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PM2.5 concentration variation during Chinese New Year

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Abstract

Introduction

The Lunar New Year is an important folk festival in Taiwan. During this period, companies and factories will be on holiday, and everyone will go back to their hometowns to reunite with their families. The whole of Taiwan presents a cheerful atmosphere. At the same time, PM2.5 is an important factor affecting air pollution in Taiwan. It is mainly caused by industrial processing in factories and the discharge of motor tools such as automobiles and locomotives. Long-term exposure to high concentrations of air PM2.5 will cause many human injuries. , such as: respiratory diseases, accelerated aging, etc. Therefore, we want to understand the PM2.5 changes and differences between the Chinese New Year and the normal times, and try to explore the reasons after these phenomena.

Purpose

Literature review

1. The pm2.5 copper plating of a place is affected by the lifestyle of its residents, such as cooking, heating fuel, etc., and the lifestyle of the residents is also deeply affected by the climate. From this study, we can know that the use of eyebrow pencil in highly-developed cities with high mileage usually consumes relatively high coal consumption and PM2.5 concentration, which will also have an impact on the health of local residents such as blood pressure. Quality improvement plays an important role.

   Original: Jinxi Hua, Yuanxun Zhang, Benjamin de Foy, Xiaodong Mei, Jing Shang, Chuan Fengc (2021)indication

2. The intensity of the holiday effect shows a clear spatial pattern. The intensity of the PM2.5 increase is related to the coal and biomass consumption for household heating in the area around the measurement point.

   The rollout of renewable energy is therefore expected to improve air quality in rural hotspots as well as in large urban developments.

   Spatial differences in holiday effects across locations reflect two different ways in which human activity affects air quality: increasing residential heating tends to increase PM2.5 and NO2 while reducing transportation emissions leads to lower NO2.

   Research on holiday effects and other natural experiments, such as the effects of revenge tourism of the Olympics covid-19 and then inverse holiday effects

   Original: Chen, Pen-Yuan , Tan, Pei-Hua , Chou, Charles , Lin, Yu-Shiuan ; Chen, Wei-Nai ,Shiu, Chein-Jung (2019)indication

Process

1. The representative research sites of each region are selected: the cultural and educational areas are the Qianjin District of Kaohsiung City and the Xinyi District of Taipei City; the residential area is Fengshan District of Kaohsiung City; the industrial area is the Linyuan District of Kaohsiung City.
2. Selected analysis time: Chinese New Year time period (2022/01/29-2022/02/06) and 9 days before and after. 2022/01/29-2022/02/06 means the time during the New Year's

holiday; the other 9 days before and after are normal working days.

3. Download the PM2.5 data results detected by the stations of the Environmental Protection Agency, Executive Yuan.
4. Use Excel to draw and compare differences in PM2.5 and differences in results.

Method

1. We used the open data from Taiwan Air Quality Monitoring Network worked by the Environmental Protection Administration Executive Yuan. It provides hourly monitoring data from every monitoring station around Taiwan.

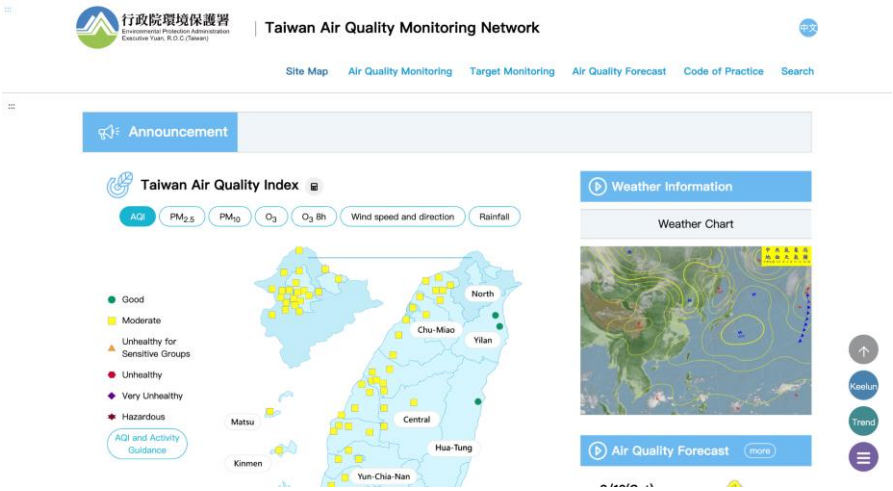

Figure.1 Taiwan Air Quality Monitoring Network's website

2. We used Microsoft Excel to analyze those data and make figures.

Results

The Lunar New Year is an important festival in Taiwan. It is the first five days of the January of the lunar calendar. During these five days, most companies and factories will shut down and take holidays. People often go back to their hometowns during this time to

celebrate the New Year and reunite with their families, and use this time to travel to other places. During these five days, the tide of people in Taiwan will move from the usual work area to the residential area, cultural and educational area. This year (2022), Taiwan's Chinese New Year holiday will last for 9 days from the weekend before New Year's Eve 01/29 to 02/06. We use the 7 days of the Chinese New Year holiday and 9 days before and after it, with a total length of 27 days as the research and analysis time.

We believe that the shutdown of factories that emit a large amount of PM2.5 in the past five days may cause the local PM2.5 concentration to drop; on the contrary, cultural, educational and entertainment areas with low PM2.5 concentrations may be affected by the traffic and crowds during the New Year. Come and make the PM2.5 concentration rise. Therefore, we have selected the following areas as the industrial area, cultural and educational area and residential area. In addition to the area where our school is located, the cultural and educational area also selects the Xinyi District in Taipei, which is the most lively and prosperous area in the capital of Taiwan. , and conduct research according to the data found at the following stations.

Choosing the regions for our research.

1. Qianjin District as a cultural and educational area : Located at the southwest end of Kaohsiung City, it has administrative, cultural and educational functions. Many government agencies and schools are located here. It is an urban functional area focusing on cultural education and scientific research.

		
Figure.2 The location of the PM2.5 station	Figure.3 The view next to the PM2.5 station	Figure.4 The feature of Qianjin District

2. Xinyi District as a cultural and educational area : Located in the very center of Taipei City, it is an area where commercial facilities, especially banks, financial centers, and shopping malls gather. Taipei World Trade Center and Taipei 101 are located here. On average, there is one department store per 0.5 square kilometers. It is the third-level administrative area with the highest concentration of department stores in the world. Many corporate headquarters and financial headquarters are located here.

		
Figure.4 The location of the PM2.5 station	Figure.5 The view next to the PM2.5 station	Figure.6 The feature of Xinyi District

3. Fengshan District as a residential area: Located in the southwest of Kaohsiung City, it is the most populous district in Kaohsiung City.

		
Figure.7 The location of the PM2.5 station	Figure.8 The view next to the PM2.5 station	Figure.9 The feature of Fengshan District

4. Liyuan District as an industrial area : Located at the southernmost tip of Kaohsiung City, the government has built a petrochemical industrial zone here since 1973. It is an important center of Taiwan's petrochemical industry. There are more than 20 manufacturers setting up factories, and air pollution is extremely serious.

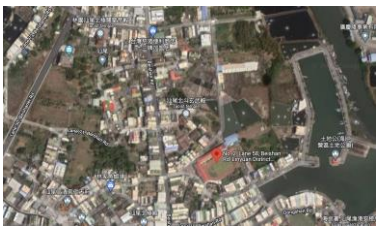		
Figure.10 The location of the PM2.5 station	Figure.11 The view next to the PM2.5 station	Figure.12 The feature of Liyuan District

Analyzing the PM2.5 concentration of four chosen area

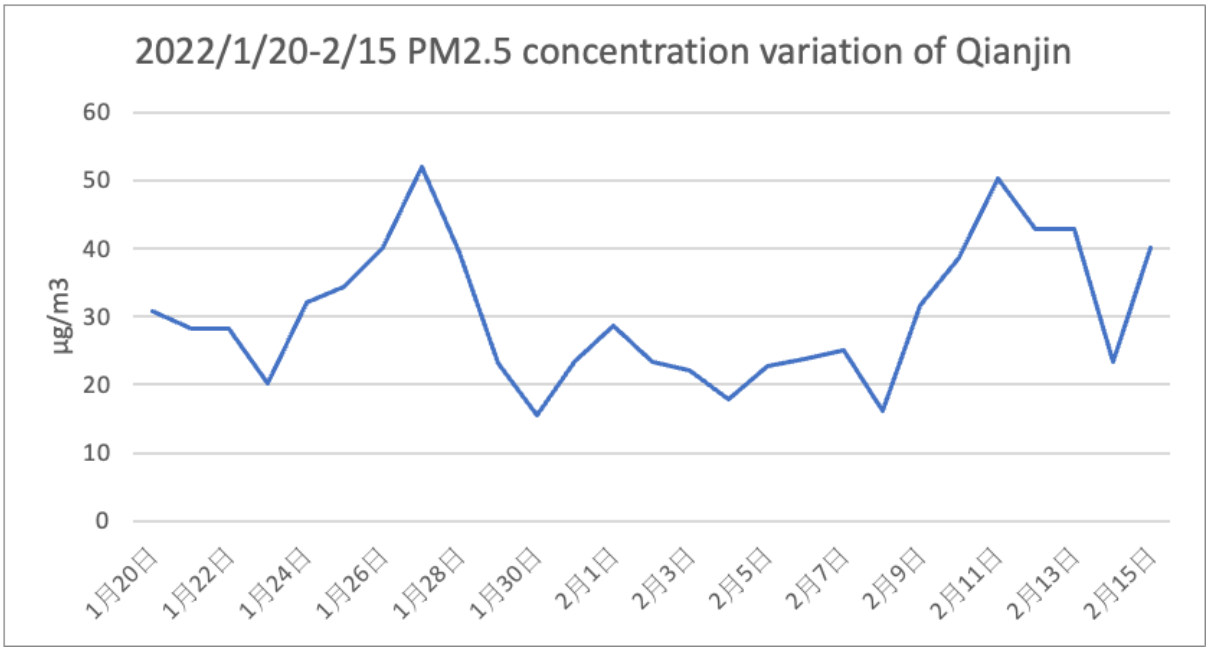

Figure.13 2022/1/20-2/15 PM2.5 concentration variation of Qianjin District

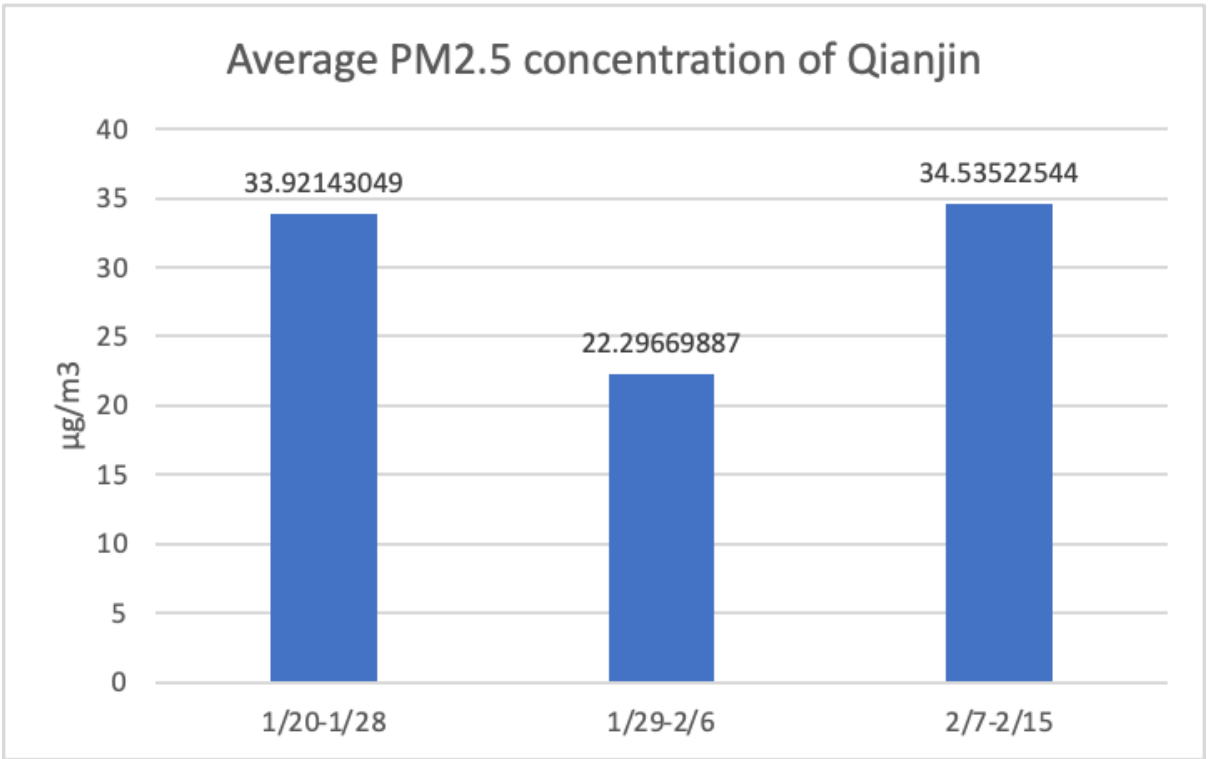

Figure.14 Average PM2.5 concentration of Qianjin District

From the analyzed data, it can be found that the PM2.5 concentration was low on 1/25 (the day before the Spring Festival holiday), and then continued to rise. On 1/27, the day before the Spring Festival holiday, it reached the highest value for 27 days, and after 1/30 was significantly reduced, and the values remained low for many days afterward. On 2/8, which is the beginning of the day when the Spring Festival ends, the PM2.5 concentration began to rise, reaching about 50 μg/m3 on 2/11, reaching the second peak in this graph. From the average data of 1/29 to 2/6 from 1/29 to 2/6, it can be seen that it is lower than normal days, so it is speculated that it is a positive holiday effect.

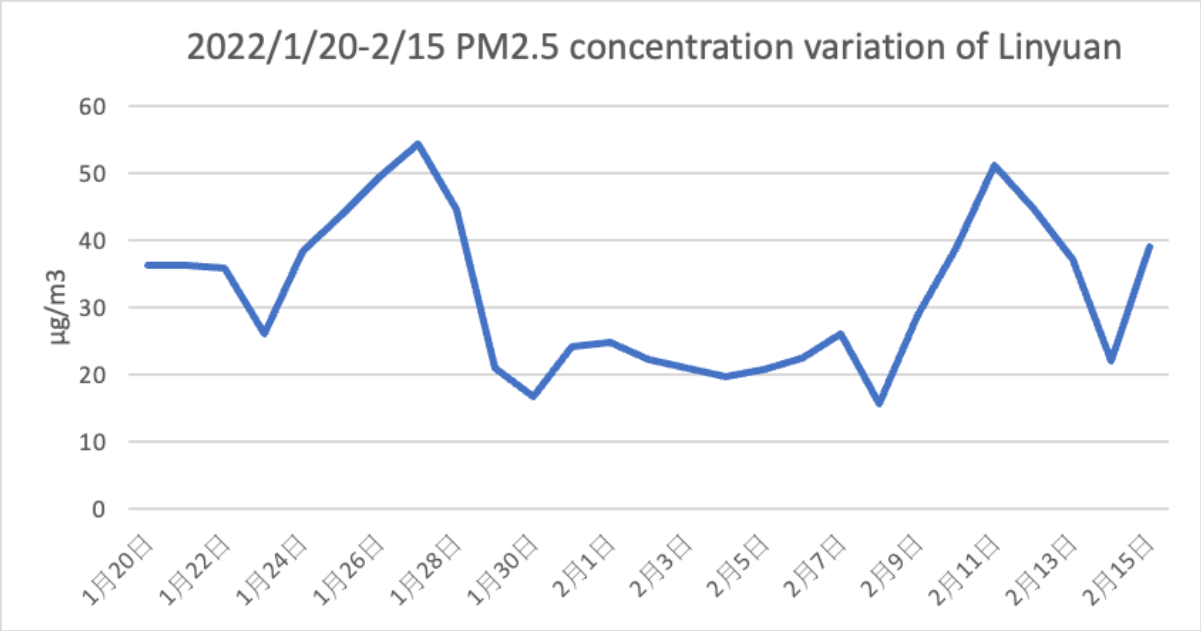

Figure.15 2022/1/20-2/15 PM2.5 concentration variation of Linyuan District

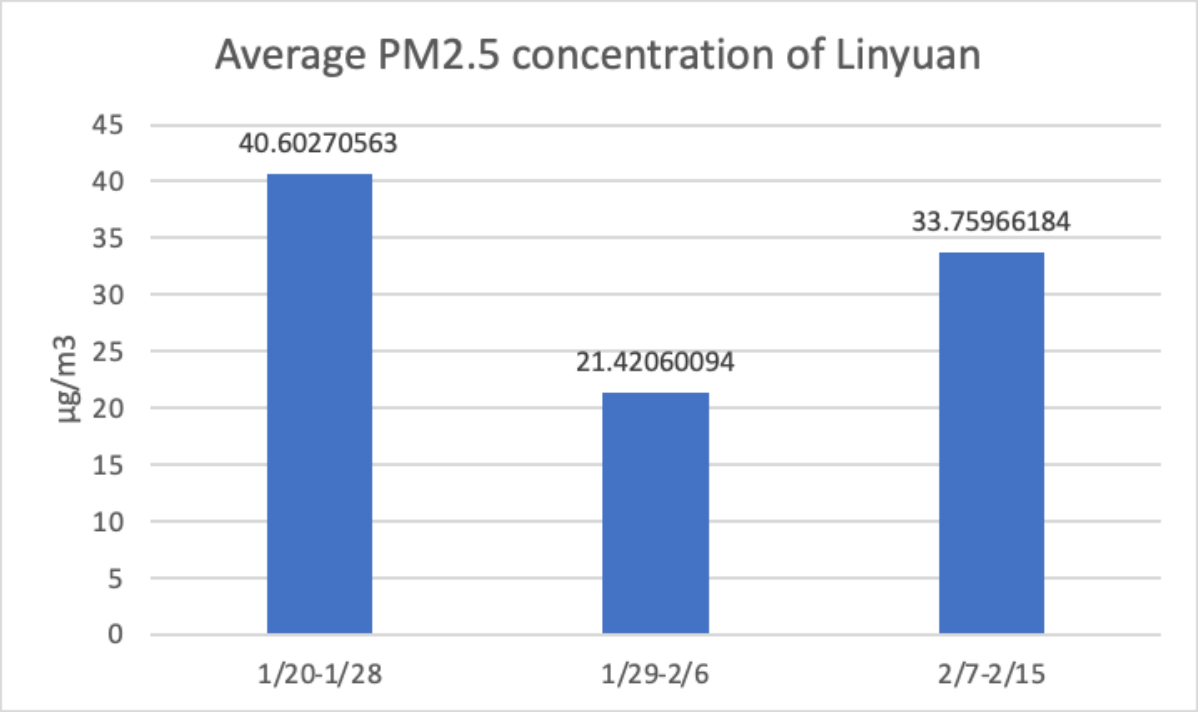

Figure.16 Average PM2.5 concentration of Linyuan District

Linyuan district is an industrial district, where the PM2.5 concentration is usually high, and the air pollution is extremely serious. However, it can be clearly seen from the figure that the PM2.5 concentration dropped by a factor of two during the Spring Festival, from 40.60 μg/m3 to 21.42 μg/m3, and immediately after the holiday, the PM2.5 concentration rose to 33.75 μg/m3.It can be seen that there is a very obvious positive holiday effect. It is speculated that many factories were on holiday during the Spring Festival, and the emission of exhaust gas was greatly reduced.

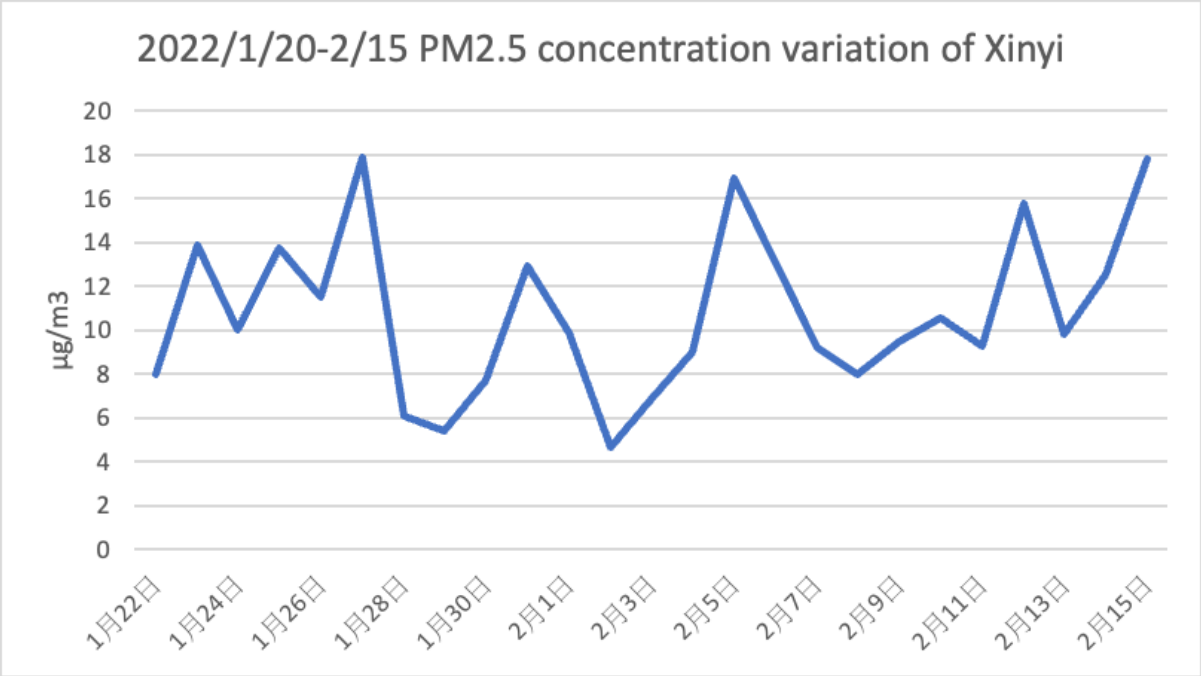

Figure.17 2022/1/20-2/15 PM2.5 concentration variation of Xinyi District

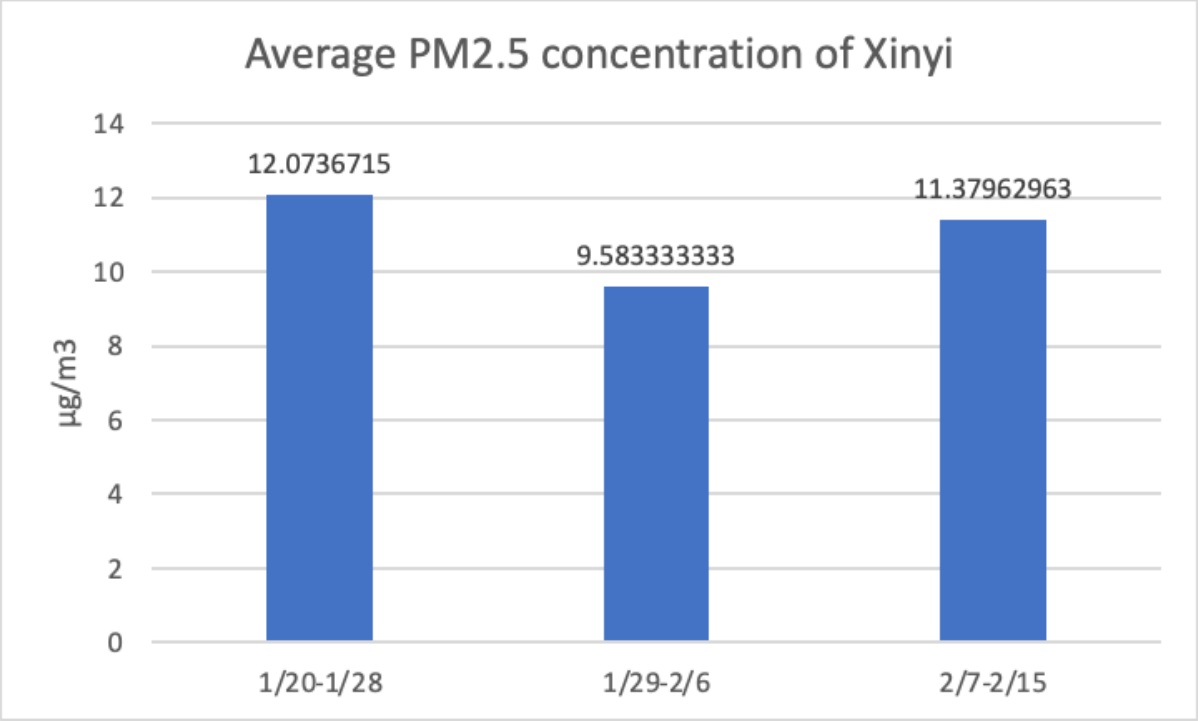

Figure.18 Average PM2.5 concentration of Xinyi District

After discussing the data of the Qianjin District in Kaohsiung City, we found that the difference is not significant, so we decided to use the most prosperous Taipei Xinyi District in Taiwan as one of the research targets.

From the data, we can know that the PM2.5 concentration in these 27 days varies widely, and there is no particularly high or special situation during the consecutive holidays. From 1/29 to 2/6, the PM2.5 concentration was 9.58 μg/m3, which was slightly different from the 12.07 and 11.38 μg/m3 during normal work hours. Judging from the definition of "urban air pollution concentration will decrease during holidays", we still can see a positive holiday effect in Xinyi district.

Discussion

Changes in air quality during Chinese New Year are an issue that deserves attention. In Li Chong-en's research (2018), it was mentioned in the analysis of the environmental factor changes of multiple consecutive holidays in western Taiwan that the CO and PM10 in northern Taiwan had a positive holiday effect, which was defined as the urban air pollution concentration would decrease during holidays, while the southern part of Taiwan had a positive holiday effect. Then there is the negative holiday effect, which is defined as the increase in air pollution concentration during holidays. Other research investigated many consecutive holidays in Taiwan, but we only focused on the Lunar New Year period.

From the results of both Qianjin and Fengshan District, it can be seen that the two peaks of PM2.5 concentration occurred in the first and last two days of the beginning and end of the Spring Festival holiday. It is speculated that these two days are the time when the traffic flow increases because many residents in Kaohsiung usually live there. If you work in the north, you will only come back to your

hometown in the south during the Chinese New Year. Although the Qianjin District of Kaohsiung City is a cultural and educational area, there are also a lot of apartment buildings in the area, so it will be affected by the traffic flow. Except for the beginning and end of the two days, the concentration of PM2.5 during the rest of the holiday period was not as high as we expected. The reason may be that the local public transportation system is developed, causing Kaohsiung people to use the more environmentally friendly public transportation system when they play, instead of doing it on their own. Drive to. On the whole, the former gold area has a regular holiday effect, and there is no increase in PM2.5 concentration during consecutive holidays. Li Chong-en (2018) also mentioned that the traffic flow to return to the hometown and travel south during consecutive holidays may worsen the air quality in southern Taiwan, and tourists traveling south will inhale worse air.

Since there are mixed residences in Qianjin District area, we want to eliminate the influence of returning people, so we chose Xinyi District, Taipei City. This area is a cultural and educational area with developed commercialization in Taipei City. There are few residential buildings, most department stores and Commercial office buildings, and the local mass transportation system is also very developed. From the Figure, we can see that during the Spring Festival, the PM2.5 concentration in Xinyi District and Qianjin District is low, which is a normal holiday effect. However, there was little difference in PM2.5 concentration between holidays and non-holidays in Xinyi District, indicating that there was no significant reduction in the number of people or traffic in the office building during the Spring Festival holiday. We speculate that the emitters of PM2.5 concentration are tourists during the Spring Festival, and usually work staff, which shows a large number of tourists.

Linyan district of Kaohsiung City is an important gathering place for factories in Kaohsiung. The main source of PM2.5 emission is air pollution during the operation of the factory. Therefore, we speculate that the PM2.5 concentration will decrease during the Spring Festival holiday for staff and temporary factory breaks. Seeing a clear holiday effect of lower PM2.5 concentrations during holidays from Figure, the results are in line with our hypothesis.

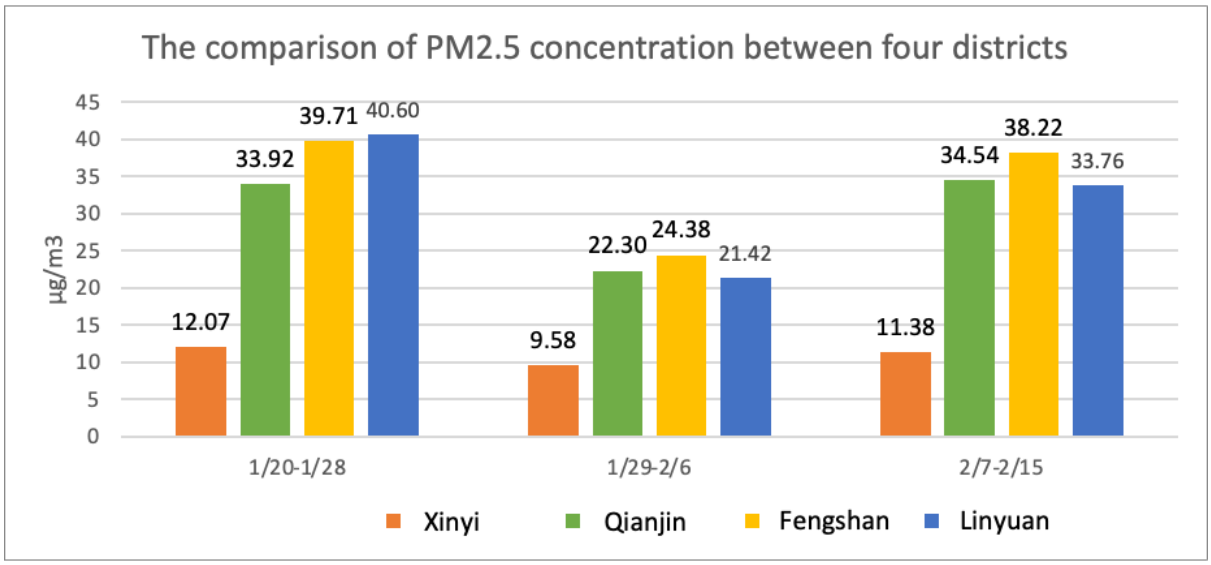

Figure.19 The comparison of PM2.5 concentration between four districts

We can also see from the Figure that in the past 27 days, the PM2.5 concentrations in Qianjin, Linyuan, and Fengshan districts **in** Kaohsiung were higher than those in the Xinyi district. The possible reason is that the monsoon direction of the Spring Festival is the northeast monsoon, which will affect northern Taipei. The pollution is brought to Kaohsiung in the south, and most of the public travel to Xinyi District is by MRT or bus, which reduces PM2.5 emissions. Compared with other areas, the source of PM2.5 in Linyuan District is cars, and the source is a large amount of industrial manufacturing. It

emits PM2.5, so the PM2.5 concentration on weekdays is the highest among the four.

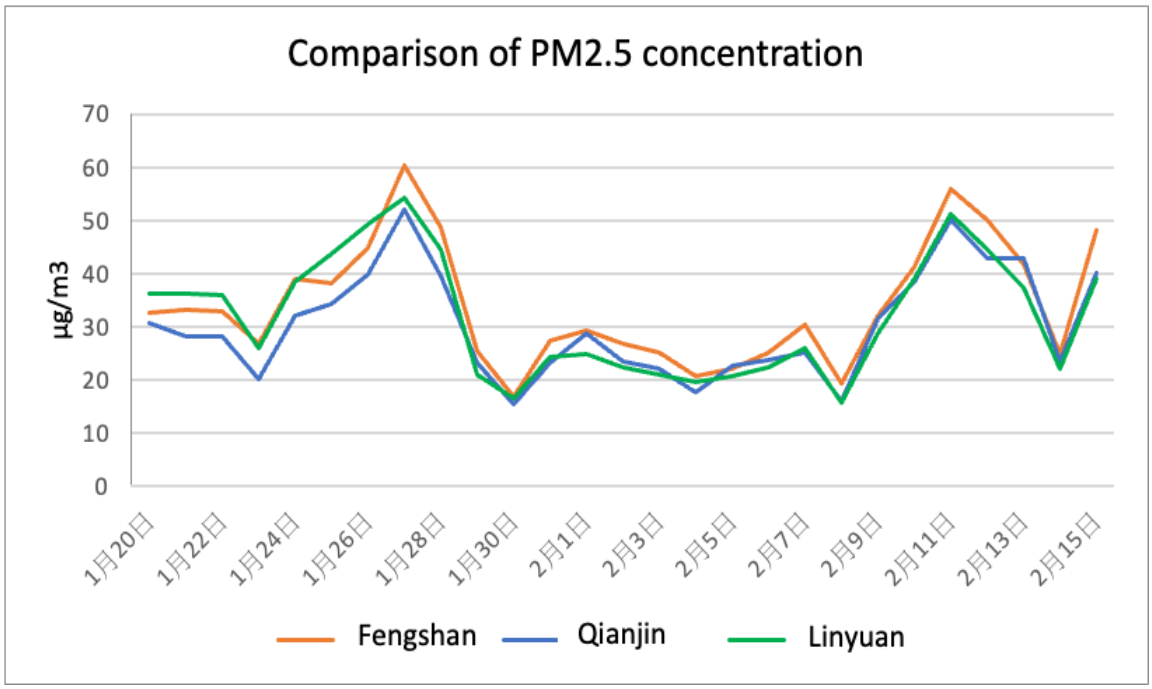

Figure.20 The comparison of PM2.5 concentration between Fenshsan, Qianjin, and Linyuan

Conclusion

According to our research, we found that …

1. During the Spring Festival holiday, the PM2.5 concentration in the industrial park is significantly lower than usual because many factories are on holiday during the Spring Festival, which greatly reduces exhaust emissions.
2. During the Spring Festival holiday, the concentration of PM2.5 in Qianjin District of the Cultural and Educational District did not increase due to the return of hometown and tourist crowds, and the holiday effect still occurred.
3. During the Spring Festival, Fengshan District, a residential area, also had a holiday effect.
4. We expected that the Xinyi District of Taipei, which is located in the center of the capital city, where tourism and commerce are

highly developed, will have a positive holiday effect. However, our research results show that the PM2.5 concentration in Xinyi District is still slightly reduced during the Spring Festival, but the detailed reasons remain to be clarified.

Future outlook

1. Find the places in Taiwan with the inverse holiday effect
2. Due to the different sources of PM2.5 in the four regions, and currently only large-scale tourist attractions in Xinyi District have statistical data on crowds on the Internet, we still want to analyze the crowds and traffic statistics during the selected time period and compare the PM2.5 concentration.