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ALTERNATIVE MEDICATION IN REDUCING BLOOD PRESSURE: MULTIPLE LINEAR REGRESSION APPROACH

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ABSTRACT: *This study work was conducted to determine whether eating habits could serve as an alternative medication in reducing blood pressure among hypertensive patients. Information was collected on patients with hypertension cases who were advised to be taking regular diets and avoid some types of feeding, such as starchy foods, foods with cholesterols and drinking alcohol. After the first three months, the patients were examined. Secondary means of data collection was employed and the methodology used was multiple linear Regressions. The final result revealed that changes in eating habits of hypertensive patients had a great effect in reducing blood pressure among hypertensive patients.*

KEYWORDS*:* blood pressure, eating habit, medication, hypertensive, multiple linear regression

INTRODUCTION

Regression analysis is a statistical technique that serves as a basis for studying the relationship between dependent and independent variables. Multiple regression models entails the regression of more than two variables, in this case we have one dependent variable and several independent or explanatory variables. This research work is a study to determine whether changes in eating habits of the hypertensive patients could be replaced or serve as an alternative medication in reducing blood pressure among hypertensive patients.

Background to the study

Hypertension is a common problem in developed countries and a major risk factor for cardiovascular diseases (CVD) (Castelli August, 1984) hypertension or high blood pressure is a condition in which the blood pressure in the arteries is chronically elevated with each heartbeat the heat pumps blood through the arteries to the rest of the body. The normal level for blood pressure is below 120/80mm, where 120 represent the systolic measurement (peak pressure in the artries)and 80 represents the diastolic measurement (minimum pressure in the artries). Blood pressure between 120/80mm and 139/89mm is called pre-hypertension (to denote increased risk of hypertension), and a blood pressure of 140/90mm or above is considered hypertension.

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Through the exact causes of hypertension are usually unknown but there are several factor that have been highly associated with the condition which include obesity, diabetes, smoking, high level of alcohol consumption, genetics and family history of hypertension insufficient calcium, potassium and magnesium consumption, aging birth control pills.

Its prevalence is probably on the increase in developing countries where adoption of western lifestyles and the stress of urbanization both of which are expected to increase the morbidity associated with unhealthy lifestyles are not on the decline. (1984) studies have shown that over many years of follow-up, coffee drinking is associated with small increases in blood pressure, but appears to play a small role in the development of hypertension (Jee et al, 1999, klag et al, 2003)

Objectives of the study

The objectives of this research are as follows:

(i) To test whether there is a relationship between the Age as a response variable Y and the set of X variable such as weight (WT), difference in body mass index (BMI) and difference in blood pressure (BP).

(ii) To deduce proper and appropriate interpretation of the multiple Linear Regression Model (MLRM)

METHODOLOGY

In any statistical investigation, data or information needed for study are either generated by the researchers or has already been generated by someone else. The data used in this research work are obtained by means of secondary system of data collection. Secondary data was extracted from the record department of Obafemi Awolowo University Teaching Hospital Complex Ile-Ife, Osun State. The pre-treatment and post-treatment data of patients were randomly selected from different consultants for eight weeks and the result computed thereafter.

Diagnostics Procedure

The appropriateness of the fitted logistic regression model needs to be examined before it is accepted for use. Diagnosing whether the fitted regression model is appropriate, detecting the outliers and identifying influential observations was carried out by adopting KOLMOGOROV – SMIRNOV GOODNESS OF FIT TEST

X^2 –Test for Regression Association

To test whether there is a regression between the response variable Y and the set of X variables $X_i,\ldots,X_{p-1}$. i.e, to choose between the alternatives:

$$H_0: \beta_1 = \beta_2 = \ldots\ldots\ldots = \beta_{p-1} = 0$$

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H_1: not all β_k (k =1,.....,p-1)equal zero
Test statistics:

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(oi - Ei)2}{Ei}$$

Where O_i and E_i are the observed and expected frequencies respectively

The decision rule to control type 1 error at α is:
If $X^2_{cal} \leq X^2_p$ (α, r-1,c-1), conclude H_o
If $X^2_{cal} > X^2_p$ (α, r-1,c-1), conclude H_1
The existence of a regression association does not ensure that useful predictions can be made by using it.

Coefficient Of Multiple Determination
The coefficient of multiple determination, denoted by r2, is defined as follows"

$$R2 - \frac{SSR}{SSTO} = 1 - \frac{SSE}{SSTO}$$

Where
SSTO = Y'Y-n$\bar{Y}^2$ = total sum of squares
SSR = X'Y $\hat{\beta}$'-n$\bar{Y}^2$= regression sum of squares
SSE = Y'Y-X'Y$\hat{\beta}$'= ERROR SUM OF SQUARES

Coefficient of multiple determination measures the proportionate reduction of total variation in Y associates with the use of the set of X variables $X_1,...,X_{p-1}$. The coefficient of multiple determination R^2 reduces to the coefficient of simple determination for simple linear regression when p-1 = 1, i.e, when one X variable is in regression model. We have

$$0 \leq R^2 \leq 1$$

Where R^2 assumes the value 0 when all b_k =0 (k=1,....,p-1), and the value 1 when all Y observation fall directly on the fitted regression surface, i.e, when $Y_i = \hat{Y}1$ for all i.

Adding more X variables to the regression model can only increase R^2 and never reduce it, because SSE can never become larger with more X variables and SSTO is always the same for a given set of responses. Since R^2 usually can be made larger by including a larger number of predictor variables, it is sometimes suggested that a modified measure be used that adjusts for the number of X variables in the model. The adjusted coefficient of multiple determinations, denoted by $R^2_{a,}$ adjusts R^2 by dividing each sum of squares by its associated degrees of freedom:

SSE
———

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$$R_a^2 = 1 - \frac{\frac{n-p}{SSTO}}{n-1} = 1 - \frac{(n-1)}{(n-p)}\frac{SSE}{SSTO}$$

This adjusted coefficient of multiple determination may actually become smaller when another X variable is interdicted into the model, because any decrease in SSE may be more than offset by loss of a degree of freedom in the denominator n-p,

$R_1^2 R_0^2$ ARE $\chi 2$ DISTRIBUTED

$R_0^2 = \min_{\beta}$ (Y-Xβ)'(Y-Xβ) = X'X$\hat{\beta}$ = X'Y is unconstraint minimization and a measure of the error

$R_1^2 = \min_{H'\beta}$ = 0(Y-Xβ)'(Y-Xβ) constrained minimization

Fisher-Cochran-s theorem

$Q = Q_1 + Q_2 + \ldots\ldots + Q_k$ when Q_s are independently distributed chi-square

Set

$$Q = Y'Y + \beta'X'X\beta - 2\beta'X'Y + \lambda'(H'\beta - \theta)$$

When λ is a non-zero vector, let $\hat{\beta}$H denote the value of β that minimizes Q

$\frac{\delta Q}{\delta \beta} = 0$ 2X'X$\hat{\beta}$H-2X'Y + Hλ = 0 ……….(i)

$\frac{\delta Q}{\delta \lambda} = 0$ H'$\hat{\beta}$H = 0 ………….(ii)

From equation (i),

$\hat{\beta}H = (X'X)^{-1}X'Y - 1/2\,(X'X)^{-1}H\lambda$ ……………(iii)

From equation (ii)

$0 = H'\hat{\beta}H = H'(X'X)^{-1}X'Y - 1/2\,H'(X'X)^{-1}H\lambda$

$= H'CX'Y = 1/2M\lambda$

When C = (X'X)-1, M = H'C

And

$$-\frac{1}{2}\lambda = M^{-1}\theta - M^{-1}H'CX'Y \quad \ldots\ldots\ldots\ldots(iv)$$

$$\text{Now } R_1^2 = (Y-X\hat{\beta})'(Y-X\hat{\beta})$$
$$=(Y-X\hat{\beta}+X\hat{\beta}-X\hat{\beta})'(Y-X\hat{\beta}+X\hat{\beta}-X\hat{\beta})$$
$$=(Y-X\hat{\beta})'(Y-X\hat{\beta}) + (\hat{\beta}-\hat{\beta}H)'X'X(\hat{\beta}-\hat{\beta}H)$$
$$R_1^2 = R_0^2 + (\hat{\beta}-\hat{\beta}H)'X'X(\hat{\beta}-\hat{\beta}H) \quad \ldots\ldots\ldots\ldots(vi)$$

Substitute for $\hat{\beta}H$ in (vi) for to obtain

$$R_1^2 = R_0^2 + (H'\hat{\beta}-\theta)'M^{-1}(H'\hat{\beta}\theta) \quad \ldots\ldots\ldots\ldots(vii)$$
$$E(R_0^2) = (n-r)\sigma^2$$
$$E(R_1^2 - R_0^2) = p\sigma^2$$

When H $\beta = \theta$

$$\frac{R_0^2}{\sigma 2} - \chi 2(n-r)$$

$$\frac{R_1^2 - R_0^2}{\sigma 2} = \chi 2p$$

And independent. Hence

$$\frac{(R_1^2 - R_0^2)}{b} \div \frac{R_0^2}{(n-r)} \sim F_{b,n,r}$$

Multiple Regression Model

In fact, several predictor variables are usually required with multiple regression to obtain relevant description and useful prediction

We consider now the case where there are p-1 predictor variables $X_1,\ldots\ldots\ldots\ldots,X_{p-1}$

The regression model:

$$Y_i = \beta_o + \beta_1 X_{i1} \_ \beta_2 X_{i2} + \ldots.. + \beta_{p-1} + \varepsilon_i$$

Meaning of Regression Coefficients for the case of two predictor variable; β_o is the Y intercept of the regression plane. Otherwise, β_o does not have any particular meaning as a separate term in the regression model. The parameter β_1 indicates the change in the mean response E(Y) per unit

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increase in X_1 when X_2 is held constant. likewise $\beta_2$indicates the change in the mean response per unit increase in X_2 is held when X_1 is held constant: However is similar to the case of two predictor variables. The parameter β_k indicates the change in the mean response E(Y) with a unit increase in the predictor variable X_k, when all predictor variables in the regression model are held constant

Assuming that E(,) = 0, we have

$$E(Yi) = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{p-1} X_{i-p1}$$

In this research work, we have **THE MODEL**

$$Age = \beta_o + \beta_1 WT + \beta_2 \Delta BM1 + \beta_3 \Delta BP$$

Where: Age denotes the age of individual

WT denotes the weight of individual

ΔBMl denote the changes in body mass index

ΔBP denotes the changes in blood pressure

Research Hypothesis

H_0:Change in eating habit of hypertensive patients have no effect reducing the blood pressure (BP) among hypertensive patients.

H_1: Change in eating habit of hypertensive patients have effect in reducing blood pressure (BP) among hypertensive patients.

Decision Rule:

Reject H_0 if f-calculated>F-tabulated, otherwise accept H_0 at ($\alpha = 0.05$)

Regression Analysis

The viable MLRM for predicting effective changes in eating habit of the hypertensive patients in having reduction in blood pressure in Obafemi Awolowo University Teaching Hospital, of Osun State is

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Age = 49.0+0.125T-0.972∆BMl-33.0∆BP

The coefficients obtained in the model above showed that the recommended eating habit of the hypertensive patients has much effect in lowering the blood pressure with the negative value obtained in their coefficients respectively.

The weight is also affected positively due to protienous intake. Hence the protienous food intake contributed about 13% increment to the weight.

Test of Regression Relation between Age, Weight, Body Mass Index and Blood Pressure.(ANOVA)

Test of Regression Relation:- Our interest is to test whether Age is related to weight (WT), Body mass index (BMI) and blood pressure

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	P
REGRESSION	3	8008.95	269.65	4.30	0.011
RESIDUAL ERORR	36	2259.05	62.7514		
TOTAL	39	3068.00			

Hypothesis formulation:

$$H_0: \beta_1 = \beta_2 = \beta_3 = 0$$

$$H_1: \text{Not all } \beta_i = 0 \qquad i=1,2,3$$

From the result above F-calculated = 4.30

Testing at $\alpha = 0.05$, we require $F(0.95;3,36) = 2.92$

The P-value for this test is significant at P = 0.011 as indicated in the minitab output labeled P.

Since-F-calulated = $4.30 < F_{tab} = 2.92$ and P-value = .011, we Accept $H_1$and conclude that Age

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is related to weight (WT), Body mass index (BMI) and Blood pressure

KOLMOGROV-SMIRNOV (GOODNESS OF FIT) OUTPUT RESULT

	AGE	WT	ΔBP	ΔBMI
N	40	40	40	40
Normal Parameters a…b mean	56	62.0750	-0.0240	1.6150
	8.8694	4.5538	0.12637	1.61492
Standard Deviation	0.124	0.124	0.179	0.132
Most Extreme	0.68	0.86	0.179	0,073
Absolute differences	-0.124	-0.124	-0.169	-0.132
Positive	0.784	0.786	1.133	0.834
Negative	0.570	0.567	0.154	0.490
Kolmogorov – Smirnov z				
Asymp.sig. (2-tailed)				

Source: Authors computation

The above result indicated that the data collected are normally distributed, therefore MLRM is appropriate.

DISCUSSION AND CONCLUSSION

Multiple Linear Regression and Binary Logistic Regression are powerful tool widely used to perform statistical analysis. In this research Multiple Linear Regression Model was used in determining whether changes in eating habits could serve as an alternative medication in lower blood pressure among hypertensive patients. And we suggest that the model of Multiple Linear Regression could be a convenient primary option.

CONCLUSSION AND RECOMMENDATIONS

From the findings of this study, MLRM served as appropriate model to determine a linear analysis and most of the analysis carried out revealed the significances of the study, as in the case of changes in eating habit of hypertensive patients.However, it is nice concluding that the changes in eating habits of hypertensive patients significantly reduces the blood pressure along with their body mass index

Based on the findings of this study, the following recommendations are hereby made:
Patients undergoing hypertension should regularly check their BMI and weight, because the two constitutes the higher risk factors in reducing the blood pressure (BP). Proper medication, regular

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diets with daily exercises and proper medical checkup should also be encouraged determine when there should be sudden changes (decreasing or increasing) in the blood pressure of the hypertensive patients.

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