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Research Article

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Statistical Analysis of the Systolic and Diastolic Blood Pressure of Working Class Adults

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Abstract Economic growth and technological advancement depends on the activities of healthy workers/ citizens of the country due to the recurrent case of high rate of hypertension in the society today. This work focuses on relationship between ages and systolic pressure of patients. The fitted model showed that there are significant relationship between blood pressure and the age of patients. Mann–Whitneyu-test shows that there are no significant differences between the cases of hypertension in male and female patients. Hence, it is concluded that the reported cases of hypertension does not depend on gender and that as the age increases blood pressure of individuals also increases. Therefore for a healthy pursuit of economic growth and technological advancement, individual workers should check their blood pressure to be physically fit to accommodate the stress in order to achieve the set goal.

Keywords Statistical Analysis, Systolic, Diastolic Blood Pressure

1. Introduction

Since ancient times, people have understood and have knowledge about different parts of the body and their specific functions and how different parts of the body work and depend on each other. But nowadays, based on research work, we find out that there are certain things in our body system in which we need to understand and have knowledge about. Hypertension, also known as high blood pressure, is the amount of force exerted against the walls of arteries as blood flows through them. Thus blood pressure refers to the pressure of circulating blood on the wall of blood vessels. Worldwide, high blood pressure is estimated to cause 7.5 million deaths, about 12.8% of the total deaths account for 57 million disability adjusted life years [1]. According to W.H.O [2], the prevalence rate of hypertension is high in Africa i.e over 40% compared to that of America at 35% for both sexes. About 75 million American adult (29%) have high blood pressure and about 54% of the patient have their condition under control. In 2013, more than 360 thousand Americans died of hypertension and almost 1000 people die each day. In the year 2000, there were 972 million people living with hypertension worldwide and it is estimated that it will be higher by the year 2025.

Hollenberg [1] carried out a research on ages of individuals and discovered that at 45–50 years, there is an increase in systolic blood pressure. Wolf-Maira [3], undertook a study that showed progressive increase in systolic blood pressure with age, reaching an average of roughly 140mg. Gillum [4] use regression analysis to conduct a research on ages and blood pressure and conclude that there's a relationship between age and blood pressure. Kaelbel [5], conducted a research on ages and blood pressure of male and female and concluded that females show low systolic blood pressure than males while women at the age of menopause passes the male systolic blood pressure. Domanski [6], found out that the systolic and diastolic blood pressure are very important in both younger and middle ages. He concluded that as systolic blood pressure rises in patient/individuals, diastolic also rises in patient and their age. Connon [7] suggested that stress that exceeded a critical threshold could strain the body beyond its adaptive-limits. In addition, it has been found that during long

term stimulation induced by stress, epinephrine and cortisone are both over produced resulting in hypertension since relevant data show direct correlation between stress and hypertension, researchers began to consider stress management as non–drug treatment for hypertension. W.H.O. [2] reported that among South American men, the incidence of hypertension has tripled in the last 5 years; for women the rate has almost doubled. Based on these facts, this paper tries to check if there is significant relationship between age and blood pressure of individuals/patients and also seek to find out if there are significant difference in the cases of hypertension in male and female.

2. Data Analysis Technique and Presentation

The technique of data analysis employed in this study is the simple linear regression analysis and the Mann-Whitney u-test.

The simple linear regression model is of the form

$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i + e_i, \quad i = 1, 2, 3, \ldots, n.$

While Y_i= Dependent variable (the estimated blood pressure)

β_0 = intercept

β_1 = Slope

e_i = error

X= (the age i.e. independent variable)

$\beta_1 = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$

Test for adequacy of the model

Hypothesis: H_0: $\beta_1 = 0$

H_0: $\beta_1 \neq 0$

Test Statistic:

$Z = \frac{\beta_i}{S/\sqrt{S_{xx}}}$ Where S = Standard deviation

Mann-Whitney u-test is given by:

$Z = \frac{U - \mu_u}{\sigma_u}$

$$U_1 = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - w_1$$

Where W = the sum of the rank

μ_u = the mean

σ_u = standard deviation

Rank correlation coefficient is given by:

$\rho = 1 - \frac{6\sum d^2}{n(n^2-1)}$

Where n = sample sizes

d = the difference of the ranks.

3. Data Analysis, Result and Interpretation

The data collected for the study was subjected to statistical analysis using linear regression to ascertain between ages and systolic blood pressure of patients.

$\sum X = 2020, \sum Y = 6116, \sum X^2 = 96354$

$\sum Y^2 = 805527, \sum XY = 256137$

$\hat{\beta}_1 = \frac{50(256137) - (2020)(6116)}{50(96334) - (2020)^2}$

$= \frac{403602}{70496} = 0.57$

$$\hat{\beta}_0 = \frac{6116}{50} - \frac{0.57(2020)}{50} = 99.2$$

Therefore the estimated regression model is given by:

$$\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X$$

$$\hat{Y} = 99.2 + 0.57X$$

For X = 29;

Y = 99.2 + 0.57(29) = 116

For X = 49;

y = 99.2 + 0.57(49) = 125 etc.

Test for adequacy of the model

H_0: $\beta_1 = 0$

H_0: $\beta_1 \neq 0$

Test Statistic

$$Z = \frac{\beta_1}{S/\sqrt{S_{xx}}} = \frac{B_1\sqrt{S_{xx}}}{S}$$

$$S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n}$$

$$S = \sqrt{MSE} = \frac{SSE}{n-2} = \sqrt{\frac{S_{yy} - \beta S_{xy}}{n-2}}$$

$$S_{xy} = \sum y^2 - \frac{\sum x \sum xy}{n}$$

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n}$$

$\therefore S_{xy}$ = 8072.04

$$S^2 = \frac{57417.88 - 0.57(8072.04)}{48}$$

S^2 = 1100. 350358 = 1100. 3504

S = $\sqrt{1100.3504}$= 33.1715

$$\boldsymbol{Z_{cal} = \frac{0.57}{0.279371} = 2.0403}$$

α = 5% level of significance

Z_2 = 1.65

Rank correlation

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} = 1 - \frac{6(14011.5)}{50(50^2-1)}$$

= 0.32

Mann-Whitney u-test

Sum of ranks:

$w_{male} = -12763.5$

$w_{female} = 17020$

$$\mu_{male} = n_{mnf} + \frac{n_m(n_m+1)}{2} - w_{male}$$

$$\mu_{male} = 50 \times 50 + \frac{50(50+1)}{2} - \underline{1010.2}$$

$$\underline{= 2500 + 1275 - 1010.2 = \boldsymbol{214.8}}$$

$$\mu_{female} = 50 \times 50 + \frac{50(50+1)}{2} - \underline{1010.2}$$

= 214.8

$$U_u = \frac{50 \times 50}{2} = 1250$$

$$\sigma_u^2 = \frac{n_m n_f (n_m + n_f + 1)}{2} = \frac{50 \times 50\,(50+50+1)}{2}$$

= 145.0575

$$Z = \frac{U_f - U_u}{\sigma_u} = \frac{214.8-1250}{145.0575} = -7.136$$

$$|Z| = |-7.136| = 7.136$$

At 5% level of significance

$$Z = Z_{0.05} = -1.96$$

$$|Z| = 1.96$$

Since $Z_{cal} > Z_{tab}$ we reject H_0 and conclude that there is no significant difference between the systolic pressure of male and female.

Decision: Since $Z_{cal} = 2.0403 > Z_{tab} = 1.65$, we reject H_0 and accept H_1, concluding that the model is adequate which implies that blood pressure is related to age.

4. Interpretation of Result

From the analysis, the fitted model shows that as age of patient/ individuals increases, systolic blood pressure also increases. The Spearman Rank Correlation Coefficient shows that there is a weak but positive relationship that exists between the two parameters and the Mann-Whitney u-test shows that there is no significant difference in the cases of hypertension between male and female patients.

5. Conclusion

For a healthy pursuit of economic growth and technological advancement, the working force must be physically fit to accommodate stress posed on them by their jobs in order to achieve the set goal.

Free medical checkup for individuals of the working class should be organize to create awareness or to ascertain that workers are physically fit to attain the high level of economic growth. Individuals in the working class should create time to rest (avoid stress) and also engage in physical exercise if the targeted weight must be attained.

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