RESEARCH PAPER

Statistical study of "Effect of Music on Mental Health"

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ABSTRACT

Music is a powerful tool. It can help boost your mood as well as mend a broken heart. For centuries, music has played an important role when it comes to our ability to cope through life's greatest highs and lows. It's only been in recent years that research has suggested music can help combat depression and anxiety, along with a host of other mental health issues. Music therapy is one technique administered by health care professionals to help support people as they strive to improve and gain control over their mental health, functioning, and well-being.

Music is said to enhance intelligence and focus, improve mental health, and boost the immune system as well as self-esteem and confidence. It can be used to relax, to boost and lift our mood, or to improve concentration. Music can also be used to aid in insomnia, helping to encourage and induce a deeper sleep. Many people have expressed how music is a form of 'escape', and can quickly and effectively transport them to a better time, place or memory.

The chi-square test of independence was applied to show significant association between instrument played, music composer, singer, music improves or worsen mental health, listen music during study can improve concentration or not. Moreover, relative risk ratios were obtained to measure the intensity of such relationship. Findings point toward main modifiable risk factors of non-listener group will arise of common mental health disorders. The motive of this study is to examine the effect of music on mental health and to determine whether music listening can reduce symptoms of common mental health disorders while improving overall emotional well-being.

We have used five different techniques to predict does music has effect on mental health or not. The implemented algorithms are logistic regression, Random Forest, Decision tree, K-Nearest Neighbour, Support Vector Machine, Naïve bayes algorithm. The experiment shows that Support Vector Machine has the highest accuracy around (83.33%).

Keywords: *Music, Concentration level, Mood Regulation, Insomnia, Stress.*

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INTRODUCTION

"Music is the strongest form of magic". Here captured the essence of music in one word. Magic. Music has great power and can reach a new depth of imagination which some consider a haven.

The music we listen to affects our mood, and our moods affect the music we choose.

This question has long been with studies indicating positive associations between music engagement and quality of life, reduced depression or anxiety symptoms, and less frequent substance use. It has been suggested that aspects of music engagement may even be associated with worse mental health outcomes.

Mental health diseases such as depression and anxiety can have devastating consequences both for patients and their families. Symptoms can be severe and debilitating, leaving individuals alone and isolated. Relationships among family and friends may suffer, and individuals may not receive the support needed to manage their disease. Music can improve symptoms associated with mental illness, but it can also provide an environment for social interaction.

Music has shown promising potential as a therapeutic resource for individuals with mental illness, offering a means of emotional expression, comfort, and connection, while also assisting in managing symptoms, promoting relaxation, and fostering a sense of hope and resilience. When we listen to music, it can have a deep soothing effect on our mental well-being that influence our emotions, reduce stress, and provide a comforting and relaxing feeling. Music can even act as a form of therapy, allowing us to explore and express our emotions, and providing a supportive outlet for our struggles.

Music engagement, including passive listening and active music-making, impacts socio-emotional development across the lifespan. Despite these advances linking engagement with music to many wellness characteristics, we have a limited understanding of how music engagement directly and indirectly contributes to mental health, including at the trait, clinical diagnoses, or as a treatment. Our goals in this scoping review are to describe the state of music engagement research regarding its associations with mental health outcomes, introduce a theoretical framework for future studies that highlight the contribution of genetic and environmental that may give rise to these associations.

1. LITERATURE REVIEW

Shrikala Deshmukh presented paper **on Psychological effects of music on mental health (2022).** In this paper the system is

generated which converts mood from negative to positive by using motivational music.

Music Therapy and Mental Health is the research paper presented by **Alankrita Verma.** This research finds that the mental health is essential for living a healthy and happy life. It affects feelings, thoughts, and behaviour and also plays an important part in our decision-making process.

The author of **Impact of Music on Mental Health** is **Ramesh Pokharel** presented their research concluded as Music affects brain at different levels. Therefore, if a person always involves in listening and practicing music in a proper way, then that person is happier than the rest, because that person is always free from anxiety and stress. In this way, listening and practice provide peace in mental health of the people. As a result, healthy mind, body and thoughts definitely create a beautiful vibe in the society.

2. MATERIAL AND METHODS

Reliability of Questionnaire: Reliability is an extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials. In short, it is the stability or consistency of scores over time or across raters. Cronbach's Alpha: An Index of Reliability.

Chi-square test: The chi-Square Test is a statistical method used to determine whether there is a significant association between two categorical variables. The chi-square Test for independence tests whether these variables are associated or if the association is random.

Classification Techniques:

a. **Clustering:** It is an iterative process of assigning each data point to the groups and slowly data points get clustered based on **similar features**. The objective is to minimize the sum of distances between the data points and the cluster centroid, to identify the correct group each data point should belong to library(cluster)

b. **Logistic Regression:** Logistic regression is one of the most popular Machine Learning algorithms, which comes under the **Supervised Learning technique**. It is used for predicting the categorical dependent variable using a given set of independent variables.

Logistic regression is used **for binary classification** where we use sigmoid function, that takes input as independent variables and produces a probability value between 0 and 1.

c. **Support Vector Machine:** Support Vector Machines (SVM) are a popular supervised learning algorithm used in machine learning for **classification** and regression tasks. The primary goal of SVM is to find the hyperplane that best separates the data points into different classes.

d. **K-Nearest Neighbors:**The K-Nearest Neighbors (KNN) algorithm is a popular machine learning technique used for classification and regression tasks. It relies on the idea that similar data points tend to have similar labels or values. The algorithm identifies the K nearest neighbors to the input data point based on their distances.

e. **Naive Bayes:** Naive Bayes algorithm is a supervised learning algorithm, which is based on **Bayes theorem** and used for solving **classification** problems. Naive Bayes Classifier is one of the simple and most effective Classification algorithms which helps in building the fast machine learning models that can make quick predictions.

f. **Decision Tree:** The tree structure is ideal for **capturing interactions** between features in the data. The data ends up in **distinct groups** that are often easier to understand than points on a multi-dimensional hyperplane as in linear regression. The interpretation is arguably simple. The tree structure also has a **natural visualization**, with its nodes and edges.

g. **Random Forest:** Random Forests are based on the concept of Bagging. The idea is to fit a bunch of independent models and use an average prediction from them. Since models are independent, errors are not correlated. We assume that our models have no systematic errors, and the average of many errors should be close to zero.

h. **Odds and Relative Risk Ratio:**

		OUTCOME	
		Disease (Case)	No Disease (Controls)
EXPOSURE	Exposed	a	b
	Unexposed	c	d

$$Odds\ of\ Exposure\ in\ Cases = \frac{Number\ of\ Cases\ with\ Exposure}{Number\ of\ Cases\ without\ Exposure} = \frac{a}{c}$$

$$Odds\ of\ Exposure\ in\ Controls = \frac{Number\ of\ Controls\ with\ Exposure}{Number\ of\ Controls\ without\ Exposure} = \frac{b}{d}$$

$$Odds\ Ratio = \frac{Odds\ of\ Exposure\ in\ Cases}{Odds\ of\ Exposure\ in\ Controls} = \frac{a/c}{b/d} = \frac{a*d}{b*c}$$

$$Relative\ Risk\ (RR) = \frac{Outcome\ Rate\ Exposed}{Outcome\ Rate\ Not\ Exposed} = \frac{a/(a+c)}{b/(b+d)}$$

Overview of the variables: Music Listener, favourite music type, time, Instrument Played, Compose Music, Sing Songs, Studying or working, Listen music in different language, Exploring New Artist, BPM, Classical Music, Film Songs, Bhajan, Lofi, Slowed and Reverb, Concentration Level, Changes your mood, Place of Listening, Depression, Anxiety, Insomnia, Stress, Heart Disease, Diabetes, BP, Type of Diet, Frequency of Fast Food, Effect of Music.

Procedure: The primary data was collected with the help of google form, reliability of the questionnaire was checked by using Cronbach's alpha method and validity using

Pearson Correlation method. Questionnaire contains all above variables and we get Cronbach's alpha was lies between 0.71 to 0.80 and for validity the Pearson's correlation is significant at 5% l o s. Hence our questionnaire was good and acceptable.

Graphical Representation:

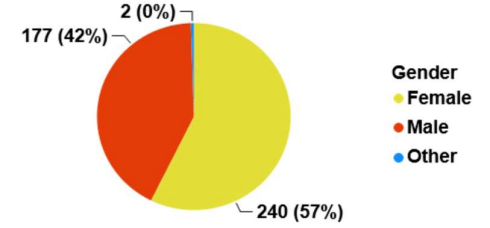


Fig-1

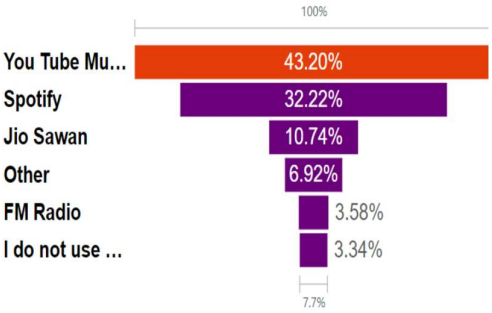


Fig-2

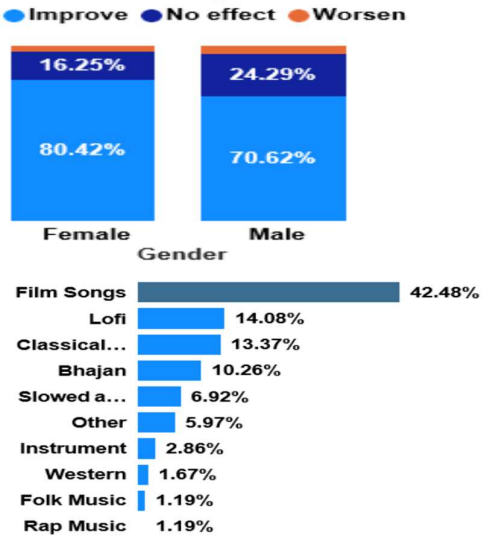


Fig-3

Fig-4

From the Fig-1 pie chart we observe that 57% are female responder. From Fig-2 funnel chart we observe that 43% people listen the music on You tube. Hence You Tube Music is the most popular online mode to listen music

From Fig-3 Bar graph we see that music proves more effective in the female as comparative males because most of the women said that the music improves their mental health condition.

From Fig-4 we see that 43% of responder said that film songs are their favourite music.

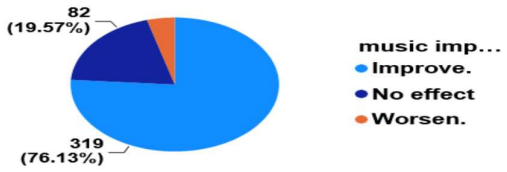


Fig-5

From Fig -5 we observe that there 76% people said that music can improve their mental health condition and it reduces the mental disorders such as stress, depression, anxiety, uneasiness.

3. DATA ANALYSIS

Chi-Square Test of Independence: This chi-square test is used to check is there any association between instrument played and music composer, music composer and singer, sing songs and music improve or worsen mental health, listen music while studying or working and concentration level, compose music and music improve or worsen mental health, etc.

Table 1:

Attribute 1	Attribute 2	P-Value	Conclusion
Sing Songs	Stress	0.026	Singing Songs is associated to reducing stress level.
Sing Songs	Changes your Mood	0.014	Sing Songs associated to Changes Your Mood.
Music Listener	Anxiety (Uneasiness)	0.010	Music Listener and Anxiety are associated to each other.
Compose Music	OCD (Unwanted Thoughts)	0.020	Compose Music is associated with OCD (Unwanted Thoughts).

Classification Techniques:

K-means clustering with 6 clusters of sizes 55, 136, 99, 11, 99, 19.

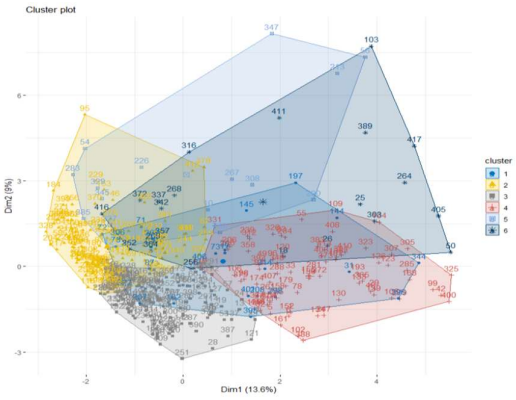


Table 2:

Cluster No.	Criterion
1	Most of the observations are student, they compose music and have medium concentration level.
2	They have good mental health.
3	Most of the people are like to listen music while studying or working, they explore new artist and listen film songs regularly.
4	Most people listen music for 0-1 hours and says music does not effect on mental health.
5	Most of the people have OCD and diabetes disease and says their mental health improved by listening music.
6	Most of the people listen music while studying or working and their mood changes.

Classification Using Machine Learning Techniques:

Various Supervised ML techniques are used for prediction purpose and checked the accuracy of models for further use. The SVM algorithm gives more accuracy (83.33%) than other ML techniques. Train-Test Ratio: 80-20.

Table 3:

Model	Logistic Regression	SVM	K-NN	Naïve Bayes	Decision Tree	Random Forest
Accuracy (%)	75.24	83.33	71.43	73.38	77.38	82

From above table we get that SVM technique gives the better result. So we predict mental health after listening the music as per given below.

Prediction of New Data Points Using SVM Algorithm:

Prediction 1:

```
import numpy as np
new_data_point = np.array([[4,0,4,3,3,0,1,3,1,2,0.3,0.86]])
predicted_label = clf.predict(new_data_point)
print("Predicted label:", predicted_label
```

Conclusion: By using data points mentioned above SVM algorithm Predicts that the Music has no effect on mental health.

Prediction 2:

```
new_data_point = np.array([[4,0,4,3,3,1,1,3,1,2,0.3,0.86]])
predicted_label = clf.predict(new_data_point)
print("Predicted label:", predicted_label
```

Conclusion: By using data points mentioned above SVM algorithm Predicts that the Music improve mental health.

Table 4:

Our aim is to find where the depression is less likely to occur in music listeners while there is chance of depression in non-listener group or not.

Attribute 1	Attribute 2	Odds Ratio	Risk Ratio
Music Listener	Depression	0.3909	0.9436

4. RESULTS

In Data Visualization heat map shows that the depression is mostly correlated with insomnia (i.e. inability to sleeping) is about 54% and also depression is 42% correlated with anxiety (Uneasiness) as well as 38% correlation between depression and OCD (Unwanted thoughts).

In music listener observe that there is highest proportion with depression in people who is already suffering from Insomnia and that proportion is 51.67%, vice versa in non-music listener observe that there is highest proportion with depression in people who is already suffering from Insomnia and that proportion is 83.33%.

5. DISCUSSION

The present study examined the effect of music on mental health using statistical analysis and machine learning techniques. The findings indicate that music plays an important role in improving emotional well-being and reducing symptoms associated with common mental health disorders. A large proportion of respondents reported that music positively influences their mood and mental health, supporting previous research that identifies music as an effective non-pharmacological intervention for stress, anxiety, and depression. The study found significant associations

between singing songs and stress reduction ($p = 0.026$), singing songs and mood improvement ($p = 0.014$), music listening and anxiety ($p = 0.010$), and music composition and OCD-related symptoms ($p = 0.020$). These results suggest that active engagement with music, such as singing or composing, may contribute to better psychological well-being.

The heat map analysis further revealed that depression is strongly correlated with insomnia (54%), anxiety (42%), and OCD (38%), highlighting the interconnected nature of mental health disorders. Odds ratio analysis showed that depression is less likely to occur among music listeners (OR = 0.3909), while the relative risk analysis indicated a higher probability of depression among non-listeners. Cluster analysis classified respondents into six meaningful groups based on their music habits and mental health characteristics, demonstrating diverse patterns of music engagement. Furthermore, among all machine learning models used, the Support Vector Machine (SVM) achieved the highest prediction accuracy of 83.33%, outperforming Logistic Regression, Decision Tree, Random Forest, K-Nearest Neighbour, and Naïve Bayes models. Overall, the findings suggest that music listening and music-related activities can serve as valuable supportive strategies for promoting mental health and emotional resilience, although further studies with larger and more diverse populations are recommended to strengthen these conclusions.

6. CONCLUSION

This study concludes that music has a significant positive effect on mental health and emotional well-being. Most respondents reported that music improves their mental health by reducing stress, anxiety, depression, and other psychological difficulties while enhancing mood and relaxation. Statistical analyses confirmed significant relationships between several music-related activities and mental health variables, indicating that music can be an effective supportive tool for improving psychological health. The odds ratio and relative risk analyses further demonstrated that individuals who do not listen to music have a greater likelihood of experiencing depression than regular music listeners.

The study also showed that music preferences, listening habits, and active participation in music influence mental health outcomes. Cluster analysis successfully identified different behavioral patterns among respondents, while machine learning models effectively predicted the impact of music on mental health. Among the classification techniques, the Support Vector Machine (SVM) achieved the highest prediction accuracy of **83.33%**, making it the most suitable model for this dataset.

In conclusion, music can be considered a simple, accessible, and cost-effective complementary approach for promoting mental well-being. Although it should not replace professional psychological or medical treatment, regular engagement with music may help individuals cope with emotional stress and improve overall quality of life. Future research involving larger and more diverse populations, longitudinal data, and clinical validation would further strengthen the understanding of music's therapeutic role in mental health.

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