LARA SULZBACH
12.01.25

Correlation between Physical Activities and Mental Health

1 INTRODUCTION

„It is exercise alone that supports the spirit and keeps the mind in vigour" (Marcus Tullius Cicero, 63 BC)[1]. This famous quote of the ancient Roman statesman shows that philosophers at the time already suspected a dependency between physical activity and mental health. In recent decades, numerous studies have been conducted on this topic, confirming the positive effect of exercises on mental health, as physical activities releases feel-good chemicals called endorphins in the brain.[2] In this report, I would like to investigate whether in survey data from the USA a direct correlation between mental health and the amount of time spent on physical activity can be found. More specifically, I want to show that in US states where people are more active, there are less mental health problems.

2 USED DATA

To elaborate this correlation, two studies from 2019 conducted by U.S. Department of Health and Human Services agencies were linked by using the common attribute state. One study is the National Survey on Drug Use and Health[3] and the other one is the Nutrition, Physical Activity and Obesity Survey[4], which are filtered in the data pipeline to the questions relevant to this topic. The resulting table integrates the percentage of people struggling with mental health and the values of people spending a certain amount of time on physical activity subdivided into the following four gradations:

- no time at all
- muscle-strengthening activities on 2 or more days a week
- at least 150 minutes a week of moderate-intensity aerobic physical activity or 75 minutes a week of vigorous-intensity aerobic physical activity and engage in muscle-strengthening activities on 2 or more days a week
- at least 300 minutes a week of moderate-intensity aerobic physical activity or 150 minutes a week of vigorous-intensity aerobic activity (or an equivalent combination)

The data is broken down to all 50 US states, with the exception of New Jersey, because the data for this state was not complete, and the District of Washington. The percentage values in the table are given as values from 0 to 100 with 2 decimal digits, so that 100 corresponds to 100%. As both studies are published under public use licence they can be utilized without any restriction or obligation.

[1] https://www.activesuffolk.org/uploads/mc-2018-11-21-suffolk-pes-conference-presentation.pdf?v=1542726705
[2] https://www.mentalhealth.org.uk/explore-mental-health/a-z-topics/physical-health-and-mental-health
[3] https://www.samhsa.gov/data/data-we-collect/n-sumhss-national-substance-use-and-mental-health-services-survey
[4] https://catalog.data.gov/dataset/nutrition-physical-activity-and-obesity-behavioral-risk-factor-surveillance-system

3 ANALYSIS

Analysis tools of Excel were used to analyse the merged data and to find a correlation between mental health and physical activities.

3.1 INSIGHT INTO MENTAL HEALTH

The data used for in-depth analysis of the mental health status in the U.S. includes all types of mental health suffered by the respondents in the study. According to the study, the lowest rate of people suffering from mental health is seen in Texas, namely 17.17%, and the highest rate in Utah with 26.86%. Across the USA, the average value in 2019 was 20.86 %. The exact breakdown of the percentage values per state is visualized in this chart:

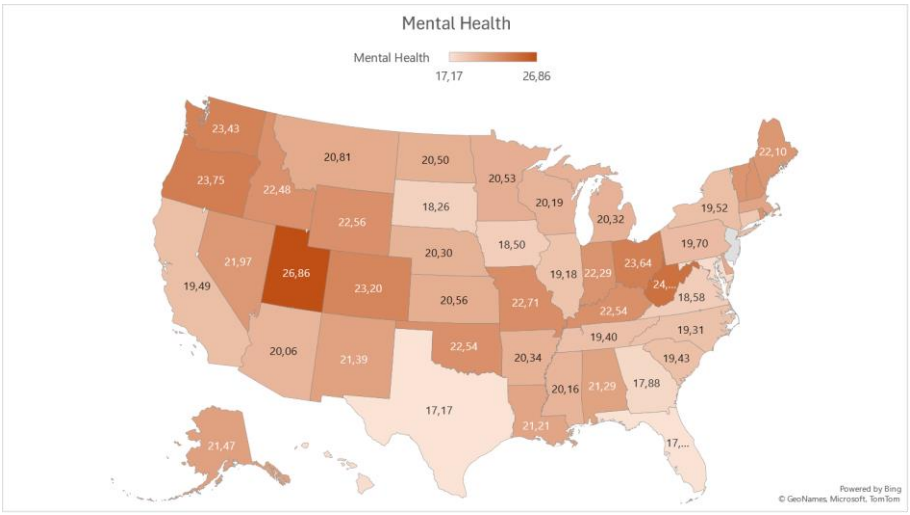


Figure 1: Visualization of the mental health situation in the US

3.2 INSIGHT INTO PHYSICAL ACTIVITY

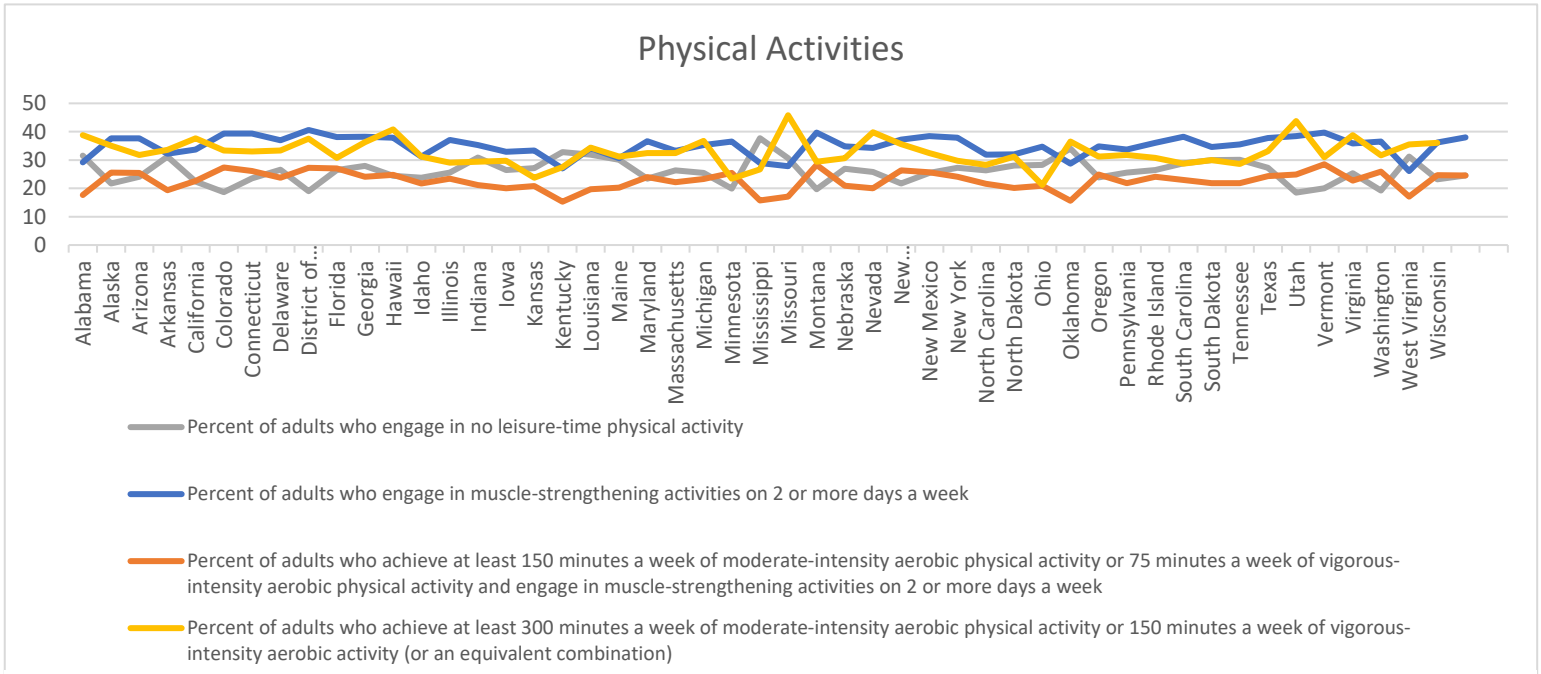
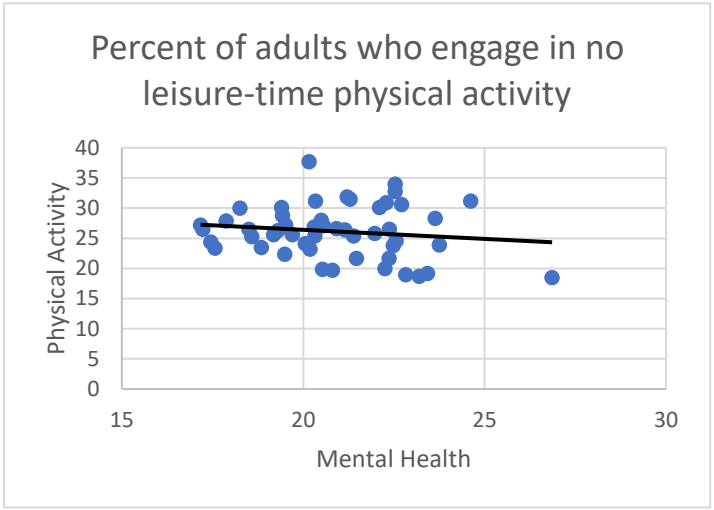


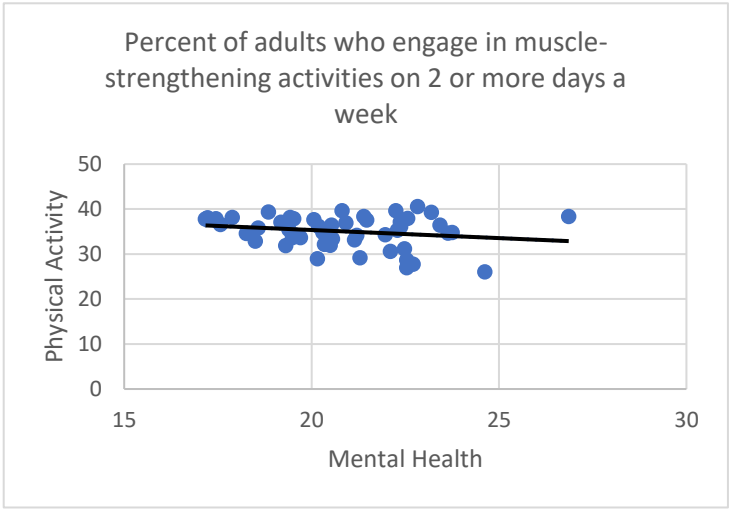
Figure 2: Visualization of the amount people spend on physical activities in the US

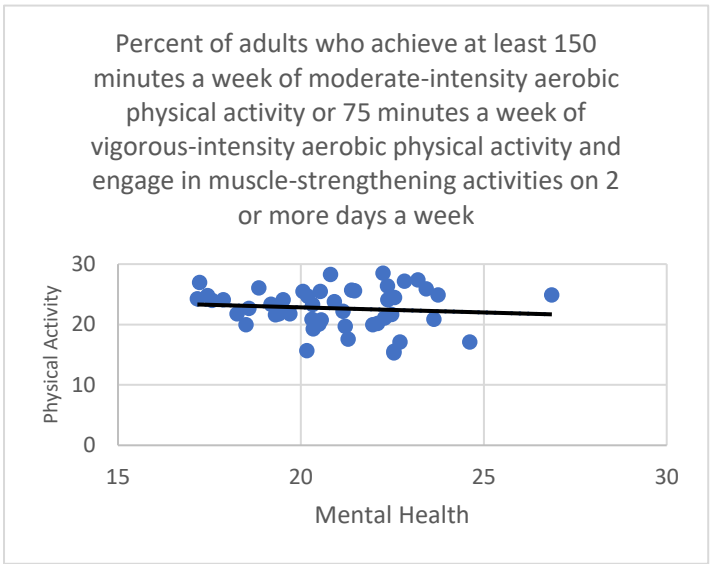
The four-level gradation of time spent on physical activity provides a deeper insight into the lifestyle of US citizens. A staggering share of 26.14% of all respondents spend no free time on physical activities, as high as 37.7% in Mississippi, but only 18.5% in Utah. On the other hand, 35.04% engage in muscle-strengthening activities for 2 or more days per week, with the smallest figure of 26.1% in West Virginia and the largest of 40.6% in the District of Columbia. The graphic above is showing the exact breakdown.

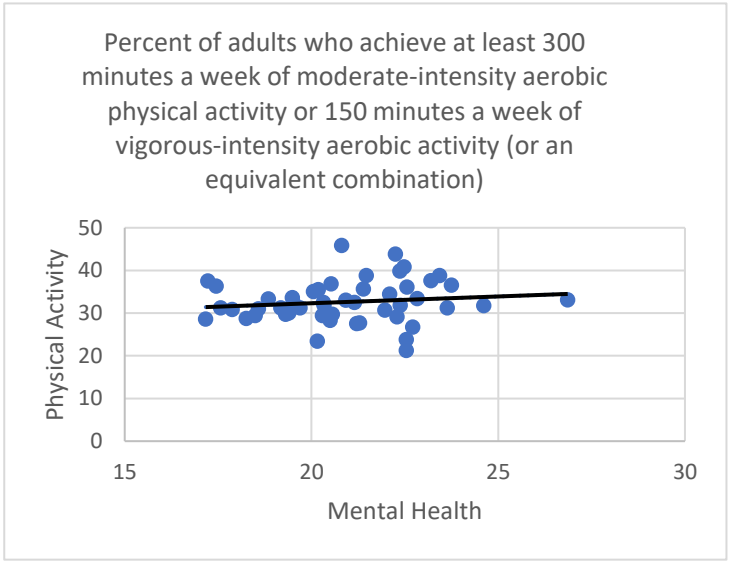
3.3 CORRELATION BETWEEN MENTAL HEALTH AND PHYSICAL ACTIVITIES

To determine the correlation between mental health and physical activities each gradation of the time spent on physical activities is viewed separately. If the data is displayed as scatter plot, a higher correlation corresponds to data points arranged in a straight line.









Obviously, the data points are highly scattered in all graphs and they are not arrange in straight lines. This scattering of data points indicates that there is no strong correlation between mental health and the amount of time spent on physical activities.[5] In order to quantify this effect the correlation coefficient for each gradation is calculated:

[5] https://texasgateway.org/resource/interpreting-scatterplots

Amount of time spent on Physical Activities	Correlation coefficient
no time at all	-0.144153906
muscle-strengthening activities on 2 or more days a week	-0.207670302
at least 150 minutes a week of moderate-intensity aerobic physical activity or 75 minutes a week of vigorous-intensity aerobic physical activity and engage in muscle-strengthening activities on 2 or more days a week	-0.10440433
at least 300 minutes a week of moderate-intensity aerobic physical activity or 150 minutes a week of vigorous-intensity aerobic activity	0.135512501

The first three correlation coefficients are negative, which corresponds to the decreasing trend lines in the scatter plots. The more people spend a certain time on physical activity, the lower the percentage of people struggling with mental health problems. However, the last correlation coefficient is positive, which indicates an inverse effect. But, all values are close to zero, which reveals that there is only a very weak correlation between the two datasets. The value furthest from zero is -0.21 which is still classified as a weak negative correlation.[6] A value of 1 respectively -1 would mean a strong correlation. The results are showing that muscle-strengthening activities on 2 or more days a week has the greatest impact onto mental health compared to the other three gradation of physical activity.

4 CONCLUSION

A general conclusion of this work is that the correlation between physical activity and mental health is very weak if two different surveys linked only by their common US state characteristic are used as basis. In fact, a noticeable correlation has only been found between percentage values of people who perform muscle-strengthening activities on 2 or more days per week and that of people who suffer from mental health, with a correlation coefficient of -0.21. All the other coefficients are too close to zero to confirm any correlation. Therefore, no correlation can be assumed for other intensities of physical activities. Even, the observed correlation for one type of physical activity is weak. One reason for this missing correlation could be that the two surveys were conducted in different groups of people of American society, as the two surveys are performed separately. The data are linked only by the state in which the respondents live. Another bias could be the fact that some people are still too ashamed to admit they have mental health problems, which could lead to a large number of unreported cases, whereas people tend to exaggerate the amount of time they spend on physical activity. However, the main reason why no correlation can be found is probably the complexity of mental health. In addition to physical activity, there are many other aspects of life having a severe impact on mental health and general well-being, such as interpersonal relationships, financial security, social background, sufficient sleeping times, age and other diseases like addictive diseases.[7] All these factors were not taken into account in the analysis even though, obviously, they have a huge impact on mental health. Therefore, it assumed that looking for correlations between physical activities and mental health could be found if data of groups with similar background according to the above mentioned aspects are linked.

[6] https://study.com/learn/lesson/correlation-coefficient-interpretation.html
[7] https://www.mentalhealth.org.uk/explore-mental-health/factors-affect-mental-health