

The Effects of Mental Health on Academic Success

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Introduction

The importance of emotional and mental support for students is becoming increasingly recognized. Academic success is not just intellectual ability; it also hinges significantly on the emotional and mental well-being of students. This is especially pertinent in an era where mental health challenges are on the rise among youth. A 2020 study in "Frontiers in Psychology"¹ reveals that students with better emotional regulation and adaptability, key aspects of emotional intelligence, tend to have higher academic success.

However, quantifying the impact of emotional and mental support on academic grades remains a challenge. Traditional measures of academic success often overlook these critical factors. This study aims to bridge this gap by providing a data-driven analysis of how emotional and mental support influences academic performance. To this end, our research utilizes a comprehensive survey from two high schools in Portugal, encompassing variables that indicate levels of emotional and mental support, such as free time, participation in romantic relationships, and extracurricular engagement opportunities.

By employing a series of multivariate regression models, our study seeks to isolate the effect of emotional and mental support on academic grades, controlling for other factors like socio-economic background and academic habits. This analysis is crucial, as it could inform educators and policymakers about the value of investing in mental health resources and supportive environments in schools. It could potentially lead to a paradigm shift in how educational success is approached, with a greater emphasis on holistic student development.

Data and Methodology

The data in this study comes from two high schools in Portugal, consisting of data from 1044 students. We subsampled from students who received a final grade above 0, bringing us down to 991 students. It was compiled and made publicly available by the UCI Machine Learning Repository. Each row in the dataset corresponds to an individual student attending one of these two schools. We performed EDA on 30% of the data, totaling about 297 students. Our outcome variable was represented on a scale from 0 - 20, so to make them percent scores, we applied a linear transformation to make the range 0 - 100.

Encoding variables for mental health, socioeconomic status, and academic habits took significant consideration. The study time variable represents on a scale from 1 - 4 how much time a student spends studying weekly. Students answer 1 if they spend less than 2 hours per week studying, 2 if they spend between 2-5 hours, 3 if from 5-10 hours, and 4 if it's greater. We chose not to adjust this variable because it was represented as a score of ranges of time, a discrete variable we would rather not touch. In addition, we decided to include socioeconomic factors into our regression analysis, which we encoded with variables indicating parent education, whether they have internet access, and whether they pay for tutoring services. All of these variables also have a discrete nature in the sense that they are represented as scores. The parent education scores range from 1 - 4. If a parent completed their education only up to the fourth grade, then they are represented with a score of 1. A score of 2 represents some middle school education. 3 signifies completion of secondary education, and 4 indicates completion of higher education. By interacting these two terms, we can highlight students that have educated parents, encapsulating their effect on their child's education. At the same time, a higher interaction score would be indicative of some socioeconomic status, so we decided to add this interaction term into our socioeconomic score. Finally, we encapsulate alcoholic consumption by interacting ratings of weekday consumption with weekend consumption. This way, we can penalize people with poor drinking habits.

¹ Köster, M., Yovsi, R., & Kärtner, J. (2020). Cross-Cultural Differences in the Generation of Novel Ideas in Middle Childhood. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.01829>.

To operationalize mental health, we took a look at the scores relating to familial and social ratings. In the survey, students were asked to rate their relationships with their family on a scale of 1 - 5, 1 indicating a very negative relationship and 5 being a very positive one. Another question asked to rate their physical health on the same scale of 1-5. There also exists an indicator variable for whether or not students partake in extracurricular activities in this survey. These are all factors that we believe can, with significance, affect a student's mental well being and how they go about their daily life. We condensed a mental health score by adding these ratings from our survey. In order to further validate our assumption of how relationships have an impact, Figure 1 plots the relationship between our mental health score and final grades. Interestingly, our data suggests that people who are not in a relationship tend to get better grades with adequate mental health support, although it becomes clear we represent more single students in our data than those in relationships.



However, we still remain interested in the mental health of a student and how it affects their academics. In order to do this, we also need to control for other large causal factors that determine grades for our regression. For that, we include the study time variable to capture a student's personal initiatives on their academic performance. We encapsulate socioeconomic variables by adding the scores pertaining to internet access (a binary indicator variable), whether or not they can afford to pay for tutoring services (another indicator), and parent education interaction scores. We fit regressions of the form,

$$final\hat{grade} = \hat{\beta}_0 + \hat{\beta}_1 \times \text{mental health} + Z_{\alpha} + \varepsilon$$

where Z is a row vector of additional covariates, and α is a column vector of coefficients. By doing this, we are able to isolate the mental health component and assess significance for that aspect.

Results:

	Dependent variable:		
	NA		
	(1)	(2)	(3)
studytime	0.304** (0.145)	0.303** (0.145)	0.267** (0.146)
higher	1.411*** (0.458)	1.436*** (0.458)	1.380*** (0.459)
failures	-1.846*** (0.190)	-1.838*** (0.190)	-1.811*** (0.191)
socioeconomic	0.071*** (0.024)	0.073*** (0.024)	0.075*** (0.024)
mental_health		-0.079 (0.064)	-0.078 (0.064)
tot_alc			-0.038 (0.025)
Constant	9.379*** (0.514)	9.974*** (0.702)	10.221*** (0.719)
Observations	836	836	836
R ²	0.177	0.179	0.181
Adjusted R ²	0.173	0.174	0.175
Residual Std. Error	3.465 (df = 831)	3.464 (df = 830)	3.461 (df = 829)
F Statistic	44.772*** (df = 4; 831)	36.151*** (df = 5; 830)	30.576*** (df = 6; 829)
Note:	p<0.1; **p<0.05; ***p<0.01		
Note that the echo = FALSE parameter was added to the code chunk to prevent printing of the R code that generated the plot.			

This stargazer table shows the results of the three regression models. Here we can see that the coefficients on studytime, higher, failures, and socioeconomic are all statistically significant consistently throughout the models. It was also observed that the mental_health variable shows no statistical significance when it was introduced. For studytime, the point estimates range from 0.267 - 0.304.

The positive coefficient for studytime for example implies that an increase in study time can be attributed to increased academic achievement in an individual.

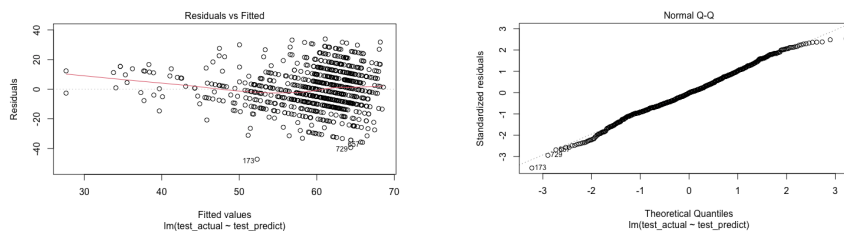
Most notably from this table, we see that the mental health variable doesn't appear statistically significant which could suggest that there is insufficient evidence to conclude that these variables (famrel, health, and activities) have a meaningful impact on grades.

While this is the case, this does not necessarily imply that there is no relationship, but rather that the effect is not detectable with the given dataset and methodology we utilized for our study.

Additionally, there are statistically significant R^2 values ranging from 0.173 to 0.181 across the three models which signifies that these variables contribute very slightly towards the explained variance in academic performance/grades. Furthermore, the low nature (deviation from 1) of the R^2 value also further indicates a lack of perfect fit for when it comes to the model explaining all forms of variability. This calls for caution when interpreting our model as well as some limitations in the power of predictability our model has.

Therefore, while our results do showcase significance of some factors when understanding academic performances, the insignificance of the mental health variable does reflect limitations in our study which we will touch on next.

Limitations:



As part of our results, we derived four plots: Residuals vs. Fitted Plot, Normal Q-Q Plot, Scale-Location Plot, as well as a Residuals vs. Leverage Plot. Based on the plots we derived, we were able to assess the validity of the linear regression model, based on which we noticed that some of the assumptions are in violation based on non-linearity, inconsistent variance, and non-normality of variance. Based on our Normal Q-Q plot, we see that there are very few deviations from the line that are representative of the residual data being a normal distribution, since the residuals have heavier tails than expected.

Additionally, it's important to consider the violations within the assumption of I.I.D. (Independent & Identically Distributed) in our plots. This assumption states that the residuals are independent of each other as well as identically distributed with constant variance. Based on our results, we see deviations from this assumption given that there is some inconsistent variance and non-normality present in our model, posing limitations.

Based on the plots as well as looking at the bigger picture conclusions we aimed to draw from our results, one of the major limitations we encountered is the sample size of the data we are evaluating. Our dataset consists of data from two schools in Portugal and 1044 students, which is a small sample size in comparison to all the high school aged students existing in Portugal. This can be an issue when it comes to making generalizations regarding how a particular environmental factor such as affording tutoring services for example truly contributes to mental health overall. Another important limitation is causation versus correlation. While we are able to

derive a mental health score based on the 'Y' variable factors affecting said score, it's difficult to be certain that these scores were not affected by external unmeasured factors. So therefore, it's difficult to assume that these results are representative of all high schoolers across the world.

In addition to this, self report bias could certainly take place in a dataset such as this one, where our methodology is heavily reliant on data that was self reported by students. Given that an individual's self reported values are dependent on their own perception of themselves, it's likely that there could be some potential for inaccuracies in arriving at a mental health score.

A significant limitation of our study is its reliance on survey data consisting largely of ordinal and categorical variables. Ordinal variables just rank items without showing how much they differ, which can oversimplify things like mental health scores. Categorical variables group detailed information into broad categories, which might miss out on the full range of how students feel about their mental health.

Furthermore, cultural significance also plays a large role in the interpretability of the data and our results. The specificity of Portuguese culture is not extremely familiar to us and thus it's difficult to draw big picture conclusions regarding mental health, since norms regarding finances, study habits, familial values, etc. vary across different cultures.

Lastly, mental health is a very dynamic measure that changes over time. Especially among teenage aged students, mood changes and fluctuations in mental well being can change drastically over the course of a few months, with intense feelings of sadness, happiness, or anger varying in cycles. So given that this sample and the results that follow are dependent on one measure of each individual's mental health also creates a caveat in our ability to comprehensively draw conclusions regarding mental well being of students overall. Hence, while we are able to derive some interesting findings through our methodology and use of regression analysis, the accuracy of these results still remain largely uncertain due to these limitations.

Conclusion:

In attempts to explore the relationship between mental well being and academic success of high school aged students across the world, we studied a dataset consistent with information from two high schools in Portugal.

As we explored our data through our methodology and multivariate regression analysis, we realized the nuanced nature of mental health and the implications we are able to draw based on our results. We aimed to isolate the effects of support while using factors such as socioeconomic status and academic study habits as control variables. Based on our plots, we learned of some issues such as deviations from linearity, inconsistent variance, and data skewed from a normal distribution. While our regression table showcased some statistically significant values such as study time, presence of higher education, failures, and socioeconomic status; mental health appears not to be statistically significant.

These results exemplify the limitations of our research discussed previously, as it's difficult to draw comprehensive conclusions regarding the mental well being of all high school aged students worldwide without more data points, a larger sample size, as well as a lack of geographic clustering. It's important to recognize the multifaceted nature of mental health as a measure and the lack of reliability and subjectivity posed by the limiting factors when attempting to generalize our findings to a broader high school student population. To better understand the scope of effect different factors have when it comes to mental health, it would be best to recollect data from diverse geographic populations, collect multiple measures per individual, and include a greater number of external factors as control variables.

In conclusion, our research and analysis have led us to believe that while mental health is in relationship to external factors, the lack of statistical significance found in our stargazer table calls for more research and data to reach further conclusions regarding the mental well being of high schoolers worldwide.