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Do Implementing Green Spaces Mitigate the Risks of Respiratory Diseases in the U.A.E?

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Abstract: As a rising number of people living in the city, the impact of urban green spaces on citizens' health has been discussed more and more frequently. This research employs simple regression models and differences and differences analysis (DID) and investigates the benefits of urban green spaces in mitigating the health risks associated with respiratory diseases in the United Arab Emirates (UAE). This research will collect data from different authorities, including the World Bank and UAE Health Administration, to explore the relationship between green spaces and respiratory health incident rates. We consider the gradual introduction of green spaces and introduce the staggered treatment in the DID analysis. The findings of this research will contribute to the discussions on sustainable urban development and public health strategies, helping city authorities to create a healthier and more sustainable environment for citizens.

Keywords: urban regeneration, green spaces, respiratory health, urban planning.

1. Introduction

The severity of respiratory diseases is becoming more and more acute, highlighting the profound challenges they pose to public health. A dramatic 40% increase in the global prevalence of respiratory diseases in 2019 is a stark illustration of this growing severity [1]. Beyond mortality, respiratory diseases often cause reduced quality of life and psychological distress [2].

The traditional approach to resolving respiratory diseases, hospitalization with medication, is effective in curing and alleviating the symptoms after the onset of the disease. However, this study aims to address the root causes. Air pollutants, one of the most significant causes, calls for an innovative, preventative, and cost-effective resolution. Increasing urban green space is very likely to be a potential solution. Green spaces play an essential role in air purification and reducing pollutants, which could reduce the incidence of respiratory diseases [3,4]. While the link is intuitive, more rigorous research is needed to validate this relationship statistically and to improve public health policies for a more sustainable future.

Our study aims to find whether there is, and to what extent, if present, a relationship between green spaces and respiratory diseases in the United Arab Emirates (U.A.E.). The U.A.E. is an ideal country

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to conduct this research because of its unique climate, rapid economic growth, and most of its population being disturbed by respiratory diseases. As a desert-driven region, the U.A.E. suffers detrimentally from sandstorms and poor air quality. “Homes are covered with choking dust, making it hard to breathe” [5]. In addition, it experienced rapid economic growth from 2000 to 2020 with evident urban regeneration [6]. Moreover, respiratory diseases are among the top 4 health concerns in the U.A.E [7]. Therefore, the U.A.E. becomes the ideal region to conduct this research.

There should be a relationship, in fact, to a great extent to which green spaces can help mitigate the rate of respiratory diseases in the U.A.E. We hypothesize that this outcome is due to 2 factors: an improvement in air quality and an increase in the rate of exercise. We plan to gather four sets of data to conduct this research. We will collect data in the UAE from 1990 to 2020, including green space coverage, the rate of respiratory diseases experienced, the amount of outdoor exercise conducted by individuals, and air pollution data. This research will analyze quantitative data using statistical methods, including a simple regression model and difference in difference (DID) analysis, to identify the patterns between the increase in urban green space areas and the number of respiratory disease cases.

2. Literature review

Copious research supports the connection between increasing urban green spaces and reducing respiratory diseases. Several epidemiological studies have demonstrated that exposure to green spaces can reduce the risk of developing respiratory diseases by decreasing exposure to air pollutants. A correlation has also been established between green spaces and decreased mortality from respiratory diseases in European studies [8]. Furthermore, it has been shown that green spaces have a variety of benefits, such as stress reduction, which can indirectly improve respiratory health [9].

The weaknesses and limitations of this body of studies should also be noticed. First, some of these studies were conducted in Western countries, such as the United Kingdom, with varying climates depending on the seasons, and some were conducted in rainforest regions. Their findings might not necessarily apply to other climates, particularly the arid climate of the U.A.E. Different climate conditions may cause different types and amounts of pollutants in the atmosphere. Also, the types and abundance of vegetation in green spaces might differ. So, our research might not be directly backed up by previous studies.

Second, the research results are acquired by analyzing the cumulative effect of green space in a city or county, making it difficult to separate and quantify the specific effects of individual parks or greenways. A cumulative effect approach may not account for differences in quality, size, and accessibility of different greenways, which could affect respiratory health differently. Therefore, to formulate specific, targeted interventions for urban planning and public health, data should be collected with a different approach.

This research aims to provide a new perspective on the influence of green spaces on respiratory disease in the U.A.E. While it will attempt to build on the foundation and overcome the limitations of previous work, it will incorporate elements unique to the U.A.E. in terms of climate, urban design, and public health. Furthermore, this research will seek to isolate the impacts of individual parks or green spaces, thereby contributing to a finer understanding of the correlation. Understanding the specific effects of individual green spaces could allow bureaucrats to design targeted public health policies and urban planning. For example, if certain types and locations of green spaces are found to be more beneficial to respiratory health, then more resources should be allocated to their construction. In conclusion, the study aims to identify the role of greenspaces in reducing respiratory diseases across the UAE, paving the way for a more effective, evidence-based policy for the UAE.

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3. Conceptual framework

Almost all respiratory diseases are caused by poor environmental conditions. Some of the most commonly known factors are smoking, allergens, and air pollution (WHO). Smoking, including secondhand smoke, can cause one to be more inclined to experience respiratory infections [1]. Allergens can stimulate airway inflammation, leading to asthma, one of the most common respiratory diseases [10]. Air pollution contains a variety of air pollutants that detrimentally trigger respiratory symptoms as well [11]. Air pollution plays a significant role in respiratory diseases. Air pollution contains malignant substances such as particulate matter (PM), nitrogen dioxide (NO2), and ozone (O3). Particle matter can reach lower airways and enter the bloodstream, leading to irritation and inflammation in the human body [11]. Furthermore, PM can also generate reactive oxygen species, possibly damaging cells and tissues within the respiratory system [12]. NO2 can weaken one's immune system, making individuals more likely to associate with respiratory diseases [13]. Ozone exacerbates respiratory symptoms, damaging the human body as well. Air pollution is a believed contributor to respiratory diseases.

Green spaces can significantly impact air purification and reduce particulate matter and air pollution. Green spaces are "an area of grass, trees, or other vegetation set apart for recreational or aesthetic purposes in an otherwise urban environment" [14]. Green spaces can purify the air through the photosynthesis process. Plants can absorb pollutants such as NO2 and O3, reducing air pollution. It can also lower PM concentrations by filtering dust, pollen, and other matters, improving air quality.

Fitness can help improve and prevent respiratory diseases [15]. When conducting aerobic exercises, any "physical activity that increases the heart rate and the body's use of oxygen", one's lung functions will be enhanced as the lungs and heart will work collectively to improve circulation and strengthen tissues (NIH National Cancer Institute). In addition, exercises focusing on cardiovascular health can help prevent some of the most common respiratory diseases, such as chronic

obstructive pulmonary disease and asthma [16]. Moreover, regular exercise can strengthen one's immune system. This can help resist respiratory infections, mitigate inflammation, and reduce the risks of respiratory diseases [17]. Adding urban green spaces will provide citizens with physical activities and outdoor recreation opportunities. Activities like jogging, cycling, jump roping, and ball games require open space. Adding urban green spaces in residential areas makes it more approachable and convenient for those nearby to engage in outdoor activities. Some are unwilling to exercise due to the inaccessibility of green spaces nearby. In addition, the aesthetics of green spaces can make it more enjoyable to exercise. It can be visually pleasing to exercise in a space surrounded by nature and greenery, increasing participation in outdoor exercises.

4. DATA

The ideal datasets for this research are the green space coverage from 1990 to 2020 in the U.A.E, the rate of experiencing respiratory diseases from 1990 to 2020 in the U.A.E., the number of people conducting outdoor exercises from 1990 to 2020 in the U.A.E, and the level of air pollution from 1990 to 2020 in the U.A.E. Although we currently don't have access to the listed data above, for the data on the rate of experiencing respiratory diseases from 1990 to 2020, we will contact the U.A.E.'s Ministry of Health and Prevention Center's Health Research Bank to try to obtain the data. Also, to obtain data on people's outdoor exercises in the U.A.E., we will contact the National Library of the U.A.E. to find the paper describing people's daily lives from 1990.

The reason for choosing these four ideal sets of data is that respiratory diseases are related to environmental quality, which indicates green space coverage and air pollution. According to the EPA, air pollution contains a variety of air pollutants that detrimentally trigger respiratory symptoms. Also, respiratory diseases are related not only to external factors but also to internal factors, which refer to

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human life habits.

We are examining the data set from 1990 to 2020 because this is the period where green spaces proliferated the most. Starting in 1990, the urban green space areas in the U.A.E. experienced rapid growth, contributing to more than 20% of the existing green space areas [18]. Beginning in 2000, the urban green space growth rate gradually decreased, and the total green space areas in the U.A.E. started to level off in 2010. Based on this observation, our research will be focusing on the time period from 1990 to 2020. We expect that the data on the prevalence of respiratory diseases and air pollution extent will decrease, and the data regarding the rate of citizens conducting exercises outdoors will increase.

5. Methods

Based on the information and knowledge we have received, to tackle the problem, we will build a simple regression model and conduct a difference in difference (DID) analysis [8]. Specifically, we will analyze the relationship between. The independent variable will be the amount of urban green spaces in square meters in the U.A.E., and the dependent variable will be the annual incidence rate of respiratory diseases in the U.A.E.

This research hypothesizes that years with more green spaces will have lower respiratory disease cases. To first examine this correlation, we create a simple regression model.

$$y_t = \beta_0 + \beta_1 \times X_t + \varepsilon_t \ldots \quad (1)$$

β_0 and β_1 represent the estimate of regression analysis, which is the relationship between the amount of urban green spaces and the number of respiratory disease cases. y_t represents the dependent variable in the regression analysis, which is the number of respiratory disease cases in a specific year in the U.A.E. X_t represents the independent variable in the regression model, which is the amount, in square meters, of urban green spaces. ε_t represents the random error term, which includes the sizes of each green space, population density, and other confounding variables that influence the relationship between urban green spaces and respiratory diseases.

To establish causal relationships, we will introduce a DID analysis. The DID model allows us to compare changes in respiratory health in the UAE with and without green spaces to determine the impact of urban green spaces. Specifically, we compare the differences in respiratory incident rates before and after introducing urban green spaces. Since not all urban green spaces are implemented simultaneously in different cities or regions, we use staggered treatment in the DID model. This design allows us to create treatment and control groups based on implementing green spaces in each region or city. The treatment groups include areas that have implemented urban green spaces, while the control groups include areas with no urban green spaces at the beginning. As time goes by, some cities or regions implement new urban green spaces, and they will now be considered in the treatment group. By conducting simple regression analysis and DID analysis with staggered treatment, this research provides a detailed understanding of the relationship between urban green spaces and respiratory health. Based on the results, city authorities can consider the association and the effect of urban green areas, developing urban regeneration plans with more significant green spaces and creating a more sustainable environment.

6. Conclusion

The rate of respiratory diseases is increasing. So, to find a cheaper and more accessible way of resolving this issue, our study aims to find whether there is, and to what extent, if present, a relationship between green spaces and respiratory diseases in the United Arab Emirates (U.A.E.). To quantify the results, we will use the following data from 1990 to 2020 in the U.A.E.: the green space

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coverage, the rate of respiratory diseases experienced, the rate of outdoor exercising, and air pollution. To evaluate the relationship, we will conduct a regression analysis followed by a DID model. We expect our findings to validate a strong relationship between implementing green spaces and mitigating respiratory diseases. However, there are limitations. One is the difficulty in measuring and quantifying the different characteristics of green spaces. This research considers all urban green spaces equally without further looking into the variations in their qualities and the effects on respiratory health. Some urban green spaces contain complete exercise facilities for citizens, while others may not. Given their heterogeneity, there should be further research in the future. If validated, we hope our findings can motivate cities with copious cases of respiratory diseases to implement more green areas when conducting city regeneration plans.

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