Improving Life with ADHD Indicators: A Statistical Investigation into Finding Significant Associated Areas

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FINAL YEAR DESIGN PROJECT REPORT

This Report Presented in Partial Fulfillment of the Requirements for the **Degree of Bachelor of Science in Computer Science and Engineering**

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APPROVAL

This Project titled "**Improving Life with ADHD Indicators: A Statistical Investigation into Finding Significant Associated Areas**", submitted by **Md. Adil Ahnaf Patwary,** ID No: **201-15-13886** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 12 January, 2025.

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I hereby declare that this project has been done by me under the supervision of **Dr. Md. Taimur Ahad, Associate Professor and Associate Head**, Department of Computer Science and Engineering, Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

This study looks at Attention-Deficit/Hyperactivity Disorder (ADHD) from a very different perspective and analyzes the mental disorder very deeply to find relations with it's behavioral symptoms. This study also places these ADHD-related challenges into four distinct behavioral categories which are linked to different brain areas of an ADHD sufferer. Finding the proven associations with these behaviors is the main goal of this study. Our study finds that people suffering from ADHD or thinking of having ADHD have significant associations with task related challenges. Most ADHD life can be improved if the individuals focus on the motivation for their completion of task, they are having now regardless of the condition. Besides, self-control challenges in social places and hyperactivity challenges have also been found with strong association with the disorder. People having these symptoms are more likely to be suffering from ADHD. This study also finds that age has a significant association with likelihood of having ADHD, which is a very valuable new insight for future work. While other demographic variables (Gender and Marital Status) have no significant association with it. Taken together, the findings highlight the importance of giving significance to help manage symptoms of ADHD, highlighting the key areas. Limitation are there in this study, if the survey was done on a large scale of population the research outcomes would've been more close to accurate.

Keywords: ADHD, behavioral analysis, attention and cognitive, hyperactivity, task completion, brain regions, ADHD management.

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Chapter 1

Introduction

In this chapter we will be providing background information on the topic, highlighting the significance of the research, and stating the objectives or of our research to give a clear understanding. It will set the context and outline the purpose of the study.

1.1 Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a constant neurodevelopmental disorder that can start from childhood and continue to adulthood. Mostly children are affected by it, or we can say it develops from early childhood. It is characterized by symptoms like inattention, impulsivity and hyperactivity, such that the disorder can severely disrupt daily activities, relationships and quality of life. ADHD is a well-studied condition, but the "how" of how ADHD symptoms are manifested, or the impact of those symptoms across type of life, is complex and multifaceted. ADHD is very much likely to be underdiagnosed and very much neglected by parents because it doesn't have visual effects on the body. This research study intends to conduct a statistical analysis to identify the main contributors to ADHD as well as high significant indicator areas related to ADHD which would finally help to understand the condition as well as manage and treat ADHD. Through this research we want to make people more aware of ADHD and how they can tackle the situation if they discover that they have ADHD.

ADHD symptoms vary and can look different among individuals. For others it may be problematic with restlessness or impulsivity or changes in mood or anxiety or sleep. This can often make it hard to pin down exactly where your individual ADHD is most affecting your life. We examine several multiple indicators such as difficulty with task completion, inattention, social behavior,

and hyperactivity in this study to identify the places most strongly associated with symptoms of having ADHD. These indicators can help create a broader understanding of how ADHD spills over into various life domains.

Through statistical analysis, we strive to identify significant relationships between different ADHD indicators and their impact on daily life. Using surveys, interviews, self-reports, etc. the study examines actual patterns or correlations between symptoms and perception of having ADHD. This statistical investigation reveals the diverse and significant impact of this mental disorder, and helps guiding future efforts for intervention in the most powerful areas to improve the quality of life for those affected.

Throughout this research we focus on contributing to enrich medical field for Bangladesh and it's people living with day to day ADHD. As it is very much neglectable from many people we want to change their view on this and help to understand that people who are suffering from this is not in a normal condition everyone perceives. We will also be showing the behavioral connections with the key effecting areas of ADHD on brain. There are 3 key areas of the brain that are implicated in ADHD- i) Cortical Regions (Prefrontal Cortex, Anterior Cingulate Cortex); ii) Subcortical Regions (Limbic system, Basal Gangila); iii) The Cerebellum. [1]

Finally, this research will build on the existing knowledge in the field of ADHD through evidence that may influence clinical practices as well as the general perception towards the disorder. The study's goal is to create the potential for personalized treatment and support for individuals with ADHD by identifying which factors impact their daily lives and in what specific ways. The end goal is to help ADHD individuals take control of their symptoms and live their lives to the fullest.

1.2 Motivation

This study embarks on a personal interest integrated with endeavor to retrieve the well-being of individuals with Attention-Deficit-Hyperactivity Disorder (ADHD) in Bangladesh. Moreover, as an adult who relates to many of the ADHD

symptoms, I have a first-hand appreciation and understanding of the day-to-day challenges that can come with inattention, impulse control, and disorganization. All these challenges when taken together can affect a person's development, educational and career path which will make them feel isolated and disconnected. Having lived in Bangladesh, there is little understanding of ADHD which makes it even more complicated.

ADHD-induced symptoms are still, somehow, misunderstood in Bangladesh, and seeking help from psychiatrists to get out of this problem is not common among people. So, several people (adults and children alike) are going undiagnosed or misdiagnosed. Adding to these barriers is the scarcity of specialized care and support services for people with ADHD. Moreover, the stigmatization of mental health concerns encourages individuals to avoid seeking help or even admitting their problems. Hence, these reasons encourage this research idea to have a positive impact on people with ADHD.

Through this study, I would like to contribute to the existing leanings about the Attention Deficiency/Hyperactivity Disorder, particularly in the context of Bangladesh. As I read as wide a variety of articles about ADHD, I do this in the hope of increasing awareness and understanding of a disorder that can be difficult to diagnose, mostly ignored by family and in the long run, spur on research that leads to better treatment and coping strategies for those afflicted by it. As someone affected, this fuels my passion for a world free of stigma for people with ADHD. In addition to the academic interest, this is a personal project amongst those with the condition who want to achieve happy and prosperous lives.

1.3 Objectives

Attention-Deficit/Hyperactivity Disorder (ADHD) is a complex disorder that profoundly affects an individual's behaviour, emotions, and functioning in everyday life. ADHD is still poorly comprehended and under-researched worldwide including Bangladesh despite its ubiquity.

Therefore, this study aims to fill the existing gap of following indicators of attention deficit hyperactivity disorder, its effects in one`s daily life and the perspective towards the disorder amongst the Bangladeshis.

With a systematic and evidence-driven exploring approach, the purpose of this study is to explore ADHD symptoms and symptom experiences in individuals located in Bangladesh. By exploring behavioural, cognitive, task completion and demographic aspects, research aims to identify specific needs that may be addressed. The final objective is to be able to offer insights to tackle diagnosis, for these few day-to-day issues, to raise awareness of ADHD and to develop support systems to provide a dedicated approach toward these individuals.

The objectives of this research are organized in an international manner to address challenges faced in understanding ADHD within the Bangladeshi setting is laid below:

i) We are aiming to find out the significantly associated indicators or behaviors related to ADHD.
ii) By analyzing the raw data collected from people the purpose is to find out how they can be used in further medical research.
iii) Based on that our objective is to give the people suffering from ADHD a better insight into which behaviors they must work on most to improve their daily lives and thrive in career.

1.4 Methodology

This study employs a structured quantitative statistical analysis of self-reported ADHD-related behaviors. The data was collected by preparing surveys that covers many age groups in Bangladesh, such as students to working adults. The survey was concerned with different signs of ADHD e.g. trouble focusing, impulsivity, task completion problems, social behavior issues, etc.

Data was preprocessed after collection, including cleaning the data set, classifying responses on behavioral indicators, and eliminating missing values.

Statistical analysis was done through chi-square tests to assess the relationship between these behavioral indicators and self-perceived ADHD. We selected this test because it is appropriate to test associations between the variables for categorical treatment.

We handled the dataset very carefully and then categorized the ADHD indicators in four main sections. Then we implemented a statistical analysis test on it and found out the key association for perception of having ADHD. This study sets out to provide actionable insights into ADHD perception in order to facilitate awareness, diagnosis and intervention in Bangladesh by identifying the major associations.

1.5 Project Outcome

Through this project, we will gain insight into some of the major behavioural indicators of how people view ADHD and explore neural correlates using self-reported data from a wide variety of people in Bangladesh.

The study will also outline other features such as hyperactivity, inattention, self-control challenges etc. related problems in ADHD people to dive deep into the symptoms. Also, how these behaviours relate to information we know about brain function in people with ADHD.

Research suggests ADHD symptoms are often associated with differences in the brain, especially areas such as the prefrontal cortex, which is vital to attention, impulse control, and organization. Blips in neural networks or the brain's dopamine system can lead to challenges such as impulsivity and trouble focusing. This study will reveal behavioural patterns, taking into account age and gender information, using statistical techniques, e.g., chi-square tests.

The results will be informative in two respects. Academically, this study will yield a better understanding of ADHD in a culture that has been less studied and will bridge behaviours to neuronal activity. Practically, it will help shape targeted awareness programs, educational tools, and intervention strategies to support individuals with ADHD in Bangladesh. The ultimate goal is to reduce

stigma, encourage early diagnosis, and improve the quality of life for those living with ADHD.

1.6 Organization of the Report

The report is written in a manner that helps the reader to comprehend the research process and results in a logical manner. The chapter be focused on a different part of the study containing details on what method have been used in this and what the result of that method is.

Chapter 1: Introduction

The Introduction chapter sets the context for the research, including the motivation behind the study, the research questions, and the objectives. It presents the importance of exploring ADHD indicators using self-reported data and gives a broad outline of the approach and methodology that will be used in the study.

Chapter 2: Background

This chapter provides the background on ADHD necessary to understand its prevalence, common symptoms, and diagnostic criteria. It also discusses relevant literature, noting previous studies that explored ADHD and associated indicators. Its purpose is to put the current research into context with existing literature and lay out the basis of the theoretical framework used in the analysis.

Chapter 3: Methodology

This chapter elaborates on the research design and approach. It describes the data collection process, including the self-reported questionnaires, and shows how ADHD-related indicators were categorized. The methodology also discusses the methods of statistical techniques, chi-square tests and the label encoding and preprocessing for analysis. Further explanation is also given regarding the reason for choosing these methods to assist in the research goals.

Chapter 4: Implementation and Result

Here, this chapter describes the real practice of the study and the findings of data analysis. It encompasses a thorough description of the implementation of the methodology, with the steps for data processing, statistical testing and analysis. At the end of the chapter, the results will be presented, with tables, charts, and graphs to illustrate the findings.

Chapter 5: Engineering Standards and Design Challenges

This chapter provides the engineering standards and design issues faced throughout the course of the research. It details the technical aspects relevant to the design of the study including data collection tools and procedures, but also highlights any difficulties encountered in the analysis, including challenges regarding data integrity, reliability and statistical validity. The answer to these challenges are also mentioned.

Chapter 6: Conclusion

In this chapter titled Conclusion, the main conclusion of the research and its implications for ADHD and its different predictors of symptoms has been discussed in detail. It provides an overview of the overall research process, discusses the implications of the study, and suggests possible directions for future research. The results of the study suggest recommendations are also provided.

This systematizes the study process, from hypothesis to outcomes, and any issues encountered along the way, ensuring that every step of the journey is documented and that the narrative is easy for the reader to follow.

Chapter 2

Background

In this chapter we will be discussing the literature study we made for conducting our whole research. It will give a thorough analysis of this throughout the whole chapter.

2.1 Introduction

This review of literature looks at significant studies that have utilized statistical approaches, particularly the chi-square tests to analyze the association between ADHD symptoms and a range of influencing factors. Research using the ASRS, a common diagnostic tool for identifying correlations between ADHD symptoms and demographic variables (for example age, gender) will be the focus of our investigation. These studies are crucial in helping to understand the condition in different populations and setting an important context to the findings we report in our own research. In addition, the review will focus on the application of chi-square testing for self-report data with the discovery of important correlations with ADHD and other variables.

Apart from behavior and demography, studies that investigate ADHD neurobiology will also be discussed in this review. We focus on research that has pinpointed brain regions implicated in ADHD, such as the prefrontal cortex, basal ganglia, and cerebellum known to affect ADHD behavior. We are aware that these regions may provide features toward the indicators identified in our study, thus we synthesize these brain-related studies to deepen the understanding of the correlation between these identified brain regions and our assessment findings. Integrating statistical analysis with neurobiological insights, this combined approach will contribute towards a comprehensive view of ADHD, thus advancing clinical and practical perspective on managing the

disorder.

In totality, this review lays the groundwork for the ensuing research which aims to bridge statistical and neurobiological findings to advance practical models of ADHD management in the real world. By reviewing these diverse areas of research, we aim to contribute new insights into ADHD's multifaceted nature, which could inform better diagnostic and therapeutic strategies.

2.2 Literature Review

First, we have to see the studies related to ADHD using regression model. The studies reviewed include a variety of methods to examine differences in ADHD, including chi-square tests and regression models. The ease of exploring relationships between categorical variables using chi-square tests was mentioned by Msuha and Mdendemi [2] in their paper. Oyeka and Okeh, [3] proposed a chi-square-based method for crossover clinical trial data; the method is useful for examining treatment effects and exit rates but needs to be validated with larger datasets. Bussing et al. [4], utilized multiple regression models to examine beliefs towards ADHD treatments, revealing stigma and side effects as major treatment barriers in adolescents, however, self-reported data limited the generalizability of their results. Lastly, Pritesh et al. [5] does chi-square analysis in a cross-sectional study among students and reported a 15.9% prevalence of ADHD, and associated ADHD with gender and education level, but the small sample and geographic spread limited the generalizability of this finding. Together the studies reinforce the value of good methodology while also emphasizing the need for broader, more representative data to enhance generalizability.

Studies were also made to understand how ADHD affects the brain, and which regions of the brain is closely associated with it. This will help us know more about the neurobiological connections of ADHD with brain. Examined studies by De La Fuente et al. [6], Dey et al. [7] display structural-functional brain abnormalities related to the functionality of the basal ganglia (more specifically caudate and putamen) and the prefrontal cortex impacting attention, impulse and execution functions.

Table 2.2.1: Summary of Literature Reviewed.

Author (s)	Year	Methodology	Key Findings
Msuha & Mdendemi [2]	2019	Chi-Square Test	Demonstrated the effectiveness of chi-square tests in assessing independence between variables. Highlighted the need for methods to quantify associations.
Oyeka & Okeh [3]	2013	Chi-square test	Effective for analyzing categorical responses in clinical trials. Applied crossover designs to compare ADHD treatment effects.
Bussing et al. [4]	2012	Multiple regression analysis, Kruskal-Wallis, ANOVA	Adolescents expressed lower willingness to use ADHD treatments than adults. Stigma and side effects were key barriers to treatment engagement.
Pritesh et al. [5]	2018	Chi-square test	ADHD prevalence was 15.9%. The inattentive type was most common. Gender and education level were strong predictors, while age was not significant.

Nakai et al. [8]	2024	Chi-square tests, Kendall rank correlations, linear regression	ADHD symptoms were associated with higher depressive symptoms, poorer quality of life, and greater work productivity impairments during the pandemic.
McGough et al. [9]	2005	Logistic regression, Kaplan-Meier survival analysis	ADHD individuals had significantly higher lifetime rates of psychiatric comorbidities and earlier onset of conditions like major depression and dysthymia.
Algadeeb et al. [10]	2024	Chi-square test, descriptive analysis	High caregiver burden (86.4%) and dysfunction (87.4%) among ADHD families. Marital status significantly influenced caregiver burden.
Radhamani & Krishnaveni [11]	2018	Chi-square test	Gender was significantly associated with ADHD symptoms, though age did not show any significant relationship.
Pawaskar et al. [12]	2019	Logistic regression, generalized mixed models	ADHD-diagnosed individuals showed better outcomes in productivity, self-esteem, and quality of life compared to undiagnosed individuals.

Ragab et al. [13]	2020	Regression analysis, chi-square	Atomoxetine treatment improved pediatric ADHD quality of life. Gender and ADHD severity were significant predictors of improvement.
Boland et al. [14]	2018	Multivariate regression	ADHD medications improved functional outcomes like academic performance, emotional regulation, and social interactions, with variation across subgroups.
Verma et al. [15]	2022	chi-square test	Found significant differences in gaming addiction rates among children with ADHD, emphasizing the need for monitoring gaming behaviors.

2.3 Gap Analysis

The papers reviewed here contribute greatly to the understanding of ADHD and its neurobiological basis, its comorbidities, its functional outcomes, and treatment effects. Yet there remain significant gaps. Although chi-square and other regression techniques are popular to examine ADHD-associated variables, studies often examine isolated variables such as symptoms or effects of treatment and ignore contextual factors such as differences in coping mechanisms and between culture or socioeconomic differences. Also, diversity of the samples in terms of demographics including age and gender is also largely limited, which makes it difficult to generalize the results. Most studies also depend heavily on self-reported data, which can introduce bias and reduce

accuracy. Few studies integrate neural network, behavioral symptom , functional outcome relationships using sophisticated integrative techniques which may help improve life of ADHD effected.

2.4 Summary

The literature review is a critical component of any research as it provides a comprehensive understanding of the existing knowledge, identifies gaps, and establishes the context for the study. It will help in understanding the review of available knowledge, the necessary literature, the gaps that the study intends to fill up and the background of the topics. The review presents a broad overview of the impact of ADHD on individuals' lives in the context of behavioral, neurological, and functional outcome domains for research set out as "Improving Life with ADHD Indicators: Areas of Significant Association." It synthesizes insights from previously reported research identifying important areas of interest such as neurological abnormalities associated with the neurodevelopmental disorder of ADHD, behavioral indicators and efficacy of current diagnosis and therapeutic measures. This enables a more in-depth insight into the underlying systems contributing to ADHD and its clinical features.

Chapter 3

Research Methodology

In this section, we are going to discuss the proposed methodology we are going to use for our research. Research methodology is a very critical part for any academic research and professional study to provide a well-defined structure for investigating, analyzing and investigating data. This also provides a guide of how the adopted methods will help to achieve the research objectives while ensuring that the findings are accurate, reliable and valid.

3.1 Methodology

3.1.1 Overview

This study explores through Bangladeshi students and people of different ages who were eager to participate in this research and had to go through our questions for helping in our findings from the survey. It is a great benefit for the medical sector to see the eagerness of these many people attending our data collection.

In this study, the methodology was developed to address the regular behavioral problems of people suffering from ADHD from authentic self-report questionnaires and give them a solution to which area of the behavioral symptoms they have to improve. This section outlines the research design, data collection methods, sampling techniques, and analytical procedures, providing a comprehensive roadmap of the research process.

3.1.2 Proposed Methodology

In the proposed methodology, we present a unique and innovative approach to implementing the outlines proposed in this paper. ADHD is a mental disorder which is very difficult for diagnosis. We are going to collect questions from valid sources on self-reporting of having ADHD and then categorize the questions by

shortening the question names for our code implementation purpose. We focus on finding out whether the questions associated with identifying ADHD has Hypothetical relationship with perception of having ADHD from our collected dataset. We are going to analyze the indicators according to our pilot research and group those indicators according to similar symptoms related to ADHD and thematic analysis of the questionnaire.

Data Collection:

The data collection process for our research was done via online google form. The survey was carefully designed. As it is a topic related to the medical sector, we had to select a questionnaire from verified source. Our google form included 18 questions related to ADHD indicators which are mainly behaviors that indicate about ADHD, that were taken directly from the Adult ADHD Self-Report Scale (ASRS) [16]. This is a valid scale made by WHO and reliable which is commonly used to self-diagnose ADHD symptoms in adults that can also be administered through medical and academic research. Aside from the 18 questions we included demographic questions about – age, gender and marital status and asked people whether they have ADHD or not depending on their response.

Although we collected data via google form, we also did onsite data collection by asking people to participate in our research in various universities. Google Sheet was used to organize and prepare the data for application in the testing. People's consent was taken for the data collection process. By that means, we have been able to uphold our ethical responsibilities and respect all respondents' privacy.

A total of 454 people took part in our survey, where 425 data was used. Out of them most are of university students' focus groups and middle aged people, we obtained a rich and varied dataset. Thus, we were able to reflect a range as well as depth of opinion and experience in our findings. Out of the participants 72.9% participants were male, 26.7% was female. Most of the participants on our survey are from the 18-24 age group (65.9%), and the second ones are from 25-34 (21.8%).

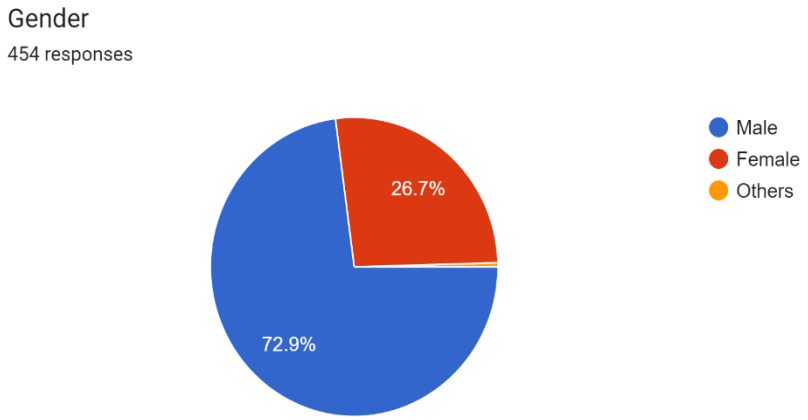

Figure 3.1.2.1: Pie Chart Visualization of Male & Female percentage participating in survey

Data Preparing:

To visualize the data collected from google form spreadsheet was used. We had to shorten the question names for easier way of applying machine learning libraries which were later grouped into 5 categories according to relating to the ADHD symptoms and thematic analysis of the questions. The indicators were divided into mainly 5 categories which are- demographic, attention and cognitive challenges, hyperactivity challenges, task completion challenges and self-control in social challenges.

The grouping aligns with the two primary ADHD symptom domains-

i) Inattention: Reflected in the "Attention and Cognitive Challenges" group and “Task Completion Challenges”.

ii) Hyperactivity-Impulsivity: Captured within the "Hyperactivity Challenges" and "Self-Control Challenges in Social Settings" groups.

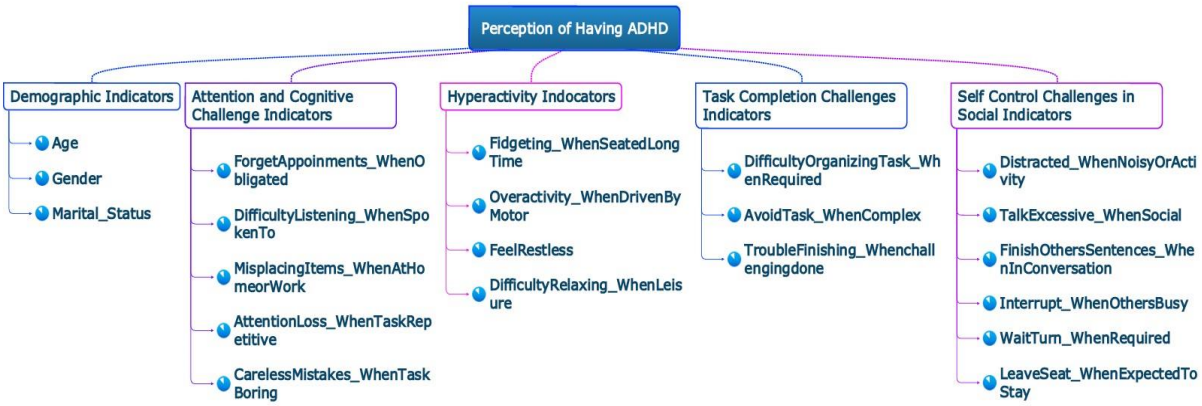

Figure 3.1.2.2: Indicators Grouping

Data Preprocessing:

As our research is solely based on statistical and exploratory analysis for better findings in ADHD, that's why the dataset was very carefully handled. There was not much there to preprocess as our data had categorical values which will be used for hypothesis test but we had 29 null values in our primary dataset. As the null values were in the section of perception of having ADHD, which is our target column in this research. That's why we didn't take those inputs related to missing values. After that, we removed the last two columns from our dataset, which are acknowledgement for participating in the survey and the rating of the survey questions, which are not necessary for the research work.

Statistical Analysis:

This is the main part of our research. We categorized the indicators (questionnaire) and then divided them according to the relation of behavioral context of ADHD. Except the demographic categories, the other four category titles can fall under the different brain areas that are responsible for having ADHD in a person. A thorough pilot study which included a detailed review of existing ADHD literature and thematic analysis of the questions was used to guide the grouping of indicators into five distinct categories for ADHD. This initial study included a comprehensive analysis of the questions and diagnostic criteria commonly used in studies and screening tools relevant to ADHD. The indicators were organized into meaningful categories that reflect key dimensions of ADHD by exploring patterns of behavioural manifestations and their

theoretical underpinnings.

Chi-Square (χ^2) Testing: Chi-Square testing helps you find if the two categorical variables are dependent or independent. It compares the observed data with what would be expected if the variables were independent. The result helps determine the significance of the difference between observed and expected values.

$$\chi^2 = \sum(O_i - E_i)^2/E_i$$

here,

O_i = observed value

E_i = expected value.

Null Hypothesis (H_o): The Null Hypothesis assumes that there is no relationship between the two variables that are being tested, meaning there is power in choosing the two independently. For instance, it might say that AvoidTask_WhenComplex is not related to perception of having ADHD.

Alternative Hypothesis (H_i): The alternative hypothesis suggests that the variables are related or dependent on one another. For instance, AvoidTask_WhenComplex is associated with perception of having ADHD.

Degree of Freedom (df): It is the number of values in the final calculation of a statistic that are free to vary. It is employed to explain the chi square statistic and assists in identifying the critical value for assessment.

P-Value: The p-value indicates the likelihood that the observed data would occur given the null hypothesis is true.

i) A smaller p-value (traditionally below 0.05) means we can reject the null hypothesis, which means that the indicator has a significant association with the perception of having ADHD.

ii) On the other hand failing to reject the null hypothesis means it has no significant association with the perception of having ADHD.

Hypothesis testing:

For the main part of our research which is to find out statistical significant association with indicators analysis through hypothesis testing, we chose the best fit model for our hypothesis analysis and found out whether they have

association with the indicators. And the indicators were categorized as behavior that is controlled by different brain parts which we later showed how they connect to the indicators. The method we used for our hypothesis test was chi-square testing which is basically a regression model that is used to find out association between two categorical data. We defined our Null Hypothesis and Alternate hypothesis and then found out outcome based on the p-value. The detailed flow diagram of our research has been shown below:

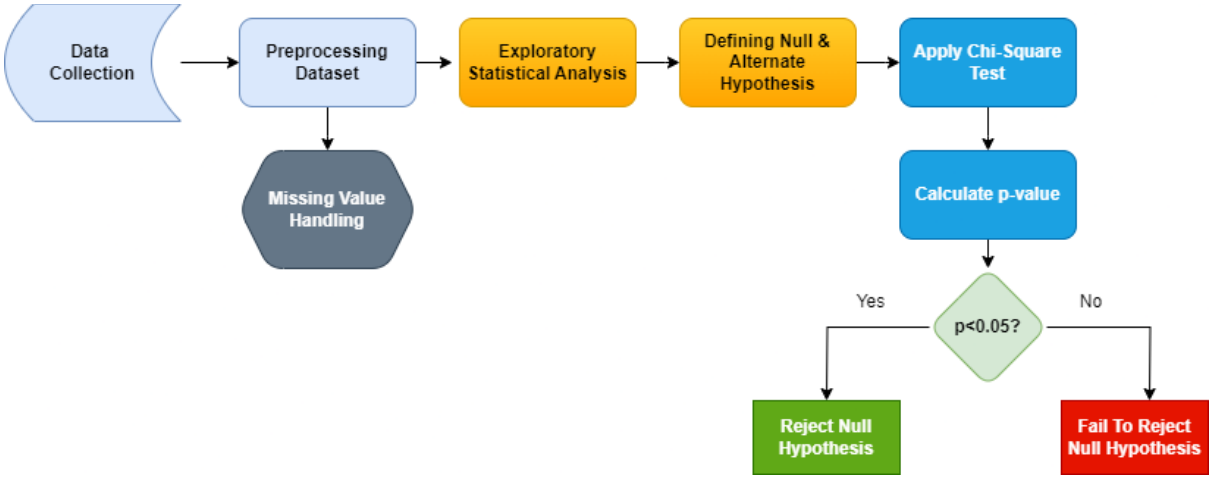

Figure 3.1.2.3: Proposed methodology and flow diagram of our work

3.2 Detailed Methodology and Design

In the previous section we have shown and given ideas about our proposed methodology for my project and now we are going to describe the other regression models that we considered implementing.

i) Kendall Rank Correlation:

This method measures the strength and direction of association between two ranked variables. It's ideal for ordinal data or when the data does not meet parametric assumptions. By focusing on ranks rather than raw data, it provides insights into monotonic relationships between variables.

ii) Linear Regression:

A statistical technique to model the relationship between a dependent variable and one or more independent variables. It predicts outcomes, estimates effect sizes, and quantifies how predictors contribute to variations in the dependent variable. It is widely used for continuous data when relationships are

expected to be linear.

iii) Multiple Regression:

An extension of linear regression, this model accounts for multiple independent variables to predict a dependent variable. It determines the relative importance of each predictor and identifies how combinations of variables explain variability in outcomes. This is particularly useful in exploring multifactorial relationships.

iv) Kruskal-Wallis Test:

This non-parametric test compares the medians of three or more independent groups to determine if there are statistically significant differences. Unlike parametric tests like ANOVA, it doesn't assume normality and is suitable for ordinal data or skewed distributions.

v) ANOVA (Analysis of Variance):

ANOVA tests whether there are significant differences between the means of two or more groups. It partitions the total variation in the data into variation between and within groups, providing a robust framework for assessing group differences in parametric datasets.

vi) Logistic Regression:

A model designed for binary or categorical outcomes. It predicts the probability of an event occurring based on predictor variables and provides odds ratios to explain relationships. It's particularly useful for dichotomous outcomes like the presence or absence of a condition.

Chi-square testing was a suitable option for our ADHD dataset as the indicators we are testing are all categorical data. This regression model is mainly used for statistical tests to check for the relationship between pair of variables which is goes more with our goal. It is also very much good at -

- Determining significant associations.
- It is a test to find out whether two random variables, ADHD perception and difficulty completing a task, are independent or related.
- Chi-square test offers initial clarity on relationships for more complex models.
- It is best fitted model for analyzing categorical data and all the testing

indicators in our dataset are categorical.

After finding out the p-values through our chi-square test model we aim to represent our result analysis through this. From which it can be easily derived which indicators have significant association with the target.

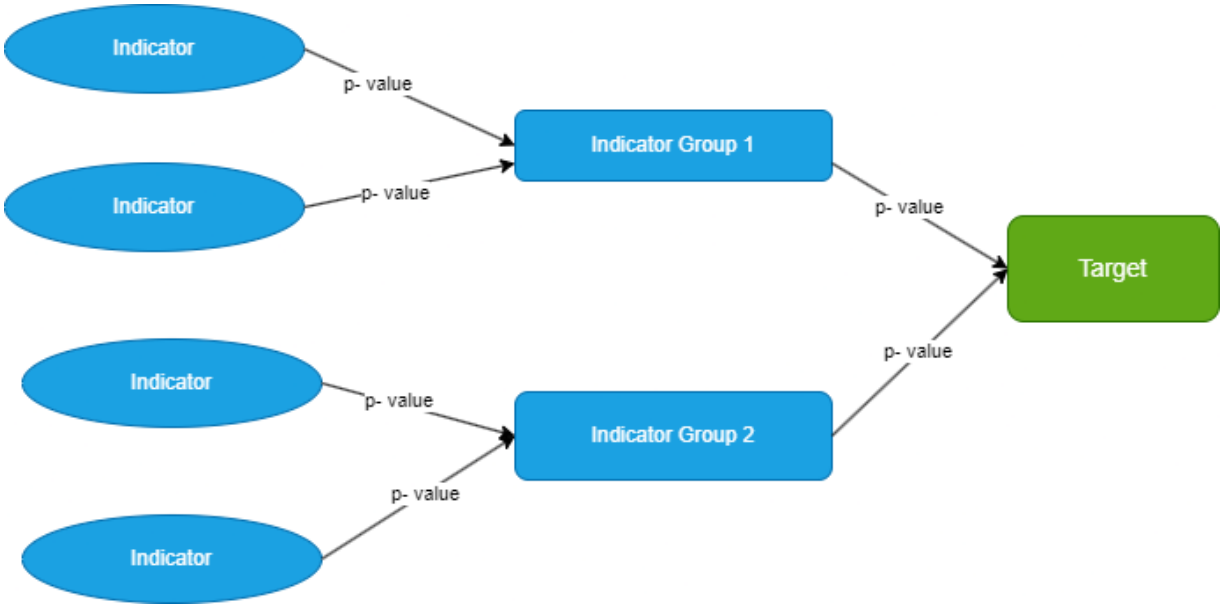

Figure 3.2.1: Conceptual Model for result visualization

.

And finally, we want to visualize the ADHD brain effected areas connection with the indicator groups. For that we have studied research papers related to it thoroughly for the brain areas that are being affected by ADHD. Here is a short description of each part. This will help to understand how each indicator groups are being affected by specific brain areas and will give us more insights on ADHD.

Prefrontal Cortex: The PFC is associated with executive functions (regulating attention, decision-making, and impulse control). In the case of ADHD, PFC dysfunction may contribute to inattention, disorganization, and impulsivity.

Basal Ganglia: The basal ganglia are sub-cortical structures implicated in motor control and learning. In ADHD the basal ganglia's abnormalities relate to

hyperactivity and motor dysregulation.

The Anterior Cingulate Cortex (ACC): This brain area is involved in emotional regulation, decision making and error detection. Dysfunction that arises in ACC in ADHD might lead to difficulties in the regulation of emotional behavior and an increase in the extent of impulsivity.

Limbic System: The emotional and memory processing of experience was virtually a part of the Limbic System — though the development of the amygdala and hippocampus and similar structures were essential. Imbalances in the limbic system in ADHD can cause emotional dysregulation and increased sensitivity to be perceived stressors.

Cerebellum: The Cerebellum functions mainly to coordinate voluntary movements and to maintain posture. Although cerebellar dysfunction has been associated with motor coordination problems and challenges in timing and attention in ADHD.

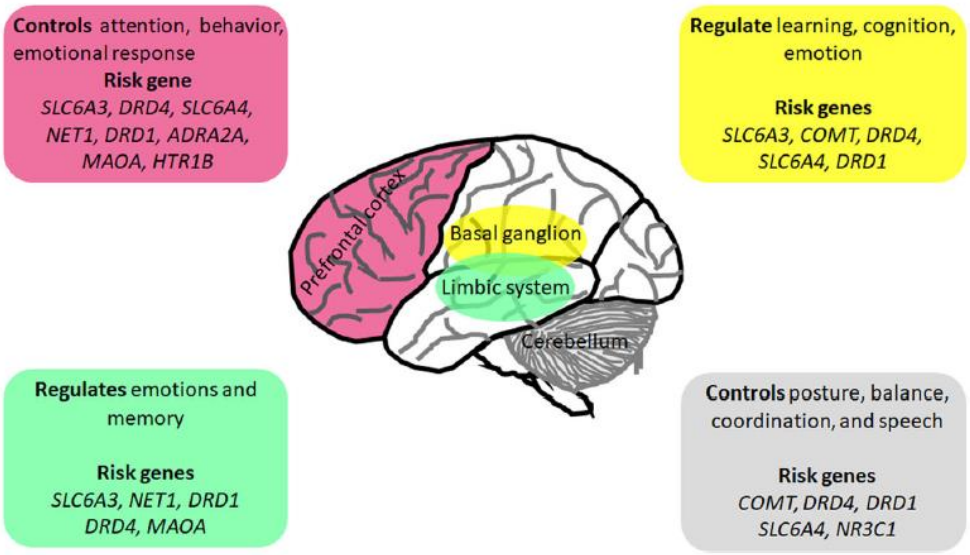

Figure 3.2.2: Brain Areas associated with ADHD [19]

This is how our each indicators relate to the ADHD affected brain areas.

Prefrontal Cortex (PFC):

- Task Completion Challenges Indicators
- Attention and Cognitive Challenges Group

Basal Ganglia:

- Hyperactivity Challenges
- Self-Control Challenges in Social

Anterior Singulate Cortec (ACC):

- Self-Control Challenges in Social

Limbic System:

- Hyperactivity Challenges
- Self-Control Challenges in Social

Cerebellum:

- Hyperactivity Challenges
- Attention and Cognitive Challenges
-

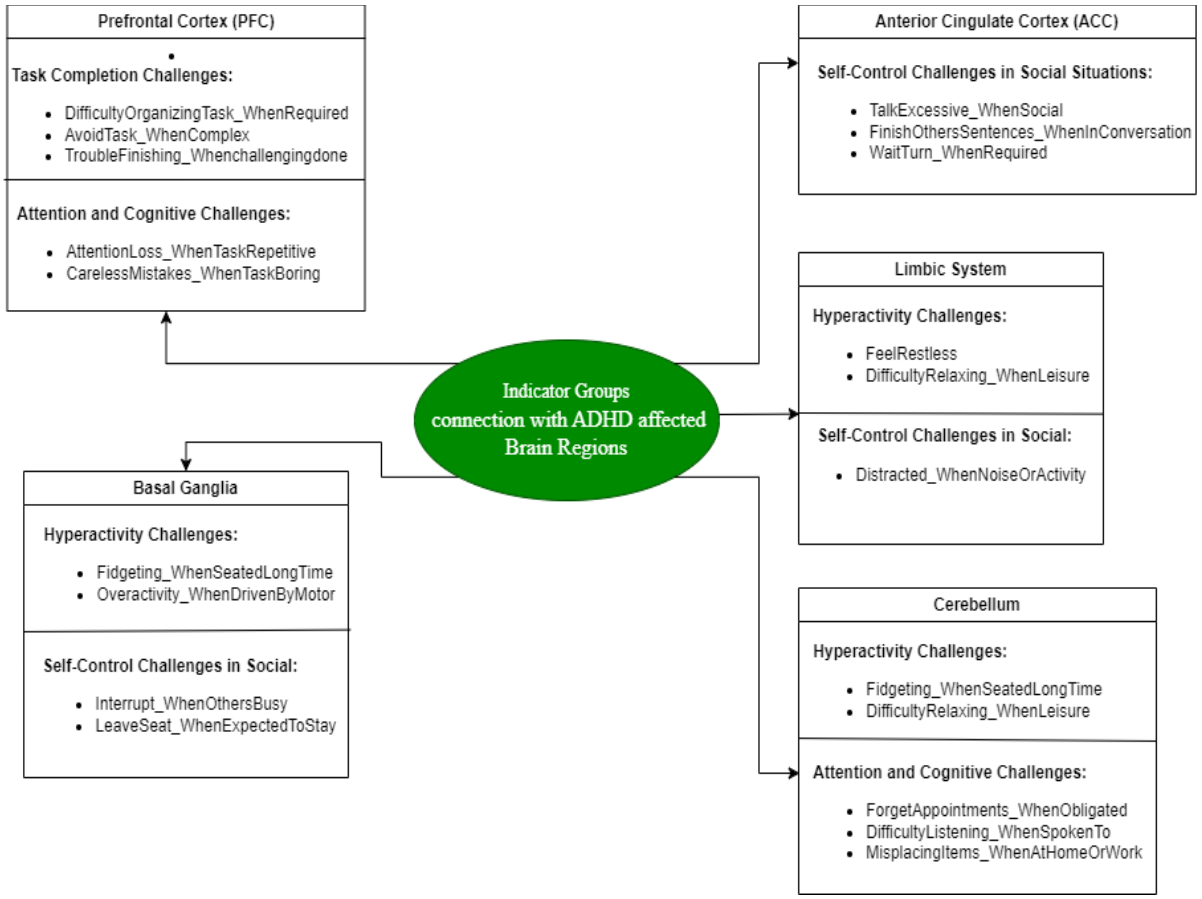

Figure 3.2.3: Brain Areas Connection with the ADHD indicators

And finally, we combined the accepted indicators that we found after our hypothesis testing according to their groups and represented scores for each indicator group.

3.3 Project Plan

The research project was planned to be done in 2 semesters which was from January 2024 to November 2024. This is the detailed planning steps which we followed initially for the whole project:

i) Planning for title selection.
ii) Necessary pilot research is done for selecting the research area.
iii) Finalizing title and research area.
iv) Doing literature review related to the topic.
v) Creating task plan and estimated completion time for it.
vi) Survey form creating
vii) Data Collection
viii) Data Preparing and Preprocessing
ix) Model Application for Statistical Analysis
x) Result Finding
xi) Report Writing
xii) Final Review

3.4 Task Allocation

After deciding the tasks we had to plan for how each task is going to be completed and have to make a deadline as it is highly important for completing a work. That's where task allocation was used to. Below is the table showing how we divided the plans into 4 tasks and their completion time.

Table 3.4.1: Task Allocation of Research Project

S.No.	Planned Task	Completion Time (MM-YY)
1	Questionnaire preparation, data collection	September-2024
2	Data Preparing, Data Preprocessing, Finding best fit model through literature review	October-2024
3	Applying the best fit model (Ch-square test), brain area representation according to indicators	November-2024
4	Result Finding, report writing and review.	December-2024

Timeline of task completion

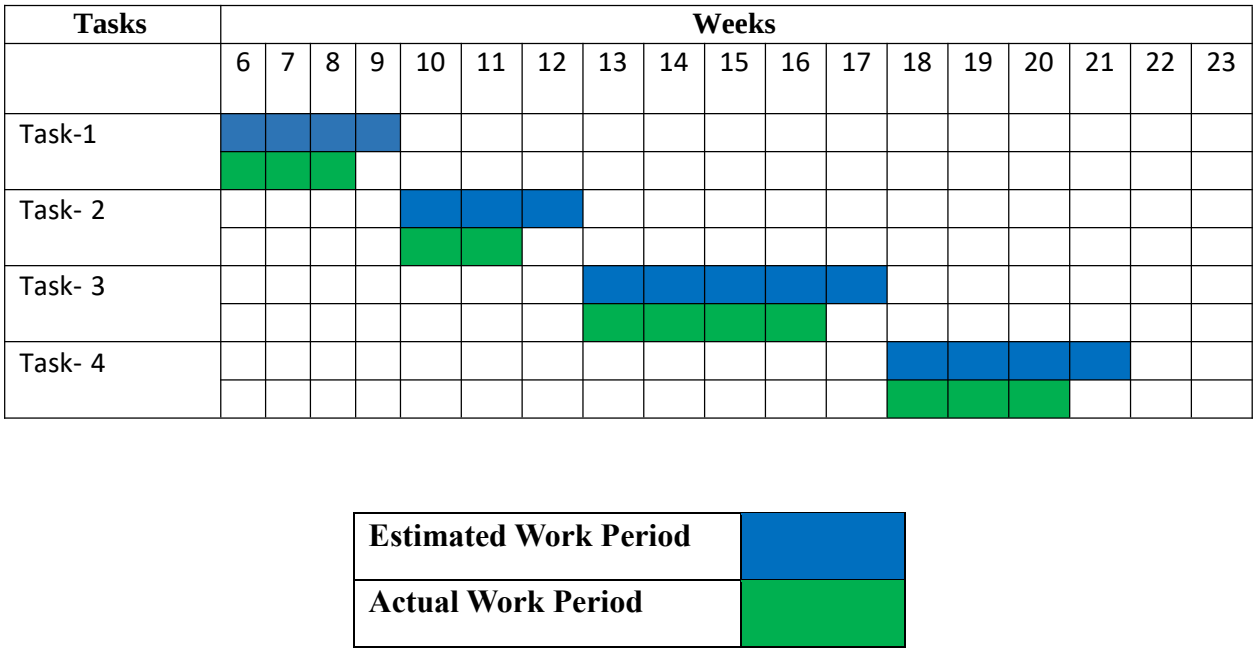

Figure 3.4.1: Gant Chart for visualizing project completion timeline

This is the overall timeline of our task completion period. The first 5 weeks were spent to get prepared for the topic and finding necessary information. The main task implementation started from week 6 which was at the beginning of September and ended in the beginning of December.

3.5 Summary

In this chapter we have talked about in detail of the whole methodology of our research and then shown the way we are going to implement them. Have also given a proper way how we did it. The project completion timeline, task allocation and planning were also discussed in details. The statistical exploratory analysis is going to find out the similarly indicators group and perception of having ADHD.

Chapter 4

Implementation and Results

4.1 Environment Setup

The research was performed on Google Colabotory (Colab), a cloud-based service designed to optimize Python-based computation and analysis. This interactive tool was a perfect place for processing data, statistical assessment as well as visualizing (which are fundamental in research workflows). This interactive tool provided an ideal environment for data processing, statistical evaluation, and visualization, offering essential features for research workflows. The section below details the setup, tools, and methodologies employed, ensuring a comprehensive understanding of the research environment.

Colab supports Python 3.x and comes with pre-installed libraries for data science work, making setup quick and enabling efficiency. In addition, whilst providing lightweight computations, the platform allows optional accelerator hardware for GPU and TPU for more intensive tasks, making it a versatile tool for both lightweight and heavy-duty computations.

Libraries and Tools:

The analysis made extensive use of Python's rich ecosystem of data science libraries, each of which played a unique role in various parts of the research:

Pandas:

Data manipulation and preprocessing was done using pandas. Its flexible DataFrame structure allowed for fast handling, filtering, and aggregating of tabular data. This library was essential for reading the dataset from a CSV file, encoding categorical variables, and calculating summary scores for behavioral indicators.

Seaborn:

Seaborn was used to create more complex visualizations Seaborn is a library

based on Matplotlib that simplifies the creation of aesthetically pleasing and informative plots. Cufflinks: This library was extensively used for heatmaps and visualizations of categorical variables, as it helped visualize correlations and trends in the dataset.

Matplotlib:

Matplotlib played a supportive role to Seaborn as it offered fine-tune control over the properties of each plot, ensuring the visual outputs of the research matched the professional standards of the study.

Scikit-learn:

We used Scikit-learn's preprocessing tools, including LabelEncoder, to encode categorical variables into numeric format. The encoding was necessary for statistical testing and correlation analysis.

SciPy:

SciPy provided over powerful metrics for the statistical analysis and hypothesis testing. Because the chi-square test is central to the study, its implementation is provided below using the statistical tools from SciPy to examine whether any potential associations exist between variables.

Tabulate:

Contingency tables were shown in a more organized format using the tabulate library. This enhanced the readability of chi-square test results in the notebook.

Data Management:

The research heavily relied on data management. Both dataset was backed up in Google Drive and since we were using Colab it was easy to load the data and save the processed data in Drive. This method allowed for consistency, security and the added benefit of no data upload or download for any new entries.

The dataset included behavioral predictors of ADHD perception. The dataset was processed carefully to retain the validity of the dataset while preparing it for analysis. So, we encoded categorical variables, aggregated behavioral metrics, filtered for specific columns and targeted analyses, and more. These operations were performed without any changes to the original dataset (reproducibility and raw data safety).

Framework of Statistical Analysis:

Using this framework, the researchers tested relationships and patterns in the

data. We applied two main approaches.

Chi-Square Test:

The Kruskal-Wallis test is a non-parametric test, it is used to assess the association between the categorical variables. It played an important role in determining if certain behavioral indicators correlated significantly with ADHD perception. The results of the chi-square tests included n values, degrees of freedom, and p-values for obtaining an informed conclusion.

Correlation Analysis:

Pearson correlation coefficients were computed to detect linear relations between encoded variables. For visual clarity, these associations were represented as heatmaps..

We designed the research environment specifically to meet the goals of the study, with a strong emphasis on efficiency, reproducibility and scalability. The integration of Google Colab's interactive platform and the rich library environment of Python allowed us to perform data preparation, perform statistical tests, and visualize the results all in one place. This approach enabled a focused research process and yielded insights into behavioral indicators and their correlation and causation with ADHD perception. This framework not only enabled analysis, but also serves as a reusable structure for similar studies in the future.

4.2 Comparative Analysis

The study presented a structured approach to examine the relationship between specific behavioral indicators and the self-perception of ADHD among individuals. By leveraging statistical methods such as the chi-square test, the research sought to determine the significance of these associations. This analysis aligns with similar studies in behavioral psychology and public health, particularly those investigating the correlation between self-reported symptoms and mental health conditions. Below is a comparative analysis that situates this research within the broader context of related academic works.

We found out the results about which indicator groups have significant association with ADHD from our research.

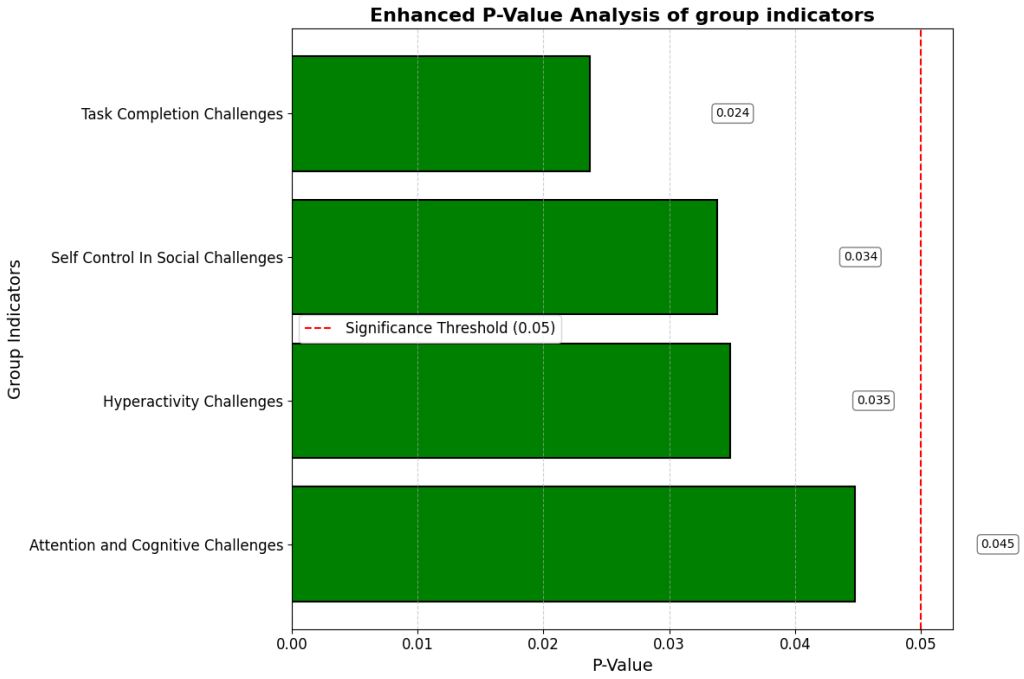

Figure 4.2.1: P-value analysis with ADHD perception

As we know the threshold for p-value in chi-square testing is 0.05. The lower the p-value the higher the significant association with target. From the comparison we can see that people having perception of ADHD are in very danger of completing tasks as it is showing the most significant association. We can come to summary that ADHD people have a higher tendency of not completing tasks in office and universities which is leading them to career failures.

Self-Control Challenges in Social and Hyperactivity Challenges these two indicators also have a very strong significant association of perception of having ADHD. It indicates that that the indicators falling under these groups are causing big problems in day to day life for people suffering from ADHD.

And finally, we can see that attention and cognitive challenges also have significant association with it but it is not much strong as the other three.

4.3 Result & Analysis

This section outlines the findings of our study, emphasizing the associations between perception of having ADHD from our survey and the grouped indicator according to the challenges: attention and cognitive challenges indicator, hyperactivity challenges indicator, task completion challenges indicator, and self-control challenges in social indicator. The results are presented using

statistical analysis, including chi-square test, to highlight key patterns and significant insights derived from the data. This result will be very much helpful to finding out key indicators that are very much associated with the perception of having ADHD.

From our pilot research and thematic analysis on the ADHD indicators we identified the questions in these 5 group indicators-

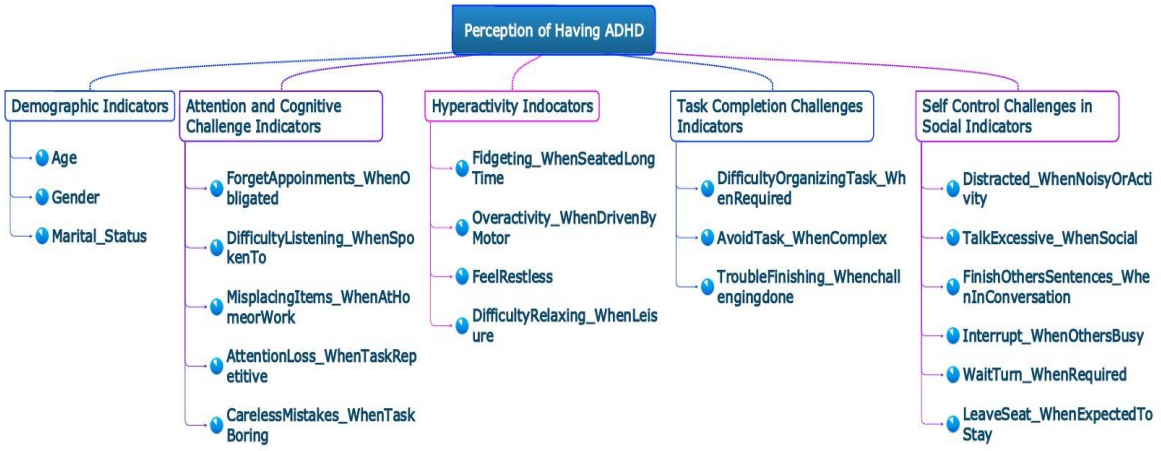

Figure 4.3.1: Indicators Grouping

For hypothesis testing we took each of these indicators according to the group then found out whether they had significant association with our target which is 'adhd_perception'.

Null Hypothesis (H_0): Has No Significant Association with the target.

Alternate Hypothesis (H_1): Has Significant Association with the target.

In the methodology we have described that when p value is smaller than .05 we will be rejecting the null hypothesis and accepting the alternate one. And in case of p-value bigger than 0.05 we will be accepting the null hypothesis.

In this way we will be finding out the p-value for every single indicator and the deleting the no significant associated indicator from the group we will be doing hypothesis testing again using chi-square test according to our model to see the significant associated indicator groups.

Attention & Cognitive Challenges Indicator Group Findings:

Table 4.3.1: Hypothesis Test Result Analysis for Attention and Cognitive indicators

SI N0.	Indicators	p-value	Chi2	P<0.05?
01	ForgetAppointments_WhenObligated	0.0017	17.24	Yes
02	DifficultyListening_WhenSpokenTo	0.0133	12.62	Yes
03	MisplacingItems_WhenAtHomeOrWork	0.0069	14.14	Yes
04	AttentionLoss_WhenTaskRepetitive	0.0001	23.25	Yes
05	CarelessMistakes_WhenTaskBoring	0.0018	17.12	Yes

From our hypothesis testing using chi-square regression model we found every indicator from attention and cognitive challenges have significant association with perception of having ADHD.

Chi-Square Test Results for whole group:

Chi-Square Statistic: 31.86

p-value: 0.04476

Degrees of Freedom: 20

Our research rejected the null hypothesis and found significant association of Attention and Cognitive Challenges with perception of having ADHD.

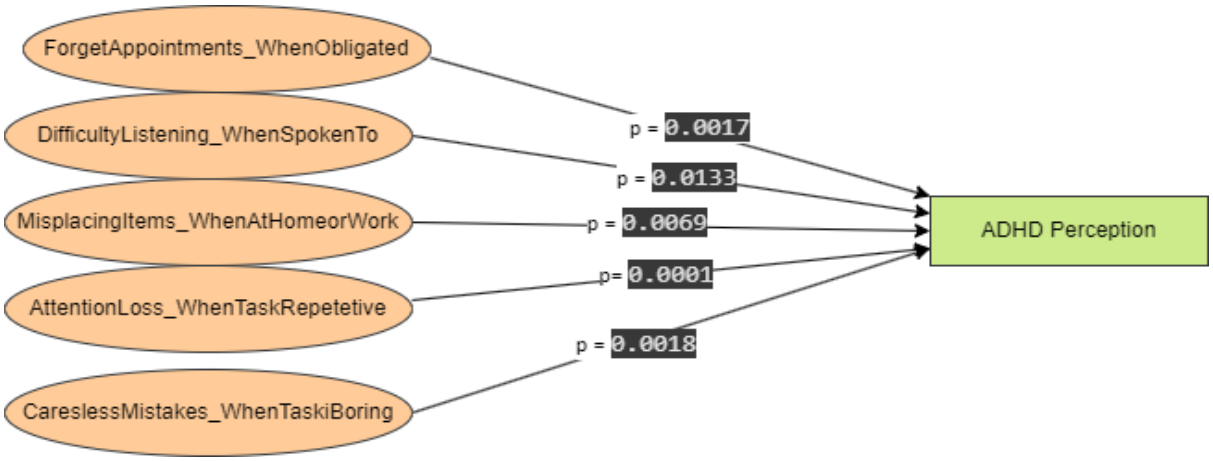

Figure 4.3.2: Conceptual model representation for Attention and Cognitive Challenges Indicator

Hyperactivity Challenges Indicator Group Findings:

Table 4.3.2: Hypothesis Test Result Analysis for Hyperactivity indicators

SI N0.	Indicators	p-value	Chi2	P<0.05?
01	Fidgeting_WhenSeatedLongTime	P<.0001*	25.06	Yes
02	Overactivity_WhenDrivenByMotor	P<.0001*	25.62	Yes
03	FeelRestless	p<.0001*	37.38	Yes
04	DifficultyRelaxing_WhenLeisure	0.0011	18.25	Yes

*P-value can never be 0 practically. In our result analysis for better representation, we took only four decimals after the point and the p values showing 0.0000 are so much close to 0 that it can be written as p<.0001

From our hypothesis testing using chi-square regression model we found every indicator from hyperactivity challenges have significant association with perception of having ADHD.

Chi-Square Test Results for whole group:

Chi-Square Statistic: 27.64

p-value: 0.03487

Degrees of Freedom: 16

Our research rejected the null hypothesis and found significant association of overall hyperactivity challenges indicator group with perception of having ADHD.

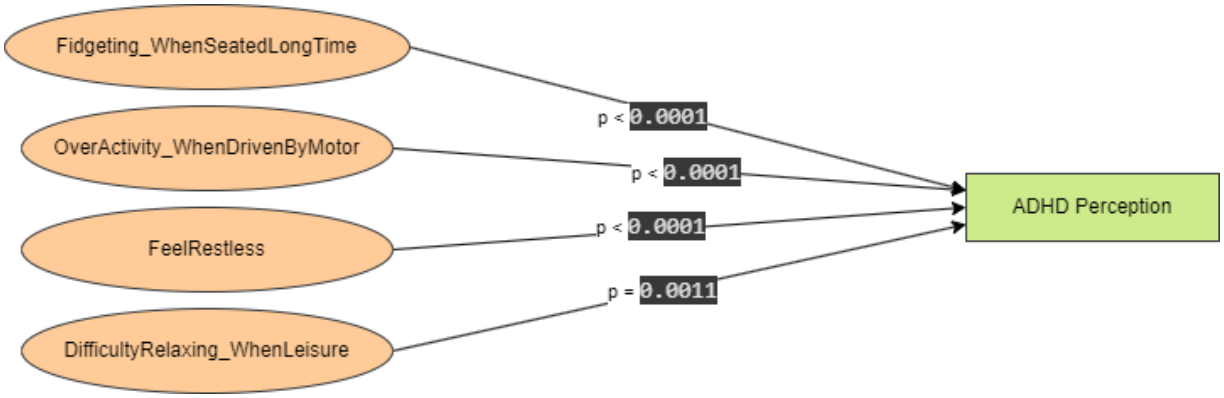

Figure 4.3.3: Conceptual model representation for Hyperactivity Challenges Indicator

Task Completion Challenges Indicator Group Findings:

Table 4.3.3: Hypothesis Test Result Analysis for Task Completion Challenges Indicators

SI N0.	Indicators	p-value	Chi2	P<0.05?
01	DifficultyOrganizingTask_WhenRequired	0.0001	22.77	Yes
02	AvoidTask_WhenComplex	0.0005	20.13	Yes
03	TroubleFinishing_Whenchallengingdone	0.0021	16.83	Yes

From our hypothesis testing using chi-square regression model we found every indicator from task completion challenges have significant association with perception of having ADHD.

Chi-Square Test Results for whole category:

Chi-Square Statistic: 23.51

p-value: 0.02368

Degrees of Freedom: 12

Our research rejected the null hypothesis and found significant association of task completion challenge indicators with perception of having ADHD.

Figure 4.3.4: Conceptual model representation for Task Completion Challenges Indicator

Self-Control Challenges in Social Indicator Group Findings:

Table 4.3.4: Hypothesis Test Result Analysis for Self-Control Challenges in Social Indicators

SIN 0.	Indicators	p-value	Chi2	P<0.05 ?
01	Distracted_WhenNoiseOrActivity	0.0547	9.27	No
02	TalkExcessive_WhenSocial	0.0116	12.94	Yes
03	FinishOthersSentences_WhenInConversation	P<.0001	27.12	Yes
04	Interrupt_WhenOthersBusy	0.0001	24.99	Yes
05	WaitTurn_WhenRequired	P<.0001	27.6	Yes
06	LeaveSeat_WhenExpectedToStay	.0049	14.89	Yes

*P-value can never be 0 practically. In our result analysis for better representation, we took only four decimals after the point and the p values showing 0.0000 are so much close to 0 that it can be written as p<.0001

From our hypothesis testing using chi-square regression model we found every indicator from task completion challenges except "Distracted_WhenNoiseOrActivity" have significant association with perception of having ADHD. After that we removed this indicator which has no significant association with perception of having ADHD and took the others to form the Sel-Control Challenges in Social Indicators group.

Chi-Square Test Results for whole indicator group:

Chi-Square Statistic: 36.83

Degrees of Freedom: 23

Our research rejected the null hypothesis and found significant association of Self-Control in Social Challenges with perception of having ADHD.

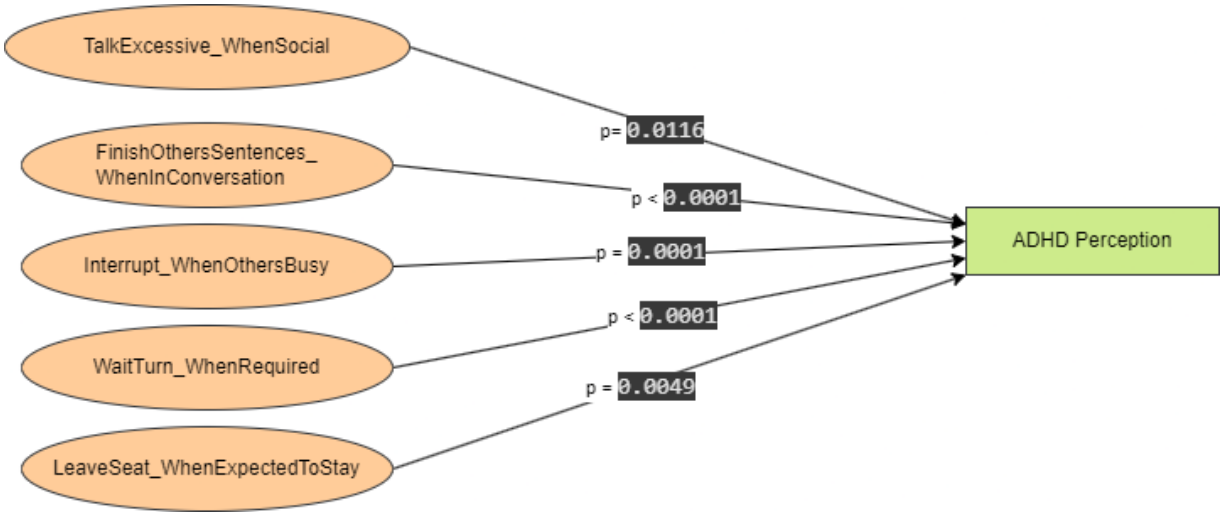

Figure 4.3.5: Conceptual model representation for Self-Control in Social Challenges Indicator

After finding all the related calculations to indicators summarizing the visualization of our indicator groups with perception of having ADHD. From this we can see that Task completion challenges have a big impact on people precepting of having ADHD.

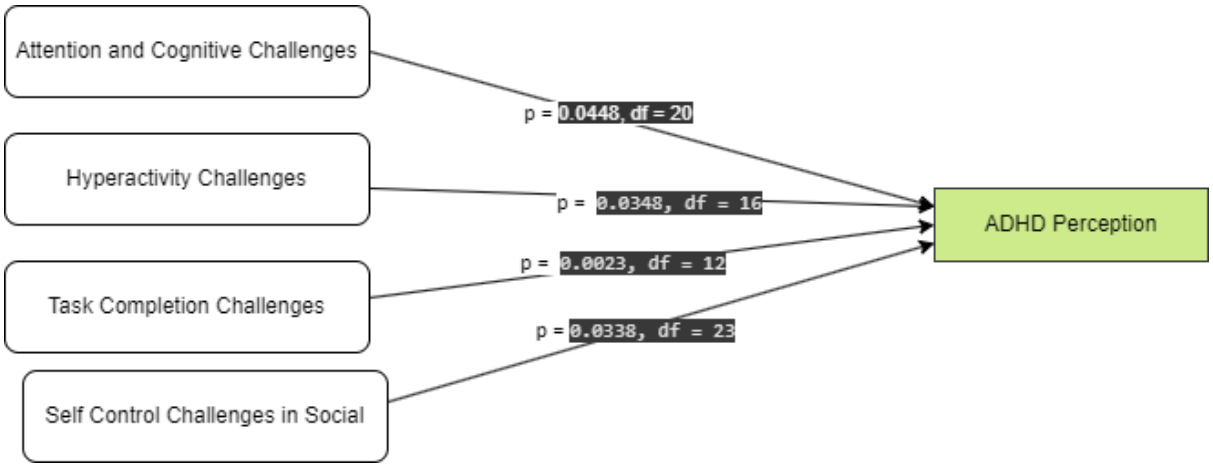

Figure 4.3.6: Conceptual model representation for every behavioral indicator group

Demographic Indicator Findings:

Table 4.3.5: Hypothesis Test Result Analysis for Demographic Indicators

SI N0.	Indicators	p-value	Chi2	P<0.05?
01	Age	0.0002	22.49	Yes
02	Gender	0.1534	3.75	No
03	Marital_Status	0.7953	0.07	No

Our hypothesis test with demographic indicators Age, Gender and marital_status found out that only Age has significant association with perception of having ADHD. That means that perception of having ADHD has a high connection with different age ranges.

And this is the final visualization of our hypothesis test results. The significantly associated indicators have been tagged as green flag and no significant associated indicators have been tagged as red flag.

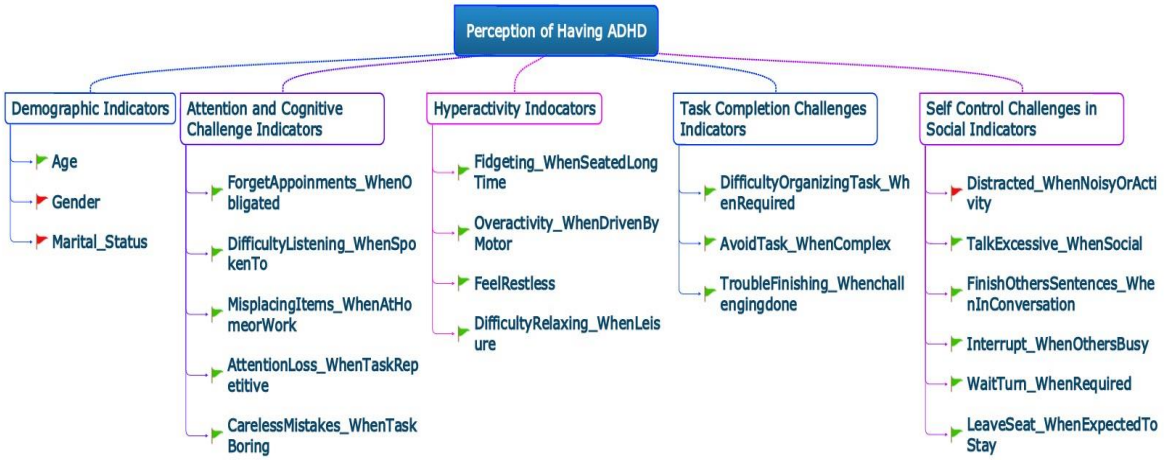

Figure 4.3.7: Final representation of the indicator groups

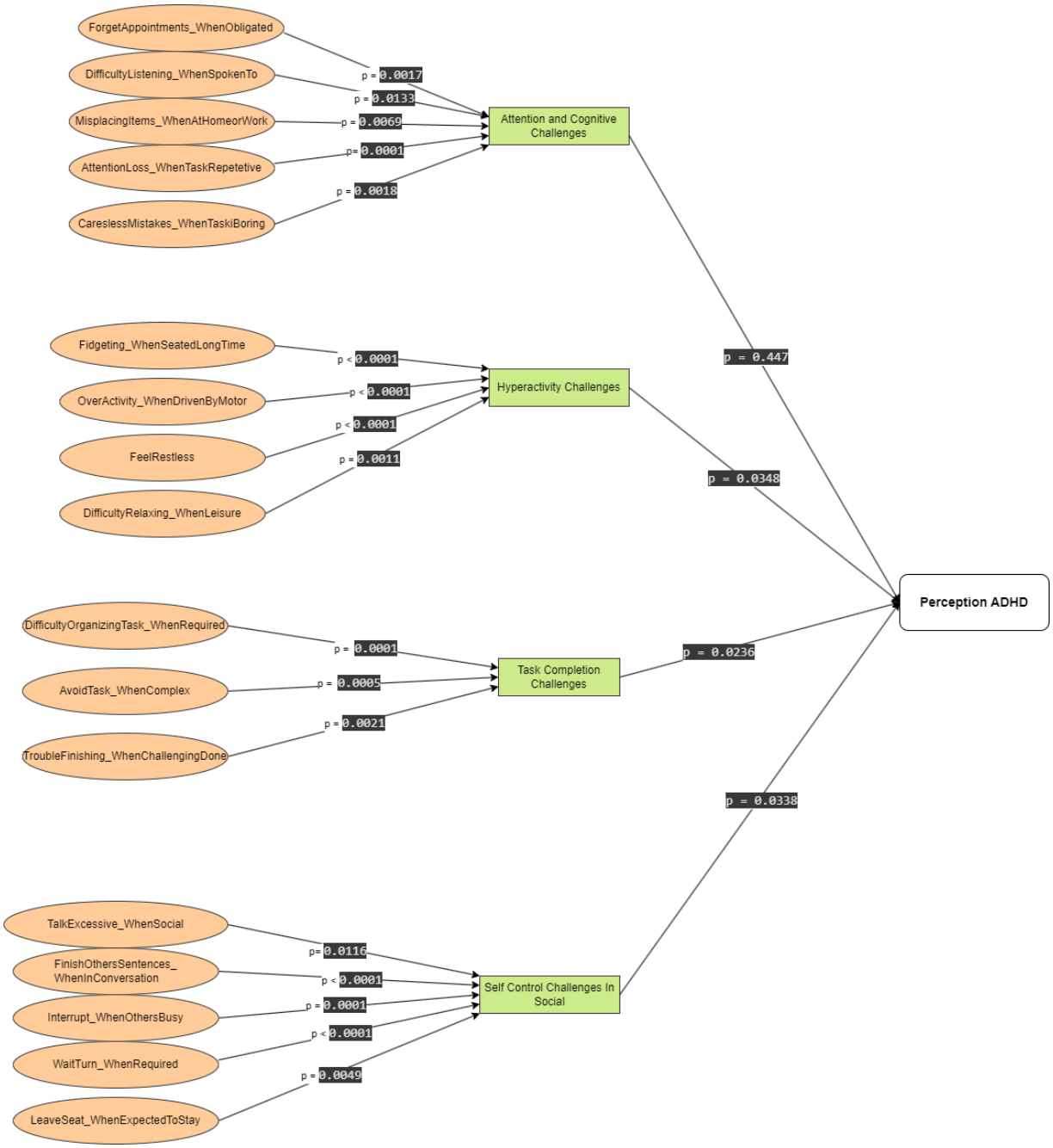

Figure 4.3.8: Final Conceptual Model Representation of all Indicator Groups

The final conceptual model represents the overall overview of the whole hypothesis test. Through this we can find out easily which areas are most significantly associated with ADHD indicators in one glance.

As we know, the smallest p-values means that the indicator has too much significant association with perception of having ADHD. From our model

application we identified many p-values which are so close to 0 that we had to write them like p<.0001. And from our study we have found out these indicators might be having too much effect on having ADHD:

- Fidgeting_WhenSeatedLongTime
- Overactivity_WhenDrivenByMotor
- FeelRestless
- FinishOthersSentences_WhenInConversation
- WaitTurn_WhenRequired

Which means ADHD perception has a very higher association with these five indicators. We can say that people showing these behaviors can be suffering from ADHD or will develop it in future.

Correlation analysis:

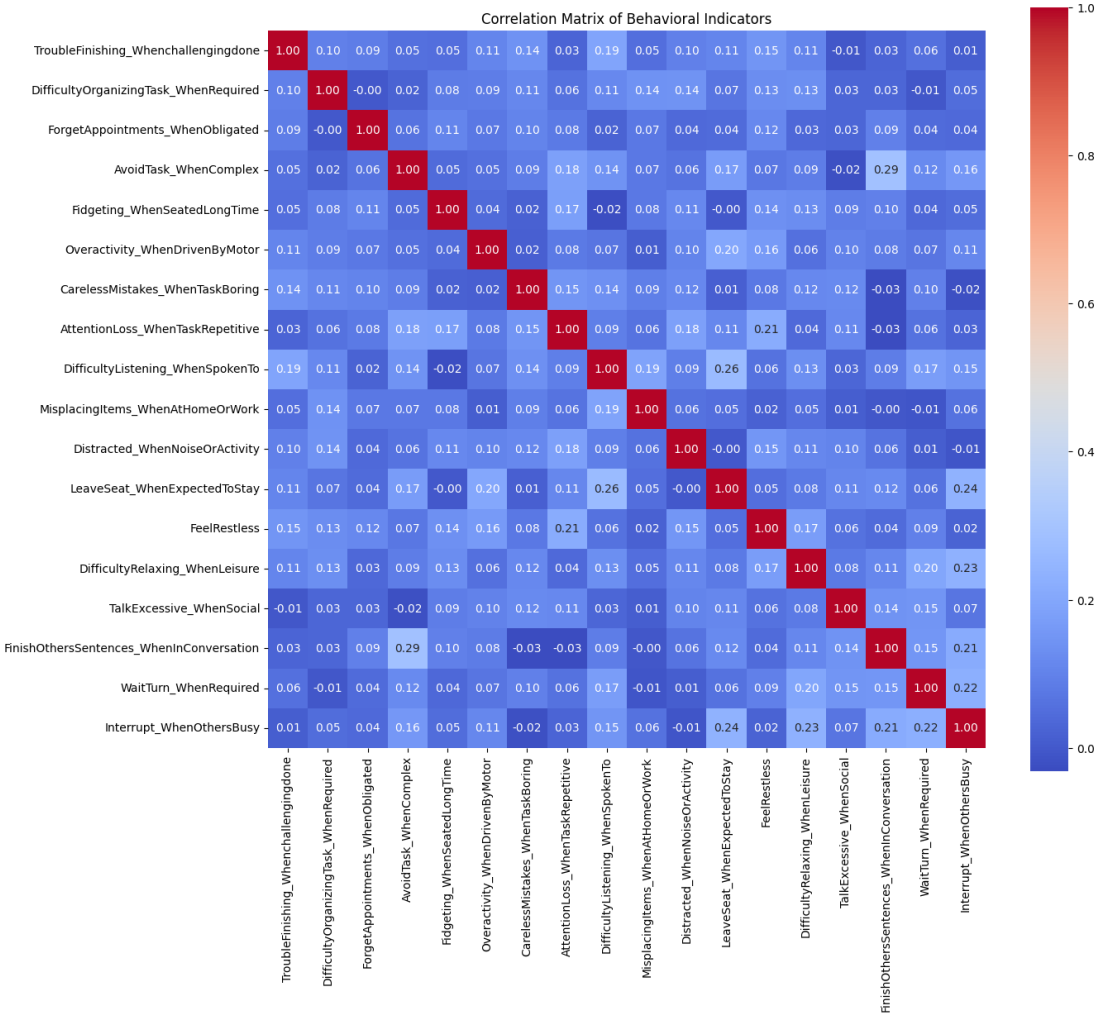

Figure 4.3.9: Correlation Heatmap

The correlation heatmap of our dataset reveals that most ADHD indicators are weakly or moderately related to each other, showing that they tend to represent distinct aspects of the condition. This means that ADHD symptoms, as reported by individuals, vary greatly and don't overlap significantly. This emphasizes the complexity and diversity of ADHD, in which antecedent traits like inattention, impulsivity and hyperactivity, task completion challenges can show up in all sorts of unique combinations among different individuals. The absence of strong correlations signals the need to consider each symptom in isolation when doing a retrospective assessment, rather than if a particular pattern applies. It also shows how deeply personal, and different ADHD vibrantly affects people, and that there isn't a solution that fits all of understanding it.

Task Completion Score:

From this graph we can see that people that are self-identifying as having ADHD are very often facing problems to complete theirs tasks on the other side people who do not think they have ADHD are also often finds themselves in task completion challenges, but in case of them they are high in number in case of rarely finding themselves in task completion challenges.

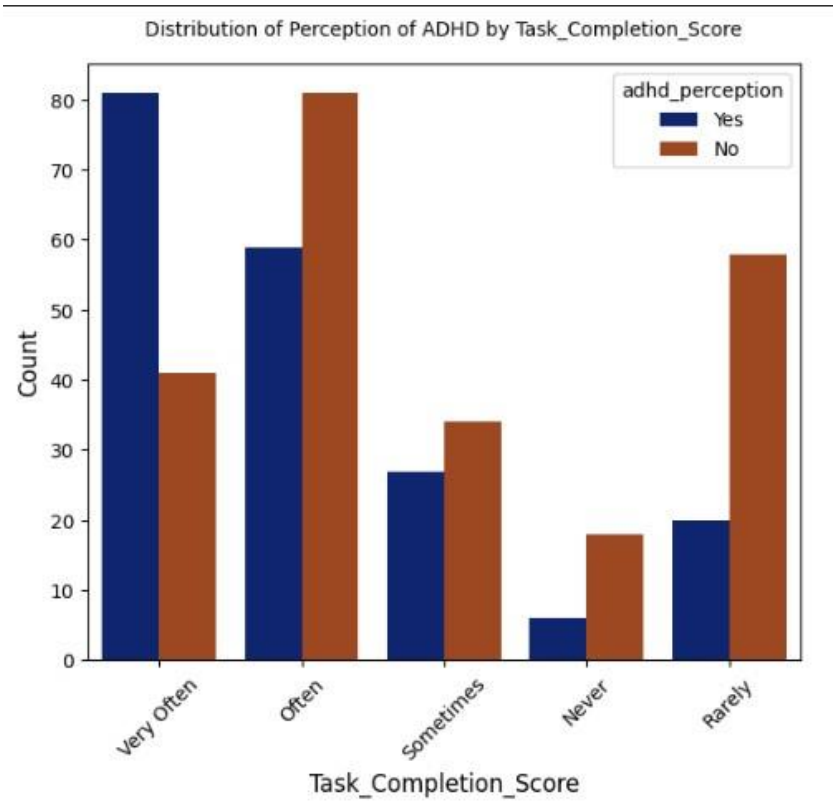

Figure 4.3.10: Distribution of perception of ADHD by task completion score

Hyperactivity Score:

Hyperactivity is more frequently reported by individuals with ADHD perception, with responses predominantly falling into the "Very Often" or "Often" categories. This suggests that hyperactivity remains a significant challenge for those with ADHD traits. To address this, interventions like mindfulness practices, engaging in regular physical activity, and utilizing impulse control therapies can be effective in reducing hyperactivity and improving self-regulation.

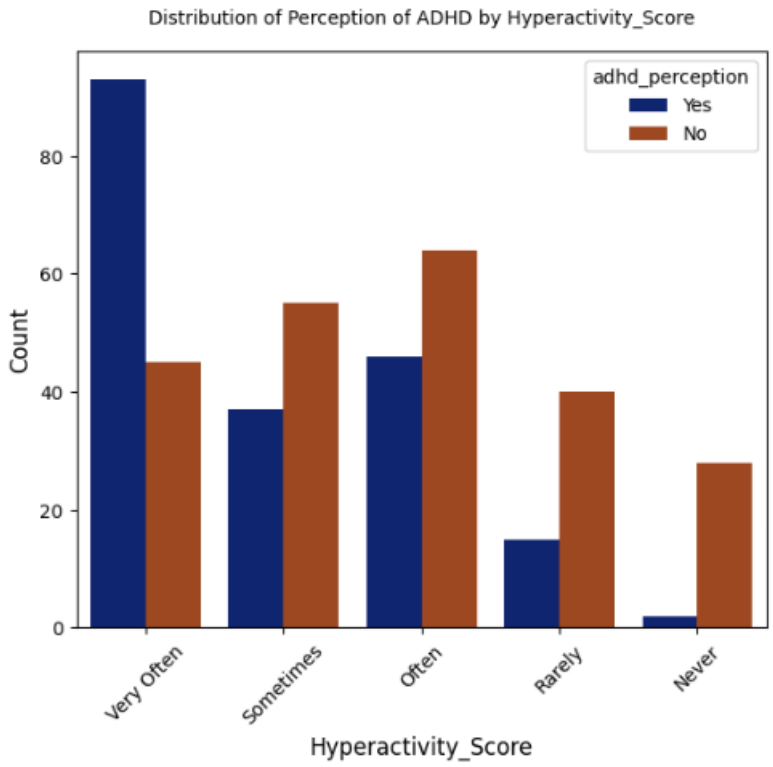

Figure 4.3.11: Distribution of perception of ADHD by hyperactivity

Attention and Cognitive Score:

Attention and cognitive challenges are commonly reported by individuals with ADHD perception, who indicate frequent struggles compared to those without ADHD traits. These difficulties highlight the importance of targeted strategies for improving cognitive functioning. Cognitive-behavioral therapy (CBT), reducing environmental distractions, and practicing mindfulness are some of the approaches that can help individuals improve their focus and cognitive abilities.

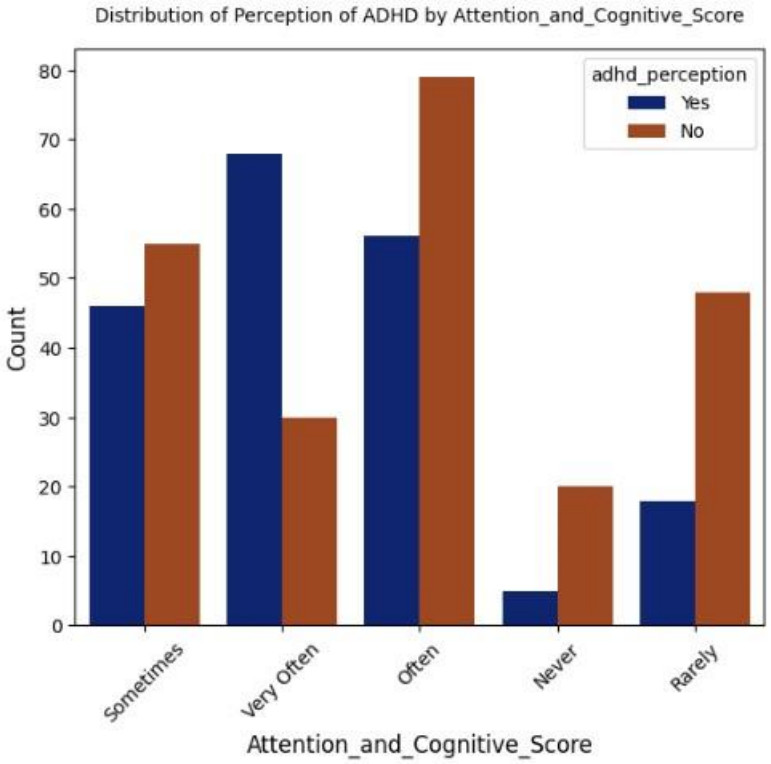

Figure 4.3.12: Distribution of perception of ADHD by task completion score

Self-Control Social Score:

Social self-control difficulties, such as impulsive behaviors in social settings, are reported more frequently by individuals with ADHD perception, particularly in the "Often" or "Very Often" categories. This underscores the need for interventions that enhance social interaction skills. Training programs focused on social skills development, along with exercises to build patience and self-control, can help individuals navigate social interactions more effectively. In this case we can also see that people that are thinking they have ADHD are also very often facing to control themselves in social situations.

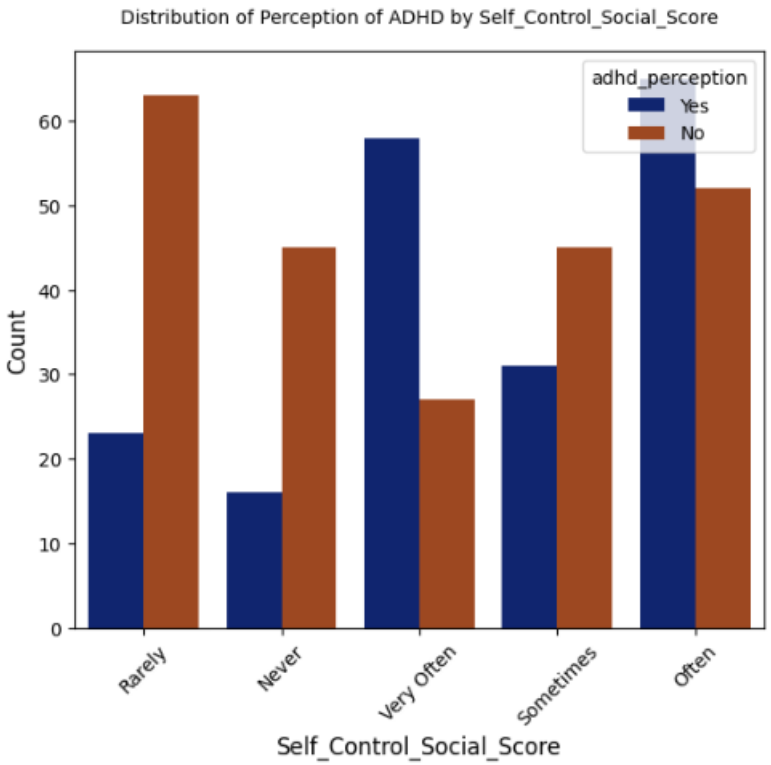

Figure 4.3.13: Distribution of perception of ADHD by self-control in social score

These behavioral domains from their analysis profile the major dilemmas for people who self-identify as having ADHD. With appropriate interventions focused upon, they can further become highly productive individuals with tools available on hand to allow them to cope with their daily lives whilst still, manage symptoms that need to be managed as a part of their day-to-day life.

4.4 Summary:

This chapter explored the link between various behavioral and cognitive characteristics and the perception of ADHD. In the "Attention and Cognitive Challenges" category, significant connections were identified with struggles like maintaining focus during repetitive tasks, making mistakes in routine activities, forgetting appointments, and difficulty paying attention while listening. These findings highlight the strong relationship between ADHD and issues with attention and cognition challenges, task completion challenges etc. of people suffering from ADHD on regular basis.

Chapter 5

Engineering Standards and Design Challenges

5.1 Compliance with the Standards

This section defines the applicable standards that were taken into consideration when executing the ADHD research project and adhered to. Data collection was performed with a basic hardware setup, analysis with the use of spreadsheets, and computational aspects were handled with Google Colab. Each subsection describes the relevant standards for the research, discusses alternatives and explains the reasons leading to the selection.

5.1.1 Software Standards

Selected Standards:

1. **ISO/IEC 27001 (Information Security Management):**
    - Ensures the secure storage and handling of sensitive data collected for ADHD research. This is crucial for maintaining confidentiality, particularly when dealing with personal or behavioral information.
2. **ISO/IEC 25012 (Data Quality Model):**
    - Focuses on the quality of datasets, ensuring attributes like accuracy, completeness, and reliability are met. These standards guide the validation of spreadsheet data and Python-based computations.

5.1.2 Hardware Standards

Selected Standards:

1. **IEEE 1680 (Environmental Standards for Electronic Products):**
    - Promotes the use of environmentally friendly and energy-efficient hardware in line with sustainable research practices.
2. **ISO 13482 (Safety for Personal Care Robots):**
    - **Pros:** Provides guidelines for hardware safety in human interactions.
    - **Cons:** Not applicable since the research did not involve robotics or advanced hardware.

5.1.3 Communication Standards

Selected Standards:

1. **ISO/IEC 7498-1 (Open Systems Interconnection - OSI Model):**
    - Governs the secure and efficient transfer of data within the research team, especially when using cloud platforms like Google Colab for collaboration.
2. **IEEE 802.11 (Wi-Fi Standards):**
    - Facilitates stable and reliable wireless communication for data sharing and real-time collaboration during the research process.

Alternatives Considered:

1. **Cloud-Specific Standards (e.g., AWS or Google Cloud Security Standards):**
    - **Pros:** Offers advanced cloud-specific features for secure data handling.
    - **Cons:** Overly complex and not essential for this research, which utilized basic Google Colab features.

Rationale for Selection:

We used the model based on OSI to manage transferring data in a research setting. Also used IEEE 802.11; the reasons being that they were simple and effective. They provide secure, fast, and reliable communication which is necessary for collaborative research efforts.

5.2 Impact on Society, Environment and Sustainability

This research on ADHD related findings which is a very much underdiagnosed mental disorder is designed to help improve the quality of life of people suffering from it, attempting to help identify behavioral patterns and cognitive challenges through data driven analysis. This knowledge adds to the research of better policies, awareness, and methods for living with ADHD in society. We will keep in mind the ethics of the project, while highlighting its impact on lives (both lives improved and lives at risk to this very moment), society overall and our planet all within this section.

5.2.1 Impact on Life

This research directly relates to, and has a significant impact on, the lives of people diagnosed with ADHD, and those who exhibit ADHD-like symptoms. The project also generates insights that can be used to personalize interventions through automated analysis of behavioral indicators including Attention Deficient Hyperactivity Disorder (ADHD) and self-control. The individual lives are expected to improve because of the following outcomes:

Improved Awareness of ADHD: The study highlights particular significant behavior problems, allowing those impacted to better understand their concerns and pursue help accordingly.

Targeted Strategies: By examining individual expressions of ADHD symptoms, this study opens pathways for personalized interventions that might include cognitive-behavioral strategies, time management techniques, or mindfulness practices for managing attention and hyperactivity.

Key Benefits of Therapy: They include the improved quality of life and better life satisfaction regarding the key indicators.

Advocacy and support: The research highlights awareness and equips families, educators and caregivers with the right accommodations.

5.2.2 Effects on Society & Environment

This research project has significant societal and environmental benefits as it mitigates broader challenges derived from ADHD:

Social Awareness and Inclusion: Through exposure and exploration of ADHD struggles, the project encourages empathy and stigma reduction. It inspires more inclusive practices at schools, at work, in public spaces.

Education: The findings from the research can be used to help educators adapt how they teach people with ADHD to improve academic performance and decrease dropout rates.

Potential Economic Impact: Early recognition and treatment of ADHD through the significant indicators may prevent awakening of comorbid condition like anxiety, depression, or substance abuse, which reduces long-term economic burden on families and health department.

Sustainable: The research focuses on sustainable solutions, notably community-owned support systems or low-cost interventions to ensure long-term, sustainable benefits without overwhelming resources.

Environmental Considerations: While this project rests primarily in the realm of human behavior and cognition, the project is able to be executed sustainably:

Scalability: Digital platforms allow you to share results and collaborate, which can amplify your project's reach with minimal resource use.

Awareness Campaigns: By encouraging ADHD-friendly workspaces and schools, the project indirectly leads to the creating of sustainable and inclusive infrastructures.

5.2.3 Ethical Aspects

The ethics project is a central project of the research project, since it contains sensitive data about individuals that relate to his behavior and cognitive characteristics. The following ethical principles were followed:

Informed consent: All data collection was performed with participants' at least tacit knowledge of the purpose and intended use of the data.

We used the pseudonymization of participants (data controllers) to maintain confidentiality in accordance with ISO/IEC 27001 requirements.

Non-Discrimination: The research promotes practices of equality and avoids

biases based on gender, age, or socio-economic status.

Openness: All findings and methods are disclosed openly so that stakeholders can understand the basis of the research and implications.

Beneficence: This research addressed an important health issue that is increasing in prevalence, with all aims serving to enhance the quality of life of people with ADHD, that no harm would result from the research itself.

Data Security : The data was fully secured and used only for research purposes.

5.3 Project Management and Financial Analysis

This section outlines the financial aspects of this ADHD research project, including a cost analysis of the budget required and an overview of the revenue model. Given the small-scale nature of the research, the project maintained a minimal An alternative budget is also proposed, along with the rationale for both budgets.

Table 5.3.1: Budget Planning

SI No.	Expense Category	Main Budget	Alternate Budget
01	Software and Cloud Services	Free	Tk. 1000
02	Data Collection, Travelling Cost	Tk. 1500	Tk. 2000
04	Report Writing	Tk. 700	Tk. 800
05	Miscellaneous	Tk. 1000	Tk. 1500
05	Total	Tk. 3200	Tk. 5300

From the table we can see that our research took only 3200 taka while we had an alternate budget of 5300 taka. Now let's see on the revenue opportunity table part of our research work.

Table 5.3.2: Revenue Opportunity Table

Revenue Source	Description	Potential Earnings per session (BDT)
Workshops and Training Programs	Conducting awareness sessions for teachers, parents, or caregivers.	5000 BDT – 10000 BDT
Collaboration with Organizations and Hospitals	Partnering with mental health organizations to implement research findings.	Based on licensing agreements or partnership terms
Research Publications	Publishing findings in journals or presenting at conferences.	Sponsored opportunities vary depending on the platform.

These tables provide a clear breakdown of the project's financial aspects, highlighting the flexibility in budget and opportunities for monetization to sustain future work related to ADHD research. From here, the future interested people related to this research domain will be getting a clear idea of finacial matters.

5.4 Complex Engineering Problems

5.4.1 Complex Problem Solving

EP1 : Depth of knowledge

The courses that were helpful for this research were statistics and probability, data mining and machine learning, research and innovation, computer fundamentals etc.

EP2 : Range of conflicting requirements

I had to study many topics that are not related to my engineering course. For example, to understand and dive deep into learning about ADHD I had to study many medical and neurobiological papers. For data collection I had to learn and improve communication skills.

EP4 : Familiarity of issues

I had to dive into the medical sector for the research project which I am not familiar with in my course.

EP7: Interdependence

Identified many components and sub problems from my research.

Table 5.4.1.1: Mapping with complex problem solving.

EP1 Depth of Knowledge	EP2 Range Of Conflicting Requirements	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of ApplicableCodes	EP6 Extent Of Stake-holder Involvement	EP7 Interdependence
✔	✔		✔			✔

Knowledge Profiles (K) mapping for Each Selected EP:

For each selected EP, we had to identify the relevant Knowledge Profiles (K1–K8):

EP1: Depth of Knowledge

K1: Natural Sciences - Understanding the biological and neurological basis of ADHD symptoms.

K3: Engineering Fundamentals - Applying foundational concepts such as data preprocessing and statistical analysis.

K4: Specialist Knowledge - Advanced knowledge of ADHD-related brain areas and their roles in behavioral symptoms.

K8: Research Literature - Reviewing and synthesizing findings from statistical analysis studies and behavioral studies

Table 5.4.1.2: Mapping with knowledge Profile EP1

K1	K2	K3	K4	K5	K6	K7	K8
✔		✔	✔				✔

EP2: Range of conflicting requirements

K2: Mathematics – Using statistical methods (chi-square test) to evaluate relationships in data.
K5: Engineering Design – Designing workflows for preprocessing raw data and label encoding.
K6: Engineering Practice – Applying practical techniques to manage noisy or incomplete datasets.
K7: Comprehension – Understanding the trade-offs in preprocessing methods and statistical thresholds.

Table 5.4.1.3: Mapping with knowledge Profile EP2

K1	K2	K3	K4	K5	K6	K7	K8
	✔			✔	✔	✔	

EP4: Familiarity Issues

K1: Natural Sciences – Dealing with unfamiliar neurological factors influencing ADHD symptoms.

K4: Specialist Knowledge – Investigating how specific brain regions correspond to behavioral symptoms in ADHD.

K8: Research Literature – Exploring cutting-edge studies on ADHD and brain function to identify gaps.

Table 5.4.1.4: Mapping with knowledge Profile EP4

K1	K2	K3	K4	K5	K6	K7	K8
✔			✔				✔

EP7: Interdependence

K1: Natural Sciences – Integrating biological and neurological knowledge with behavioral science.

K4: Specialist Knowledge – Linking ADHD symptoms to brain functions with domain-specific expertise.

K6: Engineering Practice – Implementing interdisciplinary approaches to analyze data effectively.

K8: Research Literature – Bridging diverse fields through comprehensive literature review.

Table 5.4.1.5: Mapping with knowledge Profile EP7

K1	K2	K3	K4	K5	K6	K7	K8
✓			✓		✓		✓

5.4.2 Engineering Activities

For the study lots of engineering works have been done including many activities. Mainly, EA1 (Range of resources), EA4 (Consequences for society and environment), EA5 (Familiarity) these three engineering activities areas relate with my research based study.

Table 5.4.2.1: Mapping with complex engineering activities.

EA1 Range of resources	EA2 Level of Interaction	EA3 Innovation	EA4 Consequences for society and environment	EA5 Familiarity
✓			✓	✓

5.5 Summary

This chapter explored how engineering standards contribute to safe and reliable design while supporting the overall design process. It covered the challenges engineers face, including balancing trade-offs, managing resources, and integrating diverse perspectives. The chapter emphasized the influence of standards on innovation and risk management, highlighting the importance of aligning compliance with creative solutions in engineering. By exploring the engineering problems, knowledge profiles, engineering activities this was a very good approach to learn about significant association with the research based project and engineering.

Chapter 6

Conclusion

This is the final chapter of our research work. From what we have done all the way towards the end will be explained here in detail. The limitations and future possible works will also be mentioned.

6.1 Summary

The analysis of behavioral and cognitive challenges associated with ADHD was the approach of this research to better understand the condition and its effects on individuals. The paper identified four main classes of symptoms: attention/cognitive problems, hyperactivity, trouble finishing things, and self-control problems in social contexts all of which it had problems associating with perceptions of ADHD. The study gave valuable insights by finding deep association with task completion problem and ADHD. We also got to know that age has a very strong association with perception of having ADHD. This is going to give a huge insight for people suffering from it and many other future works. For processing the indicators, data were collected and analyzed in Google Colab and spreadsheets to ensure a systematic and efficient approach. Moreover, the investigation found links among these behavioral indicators and impacted brain regions, including the prefrontal cortex, basal ganglia, anterior cingulate cortex, and limbic system.

These insights could lead to improvement of the symptoms leading to ADHD disorders, suggesting which significant behavioral areas needs to be improved. thereby helping in devising personalization to tackle the problems of attention, emotion, and task management. The research serves to enhance the lives of those affected by ADHD while raising awareness and understanding in society by accentuating the importance of strategies

backed by evidence. This research shows that we can use simple, effective tools to study complex psychopathology and sets the stage for investigating challenges related to ADHD in the future.

6.2 Limitations

While this research made valuable contributions, it was limited in ways that constrained the scope and generalizability of its findings. One of the key limitations was the reliance on self-reported data, which was prone to subjectivity and responding bias or inaccuracies in remembering behaviors. Additionally, the small sample of participants in the study limited the hope that results could be generalizable to a larger population and may not reflect the range of challenges associated with ADHD in more diverse groups. Moreover, advanced tools for analysis, including neuroimaging and real-time behavioral monitoring tools were limited. These tools would have offered objective insights into the neurological and behavioral components of ADHD. The narrower geographic scope of the research, which only included Bangladesh is another limitation, as it might not fully reflect the cultural or social elements relevant to how ADHD is perceived and acted upon. Also, the budget of the project limited the possibility of using advanced resources and conducting larger-scale data collection. Despite the study providing a unique insight into the nature of ADHD, it is imperative to overcome these limitations in order to improve its impact and reliability.

6.3 Future Work

While this study has its limitations, future works will serve to update the work and enhance it with more sophisticated methods. A larger sample size and a more diverse population would improve the generalizability of the results, allowing for more successes and challenges related to ADHD across demographics and cultures. By integrating sophisticated data-gathering technologies, like wearables or brain scans, it will be easier to obtain impartial, on-the-fly examinations of behavioral and neurological trends.

The study will also investigate partnerships with educators, mental health professionals, and caregivers to implement evidence-based interventions to mitigate IRDS effects. Such interventions could provide personalized strategies to enhance focus, regulate emotions, and manage hyperactivity, in schools, workplaces and community. Upcoming efforts will also include laying out the research findings in papers, workshops, and awareness programs to contribute to an understanding of ADHD in the public domain. The next wave of research aims to build a more holistic and effective framework to guide ADHD management and support by addressing present-day shortcomings and harnessing novel methods.

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