International Scholars Journals

International Journal of Agricultural Extension and Rural Development ISSN 3254-5428 Vol. 7 (8), pp. 001-010, September, 2019. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Socio-economic burden of guinea worm disease in Ogun State: A discriminant analysis approach

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Accepted 13 April, 2019

The paper employs discriminant analysis to examine key socio-economic variables which distinguish residents of Odeda from Obafemi – Owode local government areas of Ogun State based on the incidence of guinea worm disease status. It is evident that source of drinking water consumed, medication method adopted and duration of healing of guinea worm disease have strong discriminating effects than other socio-economic variables like age, sex, access to health education and type of labour employed. The study revealed an average man-day loss of ₦850.20 and ₦1, 350 as the cost of treating the infection that takes 43.7days to heal completely. The paper suggests provision of safe drinking water, either through boreholes, pipe borne water or ensuring that other sources of water like ponds are filtered or treated with necessary chemicals.

Key words: Discriminant analysis, copepods, Wilks' lambda, guinea worm.

INTRODUCTION

It is now well recognized by both development professsionals and policy makers that agriculture influences health and health influences agriculture, and that both in turn have profound implications for economic growth. Ba-sic economics and experience suggest that by providing food, labour and investible surplus, the rural areas help to generate urban incomes and employment. They also help to stabilize, if not reduce production costs for industries and cost of living for workers generally. Raising rural incomes and productivity thus are seen as a prerequisite for stimulating a vicious cycle of growth and development in Nigeria [see Abolarin (1981), Agunbiade (1984), Anosike (2003) and Belcher et al (1975)]. So, within the context of Nigerian economy, which is predominantly rural in settlement, the problem of economic growth and development hinges largely on raising the productivity and therefore the real income of this sector. Thus, healthy rural sector is *sine qua non* to development in developing countries.

Healthier workers are physically and mentally more energetic and robust. They are more productive and earn higher wages. They are also less likely to be absent from work because of illness (or illness in their family). Illness reduces labour hours and hourly wages substantially, with the effect especially strong in Nigeria, where over 70% of the work force is engaged in manual labour on the farm. In spite of this, the scourge of guinea worm dis-ease in rural areas is a threat to developmental initiatives in these areas of Nigeria. Moreover, developmental stra-tegies in agriculture and public health are often pursued in a parallel and unconnected fashion.

This paper is set to present new evidence on the cost of illness and the need for proper policy linkage between agriculture and health. The paper focuses on ill-health effects of a waterborne disease - guinea worm on adults and children in endemic areas of Ogun State. Attempt is made to examine key socio-economic variables explain-ing the differences between healthy and people infected with guinea worm. It is argued that this work is of value in indicating the burden of a disease and in guiding priorities in research, prevention and treatment of guinea worm. Indeed this study is expected to be an essential compo-nent of the evaluation of alternative demands on scarce health care resources in the infected region of the country.

Guinea worm is transmitted by drinking water contain-ing copepods (water fleas) that are infected with guinea worm larvae. Accordingly one year after ingestion of infected water, a female adult worm emerges from the

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Table 1. The Breakdown of Reported Cases in 16 States with Endemic Villages in 2003

State	No of reported cases
Benue	476
Oyo	347
Ebonyi	278
Niger	140
Ogun	43
Kebbi	37
Borno	34
C/River	27
Sokoto	19
Nasarawa	17
Zamfara	12
Enugu	11
Gombe	7
Kogi	5
Kwara	3
Katsina	1

Source: Guinea Worm Eradication Programme (2004), Ojodu (2004) and Ojoge (2004)

lower extremity that is, ankle and leg. The emergence of the adult female is accompanied by months of crippling pains to those affected, leaving its adult victims unable to till the field or tend their farms (Ilegbodu et al., 1991). Moreover, children victims are unable to attend school or assist their parents in farming activities after school. A United Nations Children Economic Fund (UNICEF, 1997), IRIN (2002) and Centre for Disease Control (1995) study has shown that the emergence of the adult female in the infected individuals always coincide with the peak period of agricultural activities, like land preparation or harvesting.

Health care is a consumption good as well as an investment good (Ngugi, 1999). As a consumption good, health care improves welfare, while as an investment commodity, health care enhances the quality of human capital by improving productivity and increasing the number of days available for productive activities. In fact, the time lost in production because of ill health indicates reduced output (Adewale et al., 1997; Chippaux, 1991)]. This in part explains why guinea worm as a parasite that can cause ill health, has attracted a lot of studies. Majority of these studies are from the medical field while very few empirical studies have been carried out on the effects of guinea worm disease on agricultural productivity. The breakdown of guinea worm disease in 16 endemic states in Nigeria in 2003 is shown in Table 1. Moreover, Ogun state which could safely be classified as one of the heavily infested states, with high prevalence and incidence of guinea worm in Nigeria had 12 out of her 15 local government areas infested in 1988. According to a report on the third Nigerian Guinea Worm Active Case search in Ogun State (1989 - 1990), 1,271 cases of guinea worm were reported between 1988 and 1989. This in part explains why data for this study were collected from Odeda and Obafemi Owode local government areas of the state, where the disease incident were high and proves difficult to eradicate. It is also worrisome to note from Table 2 that the spread of this disease is on the increase. Both Odeda and Obafemi - Owode local government areas are known to be high producers of crops like maize, cassava, pepper, cocoyam, and yam in the state.

Against this backdrop the paper is set to identify, compare and estimate the contributory power of key factors to the socio-economic burden of guinea worm disease among farmers in the state. Furthermore, none of the past studies were concerned with discriminating the guinea worm infected and non infected persons using the key human and social factors. This paper tends to fill this lacuna in literature.

It is argued that this study is of relevance because it indicates the burden of the disease, guides and inspires the setting of priorities in research, prevention and treatment of guinea worm in endemic areas in Nigeria. Indeed it has been claimed that the cost of illness studies are an essential component of the evaluation of alternative demands on scarce health care resources.

METHODOLOGY

Data

The study was carried out in Odeda and Obafemi-Owode local government areas of Ogun state. These are the remaining council areas with high incidences of guinea worm attack out of the 20 local government areas in Ogun state. Odeda and Obafemi-Owode local government areas are located in the forest zone of south-western Nigeria. There are 49 and 55 villages in Odeda and Obafemi – Owode local government areas respectively. Some of the villages under Odeda local government area are the Odeda- headquarters, Bosero, Abated, Ikaagbo, and Ikija among others. Obafemi (Obafe), Owode, Jibowu, Agbedi and Olowotedo are some of the villages under Obafemi-Owode local government area. The inhabitants of these local governments are mainly peasant farmers. However, like any council located in the rural area; most villages in these local government areas lack good road network, electricity and good drinking water. Lack of good drinking water in the dry season often compels residents of the study areas to source for water from guinea worm infected ponds and other stagnant water sources for drinking, hence the prevalence of guinea worm disease in these areas.

The study adopted complete enumeration for guinea worm infected individuals because of the small population while stratified random sampling was utilised in selecting uninfected residents from the population of villages under surveillance in the two council areas.

Both primary and secondary data were utilised in this study. Primary data were obtained using structured questionnaire while secondary data were collected from Ogun State Ministry of Health, the websites of the Carter Centre (Global, 2000) and their offices in Odeda and Obafemi-Owode local government headquarters, UNICEF, WHO and CDC (Center for Disease Control). The sample size was 72, 33 for guinea worm infected individuals and 39 for

Table 2. Reported Number of Cases of Guinea worm Attack in Odeda & Obafemi – Owode Local Government Areas

Local government	2003		2004		2005	
	Reported cases	Number of villages	Reported cases	Number of villages	Reporte d cases	Number of villages
Odeda	36	6	21	5	13	3
Obafemi-Owode	2	2	14	4	8	3

Source: Survey data (2005).

uninfected individuals. 30 infected and 35 uninfected respondents satisfactorily answered the questions. Each respondent answered questions on demographic and socio-economic characteristics, such as sex, present guinea worm status, method of treatment, source of drinking water, farming experience (year), size of land (hectare) used for cultivation, duration of attack, type of labour used, accessibility to health education and hired labour cost (₦, Naira)/day among others. In addition to descriptive statistics, these data were analysed using discriminant analysis (DA) and two - way analysis of variance.

Estimation Methods

Multivariate discriminant analysis:

One of the objectives of this study is to identify and examine key socio-economic as well as physical factors influencing susceptibility differentials among the rural poor in Ogun State. Here we employ discriminant analysis to distinguish the two groups of persons, the infected and non-infected farmers. To this end, each respondent, infected and non infected person was evaluated on 9 variables. We want to know whether the measurement we obtained on the 9 variables can be used as a means of discriminating between infec-ted and non-infected farmers. Also, it will be of interest to know the extent that the identified discriminating factors influence guinea worm infection status. Smith (1979) identified two procedures for conducting discriminant analysis.

Discriminant predictive analysis whose objective is to develop an equation that maximally discriminates between groups (dependent variables) using independent variables.

Discriminant classification analysis, uses the predictive functions derived in the first procedure to either classify fresh sets of data of known group membership, thereby validating the predictive function; or if the function has previously been valida-ted, to classify new sets of observations of unknown group mem-bership.

The implicit discriminant function used for this study is shown below:

$$D= \omega_o +\omega_1\lambda_1+\omega_2\lambda_2 +\omega_3\lambda_3 +\omega_4\lambda_4 +\omega_5\lambda_5 +\omega_6\lambda_6 +\omega_7\lambda_7 +\omega_8\lambda_8 +\omega_9\lambda_9 \quad (1)$$

Where:

D= guinea worm uninfected /infected individuals.

λ_1 = age of infected and uninfected respondents (year)

λ_2 = source of drinking water (pond/river = 0, tap/deep well = 1)

λ_3 = sex of the respondents (female = 0, male = 1)

λ_4 = the accessibility of respondents to health education (yes = 1, no = 2)

λ_5 = the duration of residence of respondent in the area (year)

λ_6 = the medication method adopted in treating guinea worm attack (non = 1, orthodox = 2, orthodox and traditional = 3) λ_7 = type of labour employed by respondent where applicable (self = 1, hired = 2, self and family = 3, hired and family = 4, self and hired = 5, non = 6)

λ_8 = farming experience (year)

λ_9 = healing duration of guinea worm disease (days)

The significance test for each of these socio- economic variables was carried out using Wilks' lambda test. Also classification accuracy is obtained to assess the utility of the discriminant model. This is achieved by comparing the cross – validated accuracy rate produced by the Statistical Package for Social Science (SPSS) to 25% more than the proportional by chance accuracy (same test can be carried out using chi-square test on classification table result). Moreover, significance tests were performed on the two primary assumptions of discriminant function analysis (multivariate normality and equality of covariances) using Box's M test. The hypothesis for the test is shown below:

H_o: $\psi_1 = \psi_2$ (covariance matrices do not differ between groups formed by dependent variables)

H_1: $\psi_1 \neq \psi_2$ (covariance matrices differ between groups formed by dependent variables

Acceptance of the null hypothesis means that this assumption is not violated.

It is to be noted that the choice of this technique is informed by the principal difference between the discriminant function and regression analysis. The former contains a qualitative dependent variable whereas the later has a quantitative variable (Singh and Pandey, 1981). These two authors further noted that Fisher (1950) has shown that the two methods virtually merge, if the qualitative dependent variable is quantified by assigning dummy values. However, with the help of discriminant function analysis two social groups can be separated which is not possible in regression analysis. Here, the discriminant function, also known as a classi-fication criterion was determined by a measure of generalized squared distance (Rao 1973).

Analysis of Variance (ANOVA):

ANOVA is a statistical tool used for examining the significance between more than two sample means. Specifically, ANOVA is used in this study to know if local, multinational organisations and NGOs have achieved a significant reduction in guinea worm disease over some years of their activities. The hypothesis tested is:

$$H_0 : \mu_{2003} = \mu_{2004} = \mu_{2005}$$

(There is no significant reduction in the average number of guinea worm incidence over the years)

$$H_1 : \mu_{2003} \neq \mu_{2004} \neq \mu_{2005}$$

(There is significant reduction in the average number of guinea worm incidence over the years). Where: 2003, 2004 and 2005 represent the three years under consideration.

μ_{2003} is the average number of cases of guinea worm disease reported in the year 2003. μ_{2004} is the average number of cases of guinea worm disease reported in the year 2004. μ_{2005} is the average number of cases of guinea worm disease reported in the 2005 year.

Monetary value of man day loss:

The monetary value of labour-hour loss as a result of guinea worm infection is estimated using the formula below:

Economic loss (N) = f(F_t, N_d , A_l)
Where:
F_t = average number of days loss by farmers as a result of guinea worm infection.
N_d = number of farmers infected by guinea worm disease A_L
= average amount (N) a labour received per day

RESULTS

The study reveals that 46% of the respondents were infected with guinea worm while 54% were not infected. Moreover, 65% of the respondents had access to health education on guinea worm disease. Despite the health education being embarked upon in susceptible villages by controlling bodies, 49% of respondents still rely on ponds (the breeding ground for guinea worm) for drinking water while 51% have access to borehole and deep well water for drinking. Apart from guinea worm infection incapacitating its victims, the study revealed that an ave-rage cost of treating the disease was ₦1, 350 in the two council areas. This however, did not include stipend and the cost of other treatment administered to infected persons by different local and international bodies (e.g. Carter Centre) responsible for guinea worm eradication programmes.

Additionally, because of the rural settings of the study areas, substantial numbers of respondents (68%) still combine traditional methods of treating the disease with orthodox methods. The study reveals an average man-day loss of ₦850.20, while 43.7 days (on average) is re-quired for the healing of wounds caused by guinea worm infection. Consequently, ₦38, 429.04 is lost by an infec-ted individual who engages in one farming activity or the other. The incapacitation of able bodied men and women by guinea worm disease did not only increase cost of producing arable crops in the study area but also reduced the profit margin of farmers. Figure 1 shows that guinea worm disease manifested in 39.6% of the farmers during the period that crops required constant weeding. A little over 20.02% of the respondents claimed that the disease incidence coincided with planting and harvesting opera-tions respectively (Figure 1).

Delay in planting and weeding operations usually result in appreciable reductions in crop yield. Furthermore, the study shows that farmers whose child/children is/are infected by guinea worm disease spent substantial hours/day attending to their sick children with little time available for farm activities.

Analysis of variance

The analysis of variance (2-way) result reveals that the null hypotheses are accepted ($p > 0.05$). This means that there is no significant reduction in the average number of reported cases of guinea worm infection in identified villages and among the years (2003-2005) under consi-deration. However, this result acknowledges the reduce-tion in guinea worm infection but that the reduction is not significant.

However, it should be noted that there is high hope of getting to the root of this problem as observed in many villages in the two local government areas since the early 1980s, (Third Nigerian Guinea Worm Active Case Search, 1989). Moreover, the small number of reported cases of guinea worm remaining has defied several efforts aimed at its complete eradication. For instance, there was an outbreak of the disease in villages which had not been previously known for guinea worm disease. Specifically, there was an outbreak of the disease in Kooku/Ikaagbo village - Odeda local government areas in 2004.

Discriminant analysis (DA)

The result of univariate analysis in appendix 1 shows that the average age of respondents infected by guinea worm disease (mean= 34.7 years) is more than the average age of respondents not infected by guinea worm (mean= 29.6 years). Since sex is a dichotomous variable, the mean is not directly interpretable. Its interpretation must take into account the coding by which 1 corresponds to male and 0 corresponds to female. The higher mean for respondents infected by guinea worm disease (mean= 0.57), when compared to the mean for respondents not infected by guinea worm (mean= 0.47). This implies that there are more guinea worm infected males than fe-males. The average farming experience for the infected individuals is more than (8.4 years) that of uninfected individuals (6.3 years).

The result of the discriminant analysis revealed that source of drinking water, medication method adopted by

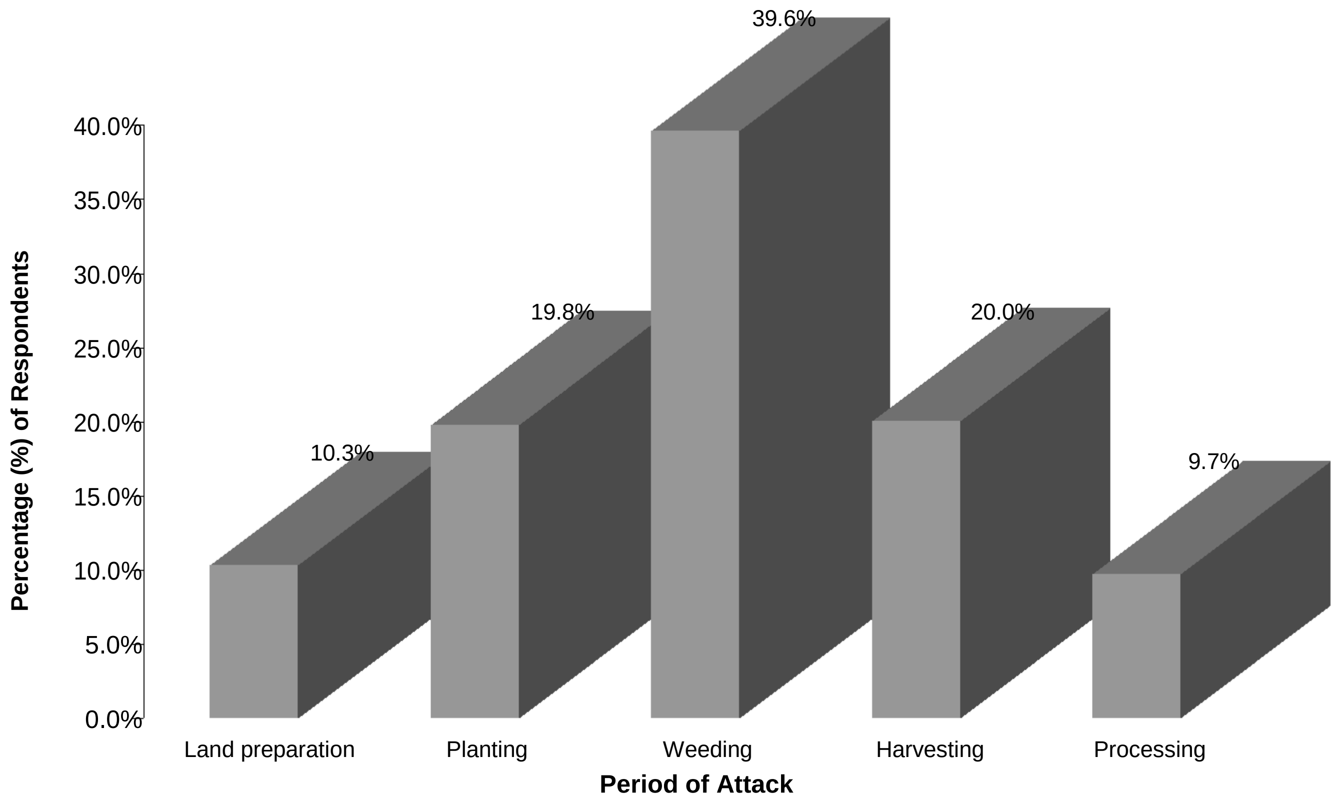

Figure 1. Period of guinea worm disease attack in the study areas.

Table 3. Analysis of variance result.

Source of Variation	SS	df	MS	F	P-value	F crit.
Rows	150.44	5	30.09	1.59	0.25	3.33
Columns	30.11	2	15.06	0.80	0.48	4.10
Error	189.22	10	18.92			
Total	369.78	17				

Source: Survey data (2005).

the infected individuals and the duration of healing of the disease on the infected individuals are significant ($p<0.05$) for the tests of equality of group means out of the 9 identified independent variables. Each test below displays the results of a one-way ANOVA (F-test) for the independent variable using the grouping variable as the factor. This result is also confirmed by the Wilks' Lambda values. The variables with smaller values are better atdiscriminating between guinea worm infected and uninfected respondents in the study areas. The order of significance is as follows: medication method (0.261), source of drinking water (0.707) and healing duration (0.912) (Table 3). Other variables are (age, sex, access to health education, duration of residence, type of labour employed and farming experience) insignificant or have weak discriminating factors on the dependent variables.

Table 3 also shows that medication method is the best, followed by source of drinking water and healing duration. Moreover, the standardized coefficient appendix 2 also confirms medication method as the variable with greater discriminating power. From Table 4, structure matrix shows that predictor variables strongly associated with discriminant function which distinguished between survey respondents of guinea worm infected and uninfected individuals are healing duration (r = 0.810) and medication method (r = - 0.548). Theoretically, a loading in the struc-ture matrix is not interpreted unless it is 0.30 or higher.

The square of canonical correlation (R_c^2) revealed that 79% variation in the dependent variable (infected and uninfected respondents) is attributed to independent variables (medication method, source of drinkable water

Table 4. Tests of equality of group means result.

	Wilks' Lambda	F	df1	Df2	Sig.
Age (Year	0.977	1.498	1	63	0.226
Source of Drinking Water	0.707	26.111	1	63	0.000
Sex	0.971	1.896	1	63	0.173
Access to Health Education	0.999	0.039	1	63	0.844
Duration of Residence	0.999	0.082	1	63	0.776
Medication Method	0.261	178.104	1	63	0.000
Type of Labour Employed	0.968	2.080	1	63	0.154
Faming Experience	0.965	2.262	1	63	0.138
Healing duration	0.912	6.091	1	63	0.016

Source: Survey Data (2005).

Table 5. Eigen values result.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	3.696	100.0	100.0	0.887

Source: Survey Data (2005).

Table 6. Wilks' Lambda Result

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.213	90.479	9	0.000

Source: Survey Data (2005).

Table 7. Box's M Result

Box's M	54.030
F Approx	1.016
df1	45
df2	12396.989
Sig.	0.443

Source: Survey Data (2005)xcz

and healing duration among others) . The remaining 28% may be attributed to other predictors that are not reflected in the model (Table 5).

Unlike Wilks' Lambda test in Table 4 which determines the independent variable to be included in discriminant function, the significance of the Wilks' Lambda test in Table 6 shows that the groups are well separated into consumer of tea and non-consumer of tea by the discriminant function.

Moreover, the significance of this test indicates that the discriminant function does better than chance at separating the groups (infected and uninfected respondents).

In Box's M test, the null hypothesis is accepted (Table 7). This means that there is no significant difference in covariance matrices between the groups formed by the dependent variables (0.443 is greater than 0.05). The acceptance of null hypothesis above (p>0.05) means that two important assumptions of discriminant analysis are not violated. This means that: covariance matrices do not differ between groups formed by the dependent variable; each predictor variable has a normal distribution about fixed values of all the other independents (multivariate norma-lity assumption).

According to Garson (2008), the probability value of F should be greater than 0.05 to demonstrate that the assumption of homoscedasticity is upheld. This test is very sensitive to meeting also the assumption of multivariate normality.

The coefficients of the classification function for guinea worm disease status (infected and uninfected respondents) is presented in Table 8. From this able the equations for the classification of predicted group membership (infected and uninfected individuals) are obtained.

$$D_{inf} = -18.23 + 0.22\lambda_1 + 5.12\lambda_2 + 5.20\lambda_3 + 7.26\lambda_4 + 0.097\lambda_5 + 7.45\lambda_6 + 0.16\lambda_7 - 0.076\lambda_8 + 0.078\lambda_9 \quad (2)$$

$$D_{un\ inf} = -30.85 + 0.29\lambda_1 + 2.49\lambda_2 + 2.81\lambda_3 + 8.10\lambda_4 + 0.024\lambda_5 + 15.70\lambda_6 + 0.35\lambda_7 - 0.20\lambda_8 + 0.023\lambda_9 \quad (3)$$

Given the equations and the observed values of λ_i , the

Table 8. Classification Function Coefficients

	Attacked by Guinea Worm	
	Infected individuals	Uninfected Individuals
Age (Year	0.219	0.291
Source of Drinking Water	5.117	2.486
sex	5.199	2.812
Access to Health Education	7.264	8.095
Duration of Residence	9.697E-02	2.394E-02
Medication Method	7.447	15.699
Type of Labour Employed	0.155	0.349
Faming Experience	-7.609E-02	-0.204
Healing duration	7.759E-02	2.347E-02
(Constant)	-18.523	-30.847

Fisher's linear discriminant functions.
Source: Survey Data (2005)

Table 9. Classification results of residents Into guinea worm infected and uninfected persons

	Predicted group Membership		
Attacked by Guinea Worm	Infected individuals	Uninfected Individuals	Total
Original Count Infected individuals	34	1	35
Uninfected individuals	0	30	30
% Infected individuals	97.1	2.9	100.0
Uninfected individuals	0	100.0	100.0
Cross validated Count Infected individuals	34	1	35
Uninfected individuals	2	28	30
% Infected individuals	97.1	2.9	100.0
Uninfected individuals	6.7	93.3	100.0

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.
b. 98.5% of original grouped cases correctly classified
c. 95.4% of cross-validated grouped cases correctly classified
Source: Survey Data (2005)

discriminant score $\left(D_{\inf} / D_{\text{un} \inf}\right)$ based on the guinea worm disease status can be obtained

From Table 9, the uninfected individuals have the better classification. Of the cases used to create the model, 30 of the 30 individuals (100%) who are previously uninfected are classified correctly while 34 of the 35 individuals (97.1%) who are previously infected are classified correctly. The percentage of the individuals predicted correctly (whether infected or uninfected) gives the original grouped cases correctly classified (98.5%). The cross- validated classification accuracy (95.4%) is signifycantly greater than the accuracy attainable by chance alone (62.5%) . The criterion for classification accuracy is satisfied. This means that the independent variables are useful predictors of the membership of the groups defined by the guinea worm infection status. The proportional by chance accuracy rate is computed by squaring and summing the proportion of cases in each group from the table of prior probabilities for groups (appendix 3): ($0.5^2 + 0.5^2 = 0.5$). A 25% increase over this would require that cross-validated accuracy to be 62.5% (1.25 × 50% = 62.5%).

DISCUSSION

The importance of source of drinking water, method of medication adopted and the duration of healing as strong discriminating factors of guinea worm disease status is revealed by this study. Sex, age and access to health education are shown not to have strong influence on guinea worm infection in the study areas.

The importance of provision of good drinking water in the eradication of guinea worm disease can not be overemphasized. Brieger et al. (1997) also exemplified the importance of safe water to the eradication of guinea worm. Their study pointed out that out of every 188 ende-mic hamlets with an estimated population of 23, 556, 74.3% of the people drink from pond water and 14.4 % has access to safe wells. Hopkins (1998) revealed that in endemic villages, 30% or more of residents may be infected during planting or harvest season. According to the Public Reference Bureau (1996), 84% of Nigerians live and earn their living in the rural areas which lack basic amenities like good drinking water. Hence, these categories of Nigerians depend on water from ponds which serve as breeding grounds for guinea worm disease. One had expected access to health education to be a discriminating factor of guinea worm disease status but it is not. Audibert et al. (1999) opined that health education intervention as the only means of controlling guinea worm disease often failed due to lack of social cohesion or of uncoordinated group-action.

The study also reveals that farmers and other residents of the affected villages were incapacitated for an average of 43.7 days during which economic activities were seriously affected. This period coincided with the peak period of major farming activities such as clearing, weeding and harvesting. The work of Adewale et al. (1997) on the impact of guinea worm disease on agricultural productivity in Owo local government area of Ondo state Nigeria revealed that *Dracunculiasis* incapacitated farmers for 3 months without going to their farms. The guinea worm attack according to the study resulted in the loss of 9,566 bags of potential harvest of cocoa worth ₦2.442 million (Naira) for the period.

The period of absence from the farm may be long where both parent and children are infected by the disease. Those who are able to recover from the attack often abandon rural areas for towns and cities. Greenaway (2004) revealed that large proportion of economically productive individuals of endemic villages are usually affected resulting in decreased agricultural productivity and economic hardship which often lead to rural-urban drift with its attending problems of overpopulation and increase in crime rate.

Moreover, the incapacitation of farmers as a result of the disease accounted for an average man day loss of ₦850.20 in the affected villages. The study revealed that the average cost of treating guinea worm disease is estimated to be ₦1, 350 per infected person. This average cost excludes the cost of removing guinea worm surgically from infected person. This amount is in agreement with Southwest Report (2004), which put average cost of treating guinea worm infected persons between ₦4, 809 and ₦9, 333 in 2003 and 2004 respectively. The report indicated that surgical extraction of guinea worm accountted for 74% of the total cost incurred on treatment.

Furthermore, 49% of the residents in the study areas relied on pond/stagnant water for drinking. This source of water was identified as the breeding ground for guinea worm disease.

Reliance on pond water for drinking, sudden disappearrance of water in boreholes, poor res-ponse to reported cases of the disease and lack of commitment on the part of field and village workers are the problems identified in the study areas. Serious efforts should be made to ensure comprehensive hydrogeological analysis for the suitability of sustainable boreholes which will in turn enhance uninterrupted water supply. However, where cost of sinking boreholes is unbearable, field health workers should ensure that ponds are regularly treated with necessary chemicals and water filters made available to residents of the areas that are prone to the disease.

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Appendices

Appendix 1. Group Statistics Result

Guinea Worm Infected Status	Mean	Standard Deviation	Valid N (listwise)	
			Unweighted	Weighted
Infected Individuals Age (Year	34.71	13.69	35	35.000
Source of Drinking Water	0.7429	0.44	35	35.000
Sex	0.57	0.50	35	35.000
Access to Health Education	1.34	0.48	35	35.000
Duration of Residence	18.00	12.41	35	35.000
Medication Method	1.06	0.34	35	35.000
Type of Labour Employed	2.71	1.53	35	35.000
Faming Experience	8.44	6.60	35	35.000
Healing duration	43.74	12.13	35	35.000
Uninfected Individuals Age (Year	29.63	17.50	30	30.000
Source of Drinking Water	0.20	0.41	30	30.000
Sex	0.47	0.51	30	30.000
Access to Health Education	1.37	0.49	30	30.000
Duration of Residence	17.03	14.84	30	30.000
Medication Method	2.47	0.51	30	30.000
Type of Labour Employed	3.27	1.86	30	30.000
Faming Experience	6.25	3.29	30	30.000
Healing duration	0.00	0.00	30	30.000
Total Age (Year	32.37	15.65	65	65.000
Source of Drinking Water	0.49	0.50	65	65.000
Sex	0.52	0.50	65	65.000
Access to Health Education	1.35	0.48	65	65.000
Duration of Residence	17.55	13.49	65	65.000
Medication Method	1.71	0.82	65	65.000
Type of Labour Employed	2.97	1.70	65	65.000
Faming Experience	7.43	5.40	65	65.000
Healing duration	23.55	23.69	65	65.000

Source: Survey Data (2005)

Appendix 2. Standardized Canonical Discriminant Function Coefficients Result

	Function
	1
Age (Year	-0.267
Source of Drinking Water	0.296
Sex	0.315
Access to Health Education	-0.106
Duration of Residence	0.261
Medication Method	-0.923
Type of Labour Employed	-0.087
Faming Experience	0.192
Healing duration	0.332

Source: Survey Data (2005)

Appendix 3. Structure Matrix Result

	Function
	1
Age (Year	0.810
Source of Drinking Water	-0.548
Sex	0.210
Access to Health Education	0.068
Duration of Residence	-0.054
Medication Method	0.054
Type of Labour Employed	0.034
Faming Experience	0.012
Healing duration	-0.008

Source: Survey Data (2005).