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Application Of Data Analytics In Mental Healthcare: Case Study Of Students Mental Health Survey

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Abstract
With the rapid increase in the use of advanced technology, the healthcare sector has actively seen the need to incorporate the technology into the system, particularly due to the increase in the use of data. This research paper explains the types of data used and the need for a data analytics department in the healthcare sector, particularly the mental healthcare sector. It also explains the various areas where Data Analytics can be applied in order to enhance decisions that will help in reducing the growing rate of mental disorders around the world. A student mental health survey was analyzed as a case study using Microsoft Excel for data cleaning, and Microsoft Power BI for exploratory data analysis and visualization to show the trends and patterns amongst students and their mental health, thereby transforming it into meaningful insight, in order to assist Mental Health Practitioners in making decisions on ways to reduce the occurrence of mental health disorder among students.
Keywords: *Data analytics, Mental health.*

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I. Introduction

Data analytics in mental healthcare aims to uncover fresh insights within datasets, enhance clinical decision-making processes, and partly automate functions like diagnosis [1],[2]. It aids mental healthcare organizations in assessing and refining practitioners, identifying anomalies in scans, and forecasting outbreaks of illnesses. Both structured and unstructured data are utilized by medical facilities in their operations. Structured data is characterized by a predefined schema, is diverse, expansive, and comes in various formats [3]. On the other hand, unstructured data, known as Big Data (BD), doesn't conform to conventional data processing formats. Big Data encompasses vast datasets that traditional tools cannot store, process, or analyze [4]. The rise in hardware cost-effectiveness and the advancement and widespread adoption of data analysis techniques have resulted in the growing scholarly and practical adoption of data analytics within the healthcare sector over the past few decades [5]. Certain data analytics solutions have shown to outperform human efforts [6]. With healthcare data being abundant and diverse, particularly in the realm of big data analysis, scientific literature has extensively explored the prospects and challenges [7]. Additionally, concepts like data mining, machine learning, and artificial intelligence have been both hyped as promotional tools for data analytics applications and genuinely heralded as innovative solutions or amalgamations of existing methods [8]. A range of AI algorithms are employed to forecast patient illnesses by analyzing historical data. Likewise, diverse wearable sensors have been created to address physical and social interactions effectively.

The mental health of individuals is assessed through a spectrum of affective disorders, leading to major depression and various anxiety disorders. Numerous conditions, such as anxiety disorder, depressive disorder, mood disorder, and personality disorder, are acknowledged as mental health issues. The proliferation of mobile apps, alongside smart devices like smartwatches and smart bands, enhances healthcare accessibility within mobile mental healthcare systems. Personalized psychiatry is also pivotal in predicting bipolar disorder, refining diagnosis, and optimizing treatment strategies. Scientists are therefore actively developing numerous machine learning algorithms to extract valuable insights from raw data, as traditional database management tools are inadequate for handling healthcare data due to its vast scale, measured in terabytes and petabytes [9].

This study aims to explore different applications of data analytics within the healthcare sector. The second section provides a detailed case study demonstrating the practical utilization of data analytics to extract valuable insights from a dataset focused on student mental health.

II. Literature Review

The field of digital mental health has undergone a revolution, with innovations proliferating rapidly. Recognizing its significance in mental healthcare, the National Health Service (NHS) is actively seeking cost-effective innovations to deliver services [10]. Some selected studies considered the relationship between

healthcare in general and a specific data analysis technique, while other studies considered the relationship between data analytics in general and a specific healthcare subfield. Most of the studies, however, considered the relationship between a specific data analysis technique and a specific healthcare subfield [11]. Hill et al. conducted a study addressing the challenges and factors to consider in advancing digital mental healthcare innovations. They proposed fostering collaboration among clinicians, industry professionals, and service users to surmount these challenges and facilitate the successful development of e-therapies and digital apps [12]. Jiang et al. conceived and constructed a wearable device equipped with multisensory functionalities such as audio detection, behavior monitoring, and environmental and physiological sensing. This device evaluated speech data and autonomously managed raw data. Test students, categorized into groups based on their scores, were tasked with wearing the device to ensure data authenticity. However, a significant hurdle in implementing IoT within the device lies in ensuring secure communication [13]. Monteith and Glenn expanded on the concept of generated data through algorithmic processes initiated by humans. These processes involve searching for disease symptoms, accessing disease-related websites, and exchanging healthcare-related emails, and sharing health information on social media. Sharing health information on social media was utilized to generate perceived data, enabling the system to predict automated decision-making while ensuring user non-involvement for security maintenance [14]. Turner et al. detailed in their article that the volume of big data is doubling every two years, providing ample resources for automated decision-making applications [15]. Passos et al. asserted that the traditional doctor-patient relationship will undergo transformation with the integration of big data and machine learning models. Machine learning algorithms can enable individuals to monitor their health regularly and notify their doctor promptly if their condition deteriorates. Timely consultation with the doctor could mitigate potential risks for the patient. If psychiatric disorders are not identified or addressed promptly, individuals may become susceptible to engaging in various illegal activities, including suicide, as a significant portion of suicide attempts are linked to mental health conditions [16]. Kessler et al. conducted a meta-analysis examining suicide rates within one year of self-harm incidents using a machine learning approach. They reviewed previous studies on suicide cases and found that predicting such outcomes was challenging due to the short duration of psychiatric hospitalizations. While several AI algorithms have been employed to forecast patient outcomes based on historical data, the primary focus of these studies was on suicide prediction through the establishment of thresholds. Establishing an accurate threshold proves to be a critical and sometimes insurmountable challenge [17]. Cleland et al. reviewed numerous studies but were unable to identify definitive principles for establishing thresholds. The authors employed a random-effects model to create a meta-analytical Receiver Operating Characteristic (ROC). Their findings suggest that the prevalence of depression serves as a mediating factor between economic deprivation and the prescription of antidepressants [18].

III. Applications Of Data Analytics In Mental Healthcare

- Patients – Staff Availability: Predicting patient-staffing needs requires a delicate balance between efficiency and manpower. Having an excess of staff during low-demand hours risks unnecessary labor costs, while understaffing during high-demand hours can lead to a decline in patient satisfaction. Moreover, timely accommodation can be critical, even life-saving, for some patients. Healthcare data analytics offers a solution by analyzing an organization's admission records to identify patterns in patient demand. Outsourcing this task to a team of healthcare specialists enables the identification of these patterns and the creation of reliable predictions. This, in turn, empowers staff to efficiently manage their shifts, effectively addressing fluctuating demand.
- Telemedicine: With the technological advancement of the internet, healthcare providers can now offer remote clinical services such as consultations, diagnoses, and monitoring through video conferencing. By harnessing insights from healthcare data analytics, providers can enhance the quality of service by improving diagnostic accuracy and crafting optimal treatment plans. This is achieved through analyzing patient records and historical trends of comparable cases, enabling more informed and effective healthcare delivery.
- Early Mental Disease Detection: Healthcare data analytics can effectively identify patterns by analyzing vast amounts of unstructured data, enabling mental healthcare professionals to pinpoint risk factors associated with specific demographics and social determinants linked to chronic mental diseases. This data can be utilized to administer preventative medicine to individuals most vulnerable to diseases based on risk assessment scores, ultimately reducing hospital admissions. Furthermore, organizations can leverage this data to prevent patient deterioration.
- Fraud Detection and Security: Healthcare fraud involves the intentional misrepresentation or alteration of medical records by individuals or organizations to achieve financial benefits. Reports suggest that losses from healthcare fraud can vary significantly, ranging from $68 billion to $230 billion annually. By utilizing healthcare data analytics driven by machine learning and big data, it becomes possible to detect discrepancies between the information provided by patients and the historical medical data collected. This helps in identifying

abnormal patterns and potentially fraudulent activities, aiding in the prevention and mitigation of healthcare fraud.

- E- Health Record: One prominent application of big data in healthcare is the development of electronic health records. These records provide comprehensive information about a patient's medical history, test results, and allergies, leading to enhanced patient care. By organizing patients' health records based on demographics, healthcare providers can analyze data to forecast trends and take proactive measures to address emerging healthcare needs.

IV. Data Analytics Case Study: Students Mental Health Survey

ABOUT DATASET: The dataset gotten from Kaggle, describes the mental health evaluation of 7022 students from different faculties. It aims to offer valuable insights into the mental well-being of students by encompassing various factors that could influence their mental health. It contains 18 columns listed below:

- Age
- Course
- Gender
- Cumulative Grade Point Average
- Stress level: The level of stress experienced by the individual.
- Depression Score: The score representing the level of depression experienced by the individual.
- Anxiety Score: The score representing the level of anxiety experienced by the individual.
- Sleep Quality: The quality of sleep experienced by the individual.
- Physical Activity: The level of physical activity.
- Diet Quality: The quality of the individual's diet.
- Social Support: The level of social support received by the individual.
- Substance Use: The frequency of substance- use such as alcohol, cigarettes or other drugs.
- Family History: Whether the individual has a family history of mental health issues.
- Chronic Illness
- Financial Stress: The level of financial stress experienced by the individual (between 0 and 5).

Link to the Dataset: Link

V. Material And Methods

Data Collection: The dataset used for this analysis was downloaded from Kaggle. It contains a total of 7022 rows representing students from different departments.

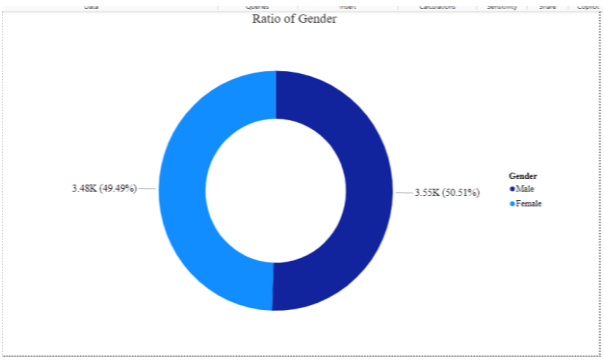
Data Cleaning: The dataset was imported into Microsoft Excel where duplicate values were removed. Columns not needed for the analysis were also removed. Each column was checked for misspellings and errors, in order to avoid inconsistencies.

Exploratory Data Analysis: The cleaned dataset was then imported into Microsoft Power BI, where descriptive analysis and visualization was carried out to discover correlations and trends across the students, their gender and various factors affecting the mental health of the students.

VI. Results

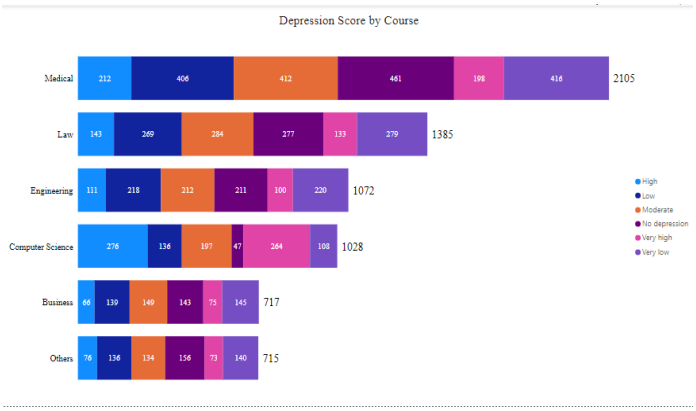
A grand total of 7022 students underwent evaluation, with 50.51% being male and 49.49% being female.

1 Total number of students



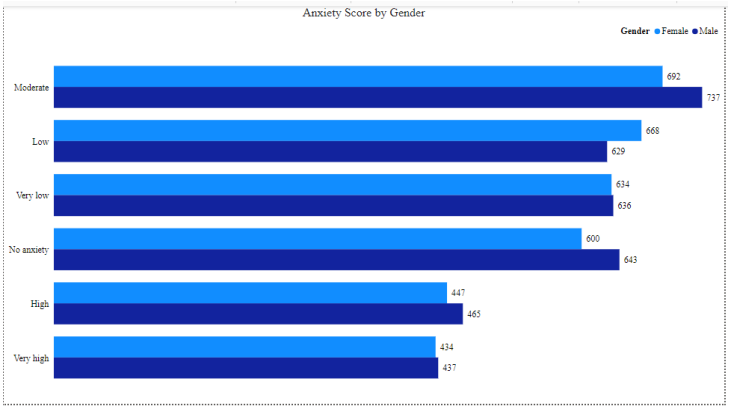
2 Ratio of Male to Female Students

Most students are enrolled in medical courses, with Law following closely behind. Engineering and Computer Science have a moderate number of students, while Business and Other courses have fewer students.



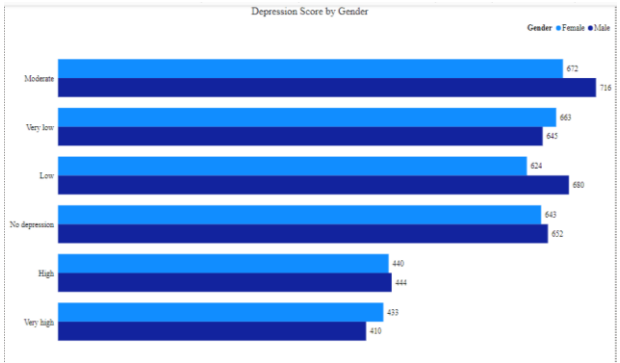
3 Depression Score by Course

The majority of evaluated students showed moderate levels of anxiety, with 737 male students and 692 female students falling into this category. Additionally, a considerable number of students demonstrated low to negligible levels of anxiety, while roughly 1600 students displayed high to extremely high levels of anxiety, with males predominating in this group.



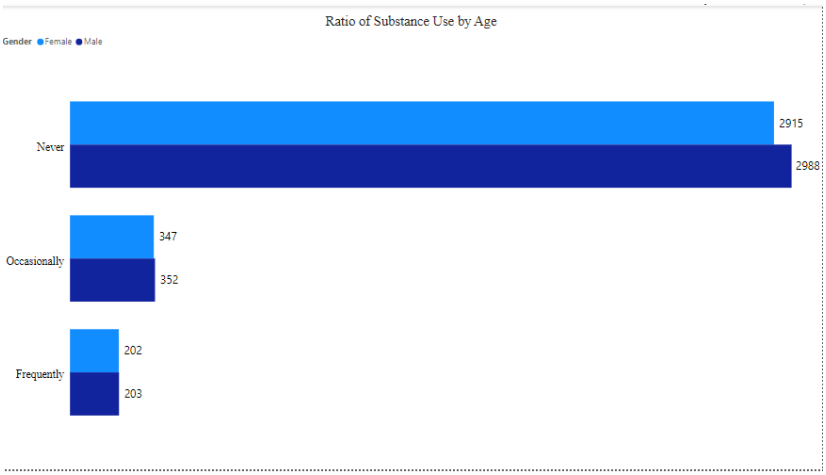
4 Anxiety score by Gender and Course

A total of 716 male students and 672 female students displayed moderate levels of depression. A greater number of students showed low to negligible depression scores. Meanwhile, 440 male students and 444 female students demonstrated high levels of depression, while 410 male students and 433 female students exhibited very high levels of depression.



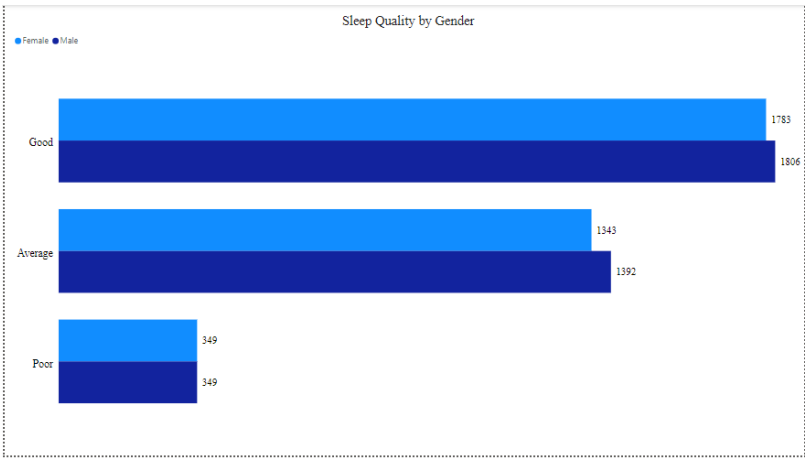
5 Depression Score by Gender and Course

Regarding substance use, most students have never used substance, while a few of them use substances occasionally and frequently.



6 Ratio of Substance abuse

It can also be inferred that the majority of students evaluated, especially males, have good to average sleep quality. An equal number of students from both genders experience poor sleep quality.



7 Ratio of sleep quality

VII. Conclusion

Through the utilization of data analytics, the student mental health dataset has been converted into valuable insights. These insights can then be leveraged by stakeholders, such as mental health care practitioners, to make informed, data-driven decisions aimed at preventing or reducing the prevalence of mental health disorders among students. Advanced data analytical technologies like Machine Learning and Artificial Intelligence (ML & AI) should also be employed to conduct predictive analysis and develop models that will assist mental health practitioners in maintaining the stability of mental health.

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