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Short Communication

STATISTICAL ANALYSIS OF MEDICAL DATA ON ANOREXIA NERVOSA PATIENTS

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ABSTRACT

A sample of twenty anorexia nervosa patients on admission at Government Psychiatric Hospital, Uselu, Benin City were placed on antidepressant, vitamin and mineral supplements. After they were discharged from the hospital, an investigation was carried out to ascertain treatment effect of the drugs on the patients. On the assumption of normality of gain or loss in the body mass indices (BMI) of the patients, the null hypothesis of no treatment effect was rejected. The statistical results showed that the drugs yielded a significant treatment effect on the patients.

Keywords: Anorexia nervosa, antidepressant, body mass index, bootstrapping, null hypothesis, patients.

INTRODUCTION

Anorexia nervosa is an eating disorder characterized by refusal to maintain a healthy body weight, and an obsessive fear of gaining weight (Keys, 1972). It is a serious mental illness and the highest mortality rate of any psychiatric disorder. Keys (1972) expatiates that a person is underweight if his/her body mass index (BMI) is in the interval [16kg/m^2, 18.5kg/m^2); normal weight if his/her BMI lies in the interval [18.5kg/m^2, 25kg/m^2); and overweight if his/her BMI is in the interval [25kg/m^2, ∞). Body mass index (BMI) of a patient is explained as the weight (in kilograms) of a patient divided by the square of his or her height (in metres). Medical data on the body mass indices of anorexia nervosa patients that were on admission at Government Psychiatric Hospital, Benin City, Nigeria and after discharge, were collected respectively for possible statistical investigation of treatment effect of drugs on the patient. In line with the works of Armitage and Berry (1994) and Altman (1991), the paired t-test statistic under the hypothesis of equal mean body mass indices for the patients on admission and after discharge from the hospital is most suited for the analysis of these data. The paired t-test statistic according to Sarmukaddam (2006) is applicable under the assumption that the data are quantitative, the distribution of the differences in body mass indices of patients on admission and after discharge is normal, and these differences are independent of each other.

Consequently, rejecting the null hypothesis of equal mean body mass indices (BMI) of patients on admission and after discharge from the hospital statistically implies no treatment effect of drugs on the patients.

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MATERIALS AND METHODS

Methods

Let $\left[x_1, x_2, \cdots, x_n\right]$ *and* $\left[x_1^*, x_2^*, \cdots, x_n^*\right]$ be the body mass indices (BMI) of anorexia nervosa patients on admission and after discharge from the hospital respectively. Define the differences $d_i = x_i^* - x_i$, *for* $i = 1, 2, \cdots, n$, which are assumed to be normally distributed with unknown mean μ_d and variance σ_d^2.

Hence, under the null hypothesis of equal mean body mass indices, $\mu_d = \mu^* - \mu = 0$, the random variable

$$T = \frac{\bar{d}\sqrt{n}}{s_d} \tag{2.1}$$

has the t-distribution (Montgomery and Runger, 2003)

$$f(x) = \frac{\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{\pi n}\,\Gamma\left(\frac{n}{2}\right)\left(\frac{x^2}{n}+1\right)^{\frac{n+1}{2}}}, \quad -\infty < x < \infty \tag{2.2}$$

with $(n-1)$ degrees of freedom, where

$\mu^* =$ mean BMI of patients after discharge

$\mu =$ mean BMI of patients on admission

$\mu_d =$ mean difference in BMI

$\bar{d} =$ estimate of μ_d

$\sigma_d^2 =$ variance of differences in BMI

$s_d^2 =$ estimate of σ_d^2
$n =$ sample size.

Let $t_{0.05,n-1}$ be the value of the random variable, T with $(n-1)$ degrees of freedom. Thus, $t_{0.05,n-1}$ is an upper tail 95 percent point of the t-distribution with $(n-1)$ degrees of freedom. Now, the decision to reject the null hypothesis of no treatment effect on the patients depends on whether (statistical rule) the value of the random variable, $T > t_{0.025,n-1}$ or $T < -t_{0.025,n-1}$.

Evidently, we have the statement of hypothesis

$$H_0: \mu_d = \mu^* - \mu = 0 \qquad (2.3)$$

$$H_1: \mu_d = \mu^* - \mu \neq 0$$

and 95 percent confidence interval for the mean difference μ_d as

$$\left(\bar{d} - s_d t_{0.025,n-1}\ ,\ \bar{d} + s_d t_{0.025,n-1}\right) \qquad (2.4)$$

The statistics $\bar{d}$ and s_d are obtained by creating 200 bootstrap samples of the differences d_i's through bootstrap re-sampling approach. Bootstrapping according to Efron and Tibshirani (1993) is a computer based method for assigning measures of accuracy to sample estimates. This method according to Varian (2005) can be implemented by constructing a number of re-samples of the d_i's, each of which is obtained by random sampling with replacement from the original data set, $d_1, d_2, \cdots, d_n$ (see Table 1)

Table 1. Bootstrapping Method.

Bootstrap Sample	Re- samples (differences, d_i)	Bootstrap estimates
1	$d_1^*,\ d_2^*,\cdots,\ d_n^*$	$\hat{\mu}_d^1$
2	$d_1^*,\ d_2^*,\cdots,\ d_n^*$	$\hat{\mu}_d^2$
3	$d_1^*,\ d_2^*,\cdots,\ d_n^*$	$\hat{\mu}_d^3$
⋮	⋮ ⋮ ⋮	⋮
200	$d_1^*,\ d_2^*,\cdots,\ d_n^*$	$\hat{\mu}_d^{200}$

By bootstrapping method,

$$\bar{d} = \frac{1}{200}\sum_{i=1}^{200} \hat{\mu}_d^i \qquad (2.5)$$

and

$$s_d = \sqrt{\frac{1}{199}\sum_{i=1}^{200}\left(\hat{\mu}_d^i - \bar{d}\right)^2} \qquad (2.6)$$

Data Collection

The body mass indices (BMI) of twenty (20) patients who were treated for anorexia nervosa on admission, and their body mass indices (BMI) after discharge from the hospital were recorded as shown in table 2.

Table 2. BMI of Anorexia nervosa Patients.

BMI of patients on Admission (kg/m^2)	16.84 16.26 14.33 14.30 11.98 13.59 13.95 14.02 12.22 12.00 16.05 15.86 11.55 15.76 14.12 14.44 18.12 12.30 15.25
BMI of patients after discharge (kg/m^2)	24.03 18.50 16.61 16.57 18.99 15.62 25.96 13.82 21.09 21.38 13.17 17.32 16.07 17.22 13.06 14.72 21.16 18.92 18.01

Source: Government Psychiatric Hospital, Benin City, Nigeria.

RESULTS AND DISCUSSION

The body mass indices's gain or loss for the patients is shown in table 3.

Table 3. BMI's Gain or Loss.

7.19	2.24	2.28	2.27	7.01
2.03	10.93	(-) 0.13	7.07	9.16
0.34	(-) 2.88	1.46	4.52	1.46
(-) 1.06	0.28	3.04	6.62	2.76

Bootstrapping the data set in table 3 generates the values of the statistics $\bar{d} = 3.33$ and $s_d = 3.61$ respectively. Hence,

$$\bar{d} - s_d t_{0.025,19} = -4.23 \text{ and}$$

$$\bar{d} + s_d t_{0.025,19} = 10.89$$

The 95 percent confidence interval for the mean difference, μ_d is (-4.23, 10.89), and the value of random variable, T = 4.13. Since T > 2.093 we reject the null hypothesis, H_0 of no treatment effect on the basis of sample data. Statistically the confidence interval for μ_d is quite wide which evidently supports the formulation of the hypothesis since zero lies in the confidence interval.

CONCLUSION

The patients on admission that were placed on antidepressants, vitamins and mineral supplements responded positively to the treatment since the null hypothesis H_0 of no treatment effect was rejected.

Hence, on the basis of sample data we conclude in statistical terms that the drugs yielded a significant treatment effect on the patients.

REFERENCES

Sarmukaddam, SB. 2006. Fundamentals of Biostatistics. Jaypee Brothers Medical Publishers Ltd, New Delhi, India. 91-93.

Altman, DG. 1991. Practical Statistics for Medical Research. Chapman and Hall, London. 37-39.

Armitage, P. and Berry, G. 1994. Statistical Methods in Medical Research (3rd ed.). Blackwell Scientific Publications, Oxford. 112-113.

Efron, B. and Tibshirani, RJ. 1993. An Introduction to the Bootstrap. Chapman and Hall, New York, USA. 201-209.

Keys, A. 1972. Body Composition and its change with age and diet. Journal of Chronic Diseases. 25(6 & 7):329-342.

Montgomery, DC. and Runger, GC. 2003. Applied Statistics and Probability for Engineers (3rd ed.). John Wiley and Sons lnc., USA. 245-265.

Varian, H. 2005. Bootstrap Tutorial. Mathematics Journal. 9:768-775.

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