Statistical Analysis Of Diagnosed Hypertensive And Non-Hypertensive Diabetic Patients.

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ABSTRACT: Hypertension and diabetes is causing affliction to the lives of most people in the world including Ghana as well as the Komfo Anokye Teaching Hospital in Kumasi. Records available at Komfo Anokye Teaching Hospital (KATH) shows that about two-thirds (2/3) of diabetic patients are hypertensive as well. This paper used statistical analysis to conduct a case study on the characteristics of those diagnosed as having diabetes with hypertension and diabetes without hypertension at the diabetic clinic of the Komfo Anokye Teaching Hospital in Kumasi. The main objectives were to verify if there is significant difference between the clinical indicators and risk factors of people diagnosed as having diabetes with hypertension and that of those diagnosed as having only diabetes and to test for association between the risk factors as well as the lifestyles of these two medical conditions (diabetes with hypertension and diabetes without hypertension).The research has achieved its objectives by seeking to contribute and educating the masses on the need to take preventive measures, where possible, against the development of diabetes and hypertension by bringing out clearly the factors responsible for the incidence of such conditions. The study has also helped to identify people with risk factors for developing diabetes and hypertension thereby reducing the incidence of these two medical conditions.

Keywords: Diabetes, Hypertension, Statistical Analysis

1 INTRODUCTION

People who suffer from diabetes are more than twice as likely to suffer High Blood Pressure as people who do not have diabetes [1]. The significance of this study stems from the fact that diabetes and hypertension are life threatening medical conditions all over the world [2]. Hence it is necessary to take preventive measures where possible and bring out the factors responsible for the two medical conditions (diabetes with hypertension and diabetes without hypertension). Studies revealed that 73% of adults with diabetes either met the diagnostic criteria for or were being treated for hypertension [3]. This statistics becomes even more frightening considering the fact that people with both diabetes and hypertension are four times more likely to develop heart diseases than people who do not have these conditions [4]. The objectives of this paper are: to verify if there is a significant difference between the clinical indicators (Blood Pressure, Blood Glucose Level, Family Clinical History, Other Related Diseases etc.) and risk factors (Gender, Age, Marital Status, Educational Level, Occupation etc.) of people diagnosed with diabetes with hypertension and that of those diagnosed with diabetes without hypertension and also to test for association between the risk factors and the lifestyles of these two medical conditions (diabetes with hypertension and diabetes without hypertension).

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The statistical procedures employed for this study were as follows: Preliminary Analysis (data exploration: mean, median, mode and graphs/charts) as well as Further Analysis (inferential statistical analysis: test for proportion, chi-square test and test for mean difference). The Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana, is the second-largest hospital in the country and the only tertiary health institution in the Ashanti Region. The hospital happens to be the main referral hospital for the Ashanti, Brong Ahafo, Northern, Upper East and Upper West Regions of the country. The hospital was built in 1954 as the Kumasi Central Hospital and was later named Komfo Anokye Hospital after Okomfo Anokye, a legendary fetish of the Ashanti. Komfo Anokye Hospital was later converted into a teaching hospital in 1975 affiliated to the medical school of the Kwame Nkrumah University of Science and Technology. The hospital is also accredited for postgraduate training by the West African College of Surgeons in surgery, obstetrics and gynaecology, otorhinolaryingology, ophthalmology and radiology. The hospital currently has about 1000 beds, up from the initial 500 when first built.

Fig. 1. Location of study area

Records available at Komfo Anokye Teaching Hospital (KATH) show that about two-thirds (2/3) of diabetic patients

are also hypertensive. Hence, it is not uncommon to see people who have been diagnosed as diabetic and hypertensive as well. Both diabetes and hypertension continue to cause affliction to the lives of millions of people worldwide [5]. What is even so disturbing is the complication of diabetes. Over time, high blood glucose level may damage blood vessels and nerves. These complications can cause damage to eyes, nerves and kidneys and increase the risk of heart attack, stroke, impotence, and foot disorders [6]. This damage may happen before an individual knows they have diabetes. Hypertension is also a serious medical condition that can damage the heart and blood vessels and can eventually lead to several other conditions including stroke, heart failure, heart attack, kidney failure, vision problems and even death [7]. These problems may come as a result of lack of awareness or lack of access to health care facilities. Also,Records available at the Biostatistics Unit–KATH show that while hypertension featured prominently among the top ten morbidity at KATH Polyclinic from 2000 to 2006, diabetes featured prominently among the top ten causes of admission and death at KATH during the same period. According to World Health Organization (WHO) and International Diabetes Federation (IDF) report in 2004, 3.2 million deaths are attributable to diabetes every year worldwide [8]. The report stated that, one in 20 deaths is attributable to diabetes; 8,700 deaths every day; 6 deaths every minute [9]. Even among policy makers at an international and national level, awareness about the public health and clinical importance of diabetes remains low [10]. Diabetes is widely perceived as a condition of low importance to the poorest population in the world [11]. In the low and middle-income countries like Ghana the impact of diabetes is largely unrecognized. Yet, the world is facing a dramatic rise in diabetes prevalence, most of which will occur in the low and middle-income countries [12]. In a similar manner Hypertension is a very serious medical condition estimated that about 23% of deaths in Ghana could be attributed to hypertension [13].

1.1 Research Design

The target population is the population of those diagnosed of diabetes with hypertension and those diagnosed of diabetes without hypertension in Ghana. The study population is the population of those diagnosed of diabetes with hypertension and those diagnosed of diabetes without hypertension at Komfo Anokye Teaching Hospital-Kumasi. The sampling method adopted here was cluster sampling (Cluster sampling is a sampling technique where the entire population is divided into groups, or clusters, and a random sample of these clusters are selected). A well-designed questionnaire was used to collect the needed information about the subjects [14]. The information collected was subjected to vigorous quantitative analysis to test specific hypotheses and examine specific relationships. Descriptive Research Design was also employed. Also, the needed information was collected from the sample of population elements only once and this made the study cross-sectional. The study employed Single Cross-Sectional Design, which meant that only one sample of respondents from the study population was involved. The respondents however, were later in the analysis split into two groups (those diagnosed with diabetes with hypertension and those diagnosed with diabetes without hypertension). In all, a sample size of two hundred and sixty (260) clients from the study population of eight Hundred and eighty (880) was selected. In fact, the technique that led to the selection of 260 clients for the study was not by direct mathematical calculation. The centre on the average attends to 110 clients per day and holds two clinics in a week. The two clinic days fall on Tuesday and Friday. Therefore, in a typical month, it is expected that 110 x 8 = 880 clients would be attended to by the doctors. This figure constituted the population size (N). Consequently, the sample size, n = 260, was obtained as a result of the use of the deductions and inductions above and the cluster sampling method. The sample size constitutes about 30% of the population size and this, in sampling theory and estimation, can be considered as large enough to do the investigation.

1.2 Quality Assurance

The research was conducted at K.A.T.H diabetic centre which is a specialist clinic. In fact, the clinic is supervised by three medical consultants and a referral centre where patients are referred to from other hospitals both in and out of the city (Kumasi). There is therefore no doubt that the personnel (doctors, nurses and other medical professionals) who work there are well-trained in the diagnoses and management of diabetes and hypertension. Research has shown that quality medical information is more likely to be obtained by medical personnel because of the faith and trust the patients have in them and their quest to seek effective treatment [15]. The verbal information (data) was collected by highly trained professional biostatisticians of whom the authors of this paper can confidently assure readers of quality (reliable) information.

1.3 Ethics

On the issue of ethics, the study was approved by the Committee on Human Research, Publications and Ethics, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana in compliance with the 1964 (revised in 2002) Helsinki declaration on human experimentation. Informed consent was obtained from all the subjects. The objectives and procedures of the survey were explained to all subjects. Subjects were made to understand that they reserve the right to be excluded from the study.

2. DATA ANALYSIS

The analysis of the data was divided into two:

- Preliminary Analysis: this was purely data exploration (descriptive analysis).
- Further Analysis: this was made up of inferential statistical analysis such as; Hypotheses testing. Based on such tests and analyses, conclusions were made.
- The Statistical Software Package for Social Scientist (SPSS) was used in analyzing the data.

2.1 Method of Analyses

(i). Hotelling's T^2

Hotelling's T^2, a multivariate *t*-test, for testing equality of vector means from measurements on $p \geq 2$ random variables of two independent populations was adopted. In

the notation below, subscript 1 denotes population 1 and subscript 2 denotes population 2. We wish to make inference about:

(mean vector of population 1) –

(mean vector of population 2) = $\mu_1 - \mu_2$. **(1)**

For instance, we wish to answer the question: is $\mu_1 = \mu_2$ (or equivalently, $\mu_1 - \mu_2 = 0$)? Also, if $\mu_1 - \mu_2 \neq 0$, which leads to the rejection of H_0, the null hypothesis of equal vector means, then we find out which of the component means are different. With a few tentative assumptions, we were able to provide answers to these questions.

(ii). Test for Proportion

In many problems of applied research, it must be decided whether observed differences among sample proportions, or percentages, are significant or whether they can be attributed to chance. For instance, if 45 percent of non-hypertensive diabetic patients in a sample of 116 non-hypertensive diabetic patients used to take alcohol and only 30 percent of hypertensive diabetic patients in a sample of 144 hypertensive diabetic patients used to take alcohol, we may want to investigate whether the difference between these two percentages is significant. Similarly, we may want to do the same thing for percentages of respondents (subjects) in the two medical conditions that used to smoke.

(iii) Chi-square Test

The association between two categorical variables has been established in this paper. Statistics commonly used for assessing the statistical significance and strength of association of cross-tabulated variables were explored. The statistical significance of the observed association is commonly measured by the chi-square statistics (χ^2). The strength of the association, or degree of the association, is important from a practical or substantive perspective. Generally, the strength of association is of interest only if the association is statistically significant. The strength of the association can be measured by the phi correlation coefficient, the contingency coefficient, Cramer's *V* or lambda coefficient.

3. RESULTS AND DISCUSSION

For the purpose of this study, primary data was used. Questionnaires were administered to patients diagnosed with diabetes with hypertension and those with diabetes without hypertension at the diabetic centre of the Komfo Anokye Teaching Hospital in Kumasi.The data analysis was done in two parts beginning with Descriptive analysis, followed by Further analysis.

Table 1. Frequency table indicating the Patients' gender in the two medical conditions

Diagnosis			Frequency	Percent	Valid Percent	Cumulative Percent
Diabetes with hypertension	Valid	Males	33.0	22.9	22.9	22.9
		Females	111.0	77.1	77.1	100.0
		Total	144.0	100.0	100.0	
Diabetes without hypertension	Valid	Males	38.0	32.8	32.8	32.8
		Females	78.0	67.2	67.2	100.0
		Total	116.0	100.0	100.0	

Table 1 is a frequency table of the two medical conditions (Diabetes with hypertension and diabetes without hypertension) indicating patient's gender. The table indicates that 144 respondents were diabetic hypertensive patients and 116 respondents were diabetic patients. From the table it can be observed in both conditions that, females have a higher risk of getting any of the two diagnoses as compared to males.

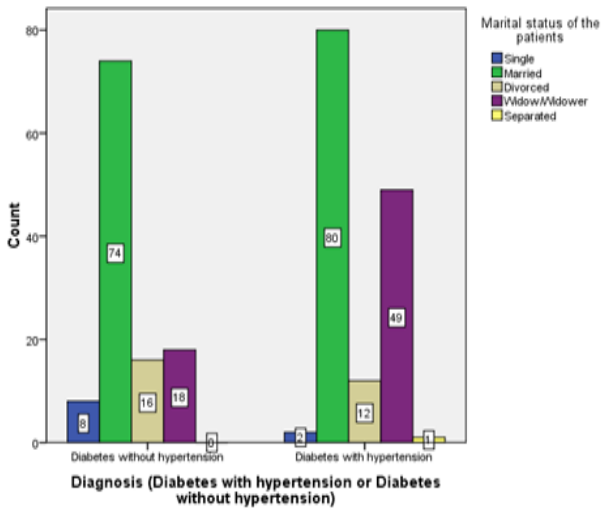

Fig. 2. Cluster bar chart indicating marital status of the patients

Table 2. Frequency table indicating the Educational level of the Patients

Diagnosis			Frequency	Percent	Valid Percent	Cumulative Percent
Diabetes with hypertension	Valid	Not at all	58.0	40.3	40.3	40.3
		First cycle	57.0	39.6	39.6	79.9
		Second cycle	20.0	13.9	13.9	93.8
		Tertiary	9.0	6.3	6.3	100.0
		Total	144.0	100.0	100.0	
Diabetes without hypertension	Valid	Not at all	31.0	26.7	26.7	26.7
		First cycle	62.0	53.4	53.4	80.2
		Second cycle	16.0	13.8	13.8	94.0
		Tertiary	7.0	6.0	6.0	100.0
		Total	116.0	100.0	100.0	

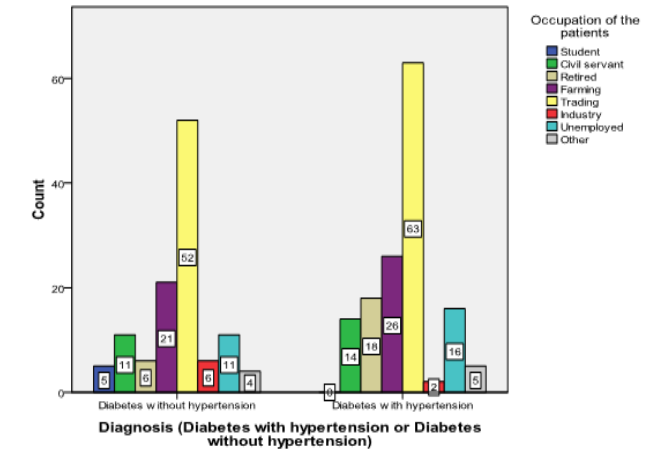

Fig. 3. Cluster bar chart indicating occupation of the patients

Table 3. Frequency table indicating the blood glucose level groupings of the Patients.

Diagnosis			Frequency	Percent	Valid Percent	Cumulative Percent
Diabetes with hypertension	Valid	IFG/IGT	3.0	2.1	2.1	2.1
		Diabetes	141.0	97.9	97.9	100.0
		Total	144.0	100.0	100.0	
Diabetes without hypertension	Valid	IFG/IGT	8.0	6.9	6.9	6.9
		Diabetes	108.0	93.1	93.1	100.0
		Total	116.0	100.0	100.0	

The above table is a frequency table indicating the blood glucose level namely as Impaired Fasting Glucose (IFG) or Impaired Glucose Tolerance (IGT) of the two categories of diagnoses.

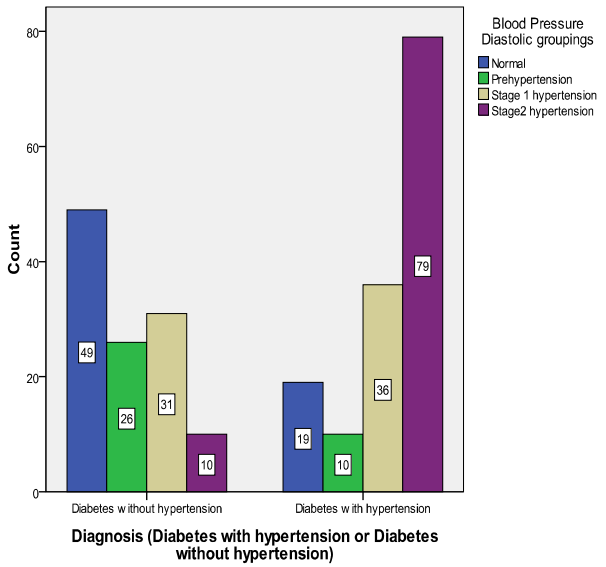

Fig. 4. Cluster bar chart indicating diastolic blood pressure groupings.

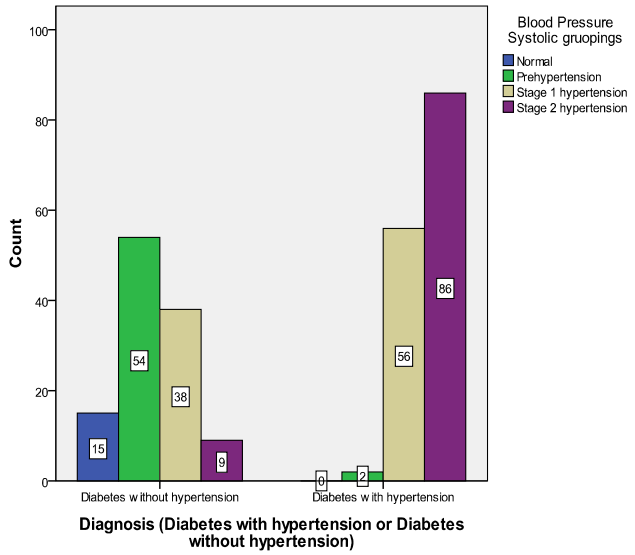

Fig. 5. Cluster bar chart indicating systolic blood pressure groupings of the patients.

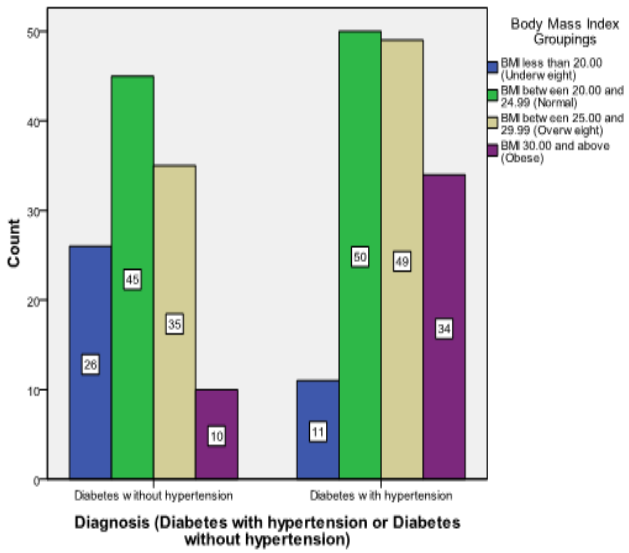

Fig. 6.Cluster bar chart indicating the Body Mass Index of the patients.

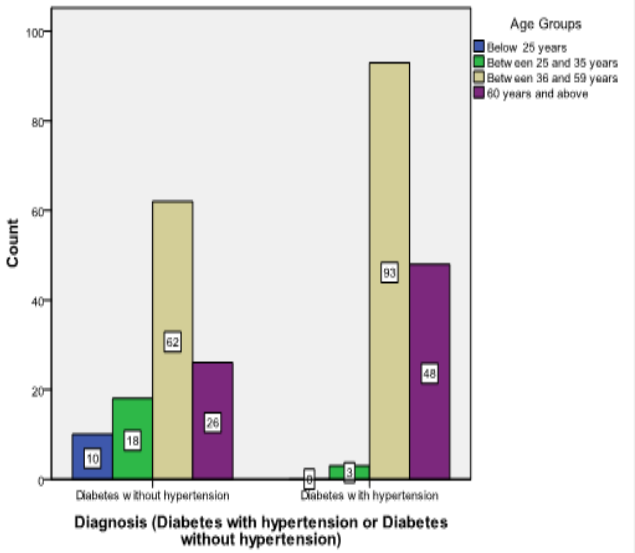

Fig. 7. Cluster bar chart indicating Age groups of the patients

3.2. FURTHER ANALYSIS

Table 4. Cross tabulation of diagnosis against Age Groups

			Age Groups				Total
			Below 25 years	Between 25 and 35 years	Between 36 and 59 years	60 years and above	
Diagnosis:	Diabetes without hypertension	Count	10.0	18.0	62.0	26.0	116.0
		Expected Count	4.5	9.4	69.2	33.0	116.0
	Diabetes with hypertension	Count	0.0	3.0	93.0	48.0	144.0
		Expected Count	5.5	11.6	85.8	41.0	144.0
Total		Count	10.0	21.0	155.0	74.0	260.0
		Expected Count	10.0	21.0	155.0	74.0	260.0

From the table above, it can be observed that those between the age groups of 36 and 59 are at risk in getting any of the two medical conditions.

3.2.1 Chi-square Tests for Diagnosis against Age groups

Null hypothesis: Diagnosis (Diabetes with hypertension or Diabetes without hypertension) is dependent on the age of the person.

Alternative hypothesis: Diagnosis (Diabetes with hypertension or Diabetes without hypertension) is independent of the age of the person.

Table 5. Tabulation of Chi-Square Tests Diagnosis against Age groups.

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	30.797[a]	3	0.000
Likelihood Ratio	35.611	3	0.000
Linear-by-Linear Association	22.008	1	0.000
Number of Valid Cases	260		

Table 6. Body Mass Index Groupings Cross tabulation of diagnosis.

			Body Mass Index Groupings				Total
			BMI less than 20.00 (Under-weight)	BMI between 20.00 and 24.99 (Normal)	BMI between 25.00 and 29.99 (Over-weight)	BMI 30.00 and above (Obese)	
Diagnosis:	Diabetes without hypertension	Count	26	45	35	10	116
		Expected Count	16.5	42.4	37.5	19.6	116.0
	Diabetes with hypertension	Count	11	50	49	34	144
		Expected Count	20.5	52.6	46.5	24.4	144.0
Total		Count	37	95	84	44	260
		Expected Count	37.0	95.0	84.0	44.0	260.0

The above table is the chi-square test performed using SPSS software with a 5% level of significance and a two tailed test. Again, since this was a two tailed test the alternative hypothesis is accepted when the significant value is less than 0.025 and rejected if otherwise. Hence 0.000 is less than 0.025 so the alternative hypothesis is rejected and a conclusion is drawn that diagnoses is dependent of the age of a person. There is also an association of 22.008 between diagnoses and age with thee (3) degrees of freedom and 0.000 significance. This indicates an association between diagnoses and age.

3.2.2 Chi-square Tests for Body Mass Index Groupings of diagnosis.

Null hypothesis: Diagnosis (Diabetes with hypertension or Diabetes without hypertension) is independent of the body mass index of a person.

Alternative hypothesis: Diagnosis (Diabetes with hypertension or Diabetes without hypertension) is dependent on the body mass index of a person.

Table 7. Tabulation of Chi-square Test results for Body Mass Index Groupings.

	Value	**df**	**Asymp. Sig.(2sided)**
Pearson Chi-Square	18.973[a]	3	0.000
Likelihood Ratio	19.678	3	0.000
Linear-by-Linear Association	17.329	1	0.000
Number of Valid Cases	**260**		

The above table is the chi-square test performed using Statistical Package Software for Social Scientists (SPSS) with a 5% level of significance and is a two tailed test. Again, this is a two tailed test the alternative hypothesis is accepted when the significant value is less than 0.025 and rejected if otherwise. Hence 0.000 is less than 0.025 so the alternative hypothesis is accepted and a conclusion is drawn that diagnoses is dependent on the body mass index of a person. Moreover, there is an association of 17.329 between diagnoses and the body mass index.

4. CONCLUSION

The study used Statistical Package Software for Social Scientists (SPSS) to ascertain the fact that there is a significant difference between clinical indicators such as (Blood Pessure and Blood Glucose Level) together with some risk factors (gender ,age , marital status, educational level , etc) of people diagnosed as having diabetes with hypertension and that of those diagnosed as having diabetes without hypertension. There is also an establishment from the outcome of the research about an association between the risk factors and the life styles of these two medical conditions (diabetes with hypertension and diabetes without hypertension).

5. RECOMMENDATION

The public should be educated on the need to take preventive measures, where possible, against the development of diabetes and hypertension since this could result into severe renal problems. People with risk factors for developing diabetes and hypertension should visit the clinic more often to seek medical advice. Patients who have been diagnosed as having any of the two medical conditions must follow the advice given to them by physicians in order to live long and stay healthy. Physicians and Para health professionals should also be willing to assist and educate people who consult them with these risk factors.

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