A Statistical Analysis Related to Meningitis

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Article Analysis

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Summary:
The researchers conducted a prospective study of 310 children with confirmed cases of meningitis between 2002 and 2003 at the Alexandria Fever Hospital in Alexandria, Egypt. It should be noted that this is the only hospital in Alexandria, Egypt that treats those affected with suspected or confirmed cases of meningitis. Egypt has a high mortality rate (55%) among those diagnosed with meningitis. Antibiotics have decreased the rate of deaths from nearly 100% to 55% in many countries. However, 55% is quite significant when considering the high number of children affected with meningitis every year (Farag, 2005).

 Those in the study were subjected to clinical examinations, CSF bacteriological and serological investigations (Farag, 2005). The inclusion criteria involved clinical signs and symptoms, laboratory test for meningitis involving CSF, demographic features, clinical presentations, medications taken and the length of the illness (Ibid).
The goal was to better understand and identify the epidemiological characteristics and clinical indicators that may predict a prognostic profile of meningitis among those affected with meningitis.

Researchers used and compared the WHO prognostic score to the CSF WBCs and the CSF glucose levels in those affected with acute bacterial meningitis (ABM) and those affected with aseptic meningitis. They further broke down the ABM by causative agents H. influenza, S. pneumonia, N. meningitides, and other. Of course the goal was to identify good predictors of bad meningitis or meningitis that leads to epilepsy or death.

It was determined that those affected with ABM were more likely to have a bad outcome with a case fatality of 13% and that the case fatalities were higher among unknown bacteria, modest with N. meningitides, and lowest with S. pneumonia and H. influenza which accounts for the importance of identifying the unknown organisms (Farag, 2005).

The study also identified age, WHO scores of \( \geq 9 \), CSF glucose levels of \(< 10 \text{ mg/dL} \), positive for generalized convulsions, have 2 or more smokers in the family, and working mothers are more likely to have a bad outcome of meningitis.

Research proved that using the above predictors with quick simple scoring scales as prognostic tools were essential to the outcome of children diagnosed with meningitis.

1. Name of Statistic: **Student T-test**

   Was this statistic covered during the class? **Yes**

   Number of times used in the article: **1**
Why do you think this statistic was used? The T-test is used when the standard deviation of all values in the population is unknown and the population has a distribution that is basically normal or >30 (Triola, 2006, p. 290).

The researchers used the T-test because the population studied was greater than 30, 310 to be exact. The T-test was needed to compare the CSF WBCs and glucose results versus WHO meningitis scoring in acute meningitis cases.

What did this statistic show or prove? The statistic showed that the “CSF WBCs count did not vary significantly by scores of meningitis (P>0.05), while CSF glucose level dropped with the high score (greater than or equal to 9) in all ABM categories (P>0.001)” (Farag, 2005). It also showed a “significant negative correlation between CSF glucose level and WHO scoring of meningitis with R= -0.4113, P<0.01” (Ibid).

Was there an associated P value? Yes.

If yes, what was the P value and what did the P value show? There were several P values. The P values for the CSF WBCs for H. influenza, S. pneumonia, N. meningitis, and other were 0.097, 0.277, 0.861, and 0.193 respectively with a coefficient of 0.1417.

The P values for the CSF Glucose for H. influenza, S. pneumonia, N. Meningitis, and other were <0.001 for each with a coefficient of -0.4113 (Farag, 2005).

The P values showed there was not a significant difference between the various types of causative organisms.

2. Name of Statistic: Mean

Was this statistic covered during the class? Yes

Number of times used in the article: 1
Why do you think this statistic was used? The researchers used the mean to evaluate the significance of laboratory finding related to the levels of CSF WBCs, CSF protein, and CSF sugar which were 121+5/cu mm, 169+142 mg/dL, and 19+3 mg/dL respectively (Farag, 2005).

What did this statistic show or prove? It proved that the CSF protein was higher than the CSF WBCs and the CSF sugar. With the CSF sugar being the lowest of the three.

Was there an associated P value? No

If yes, what was the P value and what did the P value show? N/A

3. Name of Statistic: Chi-square

Was this statistic covered during the class? Yes

Number of times used in the article: 2

Why do you think this statistic was used? Chi-square test is used to compare observed data that is expected to obtain a specific hypothesis. It is often used to test the null hypothesis.

In this case researchers used the chi-square test to compare categorical variables and to see if the prognosis of the studied case was relevant to WHO meningitis scoring based on recovery, epilepsy, and death.

The dependent variables included epilepsy or death, and independent variables such as age, sex, WHO meningitis scores, CSF glucose level, CSF WBCs count, convulsions, history of familial smoking, and working mothers.

What did this statistic show or prove? It found no difference between ABS and aseptic meningitis in urban areas, male cases among families with 2 or more smokers, and cases
with blood group A, B, AB, or O. The age of the aseptic meningitis cases occurred between the ages of 3-15 months but the ABM cases occurred after the age of 5 years. It showed a significant number of children affected with aseptic meningitis who had previously received vaccinations and between ABM and each of the low social-economic class and those with working mothers.

The prognosis of the studied case was relevant to WHO meningitis scoring in that it showed 22 of the cases experienced recurrent epileptic fits after 1 month and that 18 cases had a score of \( >9 \) which is significant for loss of life and/or epilepsy.

The recovery for cases of ABM was 78.2\% and 90.8\% for the recovery of aseptic meningitis.

Was there an associated P value? Yes

If yes, what was the P value and what did the P value show? The P value for ABM was \(<0.001\) and \(>0.05\) for aseptic meningitis. The P value showed no significant difference between expected and observed values in regards to aseptic meningitis but showed a significant difference for ABM.

The P value for the WHO meningitis scoring was \(<0.001\) for all types of meningitis organisms.

4. Name of Statistic: Multiple Logistic Regression Analysis.

Was this statistic covered during the class? Yes.

Number of times used in the article: 1
Why do you think this statistic was used? The multiple logistic regression analysis was used to identify those most at risk for a bad outcome of meningitis. Bad outcome was defined as those that resulted in epilepsy or death.

What did this statistic show or prove? It proved that bad prognosis increased significantly with meningitis scores \( \geq 9 \), CSF glucose level \(<10\) mg/dL, occurrence of generalized convulsions, infancy, presence of more than one family smoker, and those having working mothers. “Gender and CSF WBCs levels were not significant in the prognosis of meningitis” (Farag, 2005).

Was there an associated P value? No.

If yes, what was the P value and what did the P value show? N/A

5. Name of Statistic: Odds Ratio

Was this statistic covered during the class? Yes

Number of times used in the article: 1

Why do you think this statistic was used? The researcher needed to use this statistic to determine the odds of the risk factor being a predictor of bad meningitis. This will help identify children most at risk for bad meningitis.

What did this statistic show or prove? It proved that a bad prognosis increased significantly in meningitis scores with odds ratios (OR) of 22.7, CSF glucose with OR =13.3, occurrence of generalized convulsions with OR=8.05, infancy, presence of more than one family smoker with OR=3.01, and those having working mothers with OR=2 (Farag, 2005).

Was there an associated P value? No.

If yes, what was the P value and what did the P value show? N/A
6. Name of Statistic: **Confidence Interval**

   Was this statistic covered during the class? Yes

   Number of times used in the article: 1

   Why do you think this statistic was used? Researchers used the confidence interval because it shows that the data reflects a true value of the population.

   What did this statistic show or prove? It proved that bad prognosis, death and epilepsy, increased significantly in meningitis scores with 95% confidence intervals (CI) of 18.3-69.2, CSF glucose with a 95% CI of 9.01-51.1, occurrence of generalized convulsions with a 95% CI of 7.11-36.6, infancy with a 95% CI of 8.81-20.03, presence of more than one family smoker with a 95% CI of 1.07-6.9, and those having working mothers with a 95% CI of 1.17-26.6 (Farag, 2005). The significance of the confidence interval being 95% is indicative that the intervals previously mentioned contain the true values of the population mean.

   Was there an associated P value? No.

   If yes, what was the P value and what did the P value show? N/A.

7. Name of Statistic: **Categorical Variables (Independent and Dependant).**

   Was this statistic covered during the class? Yes

   Number of times used in the article: 1

   Why do you think this statistic was used? Researchers were looking for an association between independent variables and dependent variables. This would enable the
researchers to determine the strength of the association between the variables and the effects of other variables on the independent variables.

What did this statistic show or prove? The statistic showed an association between the dependent variables of death and epilepsy and the independent variables of age, WHO meningitis score, CSF glucose level, generalized convulsions, smokers in the family, and working mothers.

The study showed that age $\leq 1$ year, WHO scores of $\geq 9$, CSF glucose levels $< 10$ mg/dL, generalized convulsions present, smokers in the family $\geq 2$, and had working mothers were predictors of bad meningitis. Therefore these children were at a greater risk of epilepsy or death.

Was there an associated P value? No.

If yes, what was the P value and what did the P value show? N/A

8. Name of Statistic: Log rank test

Was this statistic covered during the class? No.

Number of times used in the article: 1

Why do you think this statistic was used? The log rank or Mantel-Cox test is a hypothesis test to compare survival distributions of two samples (GraphPad, 1999). The researchers used the log rank test to identify whether or not there was a significant difference in the 6 month survival rate between those affected with aseptic meningitis and those affected with ABM.

What did this statistic show or prove? The 6 month survival rate among those affected with aseptic meningitis was 95.4 and the 6 month survival rate among those affected with ABM
was 86.1%. The log rank test score was 6.29 which proved there was a significant difference in 6 month survival among those affected by aseptic meningitis and ABM.

Was there an associated P value? Yes.

If yes, what was the P value and what did the P value show? P=0.012. The P value showed the data to be significant for the survival rate between aseptic meningitis and ABM.
Reference

