Prevalence of Depression Among Physically Active Adults, National Health and Nutrition Examination Survey

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Abstract

Introduction: Depression is a very serious mental health issue worldwide that seems to be rising in the past decades due to various lifestyle changes brought forth my modernity. Physical activity in recent years is emerging as a promising substitute for medication which is expensive and extremely time consuming to develop and manufacture. Using the NHANES dataset, I would like to demonstrate that an increased amount of physical activity per week lowers the rates of depression for both sexes across the ages of 18-80.

Methodology: Using the R programming language, all the non-applicables from each row of the NHANES dataset were removed for the categories of Depressed, PhysActiveDays, Age and Gender then categories within PhysActiveDays and Age were created to be individually tested against Depressed. A baseline characteristics table was constructed using the chi squared test and two further tables were made proceeding this, one being a univariate and the other being a multivariate logistic regression analysis.

Results: The p values for Table 2 and 3 did not suggest that any difference was made by increasing the number of physical activity sessions per week from 1 to 7 therefore the results indicated that increased amounts of exercise had no significant effect on depression. Between Table 2 and 3, there was not much change in the p value which tells us that the Age and Gender confounders weren't very significant as they didn't have much of an effect in the multivariate analysis.

Discussion: The results indicated no association between physical activity and depression, however, there were certain limitations on the dataset which may explain the findings.

Primarily, the duration of the exercise was not documented meaning it wasn't clear how much exercise constituted a 'session'. Moreover, it could have been that the amount of exercise didn't matter to the rate of depression, just that any exercise was done at all but this hypothesis was not able to have been tested with the NHANES dataset as no participant reported 0 sessions of exercise in a typical week.

Prevalence of Depression Among Physically Active Adults, National Health and Nutrition Examination Survey

Depression affects around a tenth [1] of the people worldwide and as such it is a disease which is slowly gaining notoriety in the public eye as a serious illness to be contended with. It is remarkably poorly understood. It, like most diseases, is a complex, multifactorial problem which vague and common epithets such as 'chemical imbalance' fail to encapsulate. Various psychologists and neuroscientists have proposed models for depression in the brain, notably Chekroud's model. [9] Most depressed people rely on pharmacological means of treatment in their primary health care setting [2] which has, in short, caused the pharmaceutical industry to have a somewhat unhealthy relationship with the drugs they manufacture. Progress in psychopharmacology is also very slow and so discoveries of new anti-depressants are few and far between. The reason for this slow progress is that depression is very subject to the placebo effect and, perhaps more likely, regression towards the mean [3] i.e. people tend to take anti-depressants at the points when their depression is at its worst which means purely by chance their mental state will likely improve but not necessarily as a result of the drug. This means effective anti-depressants are hard to differentiate from the placebo effect. The Big Pharma companies realized in the 80s and 90s that millions of people were being diagnosed with depression and millions more thought they had depression even when they didn't but they were being prescribed drugs nonetheless. Thus, the manufacturing of anti-depressants became hugely profitable and because of this, vast amounts of money were poured into research. The vast majority of these drugs, however, are 'selective serotonin uptake inhibitors' (SSRIs) [3] and most of the other anti-depressants are simply SSRIs rebranded as new drugs. Apart from the occasional spurt of interest by psychiatrists in response to a new drug which acts supposedly by a different mechanism than the SSRIs, the stagnation [3] of research in the field is clear.

Depression is in need of a new treatment and that of general physical activity is very promising. The basic biological mechanism by which this works is simple [1]; the neurotrophic factors released during repeated bouts of low-intensity exercise cause neurogenesis which has long been suspected [3] of being fundamental to depression as oppose to serotonin. Moreover, endorphins [4] [10] (neuromodulatory chemicals – which reduce our nerves' response to neurotransmitters thus diminishing stress and anxiety), which are released during short bouts of high-intensity exercise. Many studies such as these [11] [12] are now indicating that depression is on the rise among the adult population worldwide due to over medication and social media. Among these claims, it is also possible that depression is becoming more prevalent in our modern society due to the fact that our lifestyles are continually becoming more sedentary. A research paper [13] documenting the new health risks associated with sedentary lifestyles estimates that we spend around 70% of our waking hours sitting. This time sitting necessarily results in a decreased time participating in physical activity which could hence lead to increasing rates of depression due to the arguments stated above. The goal in this study is that the NHANES data set will provide an association between the variables PhysActiveDays [6] (the number of days in a typical week that a participant undertakes moderate or vigorous intensity exercise reported for participants who were 12 years or older) and Depressed [6] (the self-reported number of days when the participant felt down, depressed or hopeless reported for participants aged 18 years or older) using the Age and Gender (Sex) variables as confounders. The specific categories within these variables and the reasons for choosing them will be outlined in the methodology section. It certainly is a truism that in medicine and public health, complex problems can have simple solutions and the benefits of physical exercise should not be underestimated and reduced to simply being able to solve physical problems but rather increased to areas in mental health.

Methodology

In this study, I used the NHANES dataset to conduct statistical tests on the variables relevant to the research question of how strong strongly associated are physical activity and depression taking into account the confounders of age and gender. The NHANES [6] dataset was collected by the US National Centre for Health Statistics and since approximately 1999, around 5,000 people have been interviewed and had data collected each year via mobile examination centre. The target population of the NHANESraw data set is the "non-institutionalized civilian resident population of the United States" and includes over-representative proportions of certain sub-populations such as racial minorities. The NHANES data set, in total, includes 75 variables and has a total of 10,000 rows of data to undo the original effects of the oversampling in the NHANESraw dataset. The method of analysing the NHANES dataset according to the variables and confounders relevant to the test was executed using the R programming language. Firstly, a subset of the original NHANES dataset called 'NHANES_dep_phys' was created which eliminated all the non-applicable patients in the variables of 'Depressed' and 'PhysActiveDays' and also removed all people who were younger than 18 leaving 3,340 out of the 10,000 original participants to work with for the remainder of the study. With regards to the relevant variables, (Age and PhysActiveDays only as Depressed and Gender were already categorised) the Age variable was categorized into four separate categories (changing it from a continuous variable to a categorical variable), using the 'ifelse' statements, to differentiate between people in broad stages of life by mental health and physical activity. It was expected that all the values obtained for this variable were above 5. The categories were as follows: from 18 to 20 – denoting people transitioning from secondary education to university, from 20 to 35 – denoting people who are leaving university and entering the working world, establishing a career and family life. In addition, the ages of 35 to 60 which focuses on people reaching the peak of their career whilst hopefully having a stable home life just before retirement. The final category was the comprised of the ages of 60 to 80 in which participants will be retiring from

work, enabling them to put more emphasis on home life and strong familial relationships, commonly associated with better mental health [7] [8], however, this is almost certainly the category with the lowest physical activity. The adolescent stage was purposefully not included in the study as the NHANES data set only reports people 18 years and older for the Depressed variable. The physical activity categories were selected from people who were physically active for 1-7 times a week (although the intensity and duration of the exercise was not documented) as there was no patient who had an applicable result who reported 0 sessions of physical activity per week. The three categories included: 1-3, 4-5 and 6-7 times a week, named "Average", "Quite Fit" and "Very Fit" respectably. Proceeding the making of the categories, for the baseline characteristics table, I cross referenced each of them with the Depressed categories and then used the 'prop. table' function (which finds the proportion of the count table created) to obtain a percentage. Then, to obtain a p value, I conducted the chi squared test (parametric test) on each of the variables PhysActiveDaysCats, AgeCats and Gender on the Depressed column of the NHANES_dep_phys subset. For the univariate logistic regression analysis table, I created a model, using the 'glm' function of Depressed and each of the variables AgeCats, Gender and PhysActiveDaysCats. Having created the model, I used the 'confint' function to obtain a confidence interval around the coefficient estimate and the 'exp' (exponentiate) function to obtain the odds ratio estimate with a 95% confidence interval. Finally, for the multivariate logistic regression analysis table, I created a further model using the 'glm' function to a further model which compared the Depressed variable to the AgeCats and Gender variables at the same time as the PhysActiveDaysCats variable as oppose to the previous table where the odds ratio of each variable was measured individually in relation to the Depressed variable. In addition to the making of the regression tables, I made a Receiver Operating Characteristic (ROC) [14] graph (Figure 1) which essentially shows the trade-off between sensitivity and specificity where sensitivity is how many T+/D+ and specificity is how many T-/D- you obtain

for a certain number of tests. ROC curves measure the general usefulness of a test whereby the greater area under the graph means a greater usefulness. They are also vital in determining optimal cut offs for combinations of tests which vary between each test. This is because the cost of misclassification [15] is different between positives and negatives and hence you need to be able to increase one kind of misclassification over each another.

Results

From the baseline characteristics table below, we cannot observe much particularly the p value. Unlike Table 3, the p value calculated using the chi squared test is not multivariate and hence does not take into account the other variables. This means it generates a much less accurate p value. For example, in the Age categories, the baseline characteristics table generated a p value of 0.0007886 when the p values from the multivariate calculation were around 0.4, 0.7, 0.0038.

From Table 2 which outlines the univariate logistic regression analysis, we can see that the odds ratios from the reference (1-3) to the categories of (4-5) and (6-7) have increased by factors of 1.3 and 1.2 respectively however the p value is only 1.23 for (4-5) and 0.344 for (6-7). Both of these p values are less than 0.05 which means we cannot conclude that there is any significant difference between doing 4-5 or 6-7 sessions of exercise per week compared with 1-3 sessions on depression. With regards to age and in reference to age category 1, the odds ratio of age category 2 and 3 only increased by a factor of around 1.2 and 1.1 respectively. The p values of these categories, which were 0.52574 for Cat 1 and 0.73756 for Cat 2, as they are below 0.05, tell us that the difference in odds ratios is not statistically significant. This is to say that there is no significant difference in depression rates in the 20-60-year-old group. However, the final category 4 had an odds ratio of about 2.8 relative to the reference category and the p

value of 0.00489 indicates that the difference is significant. This tells us that being in the 60-80-year-old category triples your odds of being depressed. The last of the variables in Table 2 is Gender which was split between the male and female categories. The female was the reference for largely arbitrary reasons, however the data do suggest a statistically significant difference between the two. This is due to the Male's odds ratio being around 1.38 times that of the Female's, supported by a significant p value of 0.0371. This indicates that being a Male is associated with higher odds of being depressed however this does contradict most of the surrounding psychological literature [16] [17] on the rates of depression between men and women. From Table 3 which outlines the multivariate logistic regression analysis, it is evident that, firstly for the odds ratio and p values for the physical activity categories, there is no significant change. This means that comparing the age and gender categories (confounders) at the same as the physical activity categories against depression made no significant change to any of the values. Likewise, for the all the age categories, a similar lack of effect occurred as, even taking into account confounders, the odds ratio and p values remained stable and didn't change leaving Cat 2 and 3 as having no significant effect on depression and Cat 4 as having a significant effect. Finally, for the Gender categories, the odds ratios and the p values remained largely the same with the Male category maintaining its place as being more strongly associated with depression relative to that of the Female's odds ratio.

Discussion

It was the intention of the study to find an association between greater amounts of physical activity and lower rates of depression adjusting for the relevant confounders i.e. age and gender. What the results suggest in relation to this goal is different in that I found no reason to believe that increasing one's activity from 1 session per week to 7 sessions per week would decrease

the rate of depression significantly in any given individual. The data from the results section demonstrated this across both Table 1 and Table 2. The second table is typically referred to as giving the 'crude' values as the variable in question hasn't been adjusted for confounders and the third table, by consequence, has a more accurate value but in this case, it didn't change the outcome in any significant way. However, there were a few limitations inherent to the NHANES dataset to take into account which may explain this discrepancy. It may be the case that the difference between 1-7 sessions per week made no difference on the depression outcome because the only difference which mattered was that any physical activity was done at all. It was unfortunate that no participants in the NHANES study for which there was an applicable result reported that they did 0 sessions of physical activity per week. If this were the case, it would be possible to test the hypothesis that it is only the mere performance of physical activity, however minimally, that gained the large rewards in terms of the depression outcome and any more exercise beyond that reached the point of diminishing returns very quickly and had a very small effect on depression. A further limitation with the NHANES dataset was that the extent of people's physical activity wasn't documented. The PhysActiveDays variable is described as 'the number of days in a typical week that a participant undertakes moderate or vigorous intensity exercise'. This description is problematic primarily as it does not specify the duration of the moderate or vigorous intensity exercise and it would be extremely difficult to standardize what different participants believed constituted 'moderate' or 'vigorous' exercise. In other words, what one participant describes as vigorous may not be the same as what another participant intends by the same word giving a skewed perception of the kind of physical activity the participants have done. Furthermore, there are many more possible confounders which would have to be controlled for in order to obtain an even more accurate result. The variables Age and Gender appeared to be the most relevant confounders but improvements on the study may well include more confounders such as poverty, BMI, race, diabetes [5] or sexual

orientation. Having not adjusted for these confounders, certain problems arise as to the relationship between depression and physical activity. It could be that less depressed people have a higher chance of performing physical activity as oppose to the other way around. Problems like these are hard to control for without taking in account enough confounders.

Conclusion

From my findings on the subject of whether physical activity is associated with depression, I would hesitate to conclude that exercise lowers the rate of depression among the participants of the NHANES dataset. This due to the fact that there was no considerable difference in rate of decrease of depression as the number of sessions per week of physical activity was increased. There is some hope, however, for the future of this research topic as, outlined in the discussion section, it could be that a possible (0) category for PhysActiveDays could be key in demonstrating that physical activity can alleviate depression.

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Tables

Table 1 – Baseline Characteristics

	Total (N=3340)	**None (N=2695)**	**Several (N=466)**	**Most (N=179)**	**p-value**
PhysActiveDays (1-3), N (%)	53.32335	42.1856	7.96407	3.17365	0.1665
PhysActiveDays (4-5), N (%)	29.55090	24.46107	3.74251	1.34730	0.1665
PhysActiveDays (6-7), N (%)	17.12575	14.0419	2.24550	0.83832	0.1665
Age, median [Q1-Q3]		44 [31– 58]	43 [31 – 58.75]	45 [30 – 52]	
Age (1) (>=18 – =<20) N (%)	5.658683	4.82035	0.449101	0.389221	0.0007886
Age (2) (>=20 – =<35) N (%)	27.39520	21.5269	4.311377	1.55688	0.0007886
Age (3) (>=35 – =<60) N (%)	46.46706	37.1257	6.437125	2.90419	0.0007886
Age (4) (>=60 – =<80) N (%)	20.47902	17.21556	2.75449	0.508982	0.0007886
Gender (Female) N (%)	48.26347	37.544910	7.724551	2.994012	0.000254
Gender (Male) N (%)	51.73653	43.143713	6.227545	2.365269	0.000254

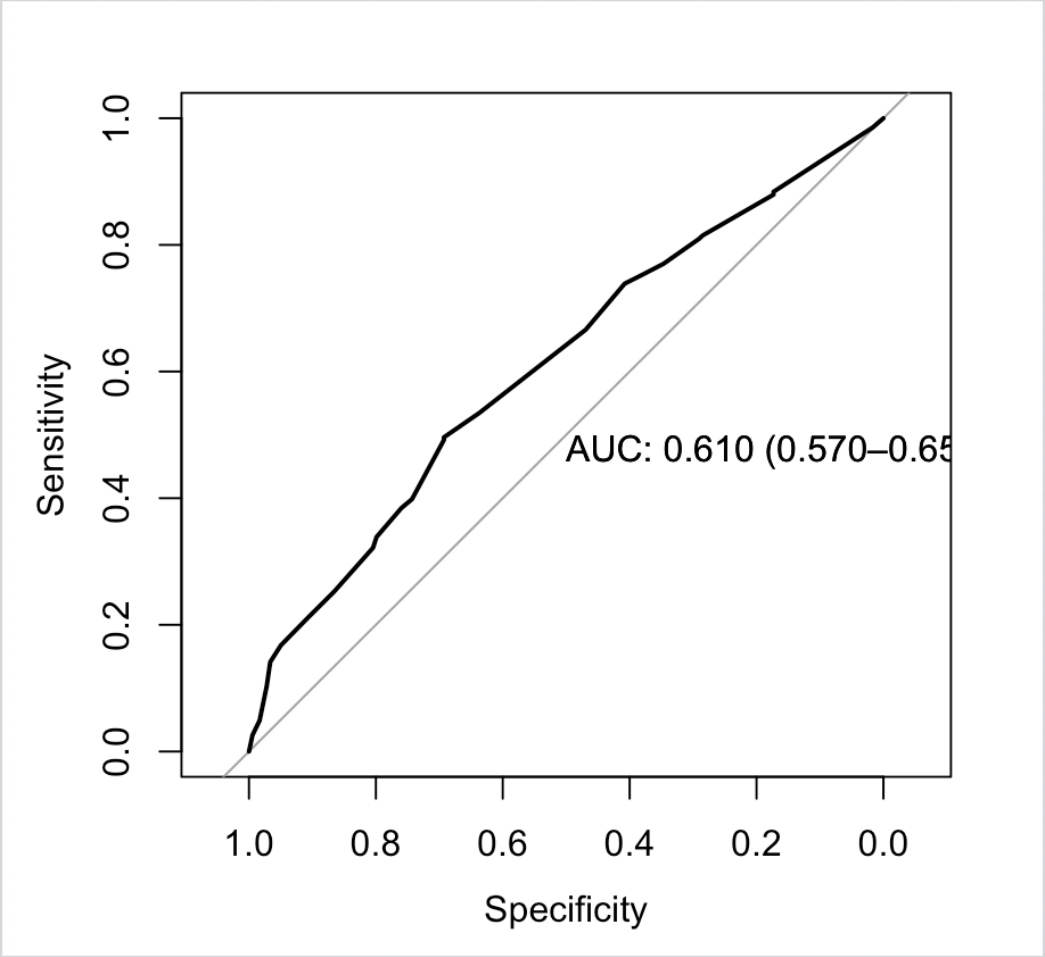
Table 2 – Univariate Logistic Regression Analysis

Covariate	**OR [95% CI]**	**p-value**
PhysActiveDays (1-3) (Ref.)		
PhysActiveDays (4-5)	1.324736 [0.9327592 - 1.911027]	0.123
PhysActiveDays (6-7)	1.229510 [0.8133997 – 1.918967]	0.344
Age (1) (>=18 – =<20) (Ref.)		
Age (2) (>=20 – =<35)	1.225852 [0.6280577 – 2.232309]	0.52574
Age (3) (>=35 – =<60)	1.107955 [0.5816552 - 1.948447]	0.73756
Age (4) (>=60 – =<80)	2.898061 [1.3560890 - 6.057886]	0.00489
Gender (Female) (Ref.)		
Gender (Male)	1.380517 [1.020621 - 1.873382]	0.0371

Table 3 – Multivariate Logistic Regression Analysis

Covariate	**OR [95% CI]**	**p-value**
PhysActiveDays (1-3) (ref)		
PhysActiveDays (4-5)	1.331445 [0.9359046 - 1.923731]	0.1185
PhysActiveDays (6-7)	1.190019 [0.7843032 - 1.863343]	0.4289
Age (1) (>=18 – =<20) (ref)		
Age (2) (>=20 – =<35)	1.255577 [0.6425630 - 2.289813]	0.4791
Age (3) (>=35 – =<60)	1.122732 [0.5886640 - 1.977786]	0.7058
Age (4) (>=60 – =<80)	2.999140 [1.3998368 - 6.286599]	0.0038
Gender (Female) (Ref)		
Gender (Male)	1.461205 [1.0784604 - 1.986285]	0.0148

Figure 1:


Sensitivity
0.0
0.2
0.4
0.6
0.8
1.0
AUC: 0.610 (0.570–0.65
1.0
0.8
0.6
0.4
0.2
0.0
Specificity