However, many others took the survey throughout China and a wide distribution of sectors was represented. While it would have been ideal to have more varied spatial, employment, and demographic data, the results do offer some unique insights into citizen perceptions of air pollution. Moreover, the survey had a settings problem in the perception of health section; some people could not answer additional questions about how air pollution affected their health, so the data about health was compromised. Also, the question about income did not represent a good range, because 36% people were at a household income level of $15,000-$77,000 per year, which represents a big gap with few details about income in this range. Then,

since the survey was written in English first, then translated into Chinese, a potential for inconsistencies arouse caused by the translation. The last problem was that when people took the survey in China using a cell phone, some slider bars could not slide, perhaps causing some data to be inadvertently incorrect.

4.1.2 Results Analysis

The results showed that some Chinese people who a hold higher education diploma and live an upper middle class life have the perception air pollution exists and that it affects health. The demographic data in Figure 3.1 may suggest that many younger people may have a growing awareness of air pollution, and they want the government to change the situation. A likely reason for this is that younger people may have started a family and become aware that air pollution is harmful to children; specifically, coal-burning plants emit air pollutants that can limit the development of children (Millman et. al., 2008). Specifically, Figure 3.18 showed that 68.89% of people felt their children's outside activities were by air pollution. Moreover, Figure 3.11 showed that most respondents chose restricted power plants as the most significant source of air pollution. This might be true; according to New York Times reports, China has contributed 47% of the world's coal, and many coal-burning power plants surround Beijing (Lallanilla, 2013). Also, respiratory disease in children has increased in eight districts of four Chinese cities due to air pollution (Zhang et, al., 2002). Another study shows that the lung function growth in children is negatively affected by air pollution (James et al., 2000). These studies may explain why younger people have a stronger negative perception of air pollution. Moreover, social media reported that young people care about air pollution more than do older people because some of them may have lived abroad and become more educated about air quality (Simon, 2016) especially since they can find so much information online, and their technology ability is sometimes better than that of older people.

These findings could echo those in Chai Jing's documentary. Her motivation to do the documentary was her child's health problem brought on by serious air pollution during her job time when she had pregnant (Chai, 2015). After the first red alert was issued, social media interviewed a doctor in the respiratory department of the Capital

Institute of Pediatrics where more than 50 children suffered from respiratory disease because of air pollution (Wang & Zheng, 2015). Children would more likely be affected their health by air pollution, because they are growing, and evidence showed that particulate air pollutants caused cough or other illness (Schwartz, 2004). Such evidence showed how harmful air pollution could be to the next generation.

As more people began to care about air pollution, the Chinese wanted the government make some changes; as the survey result indicated (Figure 3.19), most people thought government accountability was significant. However, 52% of people did not know the China Air Act exists, and most of those respondents had a higher education diploma; also, the regression model showed a significant relationship between these two variables, which indicated that the government and the public might have a disconnect with respect to their new of the law. Moreover, the answers to one open-ended question focused more on the punishment for violation of environmental action. The original China Air Pollution Prevention and Control Law was first implemented on 1987 and revised in 1995 as well as in 2000 (Finamore, 2014). The newest version, begun in 2014, was released in the first draft stage to the public and sought public opinions, which was a big step for China because policy-making is usually difficult to communicate to the public (Finamore, 2014). Possibly then, most people did not know of the revised law since it was due to activate on January 1st, 2016. If this is so, the Chinese government might make on clearer communication between the public and policy-making, because effective policy-making translates to everyday lives. While there is still much to do to reduce air pollution, it can take time to grow public awareness. For instances, compared with the United States, which first released an Air Pollution Control Act in 1955, China is nearly 30 years behind. Both countries have made amendments and improvements to their respective Acts. In the US, the Air Pollution Control Act was renamed to the Clean Air Act in 1963 and fully published in 1970, revised in 1977 and again in 1990 (EPA, 2016). To enforce the Clean Air Act, a Democratic Congress allowed public interest groups to sue when violations happened in 1970s, which preempted public awareness in the early 1970s (Melnick, 2010). Even though China is making efforts to improve air pollution

through governmental control, the government could do more to educate the public and continue making amendments to dramatically reduce air pollution.

Of the 416 respondents, the results in Figure 3.9 showed not half of them thought air pollution got worse compared with the previous year, so the research compared regions for air quality. In the regional analysis, Beijing people felt air quality to be much worse than in the previous year, meaning air quality in Beijing was worse than in other cities, especially in the first region to release a red alert. However, the Air Quality Index in Beijing and other areas showed, this could not be true; actually air quality in both regions was worse, which indicated that people in Beijing may be more concerned about air quality than people in other regions. For example, a study to investigate the perception of university students in Beijing, found that they have significant concerns about severe environmental problems (Wong, 2003).

Regarding motor vehicles and air pollution, most people chose traffic jams as a major source. As the results showed, when the number of cars increased, more severe traffic jams occurred, which means more people were driving alone at those times. As noted, driving speed can influence air pollution. Compared with Tokyo, Singapore and London, the average of driving speed in Beijing was the lowest at 7.5 miles per hour, while according to a recent study, 45-65 miles per hour is an appropriate speed to limit air pollution for vehicles (Guilford, 2014). Since transportation is a major source of air pollution (Frumkin, 2002), increasing the number of cars would make the problem more severe logically. Perhaps consequently, Figure 3.12's results showed that people might support the government developing public transportation to help reduce the number of private cars and increase the quality of fuels. Nevertheless, the top two results in Figure 3.12 were related to transportation planning, traffic jams, and too many private cars, which means China needs to focus on improving transportation planning in some way, for instance, by improving road construction or increasing public transportation, or both. Figure 3.15 showed that some people would like to choose the bus to go to work, perhaps in part because according to Figure 3.14, since not everyone has a car, perhaps many people cannot afford a car, so they take the bus. But this doesn't mean that they wouldn't prefer to drive if they could. Since

we didn't ask their preference, only what they did, we can only objectively state what they did, not what they prefer. However, in the survey, most respondents had two cars, while according to Wu's study, not every Chinese household has a car. Moreover, some two car respondents did not agree with the tag control policy. As presented in the results, the public perceives transportation as a major source of air pollution. However, it is possible that when participants were responding to the question pertaining to their agreement with the vehicular lottery and tag systems, that they were more inclined to respond because the policies reduce traffic congestion. Nevertheless, even with this assumption the data supports that people acknowledge the impacts congestion has upon air pollution (see Figure 3.12). In general, the survey showed that most people agreed with the lottery for buying cars, but they did not like the tag control policy. The evidence showed that more traffic could produce more pollution (Sun et al., 2014), and Beijing had more than five million cars contributing as a major source of air pollution (Lallanilla, 2013). Even though the policy might not be satisfactory to the Chinese public, apparently, Chinese people lacked the knowledge that they themselves could also produce air pollution (Rooij, 2010). Additionally, one reason the Chinese implemented the stated policies is because more than six million vehicles did not meet emission standards (Duggan, 2014). Ultimately, when making policy, it is difficult for the Chinese government and citizens to communicate effectively (Rooij, 2000). Therefore, while the transportation policy was not necessarily satisfactory to the Chinese people, however, it still could help reduce air pollution (Sun et al., 2014). Thus, clearly, the government needs to educate people more about fully air pollution or invest money in developing public transportation.

4.1.3 Contrast with Other Research

Unlike other research about public perception of air pollution, this study addressed public perception of air quality, its health effect, and also air pollution policies. Munro's study, for example, stressed only whether people recognized air pollution (Munro, 2014) but did not ask for the citizens' perception of government accountability. A similar study comparing rural and urban perceptions of the

environment and its pollution showed that urban people cared more about air pollution than did rural people, and rural people cared more about water pollution (Yu, 2014). Certainly, one difference between other studies and this one was that this study elicited perceptions from urban populations, with a population sample of a high degree of education. Another difference with this survey is that it was distributed shortly after a series of air pollution events in China in 2015. This suggests that the data collected is the most recent regarding urban people and their perception of air pollution – particularly as the effects of air pollution are more recently felt. Also, as previous research clarifies, many people die from air pollution. Thus, given the serious events related to air pollution in China in 2015, this research aimed to investigate how Chinese people think air pollution affected their health, so maybe future research could better understand how air pollution affects public health.

4.1.4 Policy Recommendations to Improve Current Conditions

After economic reforms, the Chinese government started to reduce stringent economic control of urban planning to attract more foreigners to invest in land to build buildings; thus, subsequent growing urbanization prompted the Chinese government to reestablish the urban planning system in 1989. To some extent every country has challenges related to urban planning. In China, urban planning could be improved by establishing an urban planning commission and an independent planning appeal system to increase public participation (Yeh & Wu, 1999). Compared with more democratic Western countries, many research and discussion about urban planning in changing progress for the past 40 years, however, there were less number of city plans prepared in China on each year (Chen, 2009). However, China has made some efforts to improve urban planning. In 2009 the country implemented new strategies, enforcing development plans and regulating planning procedures (The Shift of China's cities, 2016). The Chinese planning system is complicated, particularly because of the largely different governmental structure than most economically developed countries, and includes urban planning, land use planning and economic planning (Wu, 2015). Unlike the United States where planning often begins at a local level where planners make policies (Schmidt, 2016), the Chinese

federal government takes a more direct role in urban planning and policy development. Even though the planning system and roles of planner differ between the US and China, I present three recommendations for China to help reduce air pollution.

4.1.4.1 Transportation and Correlating Land Use Policy

Chinese urban development was based on the ancient planning system, so there are more historical buildings than in the United States; however, China built buildings first and then created train networks to make sure each city could transport goods conveniently. As China's development continued, people lived better and started to buy cars; however, inside cities, road networks were not developed for large traffic flows, which prompted subway building (e.g. Beijing). However, even though Beijing has a gully subway network, traffic jams are still a big problem. Likewise, Tianjin is also an historical city, and some subways took many years to build to avoid destroying historical sites. Based on these complex issues, appropriate and legal land use is not clear in China especially when the city needs to expand and where some factories and commercial facilities may conflict with the road network (Chen & Pan, 2015). In these cases, it is proposed that China considers zoning and economic incentive policies to support moving these factories and facilities to the outside of the city, then develop public transportation and multi-mode transportation to help reduce traffic congestion and air pollution. For instance, the country could develop railway and bus transit to reduce the number of vehicles on the road; moreover, if public transportation could develop to the degree that people felt it to be more convenient than driving a car, it could reduce traffic jams as well as air pollution. Clearly, China needs to think about providing land for transportation systems and develop more public transportation and its infrastructure where necessary.

4.1.4.2 Revise Laws and Policies for Controlling Air Pollution

The new (2016) version of the China Air Pollution and Prevention Control Law added new punishment for violators, but perhaps not enough. According to the open-ended question at the end of the survey, most people strongly suggested the law

should add more specific fines and penalties. Indeed, a review of the law shows the total policies to be only 129, which is not nearly as many or as substantial as the provisions in the U.S.'s Clean Air Act (618 sections and each section has different number of policies) (EPA, 2016). The China Pollution Control Law is also insubstantial where it addresses motor vehicle infractions because it still does not clarify what the fines are; nor does the law address the importance of citizens following that law. Comparatively, in the Clean Air Act, the highest fine for a motor vehicle or engine in violation of the law could be up to $37,500 (EPA, 2016). Additionally, with respect to China's Pollution Law, provisions for the tag control number and lottery for buying cars were not updated apparently because the government might have thought economic regulation would suffice; for example, the revised law only added some local traffic congestion fees. Even though the law was revised and put into operation in January, 2016, it still needs to add in the policies specified above and make clear the fines or penalties applying to motor vehicles. If fines and penalties are not made more prohibitive, people might be inclined to violate the law repeatedly, for instance, a study showed a fine can deter environment pollution and enhanced the reputation of the law (Shimshack & Ward, 2005) In particular, the tag control number policy and lottery for buying cars are a good start for reducing motor vehicle pollution, but if the government does not institute a deterrent punishment, these policies likely would not work. Therefore, the China Air Pollution and Prevention Control Law should more strongly enforce its mandates and clarify how local government should enforce the law. Finally, the government needs to establish a punishment system to ensure higher fines for violations of environmental laws stated in the Air Pollution Policy.

4.1.4.3 Educate People about Air Pollution

According to Figure 3.20, more than half of people did not know the China Air Pollution and Prevention Control Law exists, and yet, the vast majority of participants have some form of higher education which is more than the general public. This suggests pollution control education is important for citizens and that environmental conservation is a public as well as a political issue. One method of educating citizens

that proved beneficial in the U.S. was to enable citizens to sue for any violation of environmental policy, such as started in 1970. Since this was put into place, severe air pollution has since then always garnered public attention (Melnick, 2010). Another reason for more education is demonstrated in Figure 3.19, which shows that the number of participants who chose the response that laws and policies should be aimed at citizens is very low, which means local citizens might not have recognized they also could produce air pollution.

Adults and young children could learn various ways to spread their knowledge of the environment. For example, elementary schools could stress how environmental pollution effect health. This theme could continue through college, teaching students how energy consumption, heating, technology and policy effects air pollution. Early education is important because if young citizens witness a violation, they would recognize it as such and (hopefully) begin conversations with their parents – possibly increasing the number of violation reports and personal habit changes. Also, adults could spread the knowledge of their right to report violations perhaps by way of more advertisements or posters in the city detailing environmental violations, spreading the essential content of the law, disseminating knowledge of the law to as many citizens as possible, and clarifying causes and effects of air pollution. Finally, informed environmental task force groups in neighborhoods could establish regular meetings to promote knowledge and citizen participation in environmental activism in support of government policy.

4.2 Conclusion

Overall, public perception of air pollution is important to help government make an effective policy; however, based on the limitations of the government regime, this might not be true for China. However, the survey was useful for gathering knowledge about air pollution as it manifests for the Chinese people. As air pollution could harm public health, and as air quality has become worse in China, knowing how people thought air pollution affected health has become even more significant. The research not only addressed air quality, but it covered public health and air pollution policies.

While younger Chinese people might show a strong will to wait for the government to improve the situation, but this also means many people have started to care about air pollution. The Chinese government has done many things to regulate policies and urban planning system, however, it still needs to take important steps to educate citizens, improve urban planning and provide stronger disincentives for violating the law. In particular, the Chinese government needs to strengthen its communication with citizens. Education about air pollution needs to be more widespread, especially since the events of 2015, because air pollution cannot only be addressed by the government, but also by citizen action. If more citizens could realize the importance of air quality, there might decrease the violation of environmental action. Without knowing why, the Chai Jing documentary was banned, nonetheless, this incident shows the power of public speech to make change in China. Also, first seeking public comments for revising the China Air Prevention and Control Law was a good start to make some sort of connection between the government and the public.

Still, China needs to do more to remediate air pollution. Even though the newly revised law has started to add new transportation polices, it still needs to do more, perhaps being more aligned with the US Clean Air Act. Public participation may certainly be different in China than in the US, but public awareness of air pollution therefore is more important in such a society. Since this study addressed public perception, future study could research government perception and evaluate policy. Not only this research, but many research studies have stressed the serious of air pollution, to get more people involved and generate ideas to deal with it. In the end, the survey results might not represent the entire population of China, but the research has succeeded in its aims to clarify air pollution is a serious issue and to share that information with the people.

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Appendix A - Surveys

Survey: English

English

Consent

Welcome!

Thank you for your interest in our survey, "Public Perception of Air Quality and Effects on Public Health".

Click next to view the consent form that outlines the purpose of the survey, procedure and confidentiality of the information we are collecting.

We appreciate you interest in the survey!

Consent

Title:
Public Perception of Air Quality and Effects on Public Health

Principal Investigator:

Professor Brent Chamberlain (Primary Investigator and Contact)
Assistant Professor, Landscape Architecture and Regional & Community Planning
Kansas State University, United States of America
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With collaborators:
Yihong Yan, Graduate Student, Regional & Community Planning, Kansas State University
Professor Huston Gibson, Associate Professor, Regional & Community Planning, Kansas State University
Professor Huan Liu, School of Environment, Tsinghua University

Purpose Statement:
The purpose of this research study is to better understand the effect of air pollution in China and public attitude to air pollution. This survey is intended for research with the intent to better understand the impacts of air pollution in China and public perception of public health.

Study Procedure:
You will be asked to provide responses to several questions about air quality in China, health effects of air pollution, air pollution and environmental policies, and demographics and background. This survey is expected to take 10-15 minutes to complete. Please note that you can withdraw from this survey at any time.

Confidentiality:
The information that you provide in this experiment will be anonymous. No personally identifiable information will be collected. Your responses are collected through this secure website and will be stored with the collaborators for up to 5 years.

Funding:
This is an unfunded student-initiated project.

Contact Information:
If you have any questions or concerns about this research project, you may contact Professor Brent Chamberlain. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, you may contact the Kansas State University Research Compliance Office:

203 Fairchild Hall
Manhattan KS, 66502
785-532-3224
comply@k-state.edu

Consent:
You consent to take this survey on a voluntary basis and agree with the terms above, by clicking to proceed.

Air Quality and Pollution Sources

Air Quality and Source of Pollution

This section will ask that you provide your perspective on air quality and sources of air pollution.

How would you rate the overall air quality in your city now, compared with last year?

- Much better
- A little better
- About the same
- A little worse
- Much Worse

How much do believe each of the following activities affects air pollution in your city?

	None	Very High
Construction		
Industrial manufacturing facilities		
Motor vehicles		
Central heating of Home		
Burning of waste		
Dust and sandstorms		
Power Plant		

You stated that motor vehicles contribute to air pollution. How much do believe each of the following traffic related circumstances affects air pollution in your city?

	None	Very High
Traffic jam		
The quality of fuel is below the standard.		

Old cars do not update emissions controls actively.	
it is not enough to advocate new energy cars	
Too much time driving (number of kilometers)	
Too many private vehicles instead of public	
Weak test for checking pollution on older vehicles	

Indicate where you believe most of air pollution where you live is coming from:

	Inside City	Outside City
Slide to choose which area you think is most affected		

Air Pollution Health Effects

Health Effects of Air Pollution

In this section, we would like to know what you think about air pollution and if it has had any effect on your health.

Has air pollution affected your health in the last year?

- ○ Yes
- ○ No
- ○ Unknown

To what extent has air pollution affected your health in the last year?

	Very Little Effect	Very Significant Effect

In which of the following ways were you effected? Please select all applicable.

- [ ] Breathlessness/having more difficulty in breathing
- [ ] Asthma aggravation
- [ ] Doing less exercise outdoors
- [ ] Irritation to eyes/nose/throat
- [ ] Depression/anxiety
- [ ] Chest pain, coughing, nausea, and pulmonary congestion
- [ ] Worrying about how children are affected
- [ ] Neurological impairments
- [ ] Cancer
- [ ] Lung cancer
- [ ] Other

Air Pollution and Environmental Policies

Air Pollution and Environmental Policies

In this section we would like to know what you think about policies that (could) affect air pollution.

How much of a problem are each of the following for reducing air pollution?

	Not a problem	Significant Problem
Laws and Policies for environmental management....		
Laws and policies aimed at citizens reducing air pollution		
Financial investment in technologies that reduce air pollution		
Structure of national economy (reliance on industry [steel])		
Governmental oversight, policing and control of existing policies		
Citizen education about air pollution		
Citizen engagement and action		

Do you agree or disagree with the lottery purchasing policy to help reduce air pollution?

- Strongly Agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree
- Did not know policy existed

Do you agree or disagree with the policy to use tag numbers to help reduce air pollution?

- Strongly Agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree
- Did not know policy existed

China's Air Act began in 1987 and was revised in 2015. The newest version will operate on Jan 1st, 2016. Do you think China's current Air Act needs to be revised further?

- The current Act is adequate
- I did not know Act existed
- Current Act is not adequate because

If you saw a company or person violating policy and causing air pollution, would you report them to the government?

- No, I am against reporting
- No, not my business
- Yes, I would report: if they violate my property and rights
- Yes, I would report: if there are incentives (prizes, money, etc.)
- Yes, I would report: regardless of incentives or my own rights

Do you agree or disagree with the following statement: "Develop the economy first; then deal with air pollution"?

- Strongly disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

What if any, other problems do you believe limit the reduction of air pollution?

Demographics and Background

Demographics and Background

In this section, you will be asked for basic demographic information including age, income, employment status, and neighborhood you live in.

Please enter your age:

Gender:

- Male
- Female
- Other

Annual Household Income:

- Less than 20,000
- 20,000 - 40,000
- 40,000 - 60,000
- 60,000 - 100,000
- 100,000 - 500,000
- 500,000 - 1,000,000
- Greater than 1,000,000

Zipcode/Postal Code of your home (6 Digit)

Zipcode/Postal Code of your place of work (if applicable)

How many cars does your household own?

To what extent do you use the following modes of transportation to go to work?

	Never	Always
Drive alone		
Train/Subway		
Bus		
Electric scooter/moped/bike		
Bicycle		
Walking		
Taxi		
Carpool (as driver)		
Carpool (as passenger)		
Carshare (Uber)		
Gas motorcycle		
Other		

Select the highest level of education obtained:

- Primary (up to grade 9)
- Some High School
- High School
- Trade / technical / vocational training or degree
- Associate Degree
- Bachelors degree
- Masters/Professional degree
- Doctoral Degree

Professional or Employment Status

- Employed for wages
- Internship
- Self-Employed
- Out of work, looking
- Out of work, not looking

- Homemaker
- Student
- Military
- Retired
- Unable to work

Professional or Employer Type

- Private
- Foreign
- Government
- Non Profit
- Governmental Company

What is/was your area of expertise, occupation, or discipline?

- Public Administration
- Industry or Manufacturing
- Agriculture
- Transportation
- Travel, Restaurant, and Tourism
- Construction (Architect, Urban Planner, Engineer)
- Communication/Public Media
- Health Care (Doctor, Nurse)
- Entertainment
- Finance
- Business
- Public Organization
- Education
- Information Technology
- Other (please specify)

Comments

Do you have additional comments, questions or concerns about air pollution in your city, including policies, health and causes?

Thank you for completing the survey, we appreciate your efforts to contribute to the project!

This project is intended for research only. We are hoping to discover new insights about public perceptions of air quality and impacts to public health in China. We anticipate synthesizing this information for publication in journals and conferences. As a reminder, your data will be stored on the collaborators' computers for up to 5 years, and your data is anonymous.

If you want to know further information for this project as it progresses, please click the following link to register your contact information (this will not be associated with your responses to ensure that they continue to be anonymous): http://tinyurl.com/prv7smd

Contact Information and Questions

If you have any questions or concerns about the survey, please direct them to Professor Brent Chamberlain (brentchamberlain@ksu.edu).

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, you may contact the Kansas State University Research Compliance Office:

203 Fairchild Hall
Manhattan KS, 66502
785-532-3224
comply@k-state.edu

Survey: Chinese

简体中文 ▾

个人意愿

您好，欢迎参与这份有关空气污染及产生公共健康问题的问卷调查！

请您点击箭头继续阅读问卷调查个人意愿、问卷调查的目的、程序和我们收集的可靠信息。

非常感谢您的参与！

个人意愿

标题：
空气污染及其产生的公共健康问题

主要研究者：

Professor Brent Chamberlain（主要研究者的联系方式，请点击姓名链接）—— 美国堪萨斯州立大学景观建筑和城市规划学院的助理级教授。
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参与合作的研究学生和指导教授：
闫旖鸿 —— 美国堪萨斯州立大学的城市规划的研究生
Huston Gibson教授——美国堪萨斯州立大学城市规划副教授
帮忙给予相关研究意见教授：
刘欢——中国清华大学环境工程学院副教授

问卷调查目的：
此项研究的目的是为了了解中国空气污染以及产生的公共健康问题。此问卷调查是为了更好的了解人们对于空气污染的现象以及长生的公共健康问题。

调查程序：
您需要回答一些关于中国空气质量和污染来源、空气污染产生的健康问题、空气污染环境法规以及参与者基本信息调查。此问卷调查仅需**5-10**分钟完成。如果您觉得您不想继续此问卷调查，您可以选择退出。

保密措施：
我们不会询问您的私人信息，一切调查将以不记名的形式完成。这个网站会确保您的回答是安全保密的，并且您的**IP**地址不会记录在案。这份调查收集的数据将存档于堪萨斯州立大学至**2016**年**5**月，仅供主要研究者（**Chamberlain**教授）和参与合作的研究学生阅读。**2016**年**5**月后，此数据由**Brent Chamberlain**教授个人以电子文档的形式保存在堪萨斯州立大学数据库，有效期五年。

赞助：
此项目没有任何赞助和商业目的。

联系方式：
如果您有任何关于此调查的问题及顾虑，请联系**Brent Chamberlain**教授或者闫旖鸿。如果您有任何关于此项目的问题或顾虑，请联系堪萨斯州立大学研究顾问中心：

地址：**203 Fairchild Hall, Manhattan, KS, U.S, 66506**
电话：**001-785-532-3224**
电子邮件：**comply@k-state.edu**

个人意愿：
您的参与属于自愿形式，如果同意以上信息，请您点击箭头继续。

空气质量和污染来源

空气质量和污染来源

这个问卷部分将询问您关于空气质量以及其来源的意见或态度。

相比较去年，您如何评价您现在所居住的城市的空气质量？

- 很不错
- 有一点改善
- 基本和去年一样

- 比去年的空气差一些
- 比去年的空气糟糕

在您所居住的城市，您如何评价以下城市因素对空气质量的影响程度？（请拉动条幅来选择有无影响以及影响程度）

	没有影响	影响很高
工程建设		
工业制造		
机动车		
中央供暖		
废弃物焚烧		
雾霾和沙尘暴		
发电厂		

在上一题，由于您觉得机动车是影响空气污染的因素之一，所以在您所居住的城市，您是如何评价以下机动车的污染现象对空气质量的影响的？（请拉动条幅对每一个影响的程度进行评估）

	没有影响	很大影响
交通堵塞		
汽油的质量达不到法规规定的标准		
不常检修老旧的车		
新能源机动车宣传力度不足		
驾驶频率过高		
私家车普遍取代公共交通		
疏于检查老旧机动车的废气排放		

在您居住的城市，您认为最主要的空气污染来源于哪里？

	城市内部	城市外部
请拉动条幅进行选择		

空气污染对健康的影响

空气污染对健康的影响

此部分将询问您关于空气污染所产生的健康问题。

在去年，空气污染是否影响您的健康？

- 影响
- 没有影响
- 不知道

请您评价空气污染在去年在多大程度上影响您的健康

几乎无影响 非常严重的影响

请选择以下空气污染给您带来的影响？（多选）

- 呼吸困难
- 哮喘加剧
- 减少课外活动
- 刺激眼鼻喉
- 焦虑
- 胸痛，咳嗽，恶心和肺淤血
- 担心儿童会受到影响
- 神经功能缺损
- 癌症
- 肺部疾病/感染
- 其他 (请写出)

空气污染和环境法规

空气污染和环境法规

此部分将询问您导致空气污染的相关法规

以下哪种情况可以减少空气污染？

不能减少 很大程度减少

0 100

- 环境管理的法律法规
- 针对市民的法律法规
- 减少空气污染的技术投资

国家经济产业结构 （例如钢铁厂）	
政府疏忽和现有政策的缺乏	
公众的空气污染教育	
公众参与	

您是否同意机动车限号政策可以帮助减少空气污染？

- 强烈同意
- 同意
- 中立
- 不同意
- 强烈不同意
- 不知道有这个政策

您是否同意机动车牌照摇号政策可以帮助减少空气污染？

- 强烈同意
- 同意
- 中立
- 不同意
- 强烈不同意
- 不知道有这个政策

《中国大气污染防治法》颁布于**1987**年，**2015**年再次修订，新版本的法规将在**2016**年**1**月**1**日实施。您认为现有的《中国大气污染防治法》今后是否还需要调整？

- 现有法规已经足够了
- 不知道有此项法规
- 现有法规不充分，请在以下方框中进行补充

如果您发现有公司或个人违反环境法规导致空气污染，您是否会向相关部门举报？

- 不会，我反对举报
- 不会，和我没关系
- 会，我会举报，如果他们侵犯了我的个人财产和权利
- 会，我会举报，如果有奖金奖励
- 会，我会举报，这是我自己的权利，所以无所谓有没有奖励

您是否同意以下观点，先发展经济再解决空气污染？

- 强烈同意
- 同意
- 中立
- 不同意
- 强烈不同意

您认为是否还有其他方式可以控制减少空气污染？

参与者基本信息

参与者基本信息

此部分将会问您基本个人信息包括年龄、收入、就业情况和您所居住的区域

请填写您的年龄：

性别：

- 男
- 女
- 其他

家庭年收入（¥）：

- 少于¥20000
- ¥20000 - ¥40000
- ¥40000 - ¥60000
- ¥60000 - ¥100000
- ¥100000 - ¥500000
- ¥500000 - ¥1000000
- 多余¥1000000

家庭邮编（6位数）：

工作单位/学校邮编（如果可以提供）：

您有几辆私家车？

您平常上班采用以下哪种交通方式？（请滑动条幅选择您使用的交通工具，可多选）

	从来不用	经常使用
独自开车		
地铁		

公共汽车	
电动车	
自行车	
步行	
出租	
私家车（以司机的身份）	
私家车 （以乘客的身份）	
拼车（例如优步）	
摩托车	
其他	

请选择您的最高学历。

- 九年制基础教育
- 中专
- 高中毕业
- 职业技校
- 大专
- 本科
- 硕士
- 博士

就业状态：

- 薪资聘用
- 实习
- 自由职业
- 失业，求职中
- 失业，无求职意向
- 家庭主妇/主夫
- 学生
- 军人
- 退休
- 无工作能力

您所在公司类型：

- 私企
- 外企
- 政府
- 福利机构
- 国企、事业单位

以下哪个是您从事的领域？

- [ ] 公共行政
- [ ] 工业或制造业
- [ ] 农业
- [ ] 交通业
- [ ] 旅游和餐饮业
- [ ] 建造业（建筑师，城市规划，工程师）
- [ ] 公共媒体
- [ ] 公共健康（医生，护士）
- [ ] 娱乐
- [ ] 金融
- [ ] 商业
- [ ] 公共机构
- [ ] 教育
- [ ] 电子技术（IT）
- [ ] 其他 （请指出）

意见

请提供关于您所居住城市的空气污染的问题、意见或建议，如果有请填写在下面：

谢谢您的参与以及您的回答。
此项目近服务于学术研究。我们希望通过细项研究可以发现新的解决方案有关于中国的空气污染以及所产生的健康问题。此项研究的论文会发表在一些相关的学术杂志或会议上。您的回答数据会保留在合作的学生及教授的电脑中**5**年，并以不记名的方式保留。

如果您想知道任何关于这项研究的进展，请您点击下面的链接：
http://tinyurl.com/prv7smd

联系方式和问题
如果您有任何问题可以直接联系**Brent Chamberlain**教授 （**brentchamberlain@ksu.edu)**
如果您有任何关于问卷调查的问题和意见,可以联系美国堪萨斯州立大学研究办公室：

203 Farilchild Hall
Manhattan, KS, 66502
785-532-3224
comply@k-state.edu

Appendix B – Figures and Tables

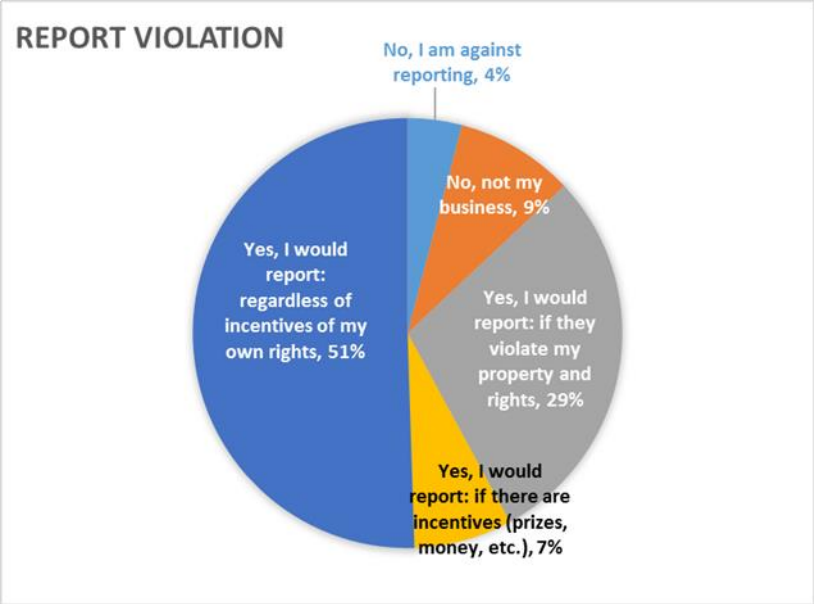

Figure B.4.1: Report Violation

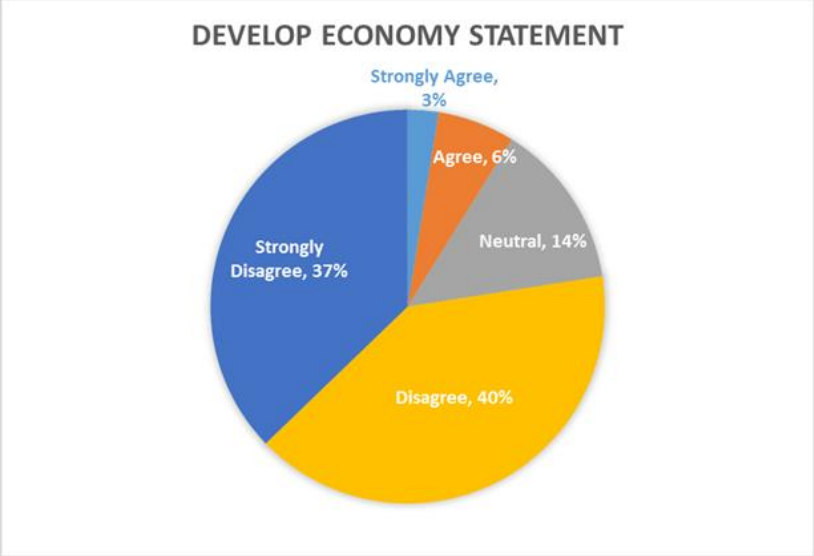

Figure B.4.2: Develop Economy Statement

	Construction	Industrial manufacturing facilities	Motor vechicles	General Heating of Home	Burning of Waste	Dust and sandstorms	Power Plant
Mean	49.49148418	57.27250608	59.36739659	35.69586375	37.85888078	43.59610706	71.60097324
Standard E	1.536424448	1.650792864	1.444688731	1.462946056	1.538159823	1.545812873	1.580830209
Median	51	60	60	33	33	40	82
Mode	100	100	100	0	0	0	100
Standard I	31.14814015	33.46674648	29.28836959	29.65850279	31.18332165	31.33847296	32.04838414
Sample Va	970.2066346	1120.02312	857.808593	879.6267877	972.399549	982.0998872	1027.098926
Kurtosis	-1.03435091	-1.12128832	-0.734060533	-0.954240332	-0.844406899	-0.94998859	-0.303174243
Skewness	0.035154897	-0.343915737	-0.368282921	0.356558139	0.451978893	0.320386634	-0.948773311
Range	100	100	100	100	100	100	100
Minimum	0	0	0	0	0	0	0
Maximum	100	100	100	100	100	100	100
Sum	20341	23539	24400	14671	15560	17918	29428
Count	411	411	411	411	411	411	411
Confidenc	3.020252231	3.245073872	2.839921202	2.875810845	3.023663575	3.038707686	3.107543605

Table B.1: The Source of Air Pollution

	Traffic Jam	*Quality of Fuel does not achieve to the regulation*	*The old cars do not update actively*	*It is not enough to advocate new energy cars*	*Too much time Driving (number of kilometer)*	*Too many private vechicles instead of public*	*Weak test for checking pollution on older vehicles*
Mean	60.63387978	54.64480874	39.53005464	43.53005464	44.7704918	56.82513661	46.45628415
Standard Error	1.575575563	1.763627286	1.629779317	1.687439606	1.608474454	1.617528824	1.691895585
Median	64	53	35	40	45	60	47
Mode	100	100	0	0	0	100	0
Standard Deviation	30.14253536	33.74017666	31.17951424	32.28262052	30.7719282	30.9451485	32.36786841
Sample Variance	908.5724381	1138.399521	972.1621079	1042.167587	946.9115652	957.6022157	1047.678906
Kurtosis	-0.828115412	-1.256641028	-0.940539667	-1.088297122	-1.034526072	-0.975119633	-1.150309851
Skewness	-0.407702702	-0.131008899	0.393334232	0.229181164	0.093380782	-0.319395657	0.105960276
Range	100	100	100	100	100	100	100
Minimum	0	0	0	0	0	0	0
Maximum	100	100	100	100	100	100	100
Sum	22192	20000	14468	15932	16386	20798	17003
Count	366	366	366	366	366	366	366
Confidence Level(95.0%)	3.098345075	3.468145892	3.204935923	3.318323993	3.163040237	3.180845517	3.327086607

Table B.2: Motor Vehicles as Source of Air Pollution

	Drive Alone	*Subway*	*Bus*	*Electric Bicycle*	*Bicycle*	*Walking*	*Taxi*	*Carpool as Driver*	*Carpool as Passenger*	*Carshare*	*Gas Motorcycle*	*Other*
Mean	36.144	29.99733333	36.34933333	8.32	17.69333333	33.088	17.312	21.23733333	10.26933333	9.445333333	2.253333333	25.91304348
Standard Error	2.093528308	1.883670323	1.977782545	1.238139021	1.639281033	1.947163202	1.385708815	1.842264509	1.18429954	1.172685658	0.661640231	8.023905253
Median	14	12	24	0	0	15	0	0	0	0	0	2
Mode	0	0	0	0	0	0	0	0	0	0	0	0
Standard Deviation	40.54100136	36.47711895	38.2995943	23.97645904	31.7445407	37.70665327	26.83413581	35.6752988	22.93386197	22.70896012	12.81260798	38.48129775
Sample Variance	1643.572791	1330.580207	1466.858923	574.8705882	1007.715865	1421.791701	720.0708449	1272.726945	525.962025	515.6968699	164.1629234	1480.810277
Kurtosis	-1.425450705	-0.776884662	-1.30119417	7.972007772	1.117431087	-1.109864112	1.988909649	0.195344803	5.092428374	6.24969687	39.57713744	-0.600774008
Skewness	0.530966517	0.864810484	0.528623259	3.027207231	1.612477785	0.674338932	1.701149672	1.366426822	2.424652973	2.641910743	6.287305865	1.104886278
Range	100	100	100	100	100	100	100	100	100	100	100	100
Minimum	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	100	100	100	100	100	100	100	100	100	100	100	100
Sum	13554	11249	13631	3120	6635	12408	6492	7964	3851	3542	845	596
Count	375	375	375	375	375	375	375	375	375	375	375	23
Largest(1)	100	100	100	100	100	100	100	100	100	100	100	100
Smallest(1)	0	0	0	0	0	0	0	0	0	0	0	0
Confidence Level(95.0%)	4.116561621	3.70391216	3.888967581	2.434586414	3.223362856	3.828759934	2.724756911	3.622494782	2.328720378	2.305883687	1.301001172	16.640561

Table B.3: Transportation Mode