Assessing Patient Satisfaction And Some Related Factors In The Kasena Nankana District - Ghana

Affi Osei Prince, Oppong Duah Kwaku, Oppong Irene

Abstract: To access the relationship between patient satisfaction and some contributing factors, a study was conducted on 200 patients from the War Memorial Hospital. 54% of the patients were males whilst 46% were females. About 67% of the patients were satisfied meaning the satisfaction level at the hospital is higher. A logistic regression model was developed to establish a relationship between patient satisfaction and some contributing factors (age, sex, education, job, health, LTIME, AESTH, PHWR and NHIS). The result indicates that the most important variables associated with patient satisfaction are Sex, LTIME (length of time in attaining services), AESTH (aesthetic features) and PHWR (Patient health-worker relationship).

Index Terms: Logistic regression, Patient satisfaction, Sex, Aesthetic features, Length of time in attaining services, Patient health-worker relationship

1 INTRODUCTION

Satisfaction, like many other psychological concepts, is easy to understand but hard to define. The concept of satisfaction overlaps with similar themes such as happiness, contentment, and quality of life. Satisfaction is not some pre-existing phenomenon waiting to be measured, but a judgment people form over time as they reflect on their experience. Simple and practical definition of satisfaction would be the degree to which desired goals have been achieved [1]. Also satisfaction comprises both cognitive and emotional facets and relate to previous experiences, expectations and social networks [2]. Satisfaction is achieved when the patient perception of the quality of care and services that they receive in healthcare setting has been positive, satisfying, and meets their expectations [3]. In recent decades, determining the level of patient satisfaction has been found to be the most useful tool for getting patients' views on how to provide care. This is based on two major principles: patients are the best source of information on quality and quantity of medical services provided and patients' views are determining factors in planning and evaluating satisfaction. Donabedian has argued that client satisfaction is of fundamental importance as measure of the quality of care because it gives information on the provider's success in meeting client values and expectations, matters on which the client is the ultimate authority [1]. The measurement of satisfaction is therefore an important tool for research, administration and planning. Client satisfaction is a crucial index for determining the quality of services and the way in which they are provided by medical staff [4,5].

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In Ghana, patient satisfaction has become a key factor to the growth of the country. In the current situation of satisfaction in Ghana particularly with the Hospitals in the Ksena Nankana District Navrongo (Upper East Region) becoming larger and with proliferation of new Hospitals, patient satisfaction and its determinants are major issues of concern. The knowledge of the current levels of satisfaction and in particular the key determinant of satisfaction help the health administrators to focus on the key areas that lead to highly satisfied patient. Hospital is an institution where people receive medical, surgical or psychiatric treatment and nursing care [6]. Medical services are to be made accessible for these patients, but the situation is different at most hospitals these are owing to many problems: inadequate health personnel at the hospital, delay in getting ones health records, long queues encountered at various health service providing areas example include pharmacy, laboratory, consultancy, etc[7]. Based on these problems this paper will try to determine the factors that contributes significantly to patient satisfaction using logistic regression model.

2 METHODOLOGY

Patient satisfaction was assessed with respect to the following factors: age, sex, education, job, health statues, LTIME, AESTH, PHWR and NHIS). The information for the buildup of this research work was obtained by making use of primary data only. A total of 200 patients within the age group 15 and above years were analysed using logistic regression analysis.

2.1 General Logistic Regression Model

Logistic regression model is widely used to model outcomes of categorical dependent variables. Logistic regression allows a researcher to test models to predict categorical outcomes with two or more categories. This type of regression consists of independent variables that are either categorical or continuous. On the other hand, multinomial logistic regression is applied on when the outcome of the response variable has more than two categories. The general logistic regression model is formulated as:

$$\text{Logit}(\pi_i) = \log\left(\pi_i / 1 - \pi_i\right) = X_i^T \beta \qquad (1)$$

Where (X_i) is a vector of continuous measurements corresponding to covariates and dummy variables corresponding to factor levels and β is the parameter vector. The simple logistic regression model on the other hand is given as;

$$\text{Log}\left(\frac{\pi_i}{1-\pi_i}\right) = \alpha + \beta x_i \qquad (2)$$

For a binary response variable Y and explanatory variable X. let, $\pi(x) = p(y = 1/X = x) = 1 - p(y = 0/X = x)$, then the Logistic regression model is;

$$\pi(x) = \frac{exp(\alpha + \beta x)}{1 + exp(\alpha + \beta x)} \qquad (3)$$

On the other hand, for a binary response variable Y with multiple explanatory variables $x_1, x_2, \ldots\ldots. x_p$ the model becomes;

$$\pi(x) = \frac{exp\left(\alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p\right)}{1 + exp\left(\alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p\right)} \qquad (4)$$

2.2 Estimation of Logistic Regression using Maximum Likelihood Estimation (MLE)

The main aim of logistic regression is to estimate the N+1 unknown parameters in the model.

$$\log\left(\frac{\pi(x)}{1-\pi(x)}\right) = \sum_{i=0}^{r} x_{ir}\beta_r \qquad (5)$$

Where i= 1,2,3,…………r

The Maximum Likelihood Estimation is used to find the set of parameters for which the chance of the observed data is the greatest. The ML equation is obtained from the probability distribution of the dependent variable since each dependent variable depict a binomial count in i^{th} population, then the joint probability mass function of Y is

$$g(y/\beta) = \prod_{i=1}^{N} \frac{n_i!}{y_i!(n_i - y_i)!} \pi_i^{y_i} (1-\pi_i)^{n_i - y_i} \qquad (6)$$

Where every population has ${}^{n_i}C_{y_i}$ different ways of selecting y_i successes from n_i trials. Since the chance of success from any one of the n_i trials is π_i then the chance of y_i successes is $\pi_i^{y_i}$ and that of $n_i - y_i$ failures is $(1-\pi_i)^{n_i - y_i}$. The joint probability mass function in equation (6) shows the value of y as a function of known and fixed values for β. This is similar to the likelihood function expressing the values of β in terms of known fixed values of y. That is:

$$L(\beta/y) = \prod_{i=1}^{N} \frac{n_i!}{y_i!(n_i - y_i)!} \pi_i^{y_i} (1-\pi_i)^{n_i - y_i} \qquad (7)$$

The values of the parameter β which maximizes the likelihood function in equation (7) are the maximum likelihood estimates. The maxima and minima (the critical point) of the function is obtained by finding the first derivative and setting it to zero. The critical point is maximum if the second derivative evaluated at the critical point is less than zero (negative). That is the ML estimates require the first and the second derivatives of equation (7) with respect to β but that is difficult because of the complex nature of the multiplicative term. But the likelihood function can be simplified. This can be done by first taking away the factorial terms in equation (7) since they constant terms (that is without π_i). Also from the law of indices if $a^{z-w} = \frac{a^z}{a^w}$. These conditions yield the equation to be maximized as: $\prod_{i=1}^{N}\left(\frac{\pi_i}{1-\pi_i}\right)^{y_i}(1-\pi_i)$ (8)

But from equation (5) taking the antilog of both sides results in

$$\left(\frac{\pi_i}{1-\pi_i}\right) = e^{\sum_{r=o}^{r} x_{ir}\beta_r} \qquad (9)$$

After solving for π_i (that is making π_i the subject) gives

$$\pi_i = \left|\frac{e^{\sum_{r=0}^{r} x_{ir}\beta_r}}{1 + e^{\sum_{r=0}^{r} x_{ir}\beta_r}}\right| \qquad (10)$$

Putting equation (9) and (10) into equation (8) with equation (9) as the first term in (8) and (10) as the second term in equation (8). The equation (8) then becomes:

$$\prod_{i=1}^{N}\left(e^{\sum_{r=0}^{r} x_{ir}\beta_r}\right)\left(1 - \frac{e^{\sum_{r=0}^{r} x_{ir}\beta_r}}{1 + e^{\sum_{r=0}^{r} x_{ir}\beta_r}}\right) \qquad (11)$$

Simplifying equation (11) by making use of the indices property $(a^z)^w = a^{zw}$ in the first part and replacing 1 with $\frac{1 + e^{\sum_{r=0}^{r} x_{ir}\beta_r}}{1 + e^{\sum_{r=0}^{r} x_{ir}\beta_r}}$ in the second part of (11)

Gives: $\prod\left(e^{\sum_{r=0}^{r} x_{ir}\beta_r}\right)^{y_i}\left(1 + e^{\sum_{r=0}^{r} x_{ir}\beta_r}\right)^{-n_i}$ (12)

The above equation (12) is the kernel of the likelihood to maximize. To make the equation (12) easy to be differentiated we took the natural log of (12) which resulted in the log-likelihood function below:

$$l(\beta) = \sum_{i}^{N} y_i \sum_{r=0}^{r} x_{ir}\beta_r - n_i \log\left(1 + e^{\sum_{r=0}^{r} x_{ir}\beta_r}\right) \quad (13)$$

Finding the critical point we differentiated equation (13) with respect to β and set it to zero. This then yields:

$$\frac{\partial l(\beta)}{\partial \beta_r} = \sum y_i x_{ir} - n_i \pi_i x_{ir} \quad (14)$$

Using equation (10) the values of the parameter β can be found from: $\sum y_i x_{ir} - n_i \pi_i x_{ir} = 0$ (15)

That is solving for β_r by setting the r+1 equation in (14) to zero.

2.3 Model Description

With regards to this paper, satisfaction o patient which is dummy (satisfied and dissatisfied) is the dependent variable and the factors assumed to be affecting patient satisfaction in the Kasena Nankana district are used as the independent or explanatory variables. The response variable which is the satisfaction of patient has two levels that are: 1 if patient is satisfied and 0 if patient is not satisfied (dissatisfied) with the independent variables considered in the model some being categorical and others continuous. The independent variables considered in the model were: Age, Sex, Education, Job, Health status, LTIME (Length of time in attaining services), AESTH (Aesthetic features), PHWR (Patient- health work relationship) and NHIS (National health insurance). The logistic regression is developed as:

P (Satisfaction) = $\pi(x) = \frac{e^{f(x)}}{1 + e^{f(x)}}$ (16)

And

P(Dissatisfied) = $1 - \pi(x) = 1 - \frac{e^{f(x)}}{1 + e^{f(x)}} = \frac{1}{1 + e^{f(x)}}$ (17)

Where $f(x)$ is a function of the independent variables. $f(x)$ is also called the logit and is of the form:

$$f(x) = \beta_0 + \beta_1 Age + \beta_2 Sex + \beta_3 Eucation + \beta_4 Job + \beta_5 Healthstat\ us + \beta_6 LTIME + \beta_7 AESTH + \beta_8 PHWR + \beta_9 NHIS$$

Logistic regression model determines the independent variables which make the dependent variable highly likely to be predicted using the maximum likelihood approach. Stepwise selection process was employed in this study. This selection process was used so as to remove all insignificant independent variables from the model condition on the Wald statistics.

2.4 Hypothesis

This study aimed at testing the significance of the below hypothesis at 0.10 level of significance.

H_0: There is no significant relationship between patient satisfaction (satisfied and dissatisfied) and the related factors such as: Age, Sex, Education, Job, Health status, LTIME (Length of time in attaining services), AESTH (Aesthetic features), PHWR (Patient- health work relationship) and NHIS (National health insurance).

H_1: There exists a significant relationship between patient satisfaction (satisfied and dissatisfied) and the related factors such as: Age, Sex, Education, Job, Health status, LTIME (Length of time in attaining services), AESTH (Aesthetic features), PHWR (Patient- health work relationship) and NHIS (National health insurance).
Mathematically:

$H_0 : \beta_i = 0$

$H_1 : \beta_i \neq 0$, for at least one i.

3. RESULTS AND DISCURSSIONS

Reviewing of the satisfaction of patients in the Kasena Nankana district led to the interview of 200 patients at the district hospital (War memorial hospital) out of this 109 of them were males and 91 females. The table below presents the sex distribution of the respondents.

Table 1

Sex distribution of the satisfaction of patients at the Kasena Nankana district

Sex of respondent	Satisfaction		Total
	No	Yes	
Male	31 (28%)	78(78%)	109
Female	35(39%)	56(61%)	91
Total	66(33%)	134(67%)	200

The frequency distribution table above gives the detailed of the relationship that exist between respondent sex and satisfaction. It was revealed that out of the 109 males interviewed 78% of the males were satisfied whiles 28% of them were dissatisfied. Also about 39% of the females out of the 91 were dissatisfied and 61% of them were satisfied. This gave an indication that the patient satisfaction level in the district is high with males being more satisfied in relation to females. Similar to the respondent age the table below also presents the age distribution of the respondents.

Table 2

Age distribution of respondents by satisfaction levels.

Age	Frequency of patients who were satisfied	Satisfaction percentage
15 – 24	42	31.34
25 – 34	60	44.78
35 – 44	12	8.96
45 – 54	13	9.70
55+	7	5.22
Total	134	100

In attempt to find out the percentage of patients satisfied within a specific age group as shown in table 2 above, about 31.34% of patients aged within 15-24 were satisfied, 44.78% of patients aged within 25-34 were also satisfied. Patients aged within 35-44, 45-54 and 55+ showed a satisfaction percentage of 8.96, 9.70 and 5.22 respectively. This result also indicates that satisfaction of patients in the district decreases with age.

This is as a result of the fact that the more you advance in age the more service you may need at the hospital to be satisfied and most of these services which are to be given to the old age are not run in the hospitals in Kasena Nankana hence the above results.

3.1Variable eligible for entry into the patient satisfaction model

Table 3

Analysis of variable eligible for entry into the logistic regression model

Effect	DF	Score chi-square	Pr>chi-square
Age	1	2.2526	0.1334
Sex	1	0.2740	0.6006
Education	1	0.8392	0.3596
Job	1	0.2281	0.6329
Health Status	1	2.8317	0.0924
LTIME	1	3.9681	0.0464
AESTH	1	10.9654	0.0009
PHWR	1	29.6753	<.0001
NHIS	1	0.7822	0.3765

Table 3 above presents the independent variables eligible to enter the model. It contains the factors assumed to have influence on patient satisfaction in the Kasena Nankana district. Factors which are significant are known based on the p-value, which indicates the significance of the independent variable. A significance level of 0.05 and 0.10 were required to allow a variable to enter into the model and stay in the model respectively. This procedure is termed as stepwise selection. In this approach an attempt is made to remove insignificant variables from the model before adding a significant variable to the model. Each addition or deletion of a variable to or from the model is listed as a separate step. In step one, variable PHWR is selected in to the model since it is the most significant variable among those to be chosen (P-Value<.0001). In step two Sex is added to the model. The model then contains an intercept and variable PHWR and Sex. Both PHWR and Sex remain significant at 0.10 a level, therefore neither PHWR nor Sex is removed from the model. In step three, variable AESTH is also added to the model. The resulting model then contains the intercept together with the variables PHWR, SEX, and AESTH. Variable LTIME is also entered into the model in step 4. Finally none of the reaming variables met the entry criterion and stepwise selection is terminated. A summary of stepwise selection is displayed in Table 4 below.

3.2 Summary of stepwise selection

Table 4

Summary of stepwise selection

Effect		DF	Number in	Score chi-square	Pr>chi-square
Enter	Remove				
PHWR		1	1	29.97	<.0001
Sex		1	2	2.999	0.0833
AESTH		1	3	4.121	0.0423
LTIME		1	4	3.136	0.0765

Table 4 shows the effects entered into the model and effects removed from the model with their entry and removed p-values. Out of the nine (9) independent variables considered as factors affecting patient satisfaction in the Kasena Nankana district four (4) of them : PHWR, Sex, AESTH and LTIME entered the model with none of them removed. These variables remain significant at 0.10 level of significance.

3.3 Parameter Estimates

Table 5

Table Showing Analysis of the Maximum Likelihood Estimates for Satisfaction

Variable	DF	Estimate	Std. Error	Wald Chisq	Pr-value
Intercept	1	2.9705	0.6273	22.4232	<.0001
PHWR	1	-1.2013	0.2743	19.1852	<.0001
Sex	1	-0.7458	0.3463	4.6382	0.0313
AESTH	1	-0.4328	0.2164	4.0000	0.0455
LTIME	1	0.2399	0.1366	3.0827	0.0791

Table 5 gives detailed analysis of the effects entered into the model. It shows the coefficient (estimate), the standard errors, the Wald chi-square statistic and the associated p- value of the final model. The table reveals that satisfaction is affected by unmeasured factors since (p-value < 0.10). In addition, there is no evidence that Age, Education, Job, Health and NHIS have a strong influence on patient satisfaction. On the other hand the contributing factors found to have severe impact on patient satisfaction are: PHWR, Sex, AESTH and LTIME. These variables therefore contribute significantly to the model at 0.1 level of significance. Therefore the logistic regression model developed is

$$\pi(y) = \frac{e^{2.9705 - 1.2013(PHWR) - 0.7458(Sex) - 0.4328(AESTH) + 0.2399(LTIME)}}{1 + e^{2.9705 - 1.2013(PHWR) - 0.7458(Sex) - 0.4328(AESTH) + 0.2399(LTIME)}}$$

Where

$$f(x) = 2.9705 - 1.2013(PHWR) - 0.7458(Sex) - 0.4328(AESTH) + 0.2399(LTIME)$$

is the logit.

This logistic regression model developed above indicates the likelihood of a patient in the Kasena Nankana district being satisfied or dissatisfied based on the contributing factors. However, patient satisfaction associated with these factors also varies. Patient-health worker relationship (PHWR) shows the greatest effect on satisfaction, this followed by Sex, Aesthetic features (AESTH), and lastly Length of time in attaining services (LTIME) .From the estimate provided by Table 5 it is clear that Sex, Aesthetic features and Patient health worker relationship tends to a downward trend of patient satisfaction since their estimate were -0.7458, -0.4328, and -1.2013.

3.4 Model Diagnostics

This section discusses the various methods employed in checking for the adequacy of the logistic regression model. Tables 6 and 7 test the overall fit of the model. The likelihood chi-square of 41.6523 with p-value <.0001 indicates that the model as whole fits significantly better than an empty model, resulting to the rejection of the null hypothesis. This brings out the implication that there exist a significant relationship between satisfaction and the factors that contribute to satisfaction. Also the Wald chi-square of 31.7767 with p-value

<.0001 indicates that the four independent variables selected in the final model contribute significantly to the output (satisfaction). From table 6 below it was also deduced that the AIC, SC and -2logL were 222.019, 238.511 and 212.019 respectively under the column caption interception and covariate which is less than the values (255.617, 258.970 and 253.671) of the same quantities under the column caption interception only. This also indicates that the model fit statistically well than an empty model that is when there was only intercept in the model.

Table 6
Model Fit Statistic

Criterion	Intercept only	Intercept and covariates
AIC	255.617	222.019
SC	258.970	238.511
-2log L	253.671	212.019

Table 7
Testing Global Null Hypothesis: BETA=0

Test	Chi-square	DF	Pr>chisq
Likelihood Ratio	41.6523	4	<.0001
Score	38.2353	4	<.0001
Wald	31.7767	4	<.0001

4. CONCLUSION

Logistic regression analysis was used to develop the model in this study. The analysis gives a confirmation at 0.10 level of statistical significance. The result presented in this work show that the model provided a reasonable statistical fit. Using the concept of p-value together with Wald-statistic, the study variables were subjected to significance testing. Only four factors, namely sex, LTIME, AESTH, and PHWR. PHWR was found to be the greatest factor that contributes significantly to satisfaction this is followed by AESTH, LTIME and lastly sex.

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