Perceived Health Benefits of Green Space and Air-Quality Among Student Populations in Shanghai: A Comparative Study of Yangpu and Fengxian Districts

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Abstract

Air quality and green space are becoming more and more important in modern-day planning. Air quality is an essential part of urban health, if the air quality is bad, more health complications arise and thus costs rise. Green space is essential for urban health to mitigate air quality problems as well as improve mental health and increase physical exercise. Shanghai, China is regarded as a green metropolitan region that has spent a lot of effort to reduce its air pollution and increase its green space. To gain more understanding of a currently underrepresented population, a younger generation of 2 districts in Shanghai are chosen to study the difference in perceived health to gain a deeper insight into possible inequality between more central and less centralized areas of the city. In the end the research question: " How do green space and air quality policies impact the perceived mental and physical health of younger generations of citizens in different neighbourhoods of Shanghai?" is answered. The results show that there is no difference between the districts but that greenspace does have an impact on health while gender and age do not have an influence. There is however a difference in how men and women experience current air quality, with women experiencing it worse. For future research, more effort needs to be put into obtaining larger samples and looking into medical data to see if air quality has indeed had no effect since perceived physical health can be different from physical health.

Contents

1. Introduction

In recent years, the world has spent much attention on climate change. Within climate change, there are different themes: where it originates from, who is responsible, who will be most affected, and many more themes can be thought of. It is a highly complex problem which is challenging both academics and politicians. Finding one solution to the entire issue is nearly impossible, and thus different layers are necessary. The international cooperation as a result of the Paris Agreement shows this too. The Paris Agreement sets targets and rules that countries collectively have to meet, such as the maximum 1.5 Celsius degrees increase of the global temperature compared to the pre-industrial level. Countries have to solve this together, but the United Nations cannot make rules specific for each country, thus they have to come up with their own strategy known as “nationally determined contributions” in Article 3 (United Nations Framework Convention on Climate Change, 2016).

In the same way that this process works on an international scale, similar developments happen on a national scale, where central governments set targets that need to be met by local governmental institutions. This system of decentralisation of governmental tasks can also be observed in China. An example is the 2013 clean air action plan(Clean Air Alliance China, 2013) that helped decrease the rampant air pollution in large Chinese cities and their surroundings by giving local governments clear directions to execute the overarching national strategy.

These ways of decentralisation show that large-scale problems are better to solve on a smaller scale. This is done to, for example; increase the citizens' involvement, and increase efficiency and lower costs that the system of government is making (OECD, 2020). Distance between different parties is already apparent between different levels of government, it is however also visible between governments and the population. Even though decentralisation aims to decrease the distance between the government and the population, this can still occur. If done incorrectly, decentralisation can even lead to more distance between the government and the population (Lele, 2012). The combination of all before mentioned subjects shows that local initiatives of global or national agreements or policies can have large effects on the local scale.

To further understand these occurrences, this research looks into a combination of the mentioned factors. There is a lack of data and research on the topic of inequality caused by environmental policies on smaller scales.

This research aims to get an insight into the inequality caused by environmental policies on residents in Shanghai, China. It focuses on the younger generations of the population in the Yangpu and Fengxian districts (Figure 1). The age category between 18 and 30 is chosen due to the scarcity of data and research on this age group and this generation will be living in and under the new policies in the future, more research is needed to make sure they benefit most. The specific districts are selected due to the different nature of location, but similar young populations. The inequality analysis is based on the directly visible effects the policies have on the citizens, such as air quality and available green space, data which is directly available. On top of this, an analysis of perceived mental and physical health is done to understand the personal experiences of residents, in connection to environmental policies, better. Focusing on these topics is important since the Chinese government is putting extra emphasis on the development of such policies. On top of this, more attention needs to be given to the people who may be disadvantaged by the policies, to create rational policies.

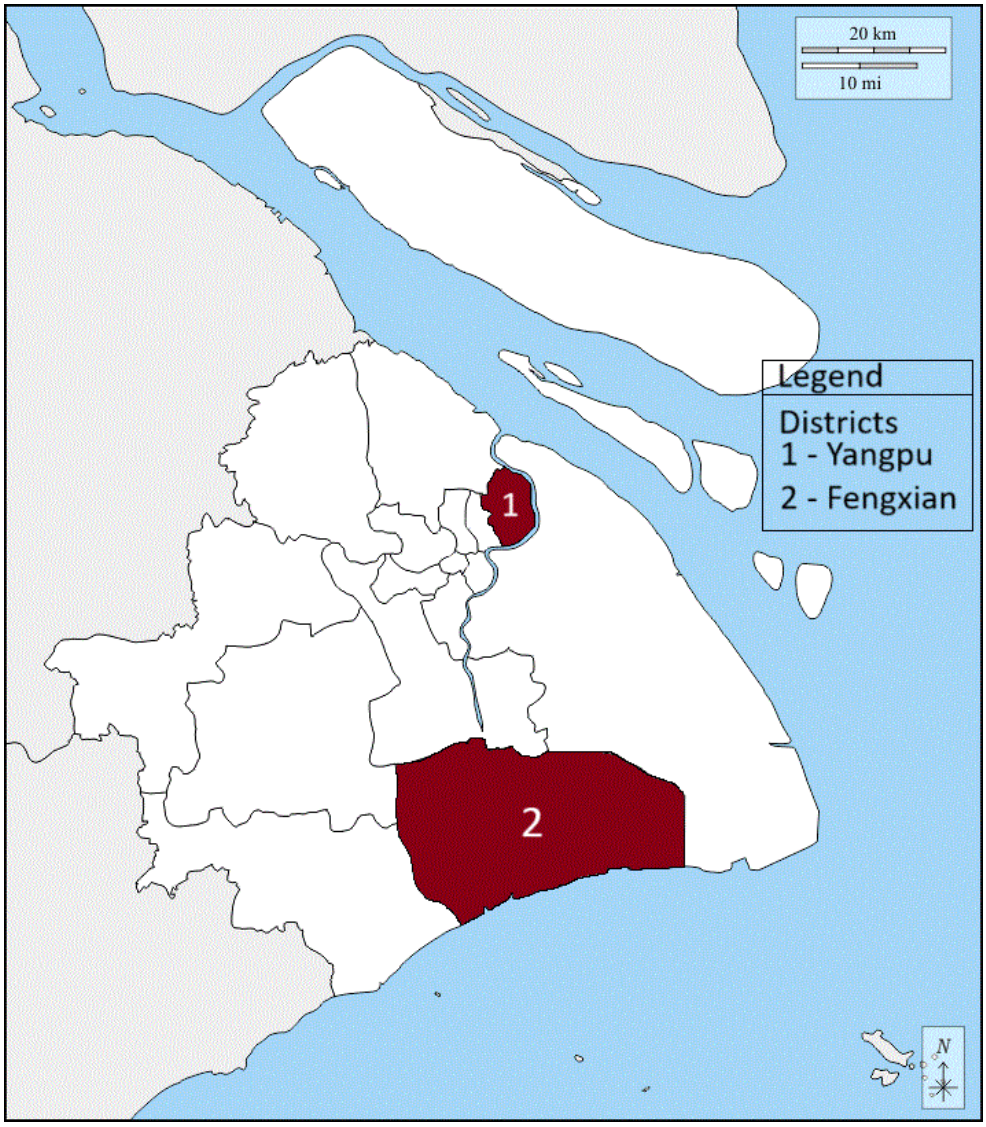

Figure 1: Location of Yangpu and Fengxian in the greater Shanghai region

This research aims to answer the question: "How do green space and air-quality policies impact the perceived mental and physical health of younger generations of citizens in different neighbourhoods of Shanghai?" The question is a combination of all the previously mentioned subjects: air quality, green space, health, and age in two different neighbourhoods. In this research, additional research questions are looked at, namely: What are the existing policies, and what is the process of implementation, what effects and health effects can be attributed to green space and air-quality policies, and who is most affected? With the presented questions, this research aims to gain better insights into how environmental policies impact people and who is impacted most, with a special focus on Shanghai. The questions; "What are the existing policies, and what is the process of implementation?" and, "What effects and health effects can be attributed to green space and air-quality policies?" are going to be discussed in the literature review, with the question "Who is impacted most?" being discussed in the quantitative research.

This research is conducted based on studies of literature and quantitative research. There will first be a section dedicated to the broader problem and recent events, on which quantitative research on these topics is conducted to gain more insights into the presented research theme. After this, a conclusion is drawn based on the literature and quantitative research.

2. Literature review

2.1. The effects of urban green space in Neighbourhoods

In Shanghai green space exists in harmony with the urban structure. The government in Shanghai also sees it as one of the important matters they are dealing with. In the a recent policy document presented in the Shanghai Masterplan of 2017 emphasis on green space is apparent (Shanghai Urban Planning and Land Resource Administration Bureau, 2018). This all is not for no reason. Green space is found to help with mental health, which is especially true for dealing with stress. The amount of stress can be mitigated thanks to green space. A lack of accessible urban green space, either a park or a private garden, can lower levels of stress (Nielsen & Hansen, 2007). Further research on this topic is available, proving the point further. The accessibility to the urban green space is one of the key factors (Grahn & Stigsdotter, 2004), this with the coverage in Shanghai is done fairly well, but the government still wants to further improve on this. Not only is stress a factor, but research suggests that also anxiety and depression can be lowered by green and blue space, on top of this air pollution is linked as a mediator to this green and blue space showing the potential effects air pollution has on health effects presented by green space, since blue space is regarded as less significant in this research (Gascon et al., 2018). The effects of green space are felt differently and experienced differently by each individual. Gender and age are essential to take into account. Often, plans and policies are made for the people but not for an individual, taking factors such as age and gender into account can help to improve existing policymaking processes. According to Sang et al. (2016), gender and age are highly influential on both green space usage as well as the perception of said green space.

Many of the fore-mentioned factors are once again restated by Nieuwenhuijsen & Khreis (2018). One additional and essential point that is however mentioned in great detail in this book is the positive effects green space can have on physical health as well and that this is most prominent in large urban settlements where, logically, there is a lower percentage of ground covered by green space. It is pointed out that green space helps to decrease cardiovascular disease and obesity, as well as raspatory diseases. Services green space provides are not always directly visible. One of the side effects green space can provide is increased physical exercise (Kabisch et al., 2017, 187-205) which is linked again to the decrease in cardiovascular disease and obesity in urban areas. All this combined shows that a good amount of green space is essential in an urban landscape, for both the attractiveness aspects and urban health due to decreased air pollution and an increase in the citizens' health.

2.2 The effects of air pollution in nNeighbourhoods

Data on air pollution is readily available, it is therefore not a shock for people to learn that bad air quality is linked to a multitude of health implications. Different exposures can result in a great quantity of health implications for a city's inhabitants. Air pollution is generally measured by looking at unacceptable amounts of particulate matter and gasses that can be harmful in larger quantities. The most important measurement of air pollution is the tracking of the particle type PM2.5, which can cause a multitude of diseases such as premature arteriosclerosis (Bourdrel et al., 2017). Not only the Pm2.5 (measured in micrometres) values of greenhouse gasses are influential, but others are critical as well, especially for larger metropolitan areas. Values of gasses such as CO, O2, N20, and SO2 are essential to further understand both the sources as well as the health effects that may be expected in the long run (World Health Organization, 2022). High levels of CO, N2O, and SO2 can be traced back to the burning of (fossil) fuels, which in eastern coastal Chinese Metropolitan cities can largely be attributed to transport and industries (Mao et al., 2022). One of the clear visible effects of air pollution is smog, which Shanghai was, until recently, famous for. This smog is caused by pollutants, mostly N20 and O2, and sunlight colliding, this is known as photochemical smog (Haagen-

Smit, 1950, 3-7). This smoke is once again caused by transport and industries. Shanghai, being the largest city in China, fits well within this narrative of industry and transport with one of the most influential trade-free zones being opened in the city, resulting in Shanghai having the largest port in the world and being the gateway to international trade. Both city transport (think of cars, buses, and trains) and industry emits these polluting particles. In combination with the largest port in the world, air quality seems to be in a challenged position. Industrial zones are scattered through the city, which on the one hand offers more dispersion and dilution potential for greenhouse gasses, but on the other hand, results in more air pollution potential throughout the entire metropolitan area (Figure 2).

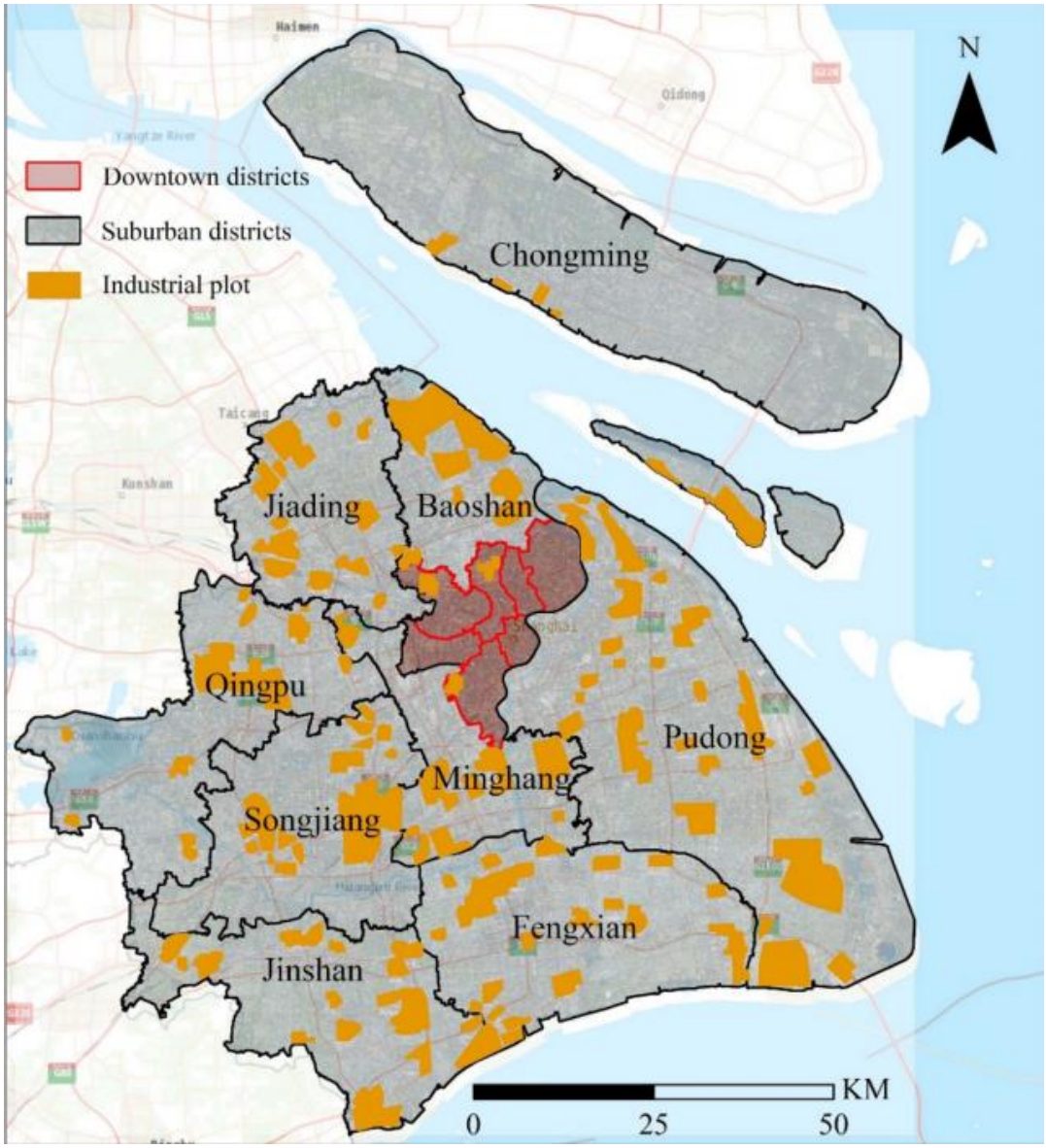

Figure 2: Locations of industrial plots in Shanghai (Yang et al., 2022, 4)

Focusing on the finer details of health implications caused by substandard air quality, multiple points can be observed. Different exposures and different pollutants can result in different medical conditions, as mentioned before, long-term exposure to PM2.5 can result in premature arteriosclerosis and many other cardiovascular diseases, and different age groups experience this differently. Whilst the elderly experience high medical effects from PM2.5, younger generations have more trouble dealing with NO2 particles (Bourdrel et al., 2017). People living in cities with large quantities of particular matter of 10 or smaller experience higher respiratory

diseases as well, resulting mostly in higher percentages of lung cancer under the cities' population, which can increase up to 5% per 10 µg/m3 PM10 (Brunekreef & Holgate, 2002). These results expose the need for well-coordinated planning structures for the benefit of the people within cities.

2.3 Inequality within city lines

New policies that help people in their day-to-day lives, be it green space-related or air-quality-related, are made to be beneficial to the entire population. Matters become more interesting as soon as more detailed studies on policy dispersion are done, these result in bias and inequality in cities and outside cities. Most essential places in cities are often regarded as the densest, most economically prosperous, and most tourists attractive parts, which can result in differences in accessibility to services and the formal job market (United Nations Department of Economics and Social Affairs, 2020). On top of this, health and education are found to be limited by socioeconomic status in large metropolitan regions, resulting in an overall less healthy population which has a lower probability of acquiring adequate healthcare solutions as well as diminished chances to become part of a higher socioeconomic group, resulting in a spiral for the inhabitants of less developed areas (OECD, 2020; Glaeser et al., 2009). Combine this lack of adequate healthcare with the high levels of air pollution and problems could arise. Additionally, as a result of the air-quality degradation healthcare costs have skyrocketed which is especially prominent in greater cities in eastern and the middle of China (Shen et al., 2021), lowering the aforementioned pollutants may therefore result in a lowering of the healthcare costs which is especially interesting for less economically developed neighbourhoods of the city since they experience disproportionately higher levels of air pollution compared to well-developed parts of cities for all the aforementioned pollutants (Wang et al., 2021). No data was found on the average income of the districts, but direct confirmation of the expected outcome was given by residents of the areas in short talks online. The expected outcome is that Yangpu is more prosperous than Fengxian and thus has better services.

2.4 Existing policies and implementation

The government of China has spent a tremendous amount of effort to increase the air quality and increase the amount of green space. In order to create well-thought-out and integrated policies, extra efforts and monetary funds need to be assigned. Observations of the rampant air pollution in its country made the Chinese government take action. The national government set goals in different plans over different periods, that local governments have to meet in order to lower air pollution. Multiple plans were made to combat bad air quality, one of these is the nationally made 5-year plan of 2006 (The State Council Of The Peoples Republic Of China) which started of air-quality adaptation policies when the government saw the influence the air had on the citizens. In this 2006 document (The State Council Of The Peoples Republic Of China), sulphur-dioxide levels were mandated to be lowered by 10%. Even though this was a first step in developing air-quality action plans, the aforementioned PM2.5 levels continued to rise in urban settlements during the implication of these 5-year action plans. These 5-year action plans turned out to not be enough.. In 2013 the State Council of the People's Republic of China (2013) came up with a policy document, the Air Pollution Prevention and Control Action Plan. In this document, a multitude of measures to lower the concentrations of influential pollutants such as PM2.5, PM10, NOX, SO2, O3, and CO (Clean Air Alliance China, 2013). This document describes that PM10 levels should be 10% lower in 2017 than they were in 2012, coal burning should be reduced, heating should be centralized, industrial complexes should restructure and invest in systems and practices that lower the emission of SO2, NOX and PM2.5/10, increase standard fossil-fuelled vehicles, increase the pressure to dispose of outdated and polluting vehicles, increase the quality of energy production and aim for more sustainable alternatives. This policy was proven effective and reduced all levels of pollutants (Aunan et al., 2018). On top of the presented plans, a three-year plan was put in place by the

central government, the Three-Year Action Plan for Winning the Blue Sky Defense War (The State Council Of The Peoples Republic Of China, 2018). In this plan, comparable statements are presented as in previous plans, but it was launched since most cities still experienced higher levels of pollution than the required levels the central government set in the 2013 plan. The effectiveness of the plan is arguably high, but factors such as weather, unknown sources of the solutions and the COVID-19 pandemic (which drastically reduced emissions in cities) make hard-proven conclusions impossible at this stage (Dai et al., 2022). Implementation of these policies is done by local governments, they come up with strategies that incorporate the essential parts of governmental policy documents in their plans to meet the central set goals (Aunan et al., 2018). The local government in Shanghai incorporates plans for the city in their own action plans (Shanghai Municipal People's Government, 2021). In this action plan, green space can be regarded as essential, but why such a large amount of thought is put into green space is not mentioned. In the Shanghai master plan 2017-2035, more details are covered. The city wants to be more climate resilient and be more inviting to go out, but further reasons can be thought of. One of these is helping with the problem of air pollution, small parks can already help reduce air pollution, which in turn can reduce earlier discussed health risks (Liu & Shen, 2014). On the notion of green space, Shanghai can be seen as striving to become the greatest metropolitan region. In their Shanghai master plan 2017-2035, a high degree of thought can be observed that is put into developing more and better green space which, in addition, is more accessible to the inhabitants. Values of 4m2 of green space per inhabitant, 90% of parks and squares (larger than 400 square meters) accessible by foot in 5 minutes, 23% forest and 60% ecological land coverage, and the addition of more larger and smaller parks show an interest in becoming a green city. Since a lot of emissions come from traffic in a city, especially NOX emissions (Mao et al., 2022), shanghai has also chosen to make 85% of public transportation green and improve on its existing public transport network (Shanghai Urban Planning and Land Resource Administration Bureau, 2018). All these plans talk about the entire city, but not much detail about equal distribution is presented, besides mentioning that all services will be available for residents, and no comments or plans on how to make sure inequality will not occur are made in the Shanghai master plan 2017-2035 and this needs further attention.

2.5

Looking into all the details provided in the literature review, the expected outcome of the research question: How do green space and air-quality policies impact the perceived mental and physical health of younger generations of citizens in different neighbourhoods of Shanghai? Is that H0: *There is no significant difference in perception of mental and physical health between people from Fengxian and from Yangpu.* With the data given, it is now suspected that there is a difference since different locations in the city have different densities as well as different amounts of industry and green space coverage. It is suspected that the amount of green space in Fengxian is higher than in Yangpu, but that the quality and accessibility of the green space is better in Yangpu. Adversely, it is suspected that overall air quality in Fengxian is better than the air quality in Yangpu due to the high density and central location with the close proximity that Yangpu has to industry. Therefore, in the end results, it is expected to see that on the basis of mental and physical health, there is a difference in perceived health, with “worse” perceived health in Yangpu due to less green space and worse air quality. With the presented data a second hypothesis can be made. The hypothesis is: *The better the air quality and green space is, the better the perceived mental and physical health is.* Following the literature, it is expected that this hypothesis can be accepted.

3. Methodology

The research is based on knowledge gained through a combination of literature and quantitative studies. Due to the broad amount of general information on this topic, without specific details on the target group, more focus needs to be put into understanding this group in order to obtain more academic knowledge. To further expand on the knowledge a base understanding of the issue at hand is needed where in this case more details are acquired by reading academic articles, news articles and policy documents. This is the basis on which the literature review is made and on which the quantitative research is built. In this research, the choice was made to go for the quantitative approach of a questionnaire, this is done for multiple reasons. The research aims to find if there is inequality between larger groups in a population. Therefore, to find a general opinion, differences in experience, and the attitudes of the neighbourhoods, it is required to have larger sample sets and this is achieved with the quantitative methods. Interviews or other methods are not reasonable with the size of the required sample. On top of this, due to the type of research, sampling bias may increase by doing (for example) interviews. In order to find people to take part in an interview, they have to be picked by the researcher, which may increase the bias. It is, however, important to mention that the research was done remotely and that it was impossible to interview a group that would have been sufficient enough for relevant outcomes that would have been reliable enough to base a full research on. Due to cultural and ethical considerations, questions regarding socioeconomic status were not asked. There is no further need for this since there is a basis for it in the literature review.

To acquire the right type of respondents for the questionnaire, a choice was made to conduct research based on random sampling. This seems counterintuitive but was chosen to have less bias since people are not selected by the researcher and everyone has an equal chance to take part in the research. However, respondents were required to provide their age and district of residence to verify that they were supposed to respond to the research. Since the research is done on people in China, a Chinese questionnaire platform was chosen, namely WJX. This was chosen since people, especially in the age category, are more familiar with the system, and it is easily spread on Chinese social media, which in this case was done through WeChat. To make people feel more at ease and to be able to fully understand the questionnaire, it was fully translated into simplified Chinese (Mandarin). Different categories are present in the questionnaire (Appendix 1); general, air quality, green space, feedback on policy (dependent), and closing remarks. These topics are then subdivided to understand the mental and physical health of the responders linked to the subjects. This questionnaire is made out of the perspective of the government, thus the result wanted is: to find out if the policy is experienced positively by the people and to see if it is effective. This means that the comment to question 18 (Appendix 1), “What is your opinion on the effectiveness of government policies regarding green spaces and air quality in your neighbourhood?”, can be linked to their perceived mental and physical health. Showing a relationship between governmental policy strategy and its effects on the people in this age group. Linking this to the comparative study is done by comparing the people from Yangpu and Fengxian. Closing remarks are there to find out the general thoughts, feelings and ideas people have on air quality and green space policies in Shanghai. Although the last question will not be tested in any statistical form, it is still relevant since it produces a narrative and portrays the feelings people may have on how to improve the situation in their district.

To do a statistical analysis which is based on the assumption of statistical normality, the minimum number of respondents per sample of the population was set at 30. With this value, normality is assumed, and therefore further parametric statistical tests can be done that more confidentially describe findings than non-parametric alternatives. In the sample of Yangpu 41 respondents were achieved and in the sample of Fengxian 32 respondents filled in the questionnaire. All these responses were completely filled in and can be used for the analysis. This results in enough cases to assume normality. With this, descriptive analysis, correlation

analysis, and regression analysis can be performed. These were performed by using the software SPSS.

4. Results

4.1 Descriptive analysis

4.1.1 Demographic analysis

For the research, the aforementioned assumption of normality is used. The value each of the groups has to meet to confirm to the normality was set to 30. In the end, the sample obtained consists of 41 respondents in Yangpu 41 and 32 in Fengxian. An interesting statistic for this sample is that 45 (61,60%) of the respondents are female and 28 (38,4%) are male. Table 1 (Appendix 2)depicts the frequency at which the respondent's location is appearing in the dataset. It can be seen that the participants are relatively equally distributed. Age is however showing more frequency in the higher values between 24 and 30 taking up 86.3% of the responses. For this, there is no clear cause, and it can be the result of sampling error by choosing random sampling. The required minimum of 30 cases was however still met within the target group, it thus makes no difference for the research, but extra attention is helpful in understanding concluding take-home messages in further results.

4.1.2 Comparative analysis of location and policy awareness

To make sure respondents understand the questionnaire, a question about awareness of the air quality and green space policies was presented, along with a brief summary of some of these policies. Since the goal is to find a difference, a Chi-Square test was chosen in this situation. As can be seen in Figure 3, most of the respondents are at least somewhat aware of the policies in their district. It is however notable that a significant difference in policy awareness was observed following the Chi-Square test with a probability value of less than 0,05 (Appendix 2, table 2). Even though most of the respondents are somewhat aware of the policy, as can be observed in the graph below, respondents from Fengxian are significantly less informed about the air quality and green space policies of the government than residents from Yangpu.

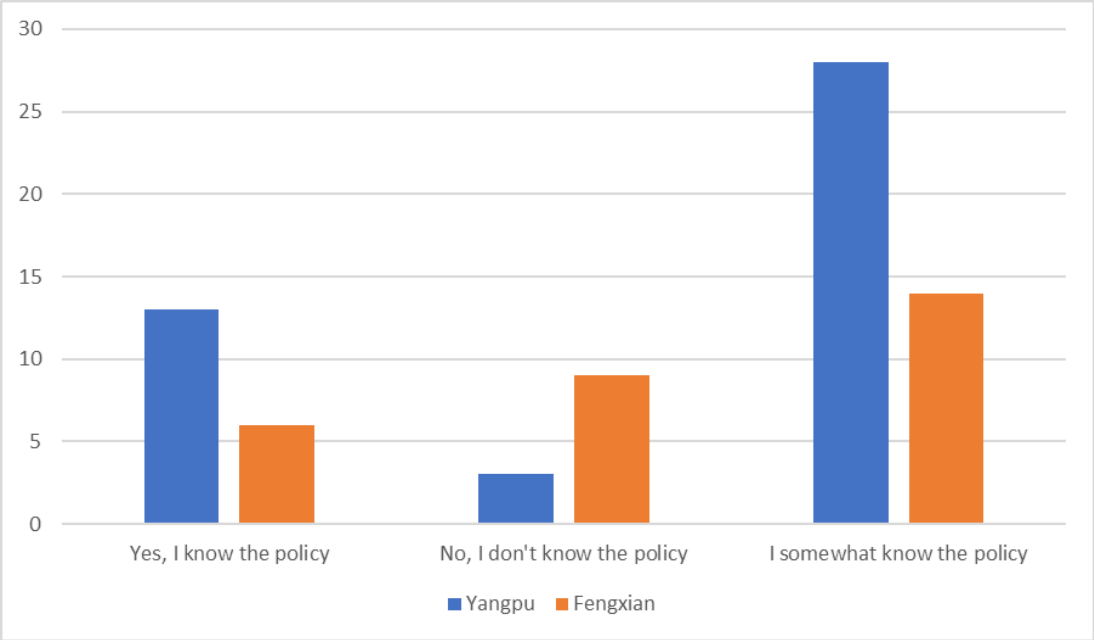

Figure 3: Graph of responses on policy awareness.

4.1.3 Gender Compared to current air quality

A result that was found, that the research was not aiming to find, is a statistically significant difference between perception of current air quality and gender. In this, it was found that females tend to rate the current air quality as worse than their male counterparts as can be seen in Table 3 (Appendix 2), with a probability value of ,031 which is below the ,05 test value. This is expected to be due to societal and cultural factors, since women spend a lot of time on health and healthy living, whereas men tend to do this less. It is however noteworthy that this is a finding based on prior observations, not a finding based on academic knowledge.

4.2 Correlation analysis

As can be seen in Appendix 1, perception of health is measured with multiple questions. A correlation test was conducted to check the correlation between the questions. The correlation analysis (appendix 2, table 4) showed that the effects of air quality on physical health and the effects of green space on physical and mental health did not significantly correlate. However, the variable “policy effectiveness” has significant positive correlations with all other variables. Besides, perceived physical and mental health from air quality are significantly positively correlated with each other, perceived physical and mental health from green space are significantly positively correlated with each other, and perceived mental health from air-quality shows significantly positive correlations with perceived physical and mental health from green space.

Reliability analysis, based on Cronbach’s Alpha as can be seen in table 5 (appendix 2), on the five questions measuring the perception of health, showed that all the five variables together had an α=0.771 which is larger than 0.6. Since the required value to meet reliability is equal to α=0.6, the 5 variables can be combined for further study, these variables will be referred to as “average health”. To deeply examine associations between variables, another correlation test was conducted as can be seen in table 6 (appendix 2). As can be seen in table 6 (appendix 2), only green space and perception of health have a significant positive correlation, indicated by the double stars. In this case saying that there is indeed a significant relation between (perception of) average health and greenspace. The other values did, however, not show a significant relationship.

4.3 Independent T-test

In order to analyse whether or not the average mental and physical health of respondents from Fengxian is different from the average mental and physical health of respondents from Yangpu. The value of "Average health" is presented in this way to deal with the merging of the variables, as shown earlier in this chapter. An independent samples t-test was performed with values for location and average health (table 7, appendix 2). To have a value to test against, the first hypothesis is tested.

Hypothesis: There is no difference in perception of mental and physical health between people from Fengxian and from Yangpu.

With the values of the aforementioned location and average health, the independent samples t-test turned out to be not significant with values far exceeding the 0.05 value required for the probability. Hence**,** it can be concluded that the average mental and physical health of respondents from Fengxian does not differ from the average mental and physical health of people from Yangpu.

4.4 Regression analysis

To analyse whether or not better green space and air quality lead to a better perception of mental and physical health. A linear regression analysis of green space and air quality on participants' mental and physical health was performed (table 8, appendix 2). The results show that VIF, which measures multicollinearity, is very low, close to the minimum of 1 and smaller than 5, therefore there are no problems with multicollinearity for estimating this regression model. The R-square reveals a significant effect. Moreover, there is a significantly positive relationship between green space and the perception of mental and physical health. However, there is insufficient evidence to conclude that perception of mental and physical health is associated with air quality. Besides, it is shown in the regression model that the perception of mental and physical health in Yangpu is slightly lower than in Fengxian, but this difference is not significant, it is however a noteworthy finding since it could be that the differences could increase over time if this is for example due to deliberate differences in policies. For the local government, it could be helpful to keep this in mind. All this results in the rejection of the hypothesis "The better the air quality and green space is, the better the perceived mental and physical health". A side note to make is that half of the hypothesis can be accepted since green space indeed does influence mental and physical health significantly, but air quality does not.

5. Discussion

The introduction raised questions which are partially explained in the literature review. In this, a base understanding of the important concepts is given, as well as a broad comprehension of how in other contexts these concepts play out. This discussion dives deeper into understanding the findings and relating them to the existing literature. The main concepts are of course air quality, green space, mental health, and physical health but these can be related to location, age and gender. The aforementioned socioeconomic status is not deeply discussed, this is due to the lack of reliable data.

5.1 Green space findings

Looking into the different aspects of the literature review, a start was made by explaining the effects green space has on inhabitants, for both mental and physical health. Looking into the results obtained from the quantitative research on the citizens in Yangpu and Fengxian it can be seen that according to the values, there is a significant and positive relationship between green space and one's mental and physical health. This is in accordance with the findings presented in the literature review in chapter 2.1. In accordance with findings from Nielsen & Hansen (2007) and Kabisch et al. (2017, 187-205) it was found that green space in Yangpu and Fengxian significantly lowers stress and increases physical health. Looking at the usage for different genders and age groups shows that the values are not in line with what is expected from the research of Song et al. (2016). According to the values of P=,224, gender does not significantly affect the usage of green space, as can be seen in Table 9 (appendix 2). Age showed similar results with no significant difference between age groups with a probability value of ,514 as can be seen in Table 10 (appendix 2).

5.2 Air-quality findings

Data presented in Chapter 2.2 presents a grim picture of possible outcomes of bad air quality. In this research, a focus was put on the younger generation and according to Bourdrel et al. (2017), younger generations have to deal with a higher sensitivity to NO2 particles, as well as an increased chance of lung cancer (Brunekreef & Holgate, 2002). The results of the quantitative research show different values. Whilst not directly asking respondents questions about NO2 particles and lung cancer rates, they present that there is no significant relation between their mental health and air quality, as well as their physical health and air quality, even though other studies present a higher potential of raspatory decreases.

Looking into current-day perception of air quality shows a significant difference in experience of air quality between men and women, with women perceiving it as worse than men. Whilst the research did not set out to find this information, it shows relevance and need for consideration in policy development. This way experiences from different genders can be taken into account in order to make a well-integrated policy without significant inequality as seen in this research.

It is interesting to find a result that does not contribute air quality to health problems, whilst on the other hand showing that one group experiences air quality as worse than the other. It is therefore expected that air quality is linked to overall health but that does not seem to be the case.

5.3 Findings on Inequality

Premade assumptions based on the literature review turn out to point to a more favourable situation for more centrally located and denser areas in the city since these generally get the most support from a government (United Nations Department of Economics and Social Affairs, 2020). Additionally, more air pollution was expected in less developed regions. This would mean that in this case a significant difference between Yangpu and Fengxian on the basis of green space availability and usage, air quality, and mental and physical health would be observed. It was however found that there is no significant difference between these neighbourhoods on any of these fronts. There seems to be a small indication for this, but this is however not statistically significant and thus no conclusions can be drawn from this minute indication of difference. As mentioned before, socioeconomic status was not researched due to the lack of information. Data on income is not presented per district and is only available for the entire city of Shanghai. As mentioned before, observations from inhabitants of these

districts do show a discrepancy in income with Yangpu being wealthier than Fengxian. Since the research is limited in time, the choice was made not to further investigate this topic.

5.4 Citizens' advise

based on question 18, respondents were asked (but not required) to come up with ideas on how to improve green space and air quality in their neighbourhood (appendix 3), this led to interesting results which mostly concluded that more citizen involvement, availability, awareness, and low emission travel modes as can be seen in the word cloud (figure 4). The word cloud used an edited dataset where the main points were included (appendix 4).This shows the interest the citizens have and the motivation they have to make their neighbourhood better. Therefore it is advisable for policy makers to listen to the ideas and thoughts of the population and see how a joined venture may help to improve policy development.

Figure 4: Word cloud based on responses to question 18 (appendix 3)

5.5 Concluding remarks on findings

Per the presented findings, the null hypothesis of: "*There is no significant difference in perception of mental and physical health between people from Fengxian and from Yangpu."* can be rejected. The second hypothesis of: "*The better the air quality and green space is, the better the perceived mental and physical health"* can partially be accepted since green space has shown to significantly improve mental and physical health, whilst air quality did not present such finding. The research question: "How do green space and air-quality policies impact the perceived mental and physical health of younger generations of citizens in different neighbourhoods of Shanghai?" can be answered as follows: Whilst air quality does not seem to have a significant influence on the perceived mental and physical health of younger generations of Yangpu and Fengxian, green space does. Gender age and location do not

seem to influence this, except for the experience of current day air quality, where there was a significantly different experience between men and women." Therefore, the specifically assigned sub-question of "Who is impacted most?" can be simply answered by saying: "According to the statistics, everyone is impacted equally except for women on their perception of the current state of air quality."

5. Conclusion

This research has compared the relationship between green space and air quality, and the perception of mental and physical health amongst younger generations in 2 neighbourhoods in Shanghai, Fengxian and Yangpu. Green space is seen as beneficial for mental and physical health, as is good air quality. Not everyone experiences this the same, and in this case, younger generations were researched, aged 18-30.

This research aimed to compare and find differences in neighbourhoods, these were however not found. Also it was found that air quality did not seem to impact student populations in shanghai. This may be due to the efforts of the government that have improved air quality in recent years.

The research was not left without results and showed that in current-day Fengxian and Yangpu, women perceive air quality as significantly worse than males. This may be due to differences in lifestyle or psychology, but further research needs to be done on this topic to draw definitive conclusions. It does however show the importance of gender consideration in policymaking. Furthermore, it was found that whilst air quality does not have a significant influence on the perception of mental and physical health in Fengxian and Yangpu, green space has.

This research was done on asmall scale, thus there may be different outcomes with larger samples. On top of this, it was done remotely, if done in the location it may help to understand the situation at hand better. Socioeconomic status was not researched to a high degree, it seems that it may have an effect on the availability of facilities for mental and physical health, as well as the availability and quality of air and green space. Researchers who want to continue with this subject can therefore focus on socioeconomic factors. For future research, it is also recommended to look closely into medical data to find if air quality has more effects than people perceive.

For future policymaking it is advisable, based on this research, to continue with developing green space, but also incorporating gender in policymaking. Low-carbon transportation and citizen involvement are also mentioned by participants to be of added value.

Despite limitations, this research has shown the importance greenspace and air quality has on young people in urban settings. Adapting policy development to include more green space and air quality-focused measures is essential, as well as incorporating gender and citizen involvement into the planning process. By implementing these recommendations cities can be a more liveable and healthier environment, especially for younger generations and women.

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7. Appendix

Appendix 1

1. Age:

Ø 18-20

Ø 21-23

Ø 24-26

Ø 27-30

2. Gender:

Ø Male

Ø Female

3. Region of Residence

Ø Yangpu

Ø Fengxian

Policy Awareness and Perception:

4. Are you aware and well-informed about the government policies related to green space and air quality?

Ø Yes

Ø No

Ø Somewhat

Air Quality Perception:

5. How would you rate the air quality in your neighbourhood 10 years ago (2013)?

Ø Very poor

Ø Poor

Ø Neutral

Ø Good

Ø Very good

6. How do you perceive the air quality in your neighbourhood currently?

Ø Very poor

Ø Poor

Ø Neutral

Ø Good

Ø Very good

7. To what extent does the current air quality affect your physical health?

Ø Not at all

Ø Slightly

Ø Moderately

Ø Highly

Ø Extremely

8. To what extent does the current air quality affect your mental health?

Ø Not at all

Ø Slightly

Ø Moderately

Ø Highly

Ø Extremely

9. How much does the current air quality contribute to your overall well-being?

Ø Not at all

Ø Slightly

Ø Moderately

Ø Highly

Ø Extremely

Green Space Impact:

10. How frequently do you use the green spaces in your neighbourhood?

Ø Three times a week and more

Ø once or twice a week

Ø once every two weeks

Ø once or twice a month

Ø Barely

11. How far is the green space from your residence ?"

Ø Very close

Ø Fairly close

Ø Moderate distance

Ø Fairly far

Ø Very far

12. Does the distance of the green space from your residence affect your willingness to use the green space?"

Ø Yes, the closer distance makes me use the green space more frequently

Ø Yes, the farther distance makes me less inclined to visit the greenspace

Ø No, it doesn't affect me, I visit the green space as needed

13. How do you perceive the quantity of green space in your neighbourhood currently?

Ø Very poor

Ø Poor

Ø Neutral

Ø Good

Ø Very good

14. How do you perceive the size of green space in your neighbourhood currently?

Ø Very poor

Ø Poor

Ø Neutral

Ø Good

Ø Very good

15. To what extent does the current green space in your neighbourhood affect your physical health?

Ø Not at all

Ø Slightly

Ø Moderately

Ø Highly

Ø Extremely

16. To what extent does the current green space in your neighbourhood affect your mental health?

Ø Not at all

Ø Slightly

Ø Moderately

Ø Highly

Ø Extremely

17. How much do green spaces contribute to your overall well-being?

Ø Not at all

Ø Slightly

Ø Moderately

Ø Highly

Ø Extremely

Government Policy Perception:

18. What is your opinion on the effectiveness of government policies regarding green spaces and air quality in your neighbourhood?

Ø Very Ineffective

Ø Ineffective

Ø Neutral

Ø Effective

Ø Very Effective

19. Suggestions to improve green spaces and air quality in your neighbourhood:

[Open-ended]

Appendix 2

		Frequency	Percent(%)
Age	18-20	5	6,80
	21-23	5	6,80
	24-26	30	41,10
	27-30	33	45,20
Gender	Male	28	38,40
	Female	45	61,60
Location	Yangpu District	41	56,20
	Fengxian District	32	43,80

Table 1 Frequency of respondents age, gender, and location

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7,479[a]	2	,024
Likelihood Ratio	7,433	2	,024
Linear-by-Linear Association	,099	1	,753
N of Valid Cases	73		

a. 1 cell (16,7%) has an expected count of less than 5. The minimum expected count is 4,77.

Table 2: Chi-Square test

	Male	Female	T	P
Current_air quality	4,07±0,858	3,64±0,773	2,20	,031

Table 3: independent sample t-test (gender - current air quality)

	Air qualty_physical health	Air quality_mental health	Greenspace_physical health	Greenspace_mental health	Policy effectiveness
Air qualty_physical health	1				
Air quality_mental health	,521**	1			
Greenspace_physical health	,202	,307**	1		
Greenspace_mental health	,134	,430**	,749**	1	
Policy effectiveness	,424**	,329**	,575**	,448**	1

Table 4: correlation analysis

Crobach's Alpha	N of Items
.771	5

Table 5: Reliability analysis

	Average_health	Green space	Air quality	location
Average_health	1			
Green space	,429**	1		
Air quality	,208	,122	1	
location	,112	-,017	,034	1

Table 6: Correlation analysis

	Yangpu	Fengxian	T	P
Average_health	3,577±0,619	3,717±0,608	-,951	,345

Table 7: independent samples t-test

	Unstandardized Coefficients		standardized Coefficients		sig.	Tolerance	VIF
Coefficients[a]	B	Std. Error	Beta	t			
(Constant)	1,704	,492		3,466	<.001		
Green space	,390	,101	,413	3,857	<.001	,985	1,015
Air qualtiy	,128	,089	,154	1,442	,154	,984	1,016
Yangpu	-,142	,133	-,114	-1,073	,287	,998	1,002
	R^2				,222		
	F				6,570		
	p				<0.001[b]		

Dependent variable: Average health

Table 8: Linear regression analysis

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5,451[a]	4	,224
Likelihood Ratio	6,100	4	,192
Linear-by-Linear Association	3,463	1	,063
N of Valid Cases	73		

a. 1 cells (16,7%) have an expected count of less than 5. The minimum expected count is 4,77.

Table 9: Frequency of Greenspace usage with gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11,175[a]	12	,514
Likelihood Ratio	13,974	12	,302
Linear-by-Linear Association	1,786	1	,181
N of Valid Cases	73		

a. 1 cells (16,7%) have an expected count of less than 5. The minimum expected count is 4,77.

Table 10: Frequency of Greenspace usage with age

Appendix 3

Adhere to green construction and green travel, what we need is a city in a garden

More natural elements

Hope to increase the green space area and rationally utilize the effective green area

Reasonable planning is very important. We hope that green spaces and urban residences can cooperate with each other more effectively, allowing residents to visit green spaces more conveniently, and allowing green spaces to better purify residents' living spaces.

I hope there will be more green space and the air quality will be better.

I hope there will be more green space, so the air quality will be much better.

I hope the green space can be larger and there are more green plants. I hope the weather forecast can report air quality more accurately.

Greening needs to be improved and more civil facilities should be provided.

Set up more corner parks and more participatory spaces. Controlling air quality requires a multi-faceted approach, and analyzing the sources of air pollution and controlling them is also one of the solutions.

Improve the leisure function of green space, such as adding seats and interesting devices.

Continue to improve and strengthen greening

The green space in the old city should be optimized and designed.

Further increase in pocket parks near residential areas

Increase low-cost parking space

more green plants

Increase greening, including green roofs

Currently, some green parks in Shanghai are closed at 19:00, which prevents 996 young people from enjoying the convenience of nearby green spaces. It is recommended to extend the night opening hours to 21:00 to provide a healthy and safe space for young people to take a walk after meals, exercise and run at night, relieve work stress.

Establish more green spaces to integrate with urban life

Evenly distributed. Some industrial areas have relatively poor greening.

Plant more trees and travel green

Strengthen the area of green space per person in the city center. Most of the time, if you choose to go to the park on weekends, it will be overcrowded. Strengthen energy conservation and emission reduction measures, promote public transportation and low-carbon travel

Improve the quality of green space in living quarters and pay attention to strengthening citizens' awareness of green protection measures

Call on every household to plant green plants, claim them and take care of them yourself

Actively practice low-carbon travel

green roof

The environment is good, and the parks I prefer to go to are far away, and those near residential areas are more green spaces in the community. However, the management and construction of new green spaces must be strengthened, and many times they are not in line with the publicity.

Appendix 4

Adhere to construction and green travel, city garden

natural elements

Hope to increase the green space area and rationally utilize the effective green area

Good planning Involvement accessibility

Quantity

Quantity

Purifying-air

Plants bigger reporting

Quality civil facilities

corner parks

participatory spaces

pollution-control

leisure-function seating interactive-leisure

improve existing parks

optimization and design.

pocket parks near residential areas

Increase low-cost parking space

more plants

green roofs

increase opening times

integration into the urban design

even distribution

more vegetation

revitalise the city-centre

promote public transportation

low-carbon travel

community-based development

strengthening citizens' awareness of green protection measures

citizen participation

low-carbon travel

green roofs

increase development of parks

nearby alternatives