Assessment of Teachers’ Knowledge about Tuberculosis at Primary School in Balad City

Wafaa S. Hasanain

Department of Mathematics, College of Science, Mustansiriyah University, Iraq
E-mail: w.s.hasanain@uomustansiriyah.edu.iq
or
E-mail: w_a_fairness@yahoo.com

Abstract. Tuberculosis (TB) is one of the most common infectious diseases worldwide and continues to be a major public health problem for low and middle-income countries. Undoubtedly, Lack of knowledge about tuberculosis among health care and education workers, as well as if knowledge and practices of tuberculosis among students were generally insufficient causes an increased risk of contracting the disease. Tuberculosis (TB) is a chronic communicable bacterial disease caused by Mycobacterium tuberculosis. The Latest World Health Organization (WHO) Report shows that there were 9.0 Million new TB cases and 1.5 Million tuberculosis deaths. The Transmission of the TB disease by Mycobacterium tuberculosis (a bacterium of a group that includes the causative agents of tuberculosis). takes place by air in the form of sneeze, talk, cough, spit, etc. [1,9,11,12,13]

This applied study attempt to identify, assess and analyze teachers' knowledge about tuberculosis in primary schools. A descriptive design, cross-sectional study was carried out in order to achieve the earlier stated objectives of this study by find out the relationship between teachers' knowledge and social demographic data (sex, age, academic achievement, ….).

The present study lasted for four months by prepared a questionnaires to assess the level of teachers' knowledge, and these questionnaire contains many themes, each theme contained a number of questions to evaluate and analyze teachers 'knowledge of tuberculosis by answering a set of questions (as a variables); (mode of transmission, symptoms and signs, diagnostic features of TB, duration of treatment, prevention methods, risk of developing tuberculosis). The research hypothesis also states that (mycobacterium tuberculosis factor) has a direct impact on TB infection, and to achieve this hypothesis, a questionnaire was distributed to a sample with a size of (58) teachers and the method of Multiple Logistic Regression was used for statistical treatment. Finally, the research concluded a set of results and conclusions included in tables by comparing Likelihood-ratio chi-square statistics and classification table of the observed versus predicted responses.

Keywords: Tuberculosis (TB); Assessment teachers' knowledge; Statistical analysis, Describing Demographic Characteristics, Logistic Regression

1. Introduction

In recent years, some models of modern statistical applications have increased in the analysis of categorical data, especially in the medical, social, cognitive and other fields, and logistic regression analysis is one of the most important statistical models used in describing and analyzing data for these phenomena.

The importance of using multiple logistic regression has increased because it is concerned with analyzing data when the dependent variable is a nominal scale and includes more than two categories [2,3,5,6,8,10,14], and it depends on choosing one of the categories of the dependent variable as a
reference class and then a binary regression analysis is done by comparing this reference class with other categories.

Multiple logistic regression can be represented as:

\[
\ln \left( \frac{p}{1-p} \right) = \beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \cdots + \beta_k x_{kj}
\] (1)

Using the logit transformation, we now have

\[
p = \frac{\exp(\beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \cdots + \beta_k x_{kj})}{1 + \exp(\beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \cdots + \beta_k x_{kj})}
\] (2)

The logistic function curve as in (figure1).

![Figure 1. Graphing the logistic function curve](image)

2. Design of the Study
A descriptive design, cross-sectional study was carried out in order to achieve the earlier stated objectives of this study, the present study is started for the period on (4 December 2018 to 3 April 2019). The study was carried out to determine the assessment of teacher's knowledge about tuberculosis in balad city as a main objective in this study.

3. Administrative Arrangement
In order to initiate this study and collecting the data, the researcher obtained the necessary official approvals. addition to these approvals, the researcher obtained the agreement from participants before distribution of the questionnaire.

4. Setting of the Study
The current study was conducted on the teachers who are working at the schools in Balad City.

5. Sample of the Study
The population in this study is the entire cohort of teachers who are working at schools in Balad. The target population of this study was the teachers who are working in Balad city,(58) teachers.

5.1. Inclusion Criteria
1- All participating teachers working at schools in Balad city.
2- Both sexes (male and female).
3- Those who are voluntary participated.
4- Those who are working at schools and are engaged in teachers tasks and responsibilities.

5.2. Exclusion criteria
1. Those are not willing to participate in the Study.
2. Respondent did not fill the questionnaire completely.
6. Instrument of the study

A questionnaire was designed by the researcher through adoption and modification of the scales that contribute in achieving the objectives of this study. The researcher was developing the instrument of the study depending on the followings:

1. Extensive review of available literature.
2. The validity of the questionnaire was determined through a panel of experts (6 experts). The questionnaire was appropriately designed and considered valid after taking into consideration their suggestion and after getting all the comments and recommendation in attention.

The questionnaire of the study is composed of two parts which are distributed as follows:

6.1. Part 1: socio-demographic information

1. Sex
   1.1. Male
   1.2. Female

2. Age
   2.1. (30 - 39)
   2.2. (40 - 49)
   2.3. (50 and above)

3. Marital status:
   3.1. Unmarried
   3.2. Married
   3.3. Divorced

4. Academic achievement:
   4.1. Graduated teacher's house
   4.2. Graduate Institute:
   4.3. College graduate / Bachelor

6.2. Part 2: Assessment of teachers' knowledge about tuberculosis at primary school

5. Tuberculosis is …:
   5.1 Communicable bacterial disease
   5.2. Disease due to smoking and alcohol
   5.3. Hereditary disease

6. Cause of TB:
   6.1. Cold wind
   6.2. Bacteria
   6.3. Smoking
   6.4. Poor hygiene:

7. Mode of transmission:
   7.1. Through coughing droplet
   7.2. Though sharing dish
   7.3. Through shaking hands

8. Signs and symptom:
   8.1. Cough for 2 weeks or above
   8.2. Weight loss
8.3. On-going fatigue
8.4. Persistent fever

9. diagnostic features of TB (Detection of Tuberculosis):
9.1. Sputum test
9.2. Blood test
9.3. Chest X-ray
9.4. Based on sign and symptom
9.5. Mantoux test (a test for immunity to tuberculosis using intradermal injection of tuberculin)

10. Duration of treatment:
10.1. (4-6) months
10.2. (6-8) months:
10.3. (8-10) months
10.4. (10-12) months

11. Prevention methods:
11.1. Cover mouth when coughing/sneezing
11.2. Washing hands
11.3. Avoiding handshakes
11.4. Isolating TB patients
11.5. Vaccination
11.6. Sufficient ventilation

12. Risk of Developing Tuberculosis:
12.1. Elderly
12.2. Family and person in close contact to patient
12.3. School Children
12.4. Smokers

7. Pilot study
After review of the questionnaire by experts and its approval, a pilot study was carried out before starting the actual data collection on a purposive sample of teachers (N = 6) from both genders at schools in Balad to achieve the following aims.
1. To determine the reliability of the questionnaires.
2. To estimate the average time required for the data collection of each respondent.
3. The clarity of questions items
   The results of pilot study display that
1. The items of the questionnaire were clear and understood.
2. The time required for answering the questionnaire range from (10-15 minutes).

8. Reliability of Questionnaire
In order to determining the reliability of the present study's instrument, Statistical Package for Social Science Program (IBM SPSS) version 24.0 was used for the purpose of reliability determination.

The Cronbach's Alpha (Alpha Correlation Coefficient) was computed in order to determine the internal consistency of the instrument (table 1).

| Scale               | Cronbach's Alpha |
|---------------------|------------------|
| Teachers knowledge  | 0.73             |

Table 1. Reliability Analysis of the Scale (n= 6)
9. Data Collection
The data were collected for the present study through the utilization of the self-administrative questionnaire, for all subjects who were included in the study sample. The researcher distributed the questionnaire for teachers after taking their willing to participate in this study.

11. Descriptive Statistical Data Analysis
After the collection of data, they have been coded and analyzed by the application of statistical procedures and by using (IBM SPSS) program to analyse and assess the results of the study.

The method of analysis used was descriptive statistical. This analysis was performed through computation (Frequencies (F)), and (Percentages (%)), as well as the use of multiple logistic regression analysis for variables.

12. Practical study
12.1 study samples by demographic characteristics
In this section, a practical study has been done to assess the result. After collecting data and relying on the results of the questionnaire, which was distributed to more than one teacher, and after excluding the non-typical answers and conforming to the fundamental rules in answering the questionnaire, the results of 58 questionnaires that represent the sample size in questions were fixed.

| Demographic data groups | Study            | F  | %   |
|-------------------------|------------------|----|-----|
| Cold wind               | 12  | 20.7|
| Bacteria                | 29  | 50.0|
| Smoking and alcohol     | 2   | 3.4 |
| Poor hygiene            | 15  | 25.9|
| Sex                     | Male            | 16 | 27.6|
|                         | Female          | 42 | 72.4|
| Age                     | 30 - 39         | 11 | 19.0|
|                         | 40 - 49         | 42 | 72.4|
|                         | 50 and above    | 5  | 8.6 |
| Academic achievement    | Graduated teachers house | 8 | 13.8|
|                         | Graduated Institute | 32 | 55.2|
|                         | College graduate / Bachelor | 18 | 31.0|
| Marital Status          | Unmarried       | 5  | 8.6 |
|                         | Married         | 53 | 91.4|
|                         | Divorce         | 0  | 0.0 |
| Tuberculosis is         | Communicable bacterial disease | 48 | 82.8|
|                         | Disease due to smoking and alcohol | 9 | 15.5|
|                         | Hereditary disease | 1 | 1.7 |
| Mode of transmission    | Through coughing droplet | 42 | 72.4|
|                         | Though sharing dish | 14 | 24.1|
|                         | through shaking hands | 2 | 3.4 |
| Signs and Symptom       | Cough for 2 weeks or above | 17 | 29.3|
|                         | weight loss     | 9  | 15.5|
ongoing fatigue 8 13.8
persistent fever 24 41.4

**Diagnostic features of TB**
(Detection of Tuberculosis)

sputum test 17 29.3
blood test 13 22.4
chest X-ray 27 46.6
Based on sign and symptom 1 1.7
Mantoux test 0 0.0

**Duration of treatment**

4 - 6 months 33 56.9
6 - 8 months 11 19.0
8 - 10 months 2 3.4
10-12 months 12 20.7

cover mouth when coughing / sneezing 6 10.3
washing hands 2 3.4

**Prevention methods**

avoiding handshakes 3 5.2
isolating TB patients 24 41.4
vaccination 17 29.3
sufficient ventilation 6 10.3
cover mouth when coughing / sneezing 6 10.3

**Risk of Developing tuberculosis**

Elderly 7 12.1
family and person in close contact to patient 9 15.5
school children 23 39.7
smokers 19 32.8

(Table 2) shows that most of the study sample were their (Cause of TB; Cold wind, Bacteria, Smoking and alcohol, Poor hygiene) which accounted (20.7, 50.5, 3.4, 25.9)% respectively, whereas most of them (50%) answer bacteria is causes the TB and it is the correct answer. The majority of studied sample was female (72.4%), and male (27.6%). At age group for participants in the study more than a half age ((40 – 49) years; 72.4%), followed by those who age ((30 – 39) years; 19.0%), those who (50 and above years; 8.6%). More than half of study group’s participants were graduated from Institute, then from college and finally from teachers house as percentages (55.2,31.0, 13.8)% respectively. The most of teachers were married, unmarried and they are accounted (91.4 , 8.6)% respectively. For the Tuberculosis, most teachers diagnosed it as a (Communicable bacterial disease at 82.8 percentage) and this is correct diagnose. For the Mode of transmission the first transmission is due to coughing droplet (72.4%), followed by those who sharing dish (24.1%), and (3.4) for shaking hands. The answer for Signs and Symptom recorded (cough for 2 weeks or above, weight loss, on going fatigue, persistent fever which accounted (29.3, 15.5, 13.8, 41.4)% respectively. The teachers diagnose features of TB as (sputum test, blood test, chest X-ray, based on sign and symptom) with (29.3, 22.4 46.6, 1.7)% respectively. For the study group about duration of treatment they came at these order (4–6 months ; 56.9, 6–8 months ; 19.0, and 8–10 months ; 3.4, 10–12 months ; 20.7) respectively. Followed by Prevention methods, they recorded (cover mouth when coughing / sneezing, washing hands, avoiding handshakes, isolating TB patients, vaccination, sufficient ventilation, cover mouth when coughing / sneezing) with (10.3, 3.4, 5.2, 41.4, 29.3, 10.3, 10.3)% respectively. Finally risk of developing tuberculosis listed (elderly, family and person in close contact to patient, school children, smokers) with (12.1, 15.5, 39.7, 32.8)%.

12.2 Building the logistic regression model for the dependent variable
After that to test the significance of relationship between the dependent and independent variables included in the study using multiple logistic regression. The factor of (causes of tuberculosis) are chosen as a dependent variable divided into four categories, and the reference category that was established indicates that tuberculosis is the result of infection with TB bacteria, and compared with the independent variables to assess and analyze the knowledge of teachers’ responses to Tuberculosis. The (table 3) indicates the categories and values of dependent variable.

| Categ. | Dep. Var. | values |
|--------|-----------|--------|
| Cold wind | 1 |
| Bacteria | 2 |
| Smoking and alcohol | 3 |

12.3  Model estimation of sex variable

A multinomial logit model is fit for the full factorial model by applying the (equation 2) and it is performed through an iterative maximum likelihood algorithm, Likelihood is often assumed to be the same as a probability or even as a P-value [Wikipedia demonstrated],[Rinar & Gray 2006 p.483] (Table 4) indicates the number of Iteration cycles of the derivative of the maximum likelihood function within the categories of the sex variable.

| Table 3. categories and values of dependent variable |
|-----------------------------------------------|
| Categ. | Dep. Var. | values |
|--------|-----------|--------|
| Cold wind | 1 |
| Bacteria | 2 |
| Smoking and alcohol | 3 |

| Table 4. Iteration Maximum likelihood of sex variable |
|-----------------------------------------------|
| Cause of TB | Iteration History* |
| -2 Log | Cold wind | Smoking and alcohol | Poor hygiene |
| Iteration | Likelihood | Intercept [Sex=1] | Intercept [Sex=1] | Intercept [Sex=1] |
| 0 | 23.633 | -0.882389 | 1.812500 | -0.659246 |
| 1 | 17.219 | -1.382389 | 1.833048 | 1.812500 |
| 2 | 17.082 | -1.426332 | 1.832578 | 1.833048 |
| 3 | 17.081 | -1.427116 | 1.832581 | 1.832578 |
| 4 | 17.081 | -1.427116 | 1.832581 | 1.832581 |
| 5 | 17.081 | -1.427116 | 1.832581 | 1.832581 |

* Source: the results are Preparing by the researcher based on of the data analysis.

From the (table 4) and to obtain the lowest value of the negative logarithm function to get an optimal estimate of the parameters, we stop in the fifth iteration of the negative derivative (-2 Log Likelihood), and we got the lowest value which is (1.139434) to the differences between the parameters, where these differences reached to less than (0.001).

| Table 5. Estimates of the logistic regression of cause of TB with sex model |
|-----------------------------------------------|
| Parameter Estimates |
| Cause of TB | B | Std. Error | Wald | df | Sig. |
| Cold wind | Intercept [-1.427] | .455 | 9.855 | 1 | .002 |
| [Sex=1] | 1.833 | .790 | 5.388 | 1 | .020 |
| [Sex=2] | 0 | . | 0 | . |
| Intercept | -3.219 | 1.020 | 9.963 | 1 | .002 |
| Smoking and alcohol | Intercept | -0.916 | .374 | 5.997 | 1 | .014 |
| [Sex=1] | 1.833 | 1.513 | 1.467 | 1 | .226 |
| [Sex=2] | 0 | . | 0 | . |
| [Sex=2] | 0 | . | 0 | . |
Poor hygiene

| [Sex=1] | 1.139 | .768 | 2.201 | 1 | .138 | .693 | 14.082 |
| [Sex=2] | 0b | . | . | 0 | . | . | . |

a. The reference category is: Bacteria.
b. This parameter is set to zero because female is reference category.

(Table 5) depict the regression coefficients, standard error, Wald statistic with degrees of freedom and significance for the indp. var. (sex) and confidence interval for Exp(B) and the constant term would have been the log odds ratio for bacteria. For the dependent variable (the Cause of TB) had been a multinomial categories, and had specified bacteria as the reference group. The constant term (B) is the estimated coefficient and equal to log-odds ratios, and the equation of estimated log. regression

log(cold wind) = -1.427 + 1.833*(sex=1)                                                    (3)

log(Smoking and alcohol) = -3.219 + 1.833*(sex=1)                                   (4)

log(Poor hygiene) = -.916 + 1.139*(sex=1)                                                  (5)

These estimates tell about the relationship between (sex) variable and the (cause of TB), where the dependent variable is on the logit scale, and from the table it turned out significance the effect of sex when the teacher is male and his choice was cold wind. The fact that the teacher is male means that it increases the probability of choosing (exposure to cold air) versus infection by bacteria (1.833) compared to the female, which represents as a reference category, that means if the sex of teacher is men, then the logarithm of the possibility [Exp(B); this is the odd ratio for the predictors, this is the exponentiation of the coefficients] of choosing cold wind versus bacteria increases by an amount (1.33), whereas the teacher’s choice of smoking and alcohol and Poor hygiene reasons did not show any significant.

The Wald columns provide the Wald chi-square value and 2-tailed p-value used in testing the null hypothesis and it is equal to (5.388).

| Observed          | Predicted          | Percent Correct |
|-------------------|--------------------|-----------------|
|                   | Cold wind | Bacteria | Smoking and alcohol | Poor hygiene | |
| Cold wind         | 6         | 6        | 0                  | 0            | 50.0% |
| Bacteria          | 4         | 25       | 0                  | 0            | 86.2% |
| Smoking and alcohol | 1       | 1        | 0                  | 0            | 0.0%  |
| Poor hygiene      | 5         | 10       | 0                  | 0            | 0.0%  |
| Overall Percentage| 27.6%     | 72.4%    | 0.0%               | 0.0%         | 53.4% |

we notice that from the classification table (table 6) the overall accuracy of this model to predict cause of TB by using the independent variable (sex) is (53.4%) which is somewhat considered acceptable. We notes that the number of classified and selected the correct answer of teachers (25 teachers) to bacteria at percentage (86.2%) and that they were wrongly chosen by (4 teachers).

12.4 Model estimation of Tuberculosis variable

Now we test the significant between the dependent (cause of Tb) and the independent (Tuberculosis).
For the (table 7) and to obtain the lowest value of the negative logarithm function to get an optimal estimate of the parameters, we stop in the fifteen iteration of the negative derivative (-2 Log Likelihood), and we got last absolute change in -2 Log Likelihood is .000, and last maximum absolute change in parameters is 1.000000.

Table 8. Estimates of the logistic regression cause of TB with tuberculosis model

| Cause of TB          | B     | Std. Error | Wald | df | Sig. | Exp(B)   |
|----------------------|-------|------------|------|----|------|----------|
| [Tuberculosis is=1]  | 15.735| 5128.877   | .000 | 1  | .997 | 6819911.866 |
| [Tuberculosis is=2]  | 18.695| 5128.877   | .000 | 1  | .997 | 131526871.70 |
| [Tuberculosis is=3]  | -18.877| 1.414     | 178.171 | 1  | .000 | 5845638.598 |
| [Tuberculosis is=1]  | 15.581| 1.743      | 79.938 | 1  | .000 | 157832242.10 |
| [Tuberculosis is=2]  | 18.877| .000       |       | 1  | .    | 42088598.410 |
| [Tuberculosis is=3]  | -16.862| 4587.407  | .000 | 1  | .997 | 10132440.360 |
| [Tuberculosis is=2]  | 17.555| 4587.407   | .000 | 1  | .997 | 42088598.410 |
| [Tuberculosis is=3]  | 0     | .          |       | 0  | .    | 1.000000   |

(Table 8) presents the regression coefficients, standard error, Wald statistic with degrees of freedom and significance for the indp. Var., significance .The teacher’s choices is the effect of infectious bacterial diseases are transmitted, which corresponds to the fact that the cause of tuberculosis is the bacterial agent. The fact that when the teacher choices communicable bacterial disease means that it increases the probability of choosing (smoking and alcohol) versus infection by...
bacteria for the cause of tuberculosis by register a number equal to \( b = 15.581 \) with \( \text{sig} = 0.00 \), compared to the rest of tuberculosis (hereditary disease), whilst there is no significant between cause of TB represented by (Cold wind and Poor hygiene) and the tuberculosis, and the equation of estimated log. regression are

\[
\log(\text{cold wind}) = -17.09 + 15.74(\text{Tuberculosis is}=1) + 15.74(\text{Tuberculosis is}=2) \\
\log(\text{Smoking and alcohol}) = -18.87 + 15.58(\text{Tuberculosis is}=1) + 18.88(\text{Tuberculosis is}=2) \\
\log(\text{Poor hygiene}) = -16.86 + 16.13(\text{Tuberculosis is}=1) + 17.56(\text{Tuberculosis is}=2)
\]

Table 9. Classification table of TB with tuberculosis variables

| Classification - TUBERCULOSIS | Observed | Predicted |
|------------------------------|----------|-----------|
| Cold wind                    | 5        | 7         |
| Bacteria                     | 1        | 28        |
| Smoking and alcohol          | 1        | 1         |
| Poor hygiene                 | 2        | 13        |
| Overall Percentage           | 15.5%    | 84.5%     |

From the (table 9) we find that the ratio of the correct classification percentage to the bacteria is (96.6%), or for those who are chosen bacteria are (28 teachers) and the rest chose cold wind, smoking and alcohol, Poor hygiene with percentage equal to zero. The overall classification rate has reached (56.9%).

Table 10. Iteration Maximum likelihood of Mode of transmission variable

| Iteration | -2 Log Likelihood | Intercept | Cold wind \[\text{Mode of transmission}\] | Cause of TB \[\text{Mode of transmission}\] | Poor hygiene \[\text{Mode of transmission}\] |
|-----------|-------------------|-----------|------------------------------------------|------------------------------------------|---------------------------------------------|
|           |                   |           | -21                                      | -21                                      | -21                                         |
| 0         | 22.299            | -8.82389 | 1                                        | 1                                        | 1                                           |
| 1         | 18.922            | .534277  | -1.706                                   | -1.706                                   | -1.706                                      |
| 2         | 18.475            | -.070414 | -1.119                                   | -1.119                                   | -1.119                                      |
| 3         | 18.406            | .001883  | -1.191                                   | -1.191                                   | -1.191                                      |
| 4         | 18.383            | -1.747419E-5 | -1.190 | -1.190 | -1.190 |
| 5         | 18.374            | 5.909074E-5 | -1.190 | -1.190 | -1.190 |
| 6         | 18.371            | -7.326481E-11 | -1.190 | -1.190 | -1.190 |
| 7         | 18.370            | 3.275862E-14 | -1.190 | -1.190 | -1.190 |
| 8         | 18.369            | -1.740438E-15 | -1.190 | -1.190 | -1.190 |
| 9         | 18.369            | -1.087408E-15 | -1.190 | -1.190 | -1.190 |
| 10        | 18.369            | 1.260736E-15 | -1.190 | -1.190 | -1.190 |
| 11        | 18.369            | -1.006894E-15 | -1.190 | -1.190 | -1.190 |
| 12        | 18.369            | -1.240451E-15 | -1.190 | -1.190 | -1.190 |
| 13        | 18.369            | -1.941337E-15 | -1.190 | -1.190 | -1.190 |
| 14        | 18.369            | -1.383785E-16 | -1.190 | -1.190 | -1.190 |
12.5 Model estimation of Mode of transmission variable

Now we test the significant between the dependent (cause of Tb) and the independent (Mode of transmission).

For the (table 10) and to obtain the lowest value of the negative logarithm function to get an optimal estimate of the parameters, we stop in the sixteen iteration of the negative derivative, Last absolute change in -2 log likelihood is (0.000), and last maximum absolute change in parameters is (1.000000).

| Cause of TB | B         | Std. Error | Wald     | df | Sig. | Exp(B) | 95% confidence interval for exp(B) |
|-------------|-----------|------------|----------|----|------|--------|----------------------------------|
| Intercept   | 0.000     | 1.414      | 0.000    | 1  | 1.000| 1.000  | [0.000, 1.000]                   |
| [Mode of transmission=1] | -1.190     | 1.479      | 0.647    | 1  | .421 | .304   | .017                             |
| [Mode of transmission=2] | -0.223     | 1.565      | 0.020    | 1  | .887 | .800   | .037, 5.521                     |
| [Mode of transmission=3] | 0b         | .          | .        | 0  | .    | .      | 17.196                           |
| Intercept   | -19.142   | 1.095      | 305.336  | 1  | .000 | 8941132, 474724                   |
| [Mode of transmission=1] | 16.006     | 1.498      | 114.197  | 1  | .000 | 8941132, 474724                   |
| [Mode of transmission=2] | 17.532     | .000       | .        | 1  | .    | 411292, 168400                    |
| [Mode of transmission=3] | 0b         | .          | .        | 0  | .    | .      | 10.540                           |
| Intercept   | -17.127   | 5236.361   | .000     | 1  | .997 | 1311366, .000                     |
| [Mode of transmission=1] | 16.389     | 5236.361   | .000     | 1  | .997 | 1311366, .000                     |
| [Mode of transmission=2] | 16.904     | 5236.361   | .000     | 1  | .997 | 2191357, 7.630                    |
| [Mode of transmission=3] | 0b         | .          | .        | 0  | .    | .      | .                                |

a. The reference category is: Bacteria.

b. This parameter is set to zero because it is redundant

(Table 11) presents the regression coeff., standard error, Wald statistic and significance for the indp. var., (mode of transmission), the value of exp(B), it turned out significance the effect of mode of transmission, when the teacher choices (through coughing droplet) instead of bacterial agent to mode of transmission means that it increases the probability of choosing (smoking and alcohol) versus infection by bacteria for the cause of tuberculosis by register a number equal to (16.006) compared to the rest of tuberculosis (through shaking hands), whilst there is no significant between cause of TB
represented by (Cold wind and Poor hygiene) and the tuberculosis, and the estimated equations

$$\log(\text{cold wind}) = 0.000 - 1.190 \times (\text{Mode of transmission} = 1) - 0.223 \times (\text{Mode of transmission} = 2)$$  \hspace{1cm} (9)

$$\log(\text{Smoking and alcohol}) = -19.142 + 16.006 \times (\text{Mode of transmission} = 1) + 17.532 \times (\text{Mode of transmission} = 2)$$  \hspace{1cm} (10)

$$\log(\text{Poor hygiene}) = -17.127 + 16.389 \times (\text{Mode of transmission} = 1) + 16.904 \times (\text{Mode of transmission} = 2)$$  \hspace{1cm} (11)

**Table 12. Classification table of TB with mode of transmission variables**

| Observed | Cold wind | Bacteria | Smoking and alcohol | Poor hygiene | Perc. correct |
|----------|-----------|----------|---------------------|--------------|---------------|
| Cold wind | 1 | 11 | 0 | 0 | 8.3% |
| Bacteria | 1 | 28 | 0 | 0 | 96.6% |
| Smoking and alcohol | 0 | 2 | 0 | 0 | 0.0% |
| Poor hygiene | 0 | 15 | 0 | 0 | 0.0% |
| Overall Percentage | 3.4% | 96.6% | 0.0% | 0.0% | 50.0% |

Table (12) exhibit the ratio of the correct classification percentage to the bacteria is (96.6%), or for those who are chosen bacteria are (28 teachers) and the rest chose cold wind (8.3%), smoking and alcohol, Poor hygiene with percentage equal to zero. The overall classification rate has reached a halve percentage (50.0%).

### 12.6 Model estimation of Signs and Symptom variable

**Table 13. Iteration Maximum likelihood of Signs and Symptom variable**

| Iteration | Log Likelihood | 2 Log Likelihood | Intercept | | Sig and Symp. | | Sig and Symp. | | Sig and Symp. | | Sig and Symp. | | Sig and Symp. | |
|-----------|----------------|------------------|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|
| 0         | 39.276         | -1.028           | -1.183    | -250 | -2.216    | -1.752    | -1.569    | 2.167    | 0.363 | -1.861    | -2.133    | -1.056 |
| 1         | 23.135         | -0.922           | -0.844    | -316 | -2.195    | -2.806    | -2.901    | 1.139    | 0.200 | -1.891    | -3.281    | -0.946 |
| 2         | 22.600         | -0.878           | -0.877    | -286 | -2.197    | -3.810    | -3.913    | 0.847    | 0.201 | -1.905    | -4.296    | -0.949 |
| 3         | 22.445         | -0.878           | -0.875    | -288 | -2.197    | -4.812    | -4.924    | 0.811    | 0.201 | -1.905    | -5.307    | -0.949 |
| 4         | 22.390         | -0.878           | -0.877    | -288 | -2.197    | -5.812    | -5.928    | 0.811    | 0.201 | -1.905    | -6.311    | -0.949 |
| 5         | 22.369         | -0.878           | -0.875    | -288 | -2.197    | -6.812    | -6.929    | 0.811    | 0.201 | -1.905    | -7.312    | -0.949 |
| 6         | 22.361         | -0.878           | -0.875    | -288 | -2.197    | -7.813    | -7.930    | 0.811    | 0.201 | -1.905    | -8.313    | -0.949 |
| 7         | 22.359         | -0.878           | -0.875    | -288 | -2.197    | -8.813    | -8.930    | 0.811    | 0.201 | -1.905    | -9.313    | -0.949 |
| 8         | 22.358         | -0.878           | -0.875    | -288 | -2.197    | -9.813    | -9.930    | 0.811    | 0.201 | -1.905    | -0.933    | -0.949 |
| 9         | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -10.813   | -10.930   | 0.811    | 0.201 | -1.905    | -11.313   | -0.949 |
| 10        | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -11.813   | -11.930   | 0.811    | 0.201 | -1.905    | -12.313   | -0.949 |
| 11        | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -12.813   | -12.930   | 0.811    | 0.201 | -1.905    | -13.313   | -0.949 |
| 12        | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -13.813   | -13.930   | 0.811    | 0.201 | -1.905    | -14.313   | -0.949 |
| 13        | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -14.813   | -14.930   | 0.811    | 0.201 | -1.905    | -15.313   | -0.949 |
| 14        | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -15.813   | -15.930   | 0.811    | 0.201 | -1.905    | -16.313   | -0.949 |
| 15        | 22.357         | -0.878           | -0.875    | -288 | -2.197    | -16.813   | -16.930   | 0.811    | 0.201 | -1.905    | -17.313   | -0.949 |
| 16        | 22.357         | -0.882           | -0.000    | -0.000 | -2.674    | -0.000    | -0.000    | -0.659    | -0.000 | -0.000    | -0.000    | -0.000 |

12
For the (table 13) we stop in the seventeen iteration of the negative derivative and the last absolute change in $-2 \log$ likelihood equal to zero, and last maximum absolute change in parameters equal to one.

**Table 14.** Estimates of the logistic regression cause of TB with signs and symptom model

| Parameter Estimates | cause of TB | b       | std. error | wald  | df  | sig. | $\text{Exp}(B)$ |
|---------------------|-------------|---------|------------|-------|-----|------|------------------|
| Intercept           | -1.099      | .667    | 2.716      | 1     |    | .099 |                  |
| [Signs and Symptom=1] | .087        | .886    | .010       | 1     |    | .922 |                  |
| [Signs and Symptom=2] | .875        | .946    | .857       | 1     |    | .355 |                  |
| [Signs and Symptom=3] | -.288       | 1.302   | .049       | 1     |    | .825 | 1.091            |
| [Signs and Symptom=4] | 0           | .     | .          | 0     |    |      | 2.400            |
| Cold wind           | -2.197      | 1.054   | 4.345      | 1     |    | .037 | .750             |
| [Signs and Symptom=1] | -17.813     | 6674.009 | .000      | 1     |    | .998 |                 |
| [Signs and Symptom=2] | -17.930     | .000    | .          | 1     |    |      |                  |
| [Signs and Symptom=3] | .811        | 1.537   | .279       | 1     |    | .598 | 1.837E-8         |
| [Signs and Symptom=4] | 0           | .     | .          | 0     |    |      | 1.633E-8         |
| Smoking and alcohol | -2.016      | 1.449   | .199       | 1     |    | .655 | 2.250            |
| [Signs and Symptom=1] | -1.905      | .890    | 4.579      | 1     |    | .032 |                 |
| [Signs and Symptom=2] | -18.313     | 3833.090 | .000     | 1     |    | .996 |                 |
| [Signs and Symptom=3] | -.894       | .976    | .839       | 1     |    | .360 | .149             |
| [Signs and Symptom=4] | 0           | .     | .          | 0     |    |      | 1.114E-8         |

* The reference category is: Bacteria.

(Table 14) presents the regression coeff., standard error, Wald statistic with and significance for the indp. var.,(Signs and symptom), the value of $\text{Exp}(B)$, it turned out significance the effect of Signs and symptom, when the teacher choices (cough for 2 weeks or above) instead of bacterial agent to signs and symptom means that it decreases the probability of choosing (Poor hygiene) versus infection by bacteria for the signs and symptom by register a number equal to (-1.905) compared to the rest of Signs and symptom (persistent fever), whilst there is no significant between cause of TB represented by (Cold wind and Smoking and alcohol) and the signs and symptom, and the estimated equations are:

$$\log(\text{cold wind})=-1.099+0.087*(\text{Signs and Symptom}=1)+0.875*(\text{Signs and Symptom}=2)$$

$$-0.288*(\text{Signs and Symptom}=3)$$  \hspace{1cm} (12)
log(Smoking and alcohol) = -2.197-17.813*( Signs and Symptom=1) -17.930*( Signs and Symptom =2)+0.811*( Signs and Symptom =3) 

\[13\]

log(Poor hygiene) = 0.201-1.905*( Signs and Symptom=1)-18.313*( Signs and Symptom=2) -0.894*( Signs and Symptom =3) 

\[14\]

| Table 15. Classification table of TB with signs and symptom variables |
|------------------|------------------|-----------|-------------|-------------|------------------|
|                  | Observed         | Predicted | Smoking and alcohol | Poor hyg. | Perc. Corr.     |
| Cold wind        | Cold wind        | Bact.     | 0           | 9           | 0               |
| Bacteria         | 0                | 20        | 0           | 9           | 69.0%           |
| Smoking and alcohol | 0               | 1         | 0           | 1           | 0.0%            |
| Poor hygiene     | 0                | 4         | 0           | 11          | 73.3%           |
| Overall Percentage | 0.0%          | 58.6%     | 0.0%        | 41.4%       | 53.4%           |

(Table 15) exhibits the ratio of the correct classification percentage to the bacteria is about (69.0%), or for those who are chosen bacteria are (20 teachers) and the rest chose Poor hygiene (73.3%), cold wind and smoking and alcohol with percentage equal to zero. The overall classification rate has reached (53.4%).

12.7 Model estimation of Duration of treatment variable

| Table 16. Iteration Maximum likelihood of Mode of transmission variable |
|------------------|------------------|-----------|-------------|-------------|------------------|
|                  | -2 Log Likelihood | Iteration     | Cause of TB |
|                  | Cold wind         | Smoking and alcohol | Poor hygiene |
| n=1         | n=3            | n=1            | n=3         | n=1             | n=3             |
| Iteration | Durati | Duratio | Durati | Durati | Durati | Durati | Intercept | Durati | Durati | Durati | Durati |
| 0         | 38.995 | . -882389 | .000 | .000 | -2.674 | .000 | .000 | -.659 | .000 | .000 | .000 |
| 1         | 19.018 | -.174056 | -.360 | -.2527 | -.708 | -3.174 | 1.288 | -1.318 | .500 | .774 | -1.700 | -2.900 | 2.433 |
| 2         | 17.512 | .018476 | -.594 | -.3808 | -.901 | -4.187 | 2.119 | -1.394 | 1.513 | .695 | -1.677 | -2.998 | 3.572 |
| 3         | 17.068 | -5.441963E-6 | -.575 | -.4813 | -.882 | -5.196 | 3.117 | -1.409 | 2.522 | .693 | -1.674 | -2.996 | 4.595 |
| 4         | 16.909 | 7.489158E-9 | -.575 | -.5822 | -.882 | -6.198 | 4.118 | -1.416 | 3.524 | .693 | -1.674 | -2.996 | 5.603 |
| 5         | 16.851 | -3.808443E-12 | -.575 | -.6825 | -.882 | -7.198 | 5.119 | -1.419 | 4.524 | .693 | -1.674 | -2.996 | 6.605 |
| 6         | 16.829 | 7.321564E-16 | -.575 | -.7826 | -.882 | -8.198 | 6.119 | -1.420 | 5.524 | .693 | -1.674 | -2.996 | 7.606 |
| 7         | 16.821 | 3.633731E-16 | -.575 | -.8827 | -.882 | -9.199 | 7.119 | -1.420 | 5.624 | .693 | -1.674 | -2.996 | 8.607 |
| 8         | 16.818 | 1.160435E-16 | -.575 | -.9827 | -.882 | -10.199 | 8.119 | -1.420 | 7.524 | .693 | -1.674 | -2.996 | 9.607 |
| 9         | 16.817 | -8.587968E-16 | -.575 | -.10827 | -.882 | -11.199 | 9.119 | -1.420 | 8.524 | .693 | -1.674 | -2.996 | 10.607 |
| 10        | 16.817 | -5.322556E-17 | -.575 | -.11827 | -.882 | -12.199 | 10.119 | -1.420 | 9.524 | .693 | -1.674 | -2.996 | 11.607 |
| 11        | 16.817 | -3.526540E-16 | -.575 | -.12827 | -.882 | -13.199 | 11.119 | -1.420 | 10.524 | .693 | -1.674 | -2.996 | 12.607 |
| 12        | 16.817 | -8.146650E-16 | -.575 | -.13827 | -.882 | -14.199 | 12.119 | -1.420 | 11.524 | .693 | -1.674 | -2.996 | 13.607 |
| 13        | 16.817 | -3.640197E-16 | -.575 | -.14827 | -.882 | -15.199 | 13.119 | -1.420 | 12.524 | .693 | -1.674 | -2.996 | 14.607 |
| 14        | 16.817 | 4.314974E-16 | -.575 | -.15827 | -.882 | -16.199 | 14.119 | -1.420 | 13.524 | .693 | -1.674 | -2.996 | 15.607 |
| 15        | 16.817 | -3.174123E-16 | 0.000 | 0.000 | -2.674 | 0.000 | 0.000 | -.659 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

For the (table 16) and to obtain the lowest value of the negative logarithm function to get an optimal estimate of the parameters, we stop in the sixteen iteration of the negative derivative, Last
absolute change in -2 log likelihood is (0.000), and last maximum absolute change in parameters is (1.000000).

Table 17. Estimates of the logistic regression cause of TB with duration of treatment model

| Parameter Estimates | Cause of TB | B       | Std. Error | Wald   | df | Sig.  | Exp.(B) |
|---------------------|-------------|---------|------------|--------|----|-------|---------|
| Intercept           | Cold wind   | .000    | .816       | .000   | 1  | 1.000 |         |
| (Duration of        | [Duration   | -.575   | .917       | .394   | 1  | .530  | .563    |
| treatment=1)       | treatment=1]|         |            |        |    |       |         |
|                     | [Duration   | -16.827 | 1425.373   | .000   | 1  | .991  | 4.922E-8|
|                     | treatment=2]|         |            |        |    |       |         |
|                     | [Duration   | -.882   | 7395.244   | .000   | 1  | 1.000 | .414    |
|                     | treatment=3]|         |            |        |    |       |         |
|                     | [Duration   | 0       |            |        | 0  |       |         |
|                     | treatment=4]|         |            |        |    |       |         |
| Intercept           | Smoking     | -17.199 | 3074.547   | .000   | 1  | .996  |         |
| and alcohol         | (Duration of| 15.119  | 3074.547   | .000   | 1  | .996  | 3682570.164|
|                     | treatment=1]|         |            |        |    |       |         |
|                     | (Duration of| -1.420  | 4652.199   | .000   | 1  | 1.000 | .242    |
|                     | treatment=2]|         |            |        |    |       |         |
|                     | (Duration of| 14.524  | .000       | .1     | 1  | .     | 2031762.849|
|                     | treatment=3]|         |            |        |    |       |         |
|                     | (Duration of| 0       |            |        | 0  |       |         |
|                     | treatment=4]|         |            |        |    |       |         |
| Intercept           | Poor hygiene| .693    | .707       | .961   | 1  | .327  |         |
|                     | (Duration of| -1.674  | .854       | 3.843  | 1  | .050  | .188    |
|                     | treatment=1]|         |            |        |    |       |         |
|                     | (Duration of| -2.996  | 1.265      | 5.609  | 1  | .018  | .050    |
|                     | treatment=2]|         |            |        |    |       |         |
|                     | (Duration of| 16.607  | 3910.318   | .000   | 1  | .997  | 16303051.70|
|                     | treatment=3]|         |            |        |    |       |         |
|                     | (Duration of| 0       |            |        | 0  |       |         |
|                     | treatment=4]|         |            |        |    |       |         |

The results of (table 17) turned out two significance the effect of duration of treatment, firstly when the teacher choices the period of treatment (4-6 months) means that it decreases the probability of choosing (Poor hygiene) versus infection by bacteria by registering a number equal to (-1.674) compared to the period of treatment (10-12 months), secondly when the teacher choices the period of treatment (6-8 months) means that it decreases the probability of choosing (Poor hygiene) versus infection by bacteria for the duration of treatment by register a number equal to (-2.996) compared to the period of treatment (10-12 months), whilst there is no significant between cause of TB represented by (Cold wind and Smoking and alcohol) and the duration of treatment, and the equations are:

log(cold wind)= 0.000-0.575*(Duration of treatment =1) -16.827*(Duration of treatment =2) + 0.882*(Duration of treatment =3)  

(15)

log(Smoking and alcohol)= -17.199 + 15.119*(Duration of treatment =1) -1.420*(Duration of treatment =2) + 14.524*(Duration of treatment =3)  

(16)
\[
\log(\text{Poor hygiene}) = 0.693 - 1.674 \times (\text{Duration of treatment} = 1) - 2.996 \times (\text{Duration of treatment} = 2) + 16.607 \times (\text{Duration of treatment} = 3)
\]

(17)

Table 18. Classification table of TB with Duration of treatment variables

| Classification - DURATION | Cold wind | Bacteria | Smoking and alcohol | Poor hygiene | Percent Correct |
|---------------------------|-----------|----------|---------------------|--------------|-----------------|
| **observed**              |           |          |                     |              |                 |
| **cold wind**             | 0         | 9        | 0                   | 3            | 0.0%            |
| **bacteria**              | 0         | 26       | 0                   | 3            | **89.7%**       |
| **smoking and alcohol**   | 0         | 2        | 0                   | 0            | 0.0%            |
| **poor hygiene**          | 0         | 7        | 0                   | 8            | **53.3%**       |
| **overall Percentage**    | 0.0%      | 75.9%    | 0.0%                | 24.1%        | **58.6%**       |

The results of (table 18) exhibit the ratio of the correct classification percentage to the bacteria is (89.7%), or for those who are chosen bacteria are (26 teachers) and the rest chose Poor hygiene (53.3%), and cold wind, smoking and alcohol with percentage equal to zero. The overall classification rate has reached (58.6%).

13. Discussion and Conclusion

1. The sex variable showed its significant effect on teachers' knowledge of the causes of tuberculosis (bacteria), where the correct classification rate was (86.2%).
2. The variable of teacher diagnosis of the disease showed a significant effect on his knowledge of the causes of tuberculosis (bacteria), where the correct classification rate was (96.6%).
3. The variable to know the methods of transmission of infection showed a significant effect on his knowledge of the causes of tuberculosis (bacteria), where the correct classification rate was (96.6%).
4. The variable to know the signs that appear on the patient with tuberculosis showed a significant effect on his knowledge of the causes of tuberculosis (bacteria), where the correct classification rate was (69.0%).
5. The variable of knowledge of the period of treatment required to recover from tuberculosis showed a significant effect on his knowledge of the causes of tuberculosis (bacteria), where the correct classification rate was (89.7%).
6. The results showed that there were no significant effect for variables (age, marital status, academic achievement) on knowledge of TB disease. Further that the teachers' knowledge of Prevention methods, Risk of Developing Tuberculosis lacked sufficient information, which caused a lack of significant effect.

14. Recommendations

1. Through reviewing the medical studies that confirmed the seriousness of this disease, we recommend the need to work hard to spread a culture of knowledge of tuberculosis through the media and to organize training courses and workshops for members of society in general and for teachers in particular because most teachers lack knowledge of the developments of this disease.
2. Recommendation to use the logistic regression model in other future studies, especially medical and educational.

15. Acknowledgement

The researcher gratefully acknowledge Mustansiriyah University-College of Science Department of Mathematics, the teachers who answered the questionnaire, and your esteemed journal for supporting this research.
16. References

[1] Abbas I and Peter J 2014 Knowledge and perception on tuberculosis transmission in Tanzania: Multinomial logistic regression analysis of secondary data Tanzania Journal of Health Research. v16i1.5 Volume 16, Number 1.

[2] Agresti, A 2002 Categorical Data Analysis. New York: Wiley-Inter science.

[3] Chan Y H 2004 Biostatistics 202: Logistic regression analysis, Singapore Med J Vol. 45(4):149.

[4] David W. Hosmer J and Stanley L Rodney X S 2013 Applied Logistic.

[5] Draper N R and smith H 1981 Applied Regression analysis, New York.

[6] Hosmer D.W Lemeshow S and Klor J 1988 Goodness of fit testing for the logistic model when the estimated probabilities, Biometrical Journal.

[7] Hosmer D.W Lemeshow S 2000 Applied logistic regression. 2nd ed. New York, NY: John Wiley & Sons Inc.

[8] International Journal of Mathematics and Statistics Invention (IJMSI) E-ISSN: 2321 – 4767 P- ISSN: 2321 - 4759 www.ijmsi.org Volume 2 Issue 5 || May. 2014 || PP-01-08 www.ijmsi.org 1 | P a g e A Multinomial Logistic Regression Analysis to Study The Socio-Economic Status On Breast Cancer Incidences In Southern Karnataka Madhu B, Ashok N C and S Balasubramanian JSS University, Mysore – 570015, India

[9] Madhukar P Marcel A B David W D and Mario R 2016 Tuberculosis Nature Reviews Disease Primers Vol. 2.

[10] Park H A 2013 An Introduction to Logistic Regression: From Basic Concepts to Interpretation with Particular Attention to Nursing Domain, J Korean Acad Nurs, vol. 43,P155.

[11] Respir A J Crit Care Med Vol.195, P7-8, 2017 ATS Patient Education Series © American Thoracic Society.

[12] World health organizing https://www.who.int/health-topics/tuberculosis#tab=tab_1.

[13] WHO. Global TB report 2017. Annex 4: TB burden estimates, notifications and treatment outcomes for individual countries and territories, Who regions and the world. Accessed on February 26,2018 /gtbr2017_anne \x4x4.pdf?ua=1.

Using Multi-response Logistic Regression Model To Determine “the Factors Affecting Eye Disease”

[14] Taleb H R, Azer k kh