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Statistical Analysis of Reported Health Habits and Mental Health from the Bridge to Health Survey 2015: Northeastern Minnesota and Northwestern Wisconsin

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Abstract

The objective of this study was to further research relating poor mental health cases with inadequate nutrition or physical activity. Research aims to support the use of health habits like diet and exercise as treatment or prevention for frequent mental distress. The analysis uses data from the Bridge to Health Survey 2015, conducted in Northeastern Minnesota and Northwestern Wisconsin and supports survey goals of gathering local health information. Initial data preparation grouped participants into a mental distress group and a good health group, based on their reported days of poor mental health. Next, logistic regression models evaluated correlation between mental health status and health habits. Emphasis was placed on diet and exercise habits, but covariates, such as employment status, gender, and income, were also included. Results suggest those who consume more servings of fruit per day or participate in some form of physical activity each month are less likely to have mental distress. There is also evidence that consuming home cooked meals and restaurant meals decreases risk when compared to fast food meals. Employment status and gender were also strongly related to mental distress rates, where those who are unemployed because of a disability or those who are female have higher risk.

Keywords: Mental Distress, Diet, Exercise

1. Introduction

In 2016, 11% of people in the United States reported having 14 or more days of poor mental health within a month[1]. This is also known as frequent mental distress. The relatively high rate stimulates questions on what preventative measures exist. Preliminary research suggests that both a balanced diet and regular, physical activity can decrease likelihood of poor mental health by interacting with serotonin levels, the neurotransmitter responsible for mood[2].

Controlled trials support the claim on physical activity, suggesting that exercise stimulates antidepressive effects if performed routinely at light to moderate rates[3]. To prove bidirectional association, statisticians also analyzed sedentary behaviors in comparison to mental disorders as found by the Health Survey for England. The results did, in fact, show an association between sedentary time and adverse mental health suggesting that adults who participate in less physical activity are more likely to experience depressive episodes or low mood. However, this did not coincide with findings of the National Health and Nutrition Examination Survey done previously[3]. Although the English survey presents evidence of exercise as a preventative measure for mental disorders, discrepancies make further studies necessary to determine the actual effectiveness.

Diet's role on mental health presents a more recent area of interest. A 2015 analysis on the Personality and Total Health (PATH) Through Life Study, completed in Australia, evaluated the link between women's food consumption

and mental health. The results suggest those who consume a "traditional" diet of vegetables, fruit, meat, fish, and whole grains have approximately 35% less risk of depression than "western diet" adherers who frequently consume fatty, processed food like pizza, chips, burgers, and alcohol[4]. Although there are some documented findings of relationship between diet and poor mental health, results are limited.

This statistical analysis aims to provide additional evidence of correlation between mental distress and diet and exercise. The overall goal is to support research for the use of health habits as nonpharmaceutical treatment and prevention for poor mental health. Additional benefits include gathering local information and raising awareness of mental health and the impacts of health habits.

The data used for this statistical analysis comes from the Bridge to Health Survey 2015 conducted in Northeast Minnesota and Douglas County Wisconsin. The telephone survey consisted of 70 questions with topics including current health conditions, lifestyle factors (nutrition, exercise, smoking, drinking, etc.), access to health and dental care, health insurance coverage, and demographics. Two-thousand fifty addresses where randomly selected from each county, and one person was surveyed at each location. Whoever answered the phone was asked to give it to the household member with the most recent birthday of age 18 or older. The result was a 28.6% response rate providing 6,976 observations[5,6].

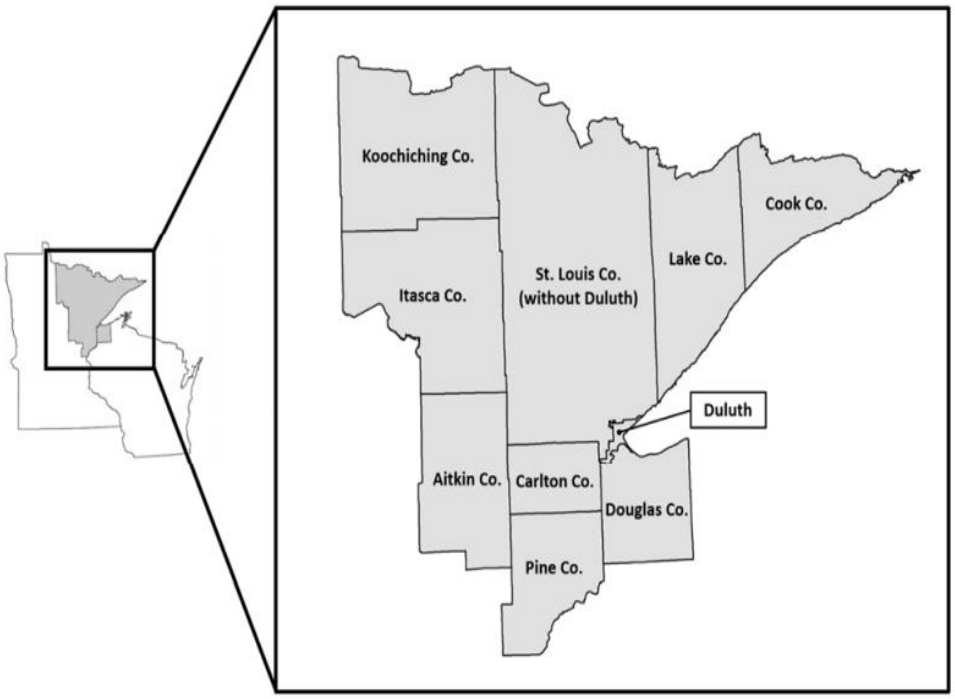

Figure 1. Survey region broken down by counties[5].

2. Methods

2.1 Mental Distress

The survey question chosen to represent mental health status asked, "Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"[7]. Participants were asked to give a number between 0 and 30. Answers outside of this range were indicated with a -4. This question was picked because it represents mental health in its entirety whereas other contenders were specific to conditions such as depression and anxiety.

Initial plans hoped to use days of poor mental health as a numerical variable following a Poisson distribution. Note that instances marked as -4 for an extraneous answer were removed since they made up less than 1% of total observations.

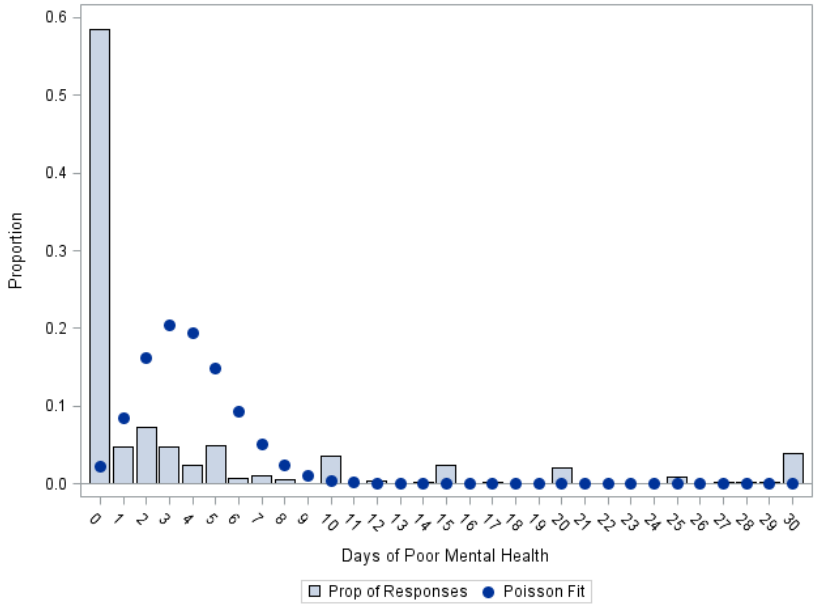

Figure 2. Poisson distribution fit to days of poor mental health

Figure 2 is a frequency plot presenting the proportion of participants who reported each number of days of poor mental health overlaid by a Poisson distribution. Due to the large number of reported zero days of poor mental health, the distribution is not a good fit.

Outside research provided reasoning to categorize the variable into two groups instead. The Behavioral Risk Factor Surveillance System is an ongoing, national telephone survey identical to the Bridge to Health Survey. The survey includes the same question about number of days' poor mental health in the past 30, and determined that mental distress is best classified as having greater than or equal to 14 days of poor health[8].

2.2 Diet And Exercise

Diet is broken up into two categories for analysis: nutrition and meal type. The three questions used to represent nutrition regard servings of fruit, vegetables, and fruit juice eaten the day before the survey. Meal type refers to average meals eaten per week from fast food places, from restaurants, or from home (home-cooked meals).

Three questions regarding exercise were also included in analysis. The first was binary, asking if one has, or has not, completed physical activity in the past 30 days. The other two asked for the average number of days per week of 30 minutes moderate physical activity and 20 minutes vigorous activity.

Like the poor mental health variable, some responses reported extraneous answers, marked as -4. Again, these made up less than 1% of total instances, so they were simply removed for analysis.

2.3 Additional Variables

Demographic variables and some additional health habits were also of interest. These included smoking, alcohol consumption, education completed, employment status, race, household income, age, and gender. Smoking consisted of three levels from never to every day while education had eight levels from 8th grade or less to graduate degree. Income also included levels ranking 1 to 10 where 1 is the lowest income bracket.

For multiple choice questions, in the case of a respondent choosing more than one value, the answer was marked as -5. For each question, the number of invalid answers made up less than 1% of the total observations so the instances were simply removed for analysis.

2.4 Logistic Regression

SAS 9.4 was the primary software used for data preparation and statistical analysis. Since mental health status was categorized into two groups—distress or good health—logistic regression models were used with an event being a person has mental distress. A 5% significance level was maintained throughout the analysis.

Initial models keep nutrition, meal type, and exercise variables separate to provide a direct look at each relationship with mental distress. Afterwards, the covariables mentioned above were added to the models, and backward selection evaluated which subset of variables best predict occurrence of mental distress. The selection used the default, stay significance level of 0.15. Finally, all three topics were combined and evaluated to see how the combination of diet and exercise affects probability of mental distress.

3. Results

Out of the 6,976 participants surveyed, approximately 11% were defined as having mental distress, meaning they reported greater than or equal to 14 days of poor mental health within a 30 day period.

3.1 Nutrition

Odds ratios for mental distress risk are presented in Table 1. Differences in distress rates based on servings of vegetables and servings of fruit juice consumed in a day were insignificant, however, servings of fruit was not. An additional serving of fruit in day decreases risk of mental distress by almost 20%. This stayed consistent after adjustment for demographic variables (age, gender, race, income, education, and employment) and other health habits (smoking and alcohol consumption). Additional variables significant for predicting occurrence of mental distress include gender, certain employment statuses, income, and age. Being unable to work because of disability presents the highest risk at 3 times more likely to have mental distress. This is followed by females having 70% greater risk than males. Inversely, the self-employed, farmers, or retired, are all about 50% less likely to have mental distress.

Table 1. Probability of mental distress by fruit and vegetable consumption

Predictor	Model 1*			Model 2**		
Variables	P-value	OR	95% CI	P-value	OR	95% CI
Serv. Veg	NS	0.94	(0.87, 1.01)			
Serv. Fruit	**<.0001**	**0.83**	**(0.76, 0.91)**	**<.01**	**0.81**	**(0.71, 0.93)**
Serv. Juice	NS	0.96	(0.87, 1.07)			
Gender				<.01	1.74	(1.26, 2.42)
Self-Emplyd/Farmer				<.05	0.49	(0.25, 0.96)
Retired				<.01	0.56	(0.36, 0.87)
Unable to Work b/c disability				<.0001	3.02	(1.98, 4.62)
Income				<.0001	0.88	(0.84, 0.92)
Age				<.05	0.99	(0.97, 1.00)

Values in bold indicate nutrition related variables of significance level $P \leq 0.05$.
OR: Odds Ratio
CI: Confidence Interval
*Model 1: Occurrence of mental distress with regressors: servings of vegetables, fruit, and fruit juice
**Model 2: Backward selection on model 1 + adjustment for smoking, alcohol, education, employment, race, income, age, and gender

3.2 Meal Type

All three meal categories present some significance. Greater consumption of fast food meals corresponds to higher risk of mental distress; however, this was not significant after adjustment for demographics and additional health habits. Odds ratios for restaurant meals and home cooked meals both indicate significantly reduced risk of mental distress (30% and 20% respectively) for an additional meal per week. This stayed significant after adjustment. Model 4 indicates that the same additional variables significant in the nutrition model (Model 2) are also significant when paired with meal type.

Table 2. Probability of mental distress by meal type

Predictor	Model 3*			Model 4**		
Variables	P-value	OR	95% CI	P-value	OR	95% CI
Fast Food Meals	**<.01**	**1.21**	**(1.05, 1.40)**			
Restaurant Meals	**<.0001**	**0.69**	**(0.60, 0.80)**	**<.01**	**0.71**	**(0.55, 0.92)**
Home Cooked Meals	**<.0001**	**0.81**	**(0.74, 0.89)**	**<.01**	**0.79**	**(0.68, 0.91)**
Gender				<.01	1.55	(1.11, 2.17)
Self-Emplyd/Farmer				<.05	0.46	(0.23, 0.94)
Retired				<.05	0.56	(0.36, 0.88)
Unable to Work b/c disability				<.0001	2.92	(1.89, 4.51)
Income				<.0001	0.88	(0.83, 0.93)
Age				<.05	0.99	(0.97, 1.00)

Values in bold indicate meal type related variables of significance level $P \leq 0.05$.
OR: Odds Ratio
CI: Confidence Interval
*Model 3: Occurrence of mental distress with regressors: average fast food meals, restaurant meals, and home-cooked meals per week
**Model 4: Backward selection on model 3 + adjustment for smoking, alcohol, education, employment, race, income, age, and gender

3.3 Physical Activity

Odds ratios for mental distress by varying amounts of physical activity were insignificant. However, participating in at least one day of physical activity for every 30 days decreases risk for mental distress by almost 50%. This stayed consistent after adjusting for demographics and additional health habits. Like the models for nutrition (Model 2) and meal type (Model 4) the variables for gender and some employment statuses, also had significant odds ratios.

Table 3. Probability of mental distress by physical activity

Predictor Variables	Model 5*			Model 6**		
	P-value	OR	95% CI	P-value	OR	95% CI
Exercise in past 30 days (Y/N)	**<.0001**	**0.56**	**(0.45, 0.70)**	**<.0001**	**0.52**	**(0.37, 0.72)**
Days Moderate Exercise	NS	0.95	(0.91, 1.00)			
Days Vigorous Exercise	NS	0.97	(0.92, 1.03)			
Gender				<.01	1.65	(1.18, 2.29)
Self-Emplyd/Farmer				<.05	0.42	(0.21, 0.86)
Retired				<.05	0.56	(0.36, 0.88)
Unable to Work b/c disability				<.0001	2.97	(1.93, 4.55)
Income				<.0001	0.88	(0.84, 0.93)
Age				<.01	0.98	(0.97, 1.00)

Values in bold indicate exercise related variables of significance level $P \leq 0.05$.
OR: Odds Ratio
CI: Confidence Interval
*Model 5: Occurrence of mental distress with regressors: exercise in past 30 days (yes/no) and average days per week of 30 minutes moderate exercise or 20 minutes vigorous exercise
**Model 6: Backward selection on model 5 + adjustment for smoking, alcohol, education, employment, race, income, age, and gender

3.4 Complete Model

Model 7 includes both diet and exercise categories. Restaurant meals and home-cooked meals are both predicted to decrease risk of mental distress along with some amount of exercise. Fruit becomes insignificant after adding exercise to the model. And again, females and those unable to work because of disabilities are more likely to have mental distress whereas the retired or self-employed are significantly less likely.

Table 4. Probability of mental distress by diet, exercise, and other lifestyle factors

Predictor Variables	Model 7*		
	P-value	OR	95% CI
Restaurant Meals	**<.05**	**0.73**	**(0.57, 0.95)**
Home Cooked Meals	**<.01**	**0.82**	**(0.71, 0.95)**
Exercise in past 30 days (Y/N)	**<.01**	**0.57**	**(0.40, 0.80)**
Gender	<.01	1.57	(1.11, 2.21)
Self-Emplyd/Farmer	<.05	0.41	(0.20, 0.87)
Retired	<.05	0.57	(0.36, 0.91)
Unable to Work b/c disability	<.0001	2.78	(1.78, 4.34)
Income	<.0001	0.89	(0.84, 0.94)
Age	<.05	0.98	(0.97, 1.00)

Values in bold indicate diet and exercise variables of significance at $P \leq 0.05$ level.
OR: Odds Ratio
CI: Confidence Interval
*Model 7: Occurrence of mental distress using backward selection on nutrition variables, meal type variables, and exercise variables + adjustment for smoking, alcohol, education, employment, race, income, age, and gender

4. Discussion

4.1 Study Strengths

Eleven percent of study participants fell into the mental distress category. This is equivalent to the national percentage which provides support that the sample is representative. Also, the survey data was collected from September to November, encompassing one season, to prevent change in health due to different weather. Finally, the large and random sample reinforces the accuracy of the data.

Logistic models were strengthened by including demographics in addition to diet and exercise variables. This allowed odds ratios to adjust for differences in age, income, race etc., between the mental distress group and the good health group to improve accuracy of ratios for diet and exercise.

4.2 Study Limitations

There are some common limitations that come with survey data. Response bias is one. Also, correlations found from observational data can not imply causation meaning that the direction of the association is unclear. For instance, having mental distress may cause people to exercise less or vice versa. However, this does not discredit the possibility of using exercise as a treatment or prevention; it provides reasoning for additional research into the correlation. Finally, the data is not well suited for analyzing mental distress with race since about 99% of participants were white. This does not leave adequate sample size for other races.

4.3 Next Steps

More advanced models could improve model accuracy by adjusting for relationships between covariates. For example, there may be correlation between number of restaurant visits and income or income and employment status. Categorizing the age variable may also improve prediction for distress by age.

5. Conclusions

Based on odds ratios for various models, diet and exercise are associated with mental distress. People who consume more servings of fruit are less likely to have mental distress along with people who participate in some form of exercise each month. Exercise and fruit were also highly correlated suggesting people who exercise also eat more fruit. This explains why the complete model did not need to include both variables. Eating home cooked meals and restaurant meals also relate to lower risk for mental distress which only leaves fast food meals as the alternative. It is unclear if frequently eating fast food significantly increases risk, but there is some evidence.

Employment status appears to have the largest impact on chance of mental distress. Being unable to work because of a disability increases risk over 3 times whereas the self-employed, farmers, or retired are likely mentally stable. Note that being a student showed significant increased risk in models that did not include age. This is likely because most students are around the same age so the best model did not need to include both. Additional variables tested that were not significant include alcohol consumption, smoking habits, education, race, and some employment statuses such as fulltime workers and part-time workers.

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