International Journal of the Physical Sciences Vol. 6(18), pp. 4458-4465, 9 September, 2011
Available online at http://www.academicjournals.org/IJPS
DOI: 10.5897/IJPS11.058
ISSN 1992 - 1950 ©2011 Academic Journals

Full Length Research Paper

Modelling morbidity related absenteeism among workers in University of Ibadan Community, Nigeria: Poisson regression

Apau, G. S., Fagbamigbe, A. F.*, Adebowale, S. A. and Bamgboye, E. A.

Department of Epidemiology and Medical Statistics, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Nigeria.

Accepted 28 June, 2011

Globally, sickness absenteeism is a contemporary public health problem, particularly in developing countries. However, very few studies had addressed the theoretical and methodological aspects of health related absenteeism among University workers. A retrospective study of sickness records of 4447 employees of University of Ibadan made available at the University Staff Clinic (Jaja). The health records of each staff for the whole 12 months in 2007 were reviewed. Data analysis was performed using descriptive statistics and Poisson distribution model was used in the data modeling. The prevalence of sick-off leave at the staff clinic was 4.7%. Also, 12.4% of all the staff had been sick at least once during the study period. There was a slight differential in absent rate by sex, age, marital status and years of service. However, differential existed in absent rate among subgroup of workers by different occupational groups and staff category. Majority of the spells lasted for between one and two days. The Poisson regression model showed that staff category and occupational group are the only predictors of days sick-off. Among the dependent variables considered, only sick-off days followed Poisson distribution model. Also, Poisson regression model is adequate to describe and predict the pattern of sickness absenteeism in the study area.

Key words: Absenteeism, Poisson, model, morbidity.

INTRODUCTION

Numerous factors determine the state of health in working people among which working conditions and the kind of job performed play indubitably a decisive function. The observation and analysis of sick absenteeism provides indirect information on the health problems facing the University workers. Globally, sickness absenteeism is a large and increasing public health problem, particularly in developing countries. However, very few studies had addressed the theoretical and methodological aspects of health related absenteeism among University workers. Hence, this study was designed to develop a statistical model to describe the pattern of sickness absenteeism. Sickness absenteeism, apart from being an indicator of occupational hazard also provides information on morbidity in countries with poor health records system (Bamgboye and Adeleye, 1992). The increase in rate of sickness absenteeism is a serious problem in many parts of the world as it affects the productivity of the organization. Also, it could be a result of poor working condition as well as environment in some of these institutions. On the other hand, it increases the expenditures of the governmental on health. It is a serious problem since it holds back labour supply and potential production growth (Selander, 2004). Unfortunately there is a paucity of sickness absence data in most institutions in Nigeria. Absenteeism is a habitual pattern of absence from a duty or obligation. Traditionally, absenteeism has been viewed as an indicator of rich individual performance, as well as a breach of an implicit contract between employee and employer; it is seen as a management problem, and framed in economic or quasi-economic terms. More recent scholarship seeks to understand absenteeism as an indicator of psychological, medical, or social adjustment

*Corresponding author. E-mail: franstel74@yahoo.com. Tel: 08188231380.

to work (Johns, 2007). Therefore, many employees feel obliged to come to work while ill, and transmit communicable diseases to their co-workers. This leads to even greater absenteeism and reduced productivity among other workers who try to work while ill. At times, work forces often engage in absenteeism caused by medical reasons if the worker supplies a doctor's note or other form of documentation.

Absenteeism plays a dual role. It is an indicator of and proxy for worker effort and productivity and as such it is used as a measure of individual response to numerous incentive schemes at the firm and national level (Ichino and Riphahn, 2003). Also, absenteeism appears as the subject of economic analyses in its own right, with investigations focusing on determinants, patterns, and correlates of workplace absences. Sometimes, people choose not to show up for work and do not call in advance, which businesses may find to be unprofessional and inconsiderate. This is called a "no call" or "no show" absenteeism. Nelson (2008) pointed out that people who are dissatisfied with their jobs are absent more frequently. They went on to say that the type of dissatisfaction that most often leads employees to miss work is dissatisfaction with the work itself. Gary (2011) stated that “In the current economy and the focus on employment law higher than ever, employers need to be certain that employees are acting in a responsible manner. No employer would want to wrongly accuse any employee that is genuinely of with illness, however in uncertain times, it had been found that an employer's suspicion can be wholly founded”, so there is need to have a model that can easily avoid uncertain accusations. Different theoretical models have been used to describe absenteeism, but the psychological model has been mostly applied. The psychological model otherwise known as "withdrawal model," assumes that absenteeism represents individual withdrawal from dissatisfying working conditions. This finds empirical support in a negative association between absence and job satisfaction, especially satisfaction with the work itself. However, the current study uses Poisson distribution model to ascertain its utilization possibilities in absenteeism problems.

In real sense, for any discrete dependent variable data, Poisson regression model has always been considered as the right preference (Cameron and Trivedi, 1990; Gurmu, 1991). This is because the model has been added as part of a regression structure (Lee, 1986), it has a simple construction, and straightforward in estimation (Greene, 1993; Lee, 1986). However, this simplicity emanates from some restrictive assumptions, which if ignored or violated can incredibly affect the model coefficients in terms of reliability and efficiency. The assumption that the variance of the dependent variable equals its mean has always been the focus of the critics of Poisson model (Greene, 1993). Another assumption is that individual occurrence is independent of the number of previous occurrences, and the expected number of occurrences is identical for every member of the sample. Despite its off-putting assumptions and the ease of use of the alternatives, modeling absenteeism using Poisson regression should be of paramount importance. The study provided a useful preliminary point to appraise what appears to be an imperative determinant of absenteeism, so far astonishingly derelict in the public health literature and in policy issues.

MATERIALS AND METHODS

A retrospective study was carried out, involving a review of all sickness records of the workers between January 1st 2007 and December 31st 2007. The study was conducted at the Jaja Clinic in the University of Ibadan, Ibadan, Nigeria. The study population comprised of all workers of University of Ibadan who visited the clinic during the academic year 2007/2008 for one ailment or the other. Records of 4447 workers during the academic year 2007/2008, consisting of 2693 academic staff members and 1754 non academic staff members were reviewed. The data were then extracted from the staff sickness records of the clinic. The data extracted included the following: Hospital number, age, sex, marital status, occupational group, staff category, working experience, date of consultation, duration of absence, diagnosis and number of spells of sickness. In this study, the Poisson regression was used to model the data and used the sick-off days as a function of the explanatory variables: Age, sex, marital status, occupation, staff category and working experience. The dependent variable Y (sick-off days) is a Poisson distribution given the explanatory variables $x_1, x_2 \ldots, x_p$ as follows: $P(k|\, x_1, x_2 \ldots, x_p) = \frac{\lambda^k}{k!} e^{-\lambda}$ where k is a discrete random variable with value 0, 1, 2, … Also, the log of the mean is assumed to be a linear function of the explanatory variables. That is, $\log(\lambda) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p +$ which implies that λ is the exponential function of the explanatory variables, $\lambda = exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \varepsilon)$, where β_0 is the regression constant, $\beta_1, \beta_2, \ldots, \beta_p$ are the coefficients of the explanatory variables and ε is the error term. We used Kruskal Wallis and Mann-Whitney tests; both are nonparametric test in comparing the differences in the sick-off days within the various age categories, this was due to the fact that the data was not normally distributed. The assumptions of the Poisson distribution are; the total count of success events need not be rare if the parameter λ is not small, and the events being counted are actually the outcomes of discrete trials (Blachaman et al., 1988).

RESULTS

There were 550 workers who visited the clinic at the period of January 2007 to December 2007, representing12.4% out of the total number of 4447 staffs. 207 workers were given sick-off out of the total number of 550 who visited the clinic, representing 37.6%. During the 12 month period, there were 1,001 spells with a total of

Table 1. Demographic characteristics of workers in University of Ibadan, 2007.

Demographic characteristics	Frequency	Percentage (100%)
Gender		
Male	358	65.1
Female	192	34.9
Marital status		
Single	30	5.5
Married	520	94.5
Staff category		
Junior	315	57.3
Senior	235	42.7
Work experience (years)		
≤5	19	3.4
6-15	282	51.3
≥16	249	45.3
Occupational groups		
Security and laborers	136	24.7
Secretarial	114	20.7
Medical	57	10.4
Administration and technical	148	26.9
Academic	95	17.3
Total	550	100.0

525 absent days. This gave an annual inception rate (S/P) of 1.8 spells per person, an index of severity/average annual duration per worker (D/P) of 2.5 days and an average length per spell (D/S) of 1.2 days.

Table 1 indicates that there were 358 males (65.1%) and 192 females (34.9%) in the study population. The mean age of the employees was 47.3 years (SD = 9.6); the mode was 56 years, and the median, 47 years. Three hundred and ten employees (56.4%) were under 49 years and 44 (8%) were aged 60 years and above. A chi-square value of 28.6 (p = 0.05) at 4 degree of freedom shows a weak statistical association between age and sex. Thirty staffs (5.5%) were single, while the remaining 520 workers (94.5%) were married with a mean age of 49.7. Moreover, 315 workers (57.3%) were in junior staff category while the remaining 235 (42.7%) were in the senior staff category. Table 1 also depicts that 3.4% of the staffs had worked for less than five years, while 282(51.3%) staffs had served for over six years. Two hundred and forty-nine workers had served for 16 years and above. Table 2 shows the mean rank of sick-off days according to demographic characteristics of workers in University of Ibadan, 2007. Workers within the age range of 20 to 39 years had a mean rank of 113.76. However, the mean rank for workers of age ranging between 40 to 59 years and age 60 years and above were 122.38 and 135.48, respectively, but the differences was not significant ($p>0.05$).

In terms of gender, the mean rank of sick-off days for male was 104.14 while that of female was 103.72 ($p>0.05$). However, the mean rank of sick-off days for the staff categories revealed that the value was higher among junior staff (112.70) than the senior staff (87.33). This difference was statistically significant using Mann-Whitney test ($p<0.05$). Also, significant differences existed in the sick-off days between different occupational groups, as security workers having the highest mean rank of 126.93 and the academic staff having the lowest mean rank of 75.98 ($p<0.05$). Table 3 showed the median number of spells of sickness for the whole population. Median was used because the distribution of the data does not follow normal distribution and as such will be a better estimate than any other measures of central tendencies. The result showed that the median spell of sleekness was 2.0 for the whole study population. Comparing the median number of spells among the different occupational groups, administration and technical workers had spell of sickness above the median spell, while majority of the junior workers were below the median spell of sickness (114). However, there was no significant difference using the median test with (x^2 = 8.171, $p>0.05$).

Table 2. Mean rank of sick-off days according to demographic characteristics of workers in University of Ibadan, 2007.

Demographic characteristics	N	Mean rank of sick-off days	p-value
Age (years)			
20-39	51	113.76	
40-59	137	122.38	0.472
60+	19	135.48	
Gender			
Male	137	104.14	0.960
Female	70	103.72	
Staff category*			
Junior	136	112.70	0.003
Senior	71	87.33	
Occupational groups*			
Security and laborers	56	126.93	
Secretarial	46	89.90	
Medical staff	18	118.08	0.001
Administration and technical	60	103.89	
Academic	27	75.98	
Total	207		

Table 3. Average number of spell of sickness.

Number of spells of sickness	Occupation group				
	Security workers	Secretarial	Medical	Admin and technical	Academic staff
> Median	22	26	15	38	13
≤ Median	114	88	42	110	82

Table 4 shows the proportion of sickness among the categories of workers in University of Ibadan. The rates of sickness were 38.2 and 20.0% for males and females, respectively. As for the age groups, it was found to be highest among workers who were above age 60 years (43.2%) and least for those in the age range of 20-39 years (37%). The sickness rate was higher among married workers (38%) as compared to unmarried workers (20.0%), while for staff category, it was 43.2% for junior staff and 30.2% for senior staff category. Non-teaching staff (39.6%) also experienced higher sickness rate than the academic staff (28.4%).

Table 5 shows monthly distribution of spells of sickness and days of sick-off. On the average, there was 36.5 spells in the year. The highest proportion of spells of sickness was located between January to April (37.3%), a decrease in between May to August (28.1%) and increased again between September to December (34.6%). However, out of the total number of 207 workers who had sick-off, January experienced the highest month with 38 workers while March the least with 9 workers.

Table 6 indicates the major causes of sickness absenteeism among workers who visited Jaja Clinic during the year 2007/2008. It was realized that Fever / Malaria was the leading cause of sickness absenteeism (28.4%), hypertension (22.7%), headache (11.5%), URTI/UTI (8.2%), Myalgia (6.0%) and injuries/accident (3.8%) consisting 80.6% of the total number of spell of sickness for the year. However, Malaria has the highest followed by hypertension and then headache. Table 6 also reveals that apigestric (0.5%) and fatigue/stress (0.2%) had the lowest number of spells of sickness. The one-sample Kolmogorov- Smirnov goodness-of-fit test for the duration of absence gave a significant p-value of 0.161 depicts that the observations follow Poisson distribution. Table 7 shows the Poisson regression model for predictors of sick-off days when all the variables were used simultaneously in the model analysis. Among all the

Table 4. Sickness rate in each category of selected variables among workers in the University of Ibadan.

Variable	Frequency	Number of days of sick-off	Mean
Gender			
Male	358	137	0.383
Female	192	70	0.365
Age			
20-39	138	51	0.370
40-59	368	137	0.372
60+	44	19	0.432
Marital status			
Married	520	201	0.387
Single	30	6	0.200
Staff category			
Junior	315	136	0.432
Senior	235	71	0.302
Occupational group			
Teaching	95	27	0.284
Non-teaching	455	180	0.396
Total	550	207	0.376

Table 5. Distribution of the spells of sickness and duration by month.

Month	Number of patients	Spells		Duration	
		Number	Percent (100%)	Number	Percent (100%)
January	38	69	15.8	101	19.2
February	21	40	9.1	55	10.5
March	9	16	3.7	21	4.0
April	17	38	8.7	33	6.3
May	13	28	6.4	32	6.1
June	14	32	7.3	35	6.7
July	11	23	5.3	30	5.7
August	18	40	9.1	45	8.6
September	13	28	6.4	32	6.1
October	16	37	8.4	47	8.9
November	18	43	9.8	50	9.5
December	19	44	10.0	44	8.4
Total	207	438	100.0	525	100.0

variables considered, when Poisson regression model was applied, only occupational group shows a significant relationship ($p<0.032$) with the sick-off days. The β coefficient of 0.941 is an indication that an increase in number of population in occupation group will increase absenteeism by 0.941. Staff category has the least p-value among the remaining variables ($p = 0.218$), although not significant, it was considered as well in further model analysis. Other variables, such as gender, marital status, work experience and age have very high p value and were excluded from further analysis. Therefore model 3 is chosen and it gives the Poisson regression model for predictors of sick-off days as: that is, $\log(\mu) = 0.7680 + 0.240stcat$ $\mu = \exp(0.7680 + 0.240stcat)$.

Table 6. Major causes of sick-off.

Diagnosis	Frequency	100%
Fever/malaria	156	28.4
HBP	125	22.7
Headache	63	11.5
URTI/UTI	45	8.2
Myalgia	33	6.0
Injuries/wounds/accident	21	3.8
Others	20	3.6
Gingivitis/conjunctivitis	13	2.4
Catarrh/cough	9	1.6
Enteritis	9	1.6
Dermatitis(skin infection)	7	1.3
Trauma	6	1.1
Asthma	6	1.1
Insomnia	6	1.1
Diabeties	5	0.9
Sorethroat/toothache	5	0.9
Gastroenteritis	5	0.9
Cyesis	4	0.7
Arthritis	4	0.7
Diarrhoea/dysentary/blood stool	4	0.7
Apigestric	3	0.5
Fatigue/stress	1	0.2
Total	550	100

The regression coefficient for staff category (that is; 0.247), indicate the strength of the association between sick-off days and staff category. The value shows that categories of staff can be used to predict the number of sick off days in a year ($p<0.05$). The regression coefficient does not pass through the origin since the value of constant which is the point at which the regression line intersects the axis of the response variable ($p<0.05$). This means that the fitted Poisson model can be used to establish relationship between the staff category and sick-off days.

DISCUSSION

Health is wealth, a nation or establishment where reasonable proportion of its workers is unhealthy may find achievement of Millennium Development Goals a mirage. The aim of any University is to produce graduates that are of high standard that can meet the challenges after graduation. Therefore, University workers irrespective of their work category contribute to accomplish this aim since the better the health of the workers, the better the quality of the graduates.

The study was based on an analysis of sick leave records of University of Ibadan staff which was routinely collected at the University staff clinic for 12 months period. It was set to examine the rate and patterns of sickness absence among heterogeneous group of employees. Although, different studies have been conducted at the study site, but very few only addressed modeling absenteeism as explored in this study.

The collected data was subjected to normality test and the result shows that the data was not normally distributed. Therefore, the need for a non parametric test statistics to evaluate factors that contribute to absenteeism became very imperative. Data analysis revealed that sickness absenteeism was higher among females than their male counterpart. Also, the junior staff is more likely to experience absenteeism than senior staff and this is similar to findings such as Johns (2007). When occupational groups were considered, security and other junior workers have the highest rate of sickness absenteeism, followed by medical staffs, administrative and technical staffs and secretarial staff while academic staff has the lowest absenteeism rate. These findings are also supported by Erinoso and Bamgboye (1988), North et al. (1993) and Fuhrer et al. (2002). They observed that there seems to be a quite linear negative association between socio-economic class (education attainment, income) and sickness absence.

This study further established that sick-off days follow the Poisson distribution and hence was modeled using Poisson regression. It was clearly seen that only staff

Table 7. Poisson regression model for predictors of sick-off days.

Variable	β	Std. error	95% Conf. interval		Hypothesis test		
			Lower	Upper	Wald χ^2	d.f	Sig.
Model 1							
Constant	2.035	0.402	1.247	2.823	25.625	1	0.000
Gender	-0.086	0.201	-0.480	0.307	0.185	1	0.667
Marital Status	0.178	0.595	-0.987	1.374	0.090	1	0.764
Work experience	-0.256	0.570	-1.374	0.862	0.202	2	0.844
Age	0.014	0.375	-0.722	0.750	0.001	2	0.933
Occupational group	0.941	0.365	0.226	1.656	6.657	4	0.032*
Staff category	0.286	0.233	-0.169	0.742	1.518	1	0.218
*Significant at 5%, Log likelihood = -338.710; Goodness-of-fit (195df) = 319.707; p = 0.039; AIC = 703.421							
Model 2							
Constant	0.636	0.140	0.362	0.910	20.629	1	0.000
Occupational group	0.486	0.159	0.174	0.799	9.297	4	0.020
Log likelihood = -343.710; Goodness-of-fit (202 df) = 126.061; p = 0.018; AIC = 697.420							
Model 3							
Constant	0.768	0.081	0.609	0.926	90.186	1	0.000
Staff category	0.247	0.096	0.058	0.435	6.603	1	0.010
Log likelihood = -346.267; Goodness-of-fit (205 df) = 130.608; p = 0.009; AIC = 696.534							

category and occupational groups were significant to sick-off days among other demographic variables considered for the analysis. The regression coefficient for staff category is an indication of the strength of the association between sick-off days and staff category. The value as evidenced in this study depicted that categories of staff can be used to foretell the number of sick off days in a year ($p<0.05$). Also, the regression coefficient did not pass through the origin which means that the fitted Poisson model can be used to establish relationship between the staff category and sick-off days.

There are a number of suggestions in tackling illegitimate absenteeism, Gary (2011) suggested that Insights private detectives can carry out discreet surveillance to gain evidence that will ascertain the validity of a claim for sickness payments from an employer and ensure that the investigation will not come to the immediate attention of an employee so as to protect the employer/employee relationship in genuine cases. We are of the opinion that Mathematical tools, such as this model remains the easiest method. The average annual duration (severity rate) of absence per worker was 2.5 days which is lower than 4 days which was obtained in the UCH in 2003 (Botwe, 2004) and 5.6 days between 1985 and 1987 (Bamgboye and Adeleye, 1992). It is also lower than the values of 14.3 and 7.2 days obtained among hospital workers in Chile and Benin City, respectively. The apparent lower rate of severity and absenteeism reported in this study were probably due to problem of recall or deliberate under reporting by respondents, in order to avoid administrative sanctions. The inception rate of 1.8 spells per person and the average length per spell of 1.2 days were found during the study period. The highest proportion of spells of sickness was between January and April, while the least was observed between May and August. January was rated the highest month of spells of sickness while March was the least. Different factors can account for this such as commencement of harmattan season where people find it very difficult to adapt to the new season. Respiratory infections are also common in January. Ill health was the commonest cause of absenteeism among the staff that had malaria and high blood pressure (HBP) contributing about 51.1% of these medical causes. Other studies have also identified the role of illness in absenteeism among workers. It is not surprising that malaria contributed the highest and this is understandable in the view of its prevalence in Nigeria.

Conclusion

Information on sickness absenteeism can vary from one institution to another. However, differential in staff category and occupational groups' socioeconomic status should be considered as a key variable in measurement of programmes to alleviate sickness absenteeism. Reliable data on sickness absence is vital to informing effective policy and practice. A standard procedure for reporting and recording of sickness absence should be an essential requirement so that the university can identify

patterns and trends and take action if appropriate.

The results of this study may not provide a decisive best analysis strategy, but do provide additional insights into research and policy framework on absenteeism research. Optimistically, future absenteeism research is expected to move beyond Poisson regression model; and other potential models which perhaps may definitely lead to the best way to analyze absenteeism data must be explored.

REFERENCES

Bamgboye EA, Adeleye AI (1992). Sickness Absenteeism in a Nigeria Teaching Hospital. East Africa Medical J., 69(8): 40-44

Blachaman NM, Ronald JE, Boersma J, Jagers AA (1988). "The Entropy of a Poisson Distribution: Problem 87-6". SIAM Rev., 30 (2): 314--317.

Cameron AC, Trivedi PK (1990). Regression-based tests for overdispersion in the Poisson model. J. Econ., 46: 347-364.

Erinoso BO, Bamgboye EA (1988). Sichness Absenteeism in a Nigerian Polytechnic: Afr. J. Med. Med. Sci., 17(I): 57-61

Fuhrer R, Shipley MJ, Chastang JF, Schmaus A, Niedhammer I, Stansfeld SA, Goldberg M, Marmot MG (2002). Socioeconomic Position, Health, and Possible Explanations: A Tale of Two Cohorts. Am. J. Public Health, 98: 1290-1294.

Gary K (2011). A Private Investigator Can Help with Employee Absenteeism Problems http://pr-usa.net/index.php?option=com_content&task=view&id=729679&Itemid=30 Accessed May. 18th 2011

Gurmu S (1991). Tests for detecting overdispersion in the positive regression model. J. Bus. Econ. Stat., 9: 215-222.

Greene WH (1993). Econometric Analysis, New York: Macmillan Pub.,

Ichino A, Riphahn RT (2003). The effect of employment protection on worker effort. A comparison of absenteeism during and after probation, CEPR Discus. Paper. No. 3847.

Johns G (2007). "Absenteeism" in George Ritzer (ed.) The Blackwell Encyclopedia of Sociology. Blackwell Pub., 2007.

Lee LF (1986). Specification test for Poisson regression models. Int. Econ. Rev., 27: 689-706.

Nelson Q (2008). Understanding Organizational Behavior, 3rd Edition. Southwestern-CENGAGE. ISBN 978-0-324-42302-0

North F, Syme SL, Feeney A, Head J, Shipley MJ, Marmot MG (1993). Explaining socio-economic differences in sickness absence: The Whitehall study. British Med. J., 306: 361-366.

Selander J (2004). Economic Incentives for Return to Work in Sweden: In Theory and in Practice. Int. J. Disability Manage. Res., 1: 107–113.