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Correlation between COPD and Physical Activity in the United States

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☒ By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission

Abstract

Objective: My objective of this project is to determine whether there is a correlation between COPD and physical activity in the United States by looking at all 50 states. Also, to determine if there is a difference between the prevalence of COPD in different regions of the US.

Methods: Data was collected and analyzed using the publicly available data set from the CDC Wonder database (wonder.cdc.gov). A Pearson correlation test and an ANOVA with post hoc tests were used to determine correlations and differences between variables to answer research questions.

Results: There is a significant negative correlation between physical activity and COPD prevalence in the US. The South has a significantly greater COPD prevalence than the West, Midwest and Northeast.

Key Words: (Chronic Obstructive Pulmonary Disease, COPD, physical activity, United States, correlation)

Introduction/Literature Review

Chronic Obstructive Pulmonary Disease (COPD) is becoming more prevalent today and is a major cause of death both in the United States and worldwide[1]. However it is a highly preventable disease by avoiding smoking and other risk factors. Once diagnosed, the patient must live with this condition and so managing symptoms could be a major way to improve their quality of life[2]. COPD exacerbations can be very life threatening and result in many hospitalizations; therefore, determining a way to reduce these complications can give patients more of their lives back[2]. With a such a large amount of our current aging population having smoked for years, managing COPD will be very important to our health system in regard to cost, treatment and most importantly, patient's lives.

COPD is often associated with many dangerous comorbidities which increase the risk of mortality[3]. Cardiovascular comorbidities are one of the more dangerous conditions associated with COPD, for example a 2018 study found that endothelial function leading to cardiovascular problems is impaired in COPD[3]. This same study also found that physical activity is the only determinant independently associated with endothelial function[3]. Managing both comorbidities and COPD symptoms may be key to increasing quality of life in these patients. Inactivity is associated with a decrease in health outcomes in the normal population as well as in those with COPD[1]. One study designed an exercise program for COPD patients and found that many (77%[1]) of them were willing to adhere to it, which is promising since physical activity may improve their COPD symptoms and lessen some of the complications of the disease. Many COPD patients are found to be less physically active than counterparts which could be

aggravating their condition and lowering their quality of life[4]. Pulmonary rehabilitation programs designed to increase physical activity in COPD may increase their exercise capacity and decrease associated morbidity of their disease[5]. Physical activity's benefit to COPD patients is very complex and needs to be studied further but there is a possibility that certain kinds of activity may improve COPD[5]. A lack of physical activity has been found to be associated with earlier in death in patients with COPD[6] and so managing this risk factor could be crucial to helping these patients live a longer and higher quality of life. It has been found that low-intensity movement had a negative correlation with body mass index and a positive correlation with health status in COPD patients[6] suggesting that even light exercise could make these patients feel better.

Physical activity is known to increase aerobic (respiratory) fitness[1] and with COPD being a respiratory problem, there may be a correlation between COPD and physical activity. With that being said, certain states and areas of the country are known to be more active than others. Certain regions have better weather, more resources and different cultures/atmospheres when it comes to physical activity. There are regional differences in habits and culture such as diet and risk behaviors like smoking. These differences may or may not then contribute to a difference in prevalence of COPD across regions as well. There is data on physical activity and COPD for each state but neither the relationship between the two variables nor if there is a regional difference in the prevalence of COPD has been determined. This paper is going to study those relationships based on the existing data.

Research Questions

Research Question #1: What is the correlation between physical activity and COPD across the United States?

Research Question #2: What are the differences in the prevalence of COPD between US regions?

Methods

Context/Protocol

I am using data from the CDC Wonder Database (wonder.cdc.gov). From the home page, I used the topic of "Health Risk Behaviors" and from there used the "Behavioral Risk Factor Surveillance System (BRFSS)" data trends. From the data trends homepage, I chose the class and topics that were relevant to COPD and physical activity for the year of 2017. This data is given for each state both as a percentage and also in total numbers.

Data Collection

For the first research question, two variables will be used for each state. The data for both variables was collected by the Behavioral Risk Factor Surveillance System (BRFSS) using telephone surveys. One variable is the prevalence of COPD in each state. The data from each state is reported as a percentage of participants who responded yes to the question "ever told you have COPD". These percentages were age-adjusted. The demographic group was adults (over the age of 18). The percentages were calculated by using a numerator of respondents that report ever having physician- diagnosed COPD, emphysema, or chronic bronchitis divided by the denominator based on total respondents (yes or no). The "yes" response means that at one point in their life they were told they have COPD. This may be limited due to inaccurate recall of respondent or misdiagnosis which can alter the true prevalence of COPD. In order to get this data set, start at the BRFSS Prevalence & Trends Data homepage, select the class of Chronic Health Indicators and the topic of COPD. This will lead you to a map of the US and lead you to the data from each state by clicking on the data sheet in the right-hand corner of the page. The second

variable is physical activity index in each state. This is measured as a percentage of respondents (adults>18 years of age) who meet aerobic physical activity guidelines for substantial health benefits and for muscle-strengthening activity. The numerator is the number of adults who get at least 150 mins/week of moderate intensity or at least 75 mins/week of vigorous aerobic exercise or a combination of moderate-intensity and vigorous-intensity physical activity (multiplied by two) totaling at least 150 minutes per week as well as muscle-strengthening exercises at least 2 times a week. This numerator was divided by a denominator based on the total number of respondents. The time period inquired about was within the last month. Starting at the BRFSS Prevalence & Trends Data homepage, select the class of Physical Activity and the topic of Physical Activity Index. This will lead you to a map of the US and lead you to the data from each state by clicking on the data sheet in the right-hand corner of the page.

For my second research question, I will use the same data for COPD and split the United States into regions. The four regions used are the ones that the US Census Bureau uses. One region is the Northeast which includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York and Pennsylvania. Another region is the Midwest which includes Indiana, Illinois, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota and South Dakota. A third region is the South which includes Delaware, D.C., Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma and Texas. The final region is the West which includes Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming, Alaska, California, Hawaii, Oregon and Washington. Figure 1 shows how the US census bureau splits the country into these four regions[7].

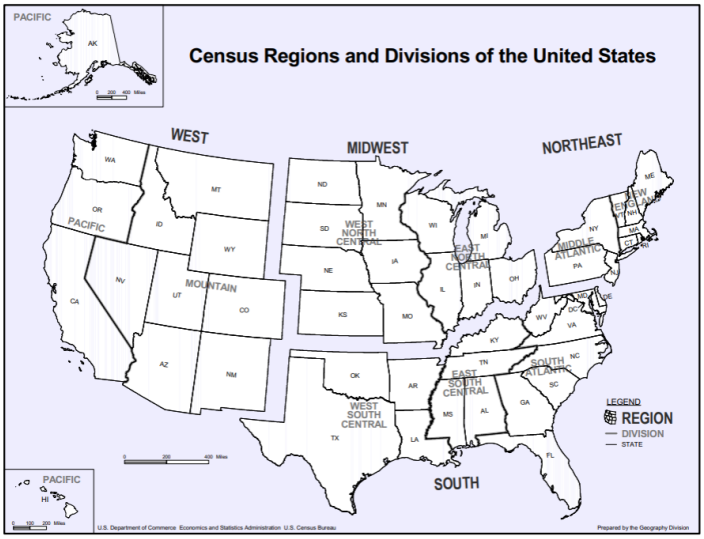

Figure 1. US regions [7]

Data Analysis

To determine the correlation between COPD and physical activity in the United States, I used a Pearson correlation test. For each state, there are two variables, one being the prevalence of COPD and the other being physical activity index. Comparing these 2 variables for every state provides us with enough information to determine whether there is a correlation present and if so, how strong that correlation is.

To determine the difference regionally in prevalence of COPD across the US, I split the US in four regions; West, Midwest, South and Northeast by state. Then I conducted an ANOVA with a post hoc test between the different regions. The ANOVA will determine if there is a difference between the regions and then post hoc test will show where the difference is.

Results

To determine the correlation between COPD and physical activity in the United States, I used a Pearson correlation between COPD prevalence and the physical activity index for

every state. I found a significant negative correlation between the two variables ($r^2 = -.709$; $p < 0.001$; Figure 2) indicating that as physical activity index goes up, COPD prevalence goes down.

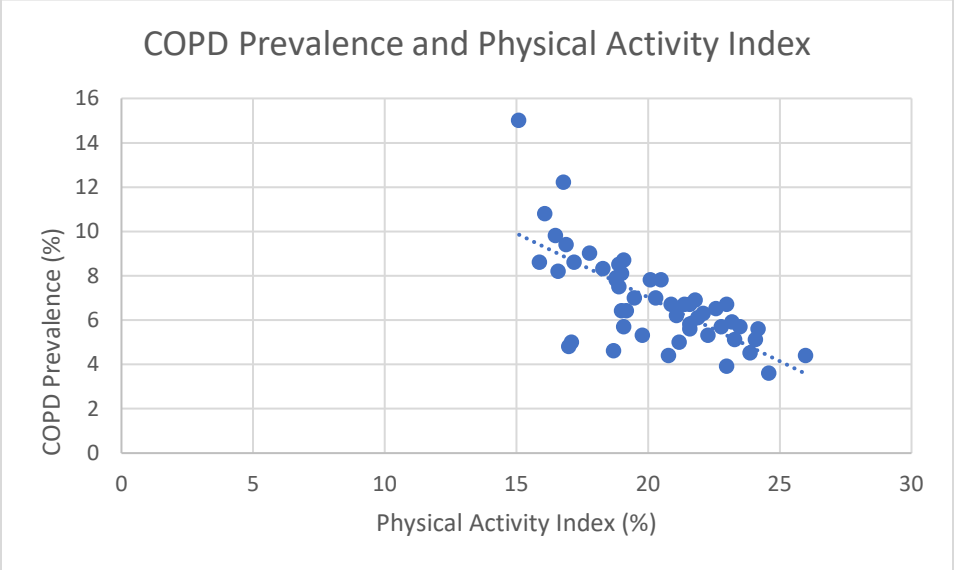

Figure 2. Plotted Physical Activity Index and COPD Prevalence data points

To determine the difference regionally in prevalence of COPD across the US, I conducted an ANOVA between the different regions of the United States. The ANOVA was significant ($F_{3,47} = 11.56$, $p < .001$) and post hoc tests indicated that the prevalence of COPD in the South was significantly different from that in the West ($p < .001$), Midwest ($p = .002$) and Northeast ($p = .001$); see Table 1.

Table 1: COPD prevalence by region

Region	N	Mean (%)	Standard Deviation
Northeast	13	6.446*	0.96
Midwest	12	6.525*	1.64
South	13	9.100	2.53

West	13	6.875**	2.13

*indicates a statistically significant difference between the South region ($p < .01$)

**indicates a statistically significant difference between the South region ($p < .001$)

Discussion/Conclusion

I first investigated if there was a correlation between physical activity and COPD prevalence based on data from each state in the United States. A significant negative correlation was found to exist between physical activity and COPD prevalence, indicating that as physical activity increases, COPD decreases. COPD impacts exercise tolerance and can lead to a decrease in a person's mobility which can in turn impact their quality of life[8]. Knowing that physical activity and COPD are linked may help to decrease the severity of some symptoms and increase their capacity to do what they want to do in life. Many exercise treatment and rehabilitation plans are currently being investigated to see if they can increase pulmonary function to better improve patients' lives with COPD. A 2020 study has found that high intensity interval training and continuous exercise lead to increases in cardiorespiratory fitness and exercise capacity in COPD patients[9]. There is a lot of interplay between these two variables. Is it the COPD that lessens the amount of physical activity or is it that those that are less physically active are more likely to have COPD?

COPD is a disease that is affected by many aspects of life and so regional differences may have some role in the disease progression and its treatment. The more comorbid conditions a person has, often the worse their COPD is[10] and these can also be regionally different. Low socioeconomic status is directly related to COPD[10] and so poorer states could be seeing more patients with COPD. Investigating my second research question, I found that the South has a significantly greater prevalence of COPD than the other regions of the US. Many factors can be

accounting for this difference in prevalence but discovering what those factors are could be instrumental to helping those patients and other residents of those states that might be harder hit by this disease.

Regional differences exist in many ways such as policies, healthcare, economy, habits, culture, weather, diet and so much more. All of these factors can play a piece into overall health and can have a huge impact on chronic conditions such as COPD. It is nearly impossible to narrow these down because they all are tied together. Finding that the South has significantly more COPD than the other regions is more complicated than it may look because there are many players in that. A 2011 study looked at major risk factors for COPD, such as smoking, and how it related to that state's level of COPD. Thinking that states with high smoking rates would be some of the higher rates of COPD too but this wasn't the case. This study found that some of the Western states have some of the highest smoking rates but not nearly as high COPD hospitalization[11] but that the high smoking rates do match up with high COPD rates in some of the Southern states. This shows that there is a lot playing into these regional differences but that they do exist and there is a reason for it.

A limitation to this study is that using aggregate data, we can only see a correlation and cannot determine causation. Looking into this further could be very helpful in the future because it could help to treat symptoms and maybe even be a way to prevent the disease in the first place. There are some additional limitations to this paper because the data collected was over the phone and might not be completely accurate since it is completely dependent on the respondents' answers. It is also difficult to determine how closely related these two variables are when other factors could be having an impact on each of them. Even with that, there was a significant

negative correlation between COPD prevalence and physical activity showing that there is some relationship that exists between them.

COPD is fourth leading cause of death in the US[10] and so finding better ways to prevent and care for these patients could really make a difference in regards to quality of life and cost of care. Patients become more disabled over time and that causes them to find other help and ways to complete even the smallest daily acitivities[10] which contributes to both cost and happiness. There is a lot of potential for more research on this topic that can make a big difference. Investigating the relationship between COPD and physical activity further could have an impact on the quality of life of these patients. Additionally, after finding that a regional difference exists for the prevalence of COPD, finding out why there is such a difference has the potential to help many people. With an already very prevalent disease and increasing as our population ages, finding the best way to care for these patients will be very important to overall health and cost.

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