Information Visualization Final Project Report

(Group 9)

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Title: Visualizing the Relationship Between Musical Metrics and Levels of Depression/Anxiety

Abstract:

This report discusses the role of music therapy in improving mental health, including the use of musical metrics. Tempo/BPM (beats per minute) can affect the mental condition of an individual. Age and musical taste can also play a role in the relationship between music and anxiety/depression, and it's important to consider an individual's preferences and emotional response to music when using it as a tool for mental health therapy. Understanding the complex relationship between musical metrics and mental health can lead to the development of more effective musical interventions to support mental health and well-being.

Introduction:

Music therapy is the use of music to improve an individual's stress, mood, and overall mental health. MT is also recognized as an evidence-based practice, using music as a catalyst for "happy" hormones such as oxytocin.

Various musical metrics, such as tempo (BPM - beats per minute), energy and lyrics, have been explored in the context of mental health. Researchers have found that the different elements of music can influence mood and emotions and therefore may have a role in the treatment of depression and anxiety.

While the relationship between musical metrics and mental health is complex and multifaceted, understanding this relationship can potentially lead to the development of more effective musical interventions to support mental health and well-being. Music has been shown to have a profound impact on our emotions and can be used as a tool for self-expression, relaxation, and emotional regulation. As such, it has been studied in relation to various mental health conditions, including depression and anxiety.

Researchers have explored the different musical metrics that can influence mood and emotions, including tempo (BPM - beats per minute), energy. For instance, slower-tempo music has been found to be effective in reducing symptoms of anxiety and depression, while fast-tempo music can exacerbate anxiety symptoms. Additionally, lyrics can play a significant role in the emotional impact of music. Songs with themes related to loss, loneliness, or hopelessness may resonate with individuals who are experiencing symptoms of depression, while songs with uplifting or empowering lyrics may be more beneficial for individuals with anxiety.

Age and musical taste can also play a role in the relationship between music and anxiety/depression. Research has shown that younger individuals tend to prefer faster and more upbeat music compared to older individuals, who may prefer slower and more relaxing music. This difference in preference may be related to age-related changes in musical perception and the emotional response to music.

Moreover, an individual's musical taste can also influence their response to music and its impact on anxiety and depression. For example, some individuals may find that listening to music in a genre they enjoy, such as classical, jazz, or pop, can have a positive effect on their mood and reduce symptoms of anxiety and depression. In contrast, listening to music in a genre they dislike may have the opposite effect and exacerbate negative emotions.

However, it's important to note that the relationship between musical taste and mental health is highly individualized, and what works for one person may not work for another. Therefore, it's essential to consider an individual's preferences and emotional response to music when using it as a tool for mental health therapy.

Problem Statement:

The objective is to discover the correlations between an individual's musical preferences and their self-reported mental health metrics (i.e., what effect music has on their mental health), and whether we can infer what musical metrics (like valence, energy, etc.) can be linked to it.

We are working to create relationships between music and mental health by visualizing and analyzing existing data. The visualizations we will be using are heatmaps, choropleth maps, grouped bar-charts, radar charts, and scatter plots.

Why it is important:

The relationship between musical metrics and mental health is a complex and multidimensional one that requires careful consideration and further research. Understanding the ways in which music can affect mood and emotions can potentially lead to the development of more effective musical interventions to support mental health and well-being.

Music therapy involves using music to alleviate an individual's stress, uplift their mood, and promote their overall mental well-being. It is considered an evidence-based approach that triggers the release of "feel-good" hormones, like oxytocin, through the power of music.

The visualizations we use might make it easier to spot areas that require additional research or intervention by highlighting important trends and patterns for researchers to make advanced research and studies.

Related Work:

We used the dataset that was the result of a survey that attempted to correlate different aspects of mental health and music.

The survey questions aimed to gather information about the respondents' musical background and listening habits (in a general sense). They hoped that these results could aid in better-informed applications of music therapy or offer intriguing insights into the workings of the human mind.

The survey required respondents to rank the frequency with which they listened to 16 different music genres, offering options to choose from including "Never," "Rarely," "Sometimes," and "Very frequently."

It collected data on the prevalence of ‘Anxiety’, ‘Depression’, ‘Insomnia’, and ‘OCD’ among respondents by asking them to rate their experience of each condition on a scale of 0 to 10. The rating scale ranges from 0, which indicates no experience of the condition, to 10, which suggests regular, constant, or extreme experiences of the condition. By collecting data on the prevalence of mental health conditions such as anxiety, depression, insomnia, and OCD, the survey provides insights into the mental well-being of individuals in different age groups. This information can be used to identify

trends and patterns in mental health and inform the development of targeted interventions for those who need them.

The survey provides a picture of the music listening habits of individuals across different age groups. This information can be used by music therapists and other healthcare professionals to better understand the musical preferences of their patients and tailor their interventions accordingly.

By examining the relationship between music preference and mental health, the survey provided insights into the potential therapeutic benefits of music. For example, the data may reveal that individuals who frequently listen to certain genres of music are less likely to experience symptoms of anxiety or depression. This information can be used to inform the development of music-based interventions for individuals struggling with mental health conditions.

Overall, the Music & Mental Health Survey Results dataset provides a valuable resource for healthcare professionals, researchers, and anyone interested in the intersection between music and mental health.

Datasets:

We have used the following datasets:

1. Music & Mental Health Survey Results | Kaggle

Variables, dimensions and some of the important attributes we are using from this dataset:

Column	Description
Age	Respondent's age
Primary streaming service	Respondent's primary streaming service
Hours per day	Number of hours the respondent listens to music per day
Fav genre	Respondent's favorite or top genre
BPM	Beats per minute of favorite genre
Anxiety	Self-reported anxiety, on a scale of 0-10
Depression	Self-reported depression, on a scale of 0-10
Insomnia	Self-reported insomnia, on a scale of 0-10
OCD	Self-reported OCD, on a scale of 0-10
Music effects	Does music improve/worsen respondent's mental health conditions?

2. https://www.kaggle.com/datasets/siropo/spotify-multigenre-playlists-data

This dataset is a collection of multiple datasets (sorted by genres). Each one has a genre's specific metric (defined by Spotify) like valence, energy, etc.

Column	Description
valence	A measure of the musical positivity or negativity of a song, typically ranging from negative (sad or angry) to positive (happy or uplifting)
danceability	A measure of how suitable a song is for dancing, based on factors like tempo, rhythm, and beat strength
energy	A measure of the intensity and activity level of a song, often related to the volume, speed, and dynamics of the music
speechness	A measure of how much spoken word content is in a song, as opposed to purely musical elements
acousticness	A measure of how much of a song's sound is produced by acoustic instruments, such as guitars or pianos, versus electronic or synthesized sounds
instrumentalness	A measure of how much of a song's sound is instrumental, without any vocals
tempo	A measure of the speed or pace of a song, typically measured in beats per minute (BPM)

Visualization Design:

We have used Choropleth, Heatmaps, Scatterplot/Radar-chart, Grouped Bar-charts.

1. Choropleth maps:

We have plotted a choropleth map to determine the anxiety and depression percentages of each country because the data on anxiety and depression may be collected from surveys or other sources that ask individuals about their mental health status, and the data may be aggregated by geographic region. Choropleth maps can then be used to visually represent this data by shading different regions with colors that correspond to different levels of anxiety or depression.

Why did we choose choropleth maps?

The advantage of using a choropleth map for this type of analysis is that it allows us to quickly and easily visualize patterns and trends in the data across different regions. Choropleth maps are a useful tool for visualizing anxiety and depression data because they provide an easy-to-understand representation of data that is linked to specific geographic regions. They allow for easy comparison between regions, capture spatial patterns, and provide important geographic context for the data being analyzed.

When to use choropleth maps?

Choropleth maps are particularly useful when you want to visualize how a particular variable or set of variables varies across different geographic regions, such as countries, states, provinces, or municipalities. These maps use different colors or shading patterns to represent the data, with darker colors or shades usually indicating higher values of the variable being measured.

2. Heatmaps:

We have used heatmaps to plot BPM scale vs Anxiety/Depression/Insomnia/OCD scale to determine what kind of BPMs (high or low) affect individuals on what level. Heatmaps can provide a clear and easy-to-understand visual representation of the data, which can be useful in communicating the findings to others. This type of visualization can also help researchers and analysts quickly identify areas of interest or further investigation.

Why did we choose heatmaps?

Heatmaps are a powerful tool for visualizing data because they can effectively show both overall patterns and specific details. The use of color gradients can help to quickly convey the intensity of certain effects, and different areas of the heatmap can provide more granularity or a broader overview as needed. Overall, heatmaps can be a valuable tool for analyzing complex data sets and communicating insights to others. By plotting the different BPM levels against measures of anxiety, depression, insomnia, and OCD, we can visually identify patterns or trends in the data that might not be as clear from just looking at a table of numbers.

When to use heatmaps?

Heatmaps are useful when you want to represent the relationship between two variables in a tabular format using color coding. Heatmaps can be used to represent a large amount of data in a compact manner, making them an effective tool for data visualization. Heatmaps are often used to visualize correlations between variables, identify patterns and trends in data, and highlight areas of high and low values. They are particularly useful when working with large datasets, as they can help to identify relationships between variables that might not be immediately obvious from a raw data table. Heatmaps are commonly used in fields such as data analysis, finance, marketing, and scientific research.

3. Scatter Plot/Scatter Plot Matrix & Radar Charts:

The Scatter plot is plotted between age and hours per day they spend listening to music. Each dot represents the age, hours per day, and other information added using interactivity.

The radar chart depicts each radial axis with Anxiety, OCD, Depression, and Insomnia. The radar points to the corresponding axis based on the point we hover the mouse on to show how the music is affecting the individual and that individual's scale values for the mental health metrics.

Why did we choose scatter plots?

A scatterplot is a useful visualization technique for exploring the relationship between two continuous variables, such as age and hours per day. By plotting each data point in a two-dimensional space, a scatterplot can help identify patterns and trends in the data, such as whether there is a positive or negative correlation between age and hours per day.

When to use scatter plots?

Scatter plots are useful when you want to examine the relationship between two continuous variables and identify any patterns or trends in the data. Scatterplots can be used for Exploratory data analysis, Correlation analysis, Regression analysis, and Outlier detection.

Why did we choose radar charts?

Radar charts are commonly used to visualize and compare multiple variables, such as Anxiety, OCD, Depression, and Insomnia because they allow us to see how each variable is related to the others. The Radar Chart makes the visualization easy to compare, Useful for identifying patterns, Useful for visualizing change, and Useful for communicating findings.

When to use radar charts?

Radar charts are useful when comparing multiple quantitative variables across different categories. They can be used when you want to show the strengths and weaknesses of each category in relation to each variable. Radar charts are also commonly used in sports to compare the performance of individual players or teams across different categories, such as points scored, rebounds, assists, and steals in basketball.

Why did we choose scatter plot matrices?

With a scatterplot matrix, each variable is plotted against every other variable in the data set, resulting in a grid of scatter plots. This allows us to see the correlations or patterns that exist between the different variables, as well as identify any outliers or unusual data points that may be present.

When to use scatter plot matrices?

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4. Grouped Bar charts:

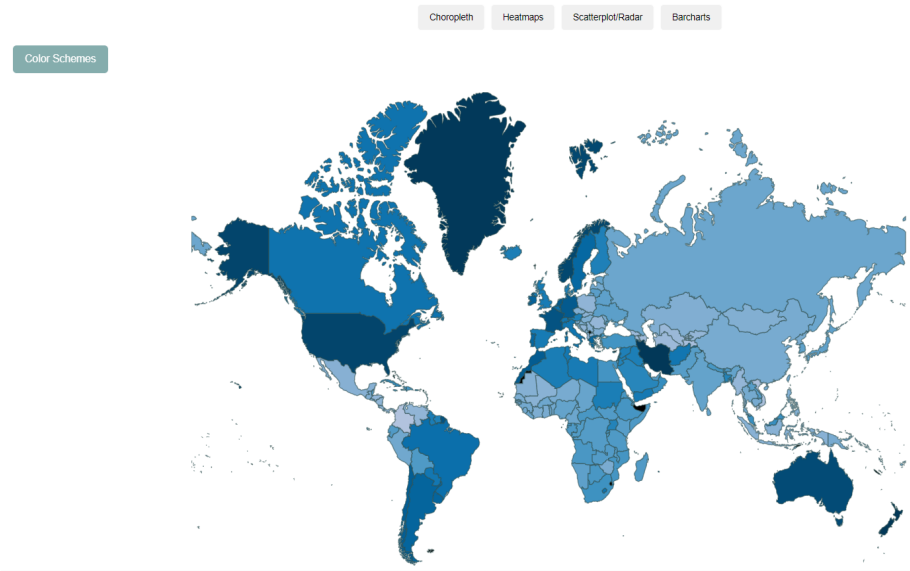
The bar charts are plotted between the favorite genre of music and the total number of people considering the constraints of anxiety, depression, insomnia, and OCD where each constraint has its own bar chart. It allows us to compare the relative popularity of different music genres within each age group and how anxiety, depression, insomnia, and OCD vary accordingly.

Why did we choose grouped bar charts?

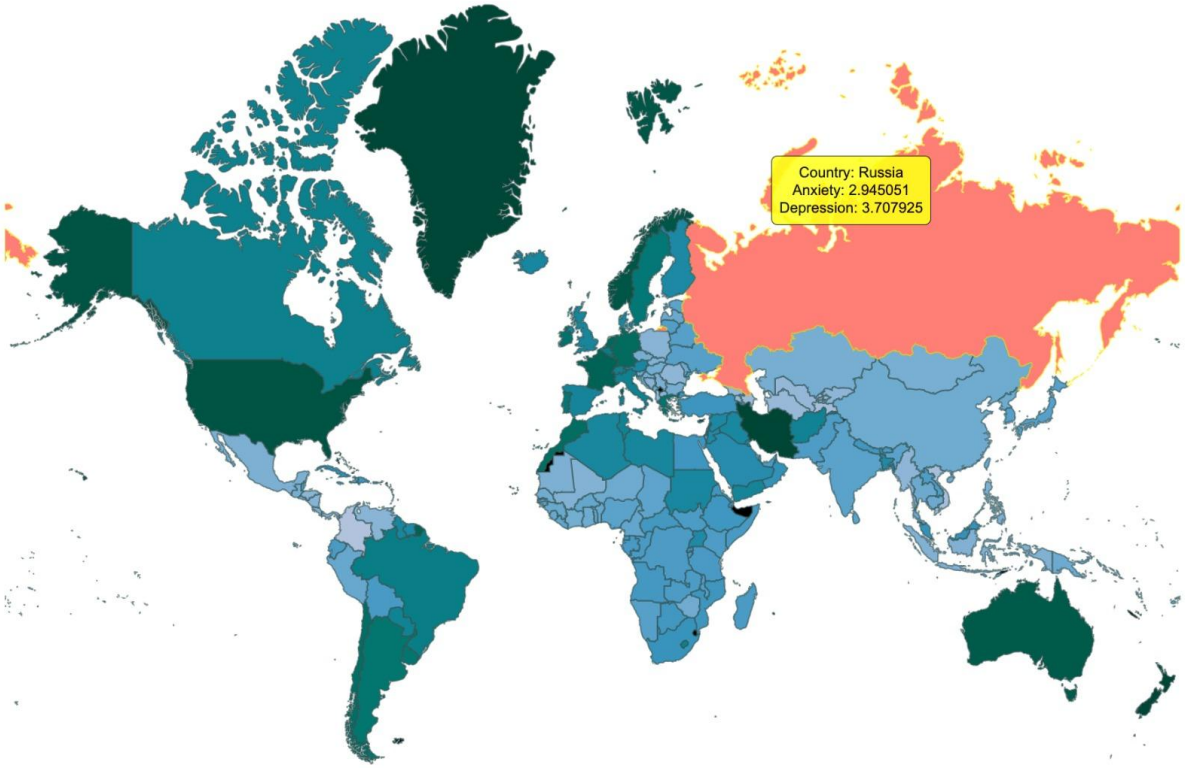
A grouped bar chart is a suitable and effective way to visualize the relationship between favorite music genres and a total number of people due to its ability to compare proportions and display categorical data in a clear and simple way. However, other types of charts may also be appropriate for different types of data or research questions.

Results/Findings:

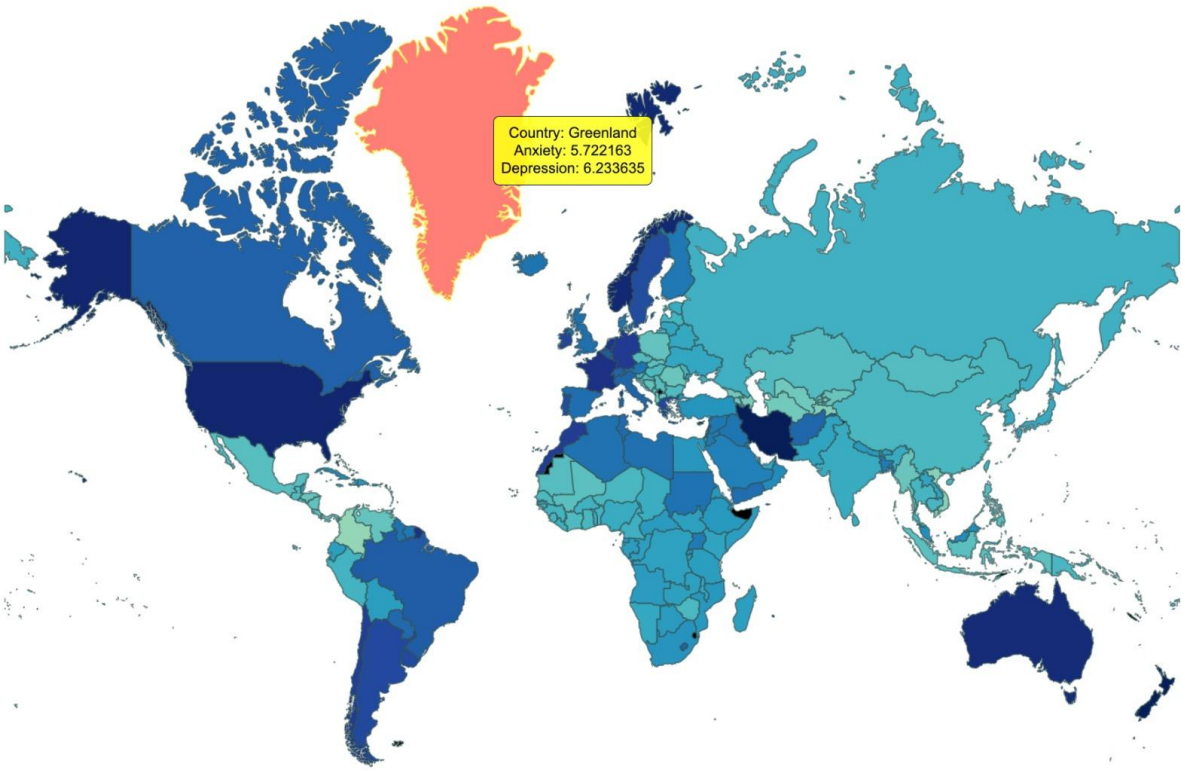
How can we visualize countries with a higher percentage of population struggling with mental health conditions like anxiety and depression? Using Choropleth map



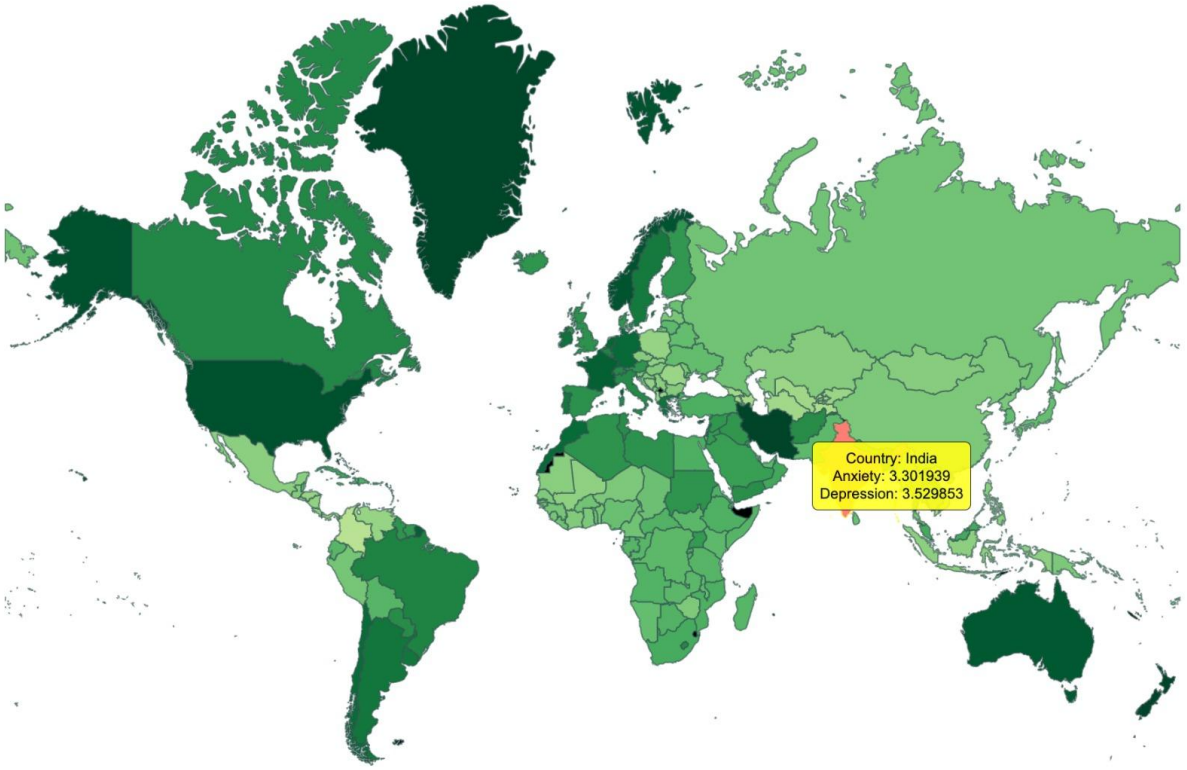
This is an overall view of a choropleth map displaying the world map



We can change the colour of the choropleth map by hovering over the colour schemas and changing the colour.



We can hover over the countries and see the depression and anxiety values of each country along with its name.



Analysis of choropleth maps:

In the choropleth map, we will be depicting the depression and anxiety of each country as we hover over the country with the mouse.

Most of the Western countries of Europe and America have anxiety levels above 5.5 and depression levels above 3.5.

African and Asian countries have relatively lower levels of anxiety percentages at 3.5 and depression at 3.5 with some exceptional countries with higher values.

The country with the highest depression percentage value is Norway with 7.585503 and the country with the lowest depression percentage value is Colombia with 2.514803

The country with the highest anxiety percentage value is Greenland with 6.233635 and the country with the lowest anxiety percentage value is Colombia with 2.196154

Why use choropleth for this analysis:

By using a choropleth map, it becomes possible to quickly identify regions where depression and anxiety scores are higher or lower, as well as to compare scores across different geographic regions.

How is this helpful to people?

This type of visualization can be useful for public health officials, policymakers, and researchers who are interested in understanding the distribution and prevalence of mental health issues in different populations.

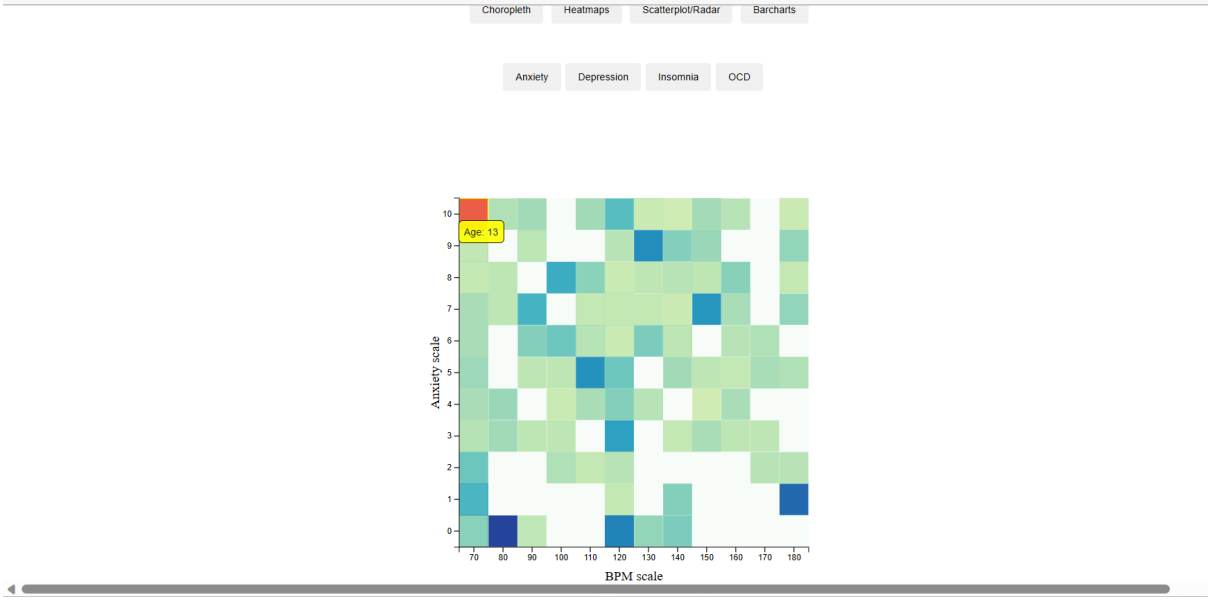
Why only choropleth?

For the global trends in mental health disorder dataset, the choropleth map is a suitable way to display the geographic distribution of depression and anxiety scores.

How does BPM (Beats per minute) of music affect mental health metrics?

2. Heatmaps:

2.1 Anxiety:



Analysis of Heat Map for Anxiety:

We can view that plotting the anxiety scale and BPM scale (beats per minute) we can see that in the heat map

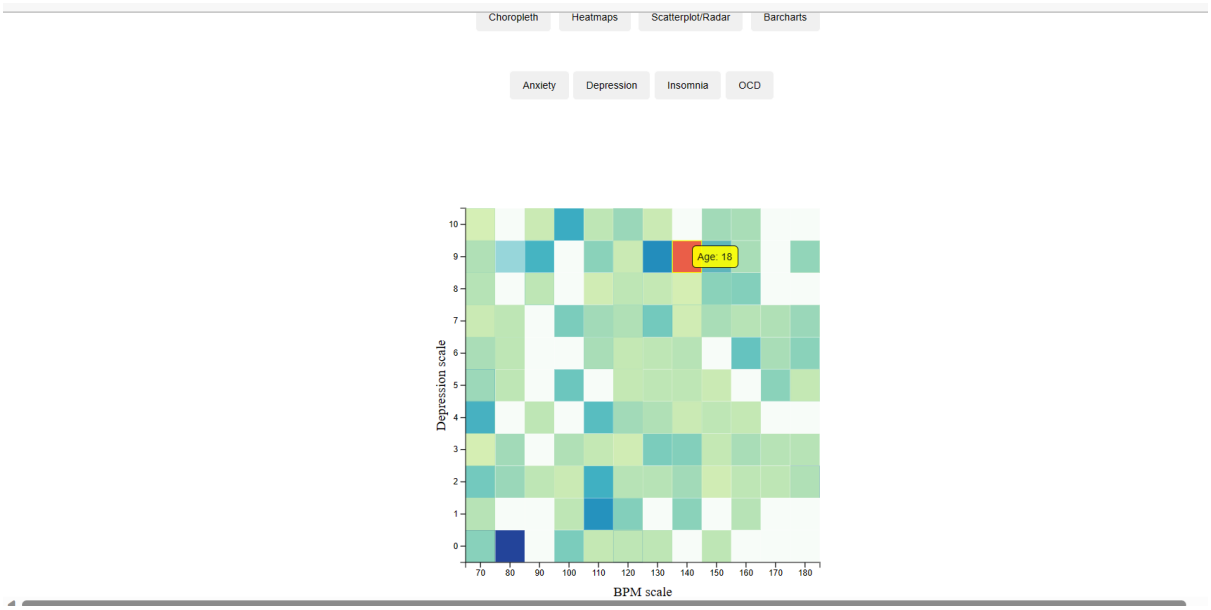
At lower BPM people in their 50's experience lower anxiety compared to people in their teenagers and people in their 20's who experience more anxiety.

In the mid-range of BPM people in their 50's experience lower anxiety and people in their teenagers experience higher anxiety levels

In the higher BPM people in their 50's experience lower anxiety compared to teenagers and people in 20's who experience higher anxiety.

By examining the heatmap, we can identify any areas where the correlation between the two variables is particularly strong or weak and use this information to better understand the relationship between musical metrics and levels of anxiety. This can help researchers and mental health professionals identify potential interventions or treatments for people experiencing anxiety.

2.2 Depression



Analysis of Heat Map for Depression:

We can view that plotting the anxiety scale and BPM scale(beats per minute) we can see that in the heat map

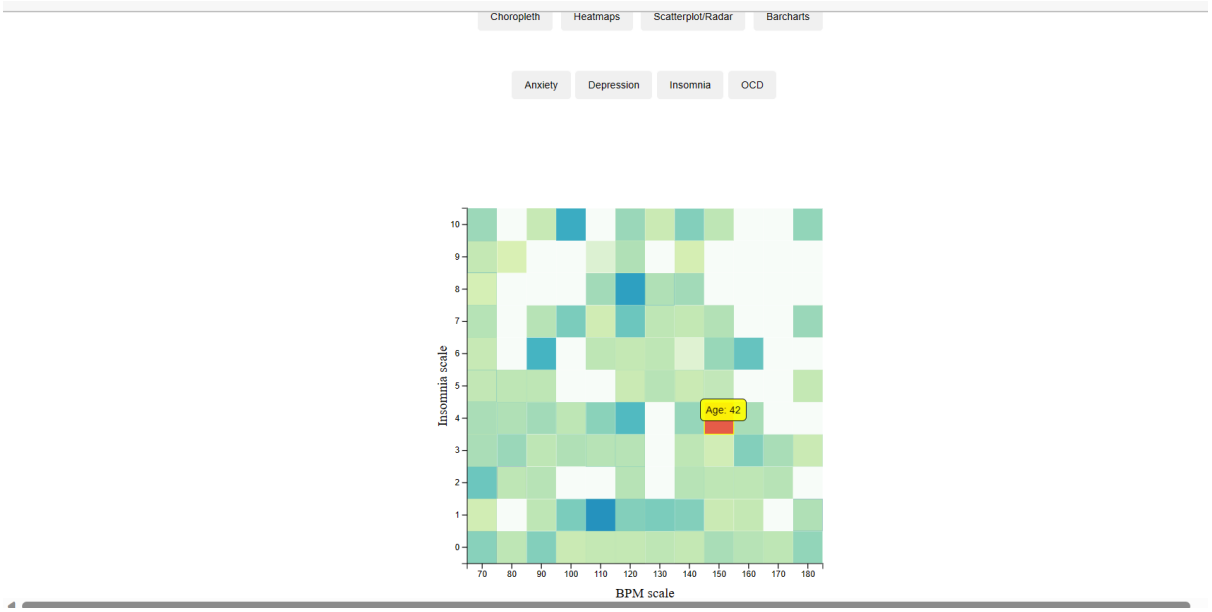
At lower BPM the people in their 50's experience lower depression compared to people in their teenagers who experience more depression than people in their 50's.

In the mid-range of BPM people in their teenage and 20's experience lower depression and people in their 40's experience higher depression levels

In the higher BPM people in their teenage and 20's experience lower and higher depression.

By examining the heatmap, we can identify any areas where the correlation between the two variables is particularly strong or weak and use this information to better understand the relationship between musical metrics and levels of depression. This can help researchers and mental health professionals identify potential interventions or treatments for people experiencing depression.

2.3 Insomnia



Analysis of Heat Map for Insomnia:

We can view that plotting the anxiety scale and BPM scale (beats per minute) we can see that in the heat map

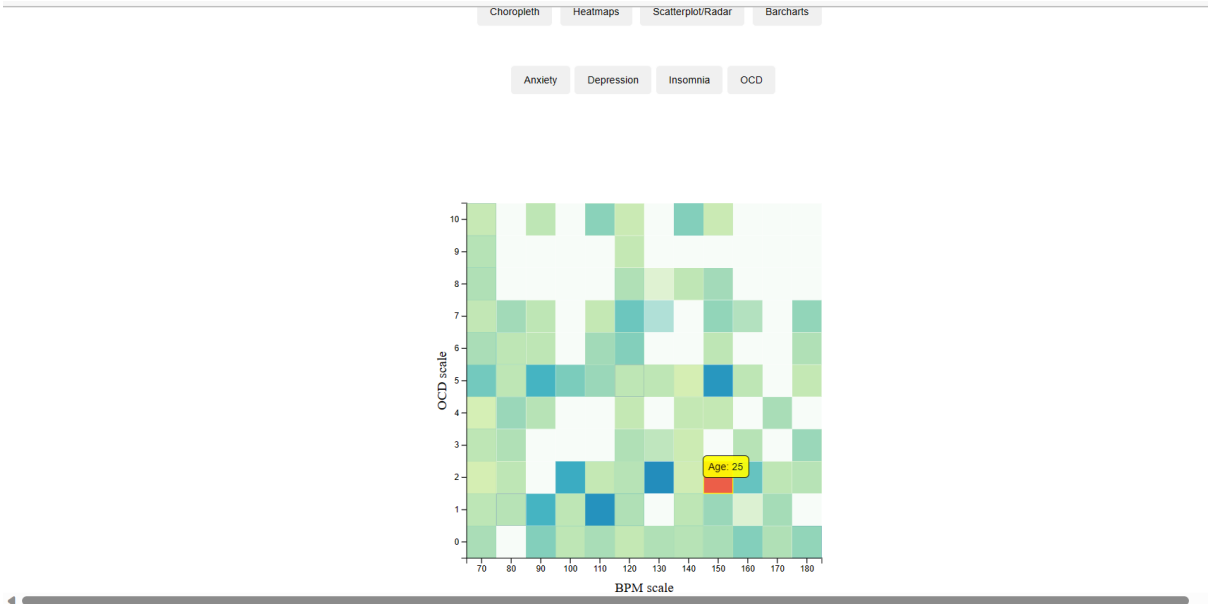
At lower BPM people in their teens and 20's experience lower insomnia and people in their teenage experience more insomnia.

In the mid-range of BPM, people in their teenage, 20's, and 40's experience lower insomnia, and people in their 20's are also vulnerable to higher insomnia levels

In higher BPM people in their teenage experience lower and people in their 20's experience higher depression.

By examining the heatmap, we can identify any areas where the correlation between the two variables is particularly strong or weak and use this information to better understand the relationship between musical metrics and levels of insomnia. This can help researchers and mental health professionals identify potential interventions or treatments for people experiencing insomnia.

2.4 OCD



Analysis of Heat Map for OCD:

We can view that plotting the anxiety scale and BPM scale (beats per minute) we can see that in the heat map

At lower BPM people in their teens, 20's, and 30's experience lower OCD, and people in their teenage of age 18 experience more OCD.

In the mid-range of BPM, people in their teenage, 20's and 40's experience lower OCD, and people in their teens and 20's are vulnerable to higher OCD levels

In the higher BPM people in their 20's experience lower OCD and no age group experience higher OCD.

By examining the heatmap, we can identify any areas where the correlation between the two variables is particularly strong or weak and use this information to better understand the relationship between musical metrics and levels of OCD. This can help researchers and mental health professionals identify potential interventions or treatments for people experiencing insomnia.

Why use Heatmaps:

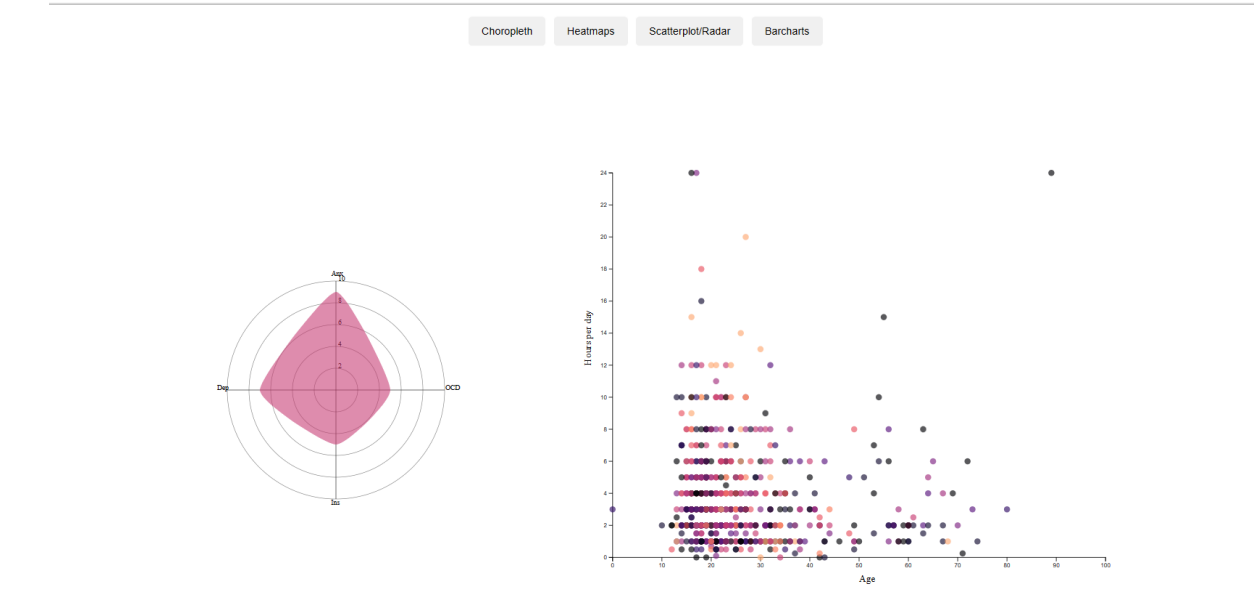
The reason for plotting a heatmap between the BPM (beats per minute) scale and anxiety scale in the Music & Mental Health Survey Results dataset is to visualize the relationship between the two variables and identify any patterns or correlations.

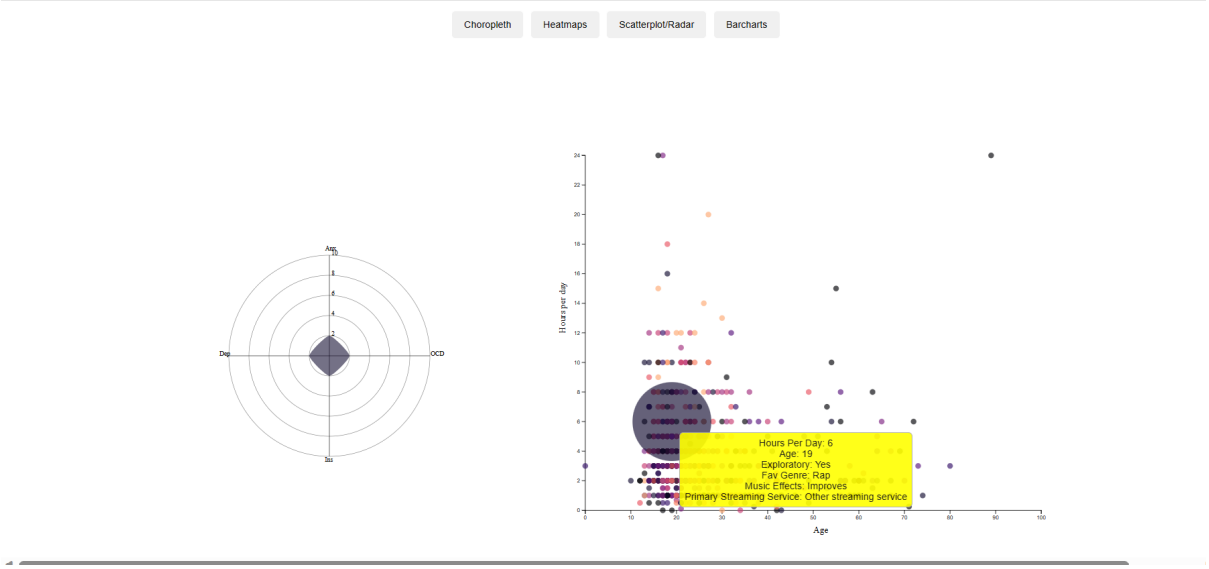
The output of a heatmap between these two variables would be a color-coded matrix where each cell represents the intensity of the correlation between a particular BPM value and a particular anxiety level. The color of each cell in the matrix represents the strength of the correlation, with warmer colours (such as red or orange) indicating a stronger positive correlation and cooler colours (such as blue or green) indicating a weaker or negative correlation.

By examining the heatmap, we can identify any areas where the correlation between the two variables is particularly strong or weak and use this information to better understand the relationship between musical metrics and other levels. This can help researchers and mental health professionals identify potential interventions or treatments for people experiencing insomnia.

3. Scatterplot/ Radar Chart

What age groups listen to how many hours of music per day on an average? Using Scatter Plot Visualisation





Hovering over the scatterplot points shows the age group, type of music, effect, etc, and based on these details the pointer is inclined toward the levels of anxiety, OCD, depression, and insomnia.

Analysis of Scatter Plot/Radar chart:

From the scatterplot we can see the visualization that-

People in their teenage, 20's, 30's, 40's, 50's, and 60's spend a lesser and medium(12 hours) amount of time listening to music and it improves or shows no effect sometimes on them.

It is interesting to see that people of ages 16 and 17 spend 24 hours of their time listening to music.

People in their old age of 80's spend 24 hours of their time listening to music but it shows no effect on their mood.

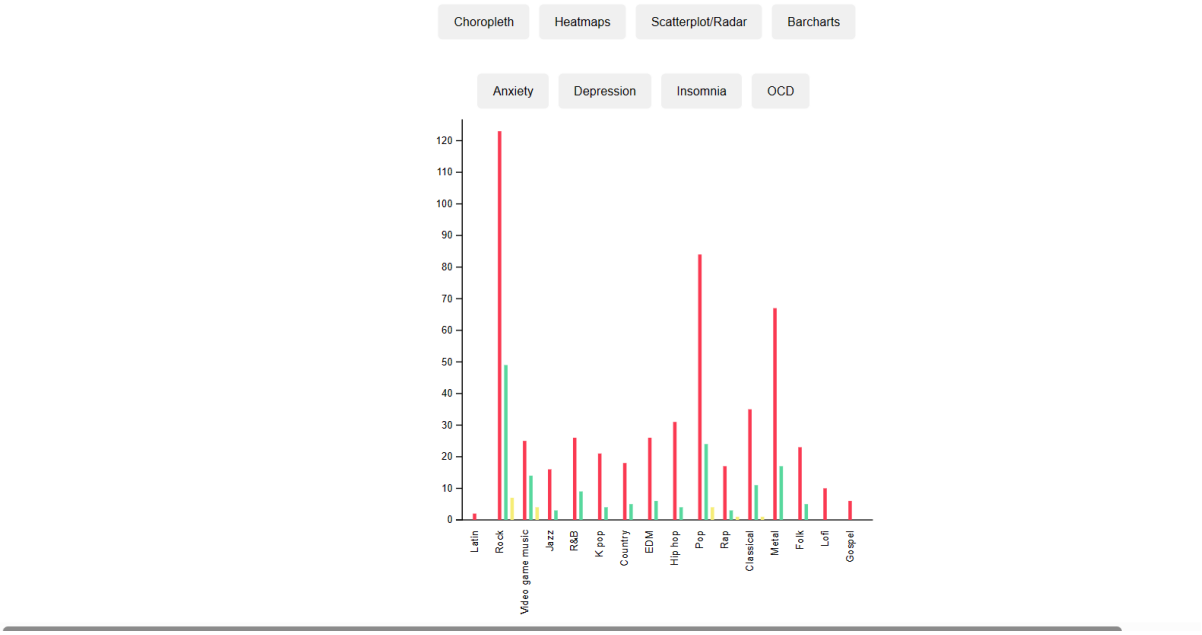
Why use Scatterplot and Radar Chart:

We plot age and hours per day using a scatter plot to explore the relationship between age and the amount of time spent listening to music. The scatter plot can show if there is any pattern or correlation between the two variables.

On the other hand, we use a radar chart to plot the levels of anxiety, OCD, depression, and insomnia. The radar chart can help in visualizing how these different variables compare to each other for each individual. This allows us to quickly identify patterns or trends in the data and compare them across different individuals.

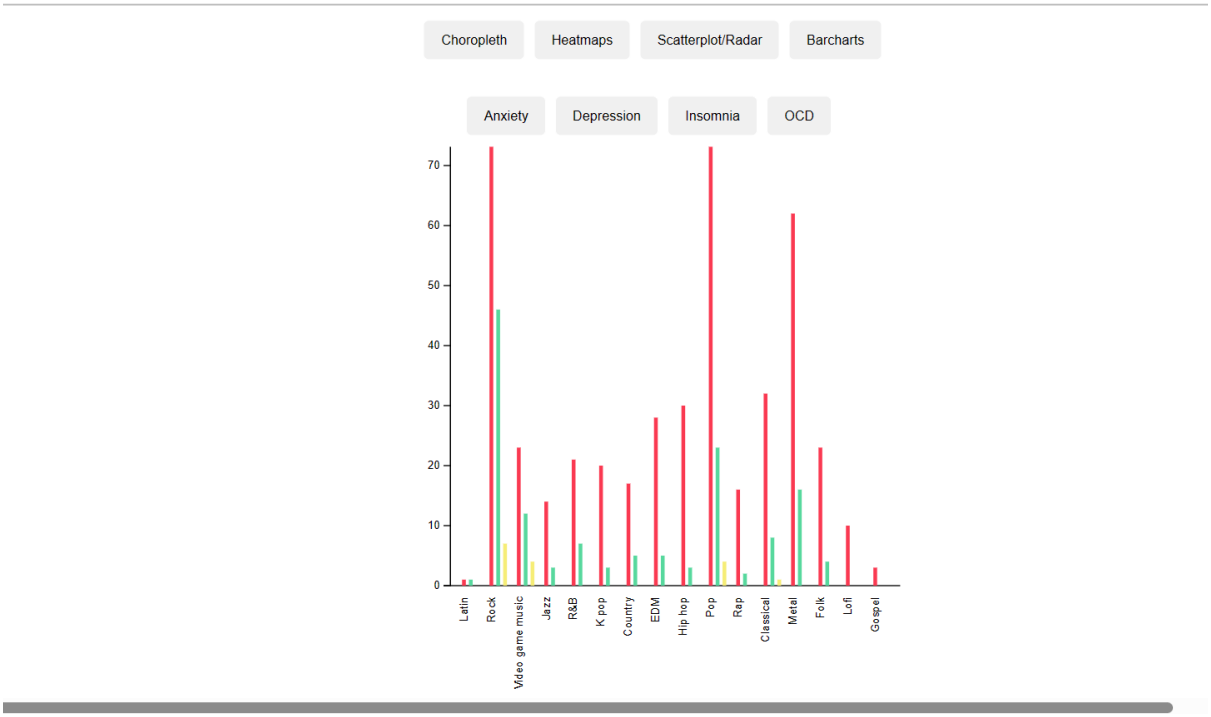
4. Grouped Bar charts:

4.1 Anxiety:

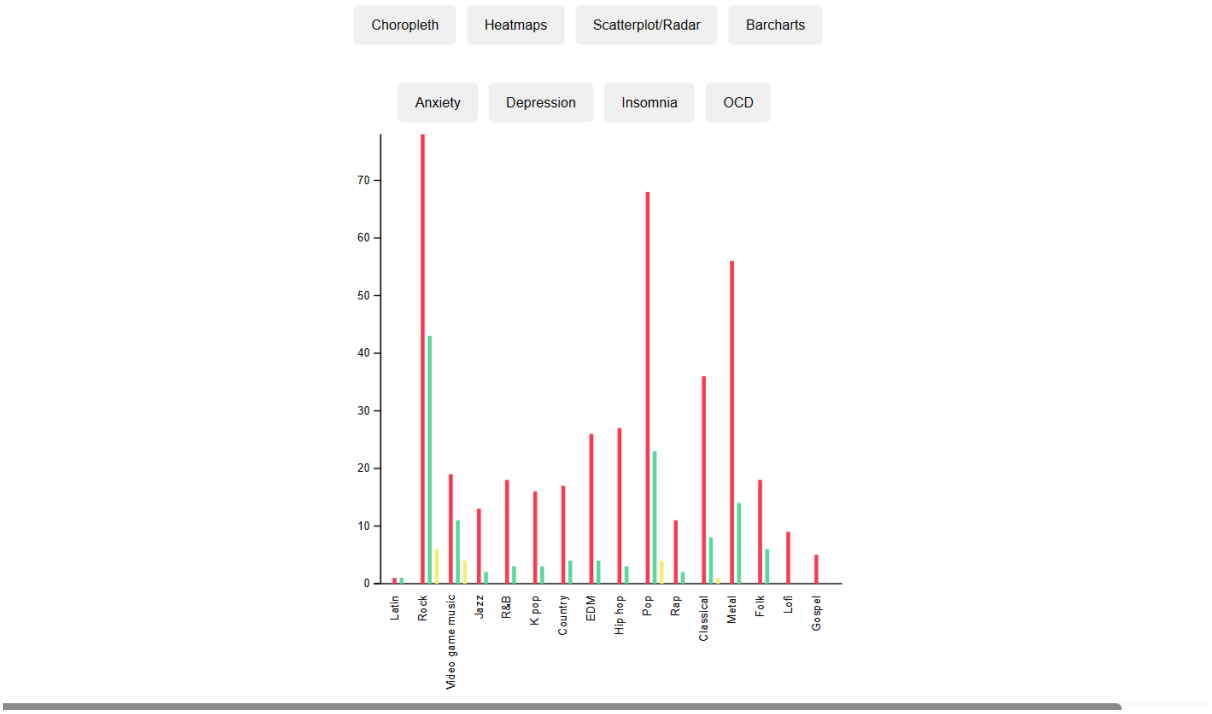


Analysis of Grouped bar chart for anxiety:

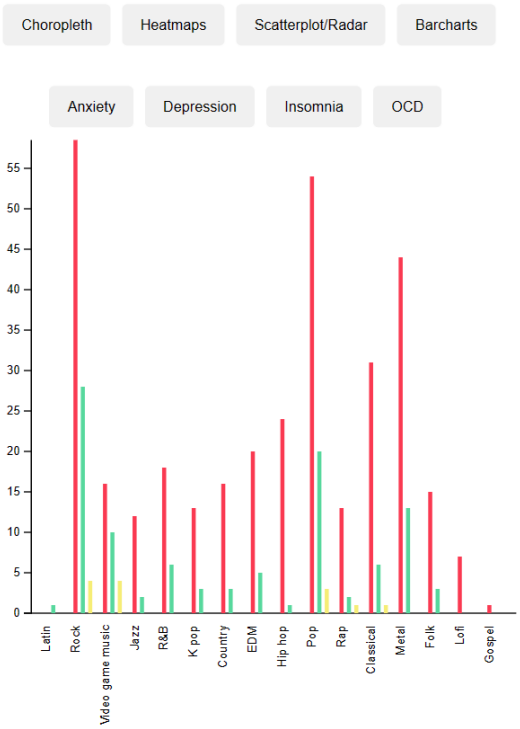
4.2 Depression:



4.3 Insomnia



4.4 OCD



Why use grouped bar charts:

We are using grouped bar charts to visualize the distribution of people's favorite music genres across different age groups. Grouped bar charts are useful for showing how different categories contribute to the total value, in this case, the total number of people who participated in the survey.

By using grouped bar charts, we can compare the relative sizes of different categories (music genres) and how they are distributed across different age groups. We can also see the trends in favourite music genres across different age groups and identify any patterns or differences in music preferences between age groups.

Findings:

We can see that mental health issues such as anxiety, depression, insomnia, and OCD are prevalent among the population in Western nations such as Europe and America, with Norway having the highest proportion of its population suffering from depression, while Greenland has the highest proportion of its population experiencing anxiety. On the other hand, African and Asian countries have lower levels of anxiety and depression.

Regarding music preferences and their impact on mental health, the data indicates that rock music is the most popular genre, and people of all age groups enjoy it. However, younger people tend to prefer genres like rap, R&B, lo-fi, and K-pop. Gospel and Latin music are the least popular genres, but those with anxiety and depression who listened to gospel, lo-fi, and Latin reported improved symptoms. Specifically, only those with depression who listened to Latin and Gospel saw improvements. Only those with insomnia who listened to gospel and lo-fi music reported improved symptoms, and only those with OCD who listened to gospel and lo-fi music reported improved symptoms, but the OCD was not affected by Latin music.

Interestingly, everyone who chose Gospel and Lofi as their preferred genres agreed that music has positive effects, whereas those who identified video game music as their preferred genre had the most varied responses. Approximately 40% of these respondents said they did not find music to be at all beneficial, and 10% said it had a detrimental effect on their mental health. Only the respondents who listed Classical, Pop, Rap, or Rock music as their preferred genre also said that music was harmful.

In summary, the given information suggests that mental health issues such as anxiety and depression are prevalent in Western nations, with Norway having the highest proportion of its population suffering from depression, while Greenland has the highest proportion of its population experiencing anxiety. Furthermore, individuals with mental health issues who listen to gospel, lo-fi, and Latin music may experience improved symptoms. However, the effects of music on mental health vary depending on the genre, with those who prefer video game music having the most varied responses.

What can we infer from this?
Mental health issues such as anxiety and depression are prevalent in Western nations, with higher levels than in African and Asian countries.

1. The prevalence of anxiety and depression varies by country, with Norway having the highest proportion of its population suffering from depression, while Greenland has the highest proportion of its population experiencing anxiety.
2. Rock music is the most popular genre, but younger people tend to prefer genres like rap, R&B, lo-fi, and K-pop.
3. People who suffer from mental health issues such as anxiety, depression, insomnia, and OCD can benefit from listening to specific genres of music, such as gospel, lo-fi, and Latin.
4. People who prefer video game music have the most varied responses when it comes to the effects of music on their mental health, with approximately 40% saying they did not find music to be beneficial, and 10% saying it had a detrimental effect on their mental health.
5. Classical, Pop, Rap, and Rock music are the genres that people listed as their preferred genre and also reported negative effects on their mental health.

Overall, this suggests that music can have a positive impact on mental health, but the effects can vary depending on the individual's musical preferences and the genre of music they listen to. It is essential to continue researching the relationship between music and mental health to better understand how music can be used as a therapeutic tool.