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Infant mortality by congenital malformations

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الملخص :

عدد الأطفال المصابين بالتشوهات المتنوعة في تزايد مستمر وكل المواليد لديهم خطر الإصابة بعيوب خلقية عديدة. في ليبيا تعد التشوهات الخلقية من أكثر الأسباب شيوعا للوفاة بين المواليد وعليه تم سحب عينة عشوائية بسيطة 1155 حالة وفاة من مجموع حالات الوفيات الكلية التي كانت 4803 حالة وفاة في الفترة (1995 -2005) لوفيات أطفال دون السنة الأولى من العمر من بنغازي وضواحيهما العينة أوضحت أن أكثر الوفيات كانت بسبب التشوهات الخلقية خاصة تشوهات القلب والمخ ثم التشوهات الأخرى , ولهذا دعت الحاجة إلي إجراء دراسة تحليلية لتحديد العوامل التي تؤدي إلي التشوهات لدي الأطفال عند الولادة .

الأهداف الرئيسية لهذه الدراسة:

1. تحديد العوامل الديمغرافية و عوامل (الأم-الطفل حديث الولادة) المؤثرة في التشوهات الخلقية .
2. مقارنة العوامل التي تؤثر في المجموعتين (منطقة بنغازي وضواحيهما المناطق الشرقية) .

هذه الدراسة تعتمد علي عينة عشوائية بسيطة من 449 حالة وفاة بسبب التشوهات الخلقية فى الفترة (2000 – 2005) ,حيث أن 229 حالة منها فى بنغازي وضواحيها من مستشفى الأطفال و 150 حالة وفاة فى مستشفى المرج المركزي متضمنة المناطق الشرقية وكان العدد الكلى للمتغيرات فى هذه الدراسة 15 متغير ، بعض هذه المتغيرات كمية والأخرى متغيرات وصفية تم إدخالها للتحليل باثنين أو أكثر من المصنفات. المتغيرات الكمية متضمنة فى التحليل مباشرةً بينما المتغيرات الوصفية متضمنة فى التحليل باستخدام المتغيرات الوهمية .

لتحقيق الهدف الأول من هذه الدراسة تم استخدام تحليل الانحدار اللوجستي الذي يصف العلاقة بين العوامل الديمغرافية وعوامل(الأم -الطفل حديث الولادة) ونوع التشوه وكانت نتائج التحليل كالتالي:

1. الوزن الكبير للطفل عند الولادة يؤثر فى نوع التشوه ، اى أن وفيات الأطفال بالتشوهات الخلقية تزداد فى حالة وزن المولود الكبير .
2. وفيات الأطفال بالتشوهات الخلقية تزداد فى حالة الولادة الطبيعية وتنقص فى حالة الولادة القيصرية (نوع الولادة له تأثير سلبي على وفيات الأطفال) ,حسب التحليل.
3. وفيات الأطفال بالتشوهات تزداد فى حالة تطابق فصيلة دم الأم مع فصيلة دم الطفل المولود .
4. عامل الإقامة له تأثير ايجابي على وفيات الأطفال حيث تزداد الوفيات بالتشوهات الخلقية فى المناطق الشرقية .
5. يزداد احتمال الوفاة عند الاطفال ذوي التشوهات الخلقية بزيادة العمر .
6. تكرار عدد مرات الولادة يؤدي الي ظهور الطفل المشوه ومن ثم يؤدي الي زيادة الوفيات بالتشوهات الخلقية.
7. يزداد احتمال الوفاة عند الاطفال ذوي التشوهات الخلقية بزيادة الوزن.

لمقارنة منطقة بنغازي وضواحيها والمنطقة الشرقية :

1. وفيات الأطفال بسبب التشوهات الخلقية فى المناطق الشرقية كانت أكثر من وفيات الاطفال بنفس السبب في منطقة بنغازي وضواحيها . وفيات الأطفال فى بنغازى كانت وفيات بنغازى المركز أكثر من وفيات (البركة - السلاوى - الساحل والعقورية) ،أما وفيات المنطقة الشرقية كانت فى المرج أكثر من (البيضاء – درنة) .
2. وفيات الأطفال بالتشوهات الخلقية فى حالة الولادة الطبيعية أكثر من وفيات الولادة القيصرية ، كذلك فى منطقة بنغازى وضواحيها والمنطقة الشرقية .
3. نسب وفيات الأطفال بالتشوهات الخلقية عندما يكون هناك قرابة بين الزوجين تكون أكثر من عدم وجود قرابة بينهما في النموذج العام. وكذلك فى النماذج الفرعية (منطقة بنغازى وضواحيها – المنطقة الشرقية) .
4. وفيات الأطفال للامهات في الأعمار الأقل من (40) تكون أكثر من باقي الأعمار.

وكانت جميع هذه النتائج متفقة مع الرأي الطبي والدراسات العلمية السابقة

Abstract

The infant mortality by congenital malformation is considered as one of the most important causes of death, it has many complications on both the infant and the mother. The main objectives of this study are: (I) to identify the demographic and maternal-infant factors which influencing the congenital malformation (II) to compare the factors which affected congenital malformation in the two groups (Benghazi, its suburbs, and Eastern area). To achieve these objectives, a simple random sample of size 449 of infant mortality for the period (2000-2005) , 299 of them from Benghazi pediatric hospital (new born baby section) of Benghazi, and its suburbs, and the other (150) from El-Marj central hospital of Eastern area. Multiple logistic regression, comparison of proportions are used to achieve the above objectives. The results of the multiple logistic regression analysis for the type of malformation revealed that the mortality by congenital malformation increases as age of infant increases, and death by congenital malformation increase in the case of big size baby, deaths by congenital malformation increased in the case of identification of the blood groups of mother and the child, and increased in Eastern area, also type of delivery has negative effect on heart, and brain malformation. That is it increases in normal delivery, and the probability of death by congenital malformation increases as the weight of the child increases, also mother frequently delivery increase the chance of heart and brain malformation occurrence. The results of comparison of the two group's proportions, the congenital malformation seems to be associated with the residence factors, also it associated type of delivery, and frequently in normal delivery, parent's kinship is correlated with infant mortality by congenital malformation; also the age of mother is correlated with infant mortality.

Introduction

Infant mortality encompasses all deaths that occur within the first year of life and excludes fetal death (miscarriages and abortions) , and infant mortality represented a large proportion of all deaths and was the main reason for the low level of life expectancy. In Libya, the congenital malformations are the common cause of baby death, and their effect is different due to the type, and place of the malformation. Some of them are dangerous, and may lead to death of the embryo inside the womb, and some are simple. In Benghazi, and its suburbs, when a simple random sample of the deaths under one year of age (the total number of 4803), it was found that most of the deaths were by the congenital malformations especially the malformations of the heart and brain. Therefore, it was necessary to study this phenomenon as a main cause of death, in order to know its causes, and the factors which affected it from the statistical side. The main objectives of the present study are: To identify of the demographic and infant-maternal factors which influencing the congenital malformations, To compare the factors which affect the two groups (Benghazi, its suburbs and Eastern area). In this study a simple random sample of 1155 deaths babies less than one year of age from the total mortality cases (4803) in the period (1995-2005) in Benghazi ,the main causes of death from the data of the selected sample are the congenital malformations, heart disease, respiratory, Blood disease, gall , kidney failure, chronic diarrhea, Mongolian children, and aids, It has been noticed that most of the death cases were because of the congenital malformations, and therefore , a second simple random sample was selected from the congenitally malformed children of (449) cases of children deaths for the period (2000-2005), where 299 of them from Benghazi malformation. pediatric hospital (new born baby section) of Benghazi, its suburbs, and 150 cases from El-marj central hospital of Eastern area, and most of these malformation were in the heart, and the brain, and other. The total number of variables under consideration of the present study is 15 variable. Some of these variables are quantitative, and some of them are qualitative with two or more distinct categories: the infant mortality (x1), Sex (x2), Birth weight (x3), Number of delivery mother(x4), Mother's blood group identical of the child (x5), The infant weight after birth (x6), Taking the treatment (x7), Age of mother (x8),Parent's kinship (x9), The residence (x10), Type of delivery (x11), Order of infant in the family (x12) ,Malformation size (x13), The morbidity (x14) and Infant mortality by congenital malformation (x15).

Methodology

In this study Logistic Regression Model will be used, In logistic regression the dependent random variable Y is a dichotomous variable taking the value one with probability P and the value zero with probability 1-P, depending on the presence or absence of malformation in the heart and brain. This variable has the simple discrete probability distribution

$$p_r\ (Y = y, p) = p^y\ (1-p)^{1-y}\ ;\ \ y = 0\ ,1$$

Suppose that there are n individuals and K independent variables. $x_1, x_2 ..., x_k$ These independent variables may be quantitative, qualitative of the two or more categories, for the i–th individual it can be written

$$p_{i=}\ p(y_i = 1) \quad and \quad 1 - p_i = p(y_i = 0)$$

The non-linear relationship between the binary dependent variable and the independent variables is as described by the logistic function which is

$$P_i = \frac{e^{x'_i B}}{1+e^{x'_i B}} \qquad 1-P_i = \frac{1}{1+e^{x'_i \beta}}$$

Another interpretation of the logistic regression model uses the odds and odds ratio, it's ratio between the probability of absence and presence of the malformation in the heart ,(i.e. P_i between and (1- P_i) is defined by

$$odds = \frac{P_i}{1-P_i} = e^{x'_i \beta}$$

The natural logarithm for the odds is $Ln\ odd = x'_i \beta$

this quantity is called logit of P.

Estimation of parameters

Estimates of the parameters in the logistic model can be obtained by applying a statistical technique, called maximum likelihood estimation.

Let $y_1, y_2 \ldots, y_k$ are n individuals where $P(Y_i = y_i, P) = P_i^{y_i} \ (1-P_i)^{1-y_i}$

since the likelihood function is the product of the probabilities , it is given by

$$L(y, \beta) = \prod^{n} P_i^{y_i} \ (1-P_i)^{1-y_i}$$

$$= \prod_{i=1}^{n} \left(\frac{p_i}{1-p_i}\right)^{y_i} \ (1-p_i)$$

$$= \prod_{i=1}^{n} (e^{x'_i \beta})^{y_i} \ \left(\frac{1}{1+e^{x'_i \beta}}\right)$$

and the ln of likelihood function is $\ln L(Y, \beta) = \sum_{i=1}^{n} y_i x'_i \beta - \sum_{i=1}^{n} (1+e^{x'i\beta})$

maximum likelihood estimator of β,s can be obtained by taking derivative of the ln likelihood function with respect to β

$$\frac{\partial \ln L(y, \beta)}{\partial \beta} = \sum_{i=1}^{n} y_i \ x_i - \sum_{i=1}^{n} \left[\frac{e^{x'_i \beta}}{1+e^{x'_i \beta}}\right] x_i$$

The estimate of the each element of, say b, vector is obtained from the solving of (k+1) equation simultaneously.

The testing of hypothesis

The testing of hypothesis about the coefficients in logistic regression based on the Wald statistic. The Wald statistic has chi-square distribution with degrees of freedom equal to one less than the number of categories and it is the square of the ratio of the coefficient to its standard

$$(Z = \hat{\beta} / SE)$$

Wald statistic has a very undesirable property, when the absolute value of regression coefficient becomes large; the estimated standard error is too large. In this case Wald statistic will be too small, so the null hypothesis that the coefficient is zero will be accepted when in fact it will be rejected. To solve this problem the change in the -2 ln likelihood can be used for the test of hypothesis. It also has chi-squared distribution with n-k degrees of freedom where k is the number of parameters in the model. A good model will be has a high likelihood this translates to a small value for -2 ln likelihood.

Goodness of Fit of the Logistic Model

One measure of the quality of the logistic regression fit is 2×2 classification tables which based on comparing the predictions to the observed value, the diagonal elements of this table indicate how many cases are correctly classified and the off diagonal entries of the data indicate the number of cases not correctly classified. If classification rate 50 percent this imply that model have good predictive validity .Another way to measure of performance of the logistic model by using the alternative of R^2 .This criteria is defined as (ρ) where it given by

$$\rho = \frac{L_0 - L_1}{L_0}$$

Where L_1 represents the value when of the ln likelihood function has been maximized, and L_0 is the value of the ln likelihood function when all of the parameters are equal to zero.

Comparison of Several Proportions

In this type of problem, we have k independent samples of binary data $(n_1, x_1), (n_2, x_2) \ldots (n_k, x_k)$, where the n's are sample sizes, and the x's are the numbers of positive outcomes in the k samples. the null hypothesis is:

$$H_o : \pi_1 = \pi_2 = \ \ldots = \ \pi_k$$

Expressing the equality of the k population proportions. Let $P_i = x_i / n_i$, $i = 1,2, \ldots, k$

Be the sample proportion of group i and p be the "pooled proportion" defined by : $p = \frac{x_1 + x_2 + \ldots + x_k}{n_1 + n_2 + \ldots . + n_k}$. The test statistic is given by the following formula, $\chi^2 = \frac{\sum n_i (p_i - p)^2}{p(1-p)}$

Where the summation is over the k groups and the decision is made referring to the chi-square distribution with (k-1) degrees of freedom**.**

Relative Risk

one of the most often used ratios in epidemiological studies is the relative risk or risk ratio, a concept for the comparison of two groups or sup-population with respect to a certain unwanted event (disease or death).the traditional method of expressing it in prospective studies is simply the ratio of the incidence rates:

Relative Risk=infant mortality incidence in group 1\ infant mortality incidence in group 2

Confidence interval (e^{c_1}, e^{c_2})s given by

$$c_1 = \ln R\hat{R} - Z_{\alpha/2}\sqrt{\frac{c}{an_1} + \frac{d}{bn_2}} \qquad c_2 = \ln R\hat{R} + Z_{\alpha/2}\sqrt{\frac{c}{an_1} + \frac{d}{bn_2}}$$

To test whether or not the proportions are the same in the two independent samples (i.e., age of mother for ≥ 40 and < 40) the Z-test is used. Where

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}(\frac{1}{n_1} + \frac{1}{n_2})}}$$

Which follows standard normal distribution. If $Z \geq Z_{\alpha/2}$ we reject the null hypothesis that the two proportions are same in the two independent samples n_1, n_2

Analysis and Results

Table (1) : Multiple logistic regression model for type of malformation (x_{15})

Variables	Estimate(β)	S.E	Wald statistic	P-Value
X_1	.270	.077	12.125	.000
X_2	.069	.337	.042	.838
X_3	.750	.294	6.526	.011
X_4	.314	.125	6.350	.012
X_5	1.507	.739	4.155	.042
X_6	.662	.327	4.089	.043
X_7	-.214	.377	.320	.571
X_8	-.010	.034	.091	.763
X_9	.740	.481	2.371	.124
X_{10}	1.877	.376	24.914	.000
X_{11}	-1.404	.501	7.869	.005
X_{12}	-.021	.093	.051	.821
Constant	-5.208	2.067	6.350	.012
Chi-square =104.525		ρ =.29		P-Value = .000

- The measure of goodness of fit of the model is 2×2 classification table

Table (2) : Classification for type of malformation

Observed	Predicted		Percentage correct
	Other malformation	Heart and Brain malformation	
Other malformation	22	39	36.1
Heart and Brain malformation	8	380	97.9
Overall Percentage 89.5			

Comparison of Several Proportions

When test of the residence factor, the result of this is significant a (P- value =.000), the result were that the difference between the two groups (Benghazi and its suburbs, Eastern area) is significant, infant mortality because of the congenital malformation seem to be an associated with the residence factor. In Benghazi 33.4%, Eastern area 66.6% and Chi-square value as 29.569 with d.f =1. For Benghazi and its suburbs (first area) be four area (center of Benghazi, El-berka, Al-slawee, Al-sahel and Al- goreia),were mortality proportions in the area precedent 93 % , 0.7 % , 4 % , 2.3 % , the result of test (p – value = .010) is significant , Chi-square value = 11.371 with 3 d.f , where the infant mortality seem to be associated with the residence factor on the four area. For Eastern area (second area) be three area (Al-marj , bida , derna), were mortality proportions 89.3 % , 8.7 % , 2 % , the result of the test (p – value = 0.217) is not significant , Chi-square value = 3.055 with 2 d.f , where the difference between the three groups are not significant , the infant mortality does not seem to be associated with the residence factor in the three area .

Test of proportions of infant mortality according to type of delivery (x11)

When the test of type of delivery the proportions for infant mortality were 91.8 % for normal delivery and 8.2 % for cesarean section, the result of test (p – value = .000) is significant, and Chi-square =56.249 with 1 d.f, i.e., the infant mortality by congenital malformations seems to be associated with the type of delivery and frequently in normal delivery. For Benghazi and its suburbs proportions were 93.3 % for normal delivery and 6.7 % for cesarean section, were (p – value = .040) with d.f =1, Chi-square =4.223 is significant, type of delivery factor in first area is correlate with the infant mortality by congenital malformations. For Eastern area proportions were 88.7 % for normal delivery and 11.3 % for cesarean section, where (p – value =.210), Chi-square = 1.574 with 1 d.f is not significant, that is the type of delivery factor in second area is not correlate with infant mortality.

Test of proportion of infant mortality according to parent's kinship (x9)

The infant mortality proportions by congenital malformation if parent's is present 71.7 % and 28.3 % if it's absent. The result of test (p – value =.005) is significant, Chi-square = 8.009 with 1 d.f, that is parent's kinship is correlate with infant mortality. For Benghazi and its suburbs were proportions 68.6 % if parent's is present and 31.4 % if it's absent , the p-value = .083. Is not significant, Chi-square = 3.009 with 1 d.f, that is parent's kinship does not seem to be associated with infant mortality in first area. For Eastern area were proportions 78 % for parent's is present and 22 % if it's absent , the p-value = .671 is not significant, Chi-square = .180 with 1 d.f, that is parent's kinship does not seem correlate with infant mortality in second area.

Test of proportion of Infant mortality according to age of the mother(x8)

The age of mother groups and infant mortality proportions for all age are the statistic Chi-square = 39.431 with 9 d.f. P-value = .000 is significant, that is the difference between the groups is significant, age of mother seems to be associated with infant mortality.

Table (3) : Results of Test of proportions of Infant mortality according to age of the mother

Age of mother	Infant mortality proportions by congenital malformation
25 -29	4.7 %
30 -34	22.9 %
35 -39	42.3 %
40 -44	18 %
45 -49	12 %
Total	100 %

For Benghazi and its suburbs the age of mother groups and infant mortality proportions for all ages are shown, and the statistic Chi-square = 15.433 with 7 d.f ,P-value =.031 is significant, that is age of mother in first area is correlate with infant mortality.

Table (4) : Results of Test of proportions of Infant mortality according to age of the mother in Benghazi, its suburbs Area

Age of mother	Infant mortality proportions by congenital malformation
25 - 29	1 %
30 - 34	22.7 %
35 - 39	31.3 %
40 -44	27.1%
45 -49	18.1 %
Total	100 %

For Eastern area the age of mother ranges and infant mortality proportions for all ages are shown in table (6), and the statistic Chi-square = 4.365 with 4 d.f, P-value =.359 is not significant, that is age of mother in second area does not correlate with infant mortality.

Table (5) : Results of Test of proportions of Infant mortality according to age of the mother in Eastern Area

Age of mother	Infant mortality proportions by congenital malformation
25 - 29	12 %
30 - 34	23.4 %
35 - 39	64.7%
40 - 44	-
45 - 49	-
Total	100 %

Relative Risk

Table (6) : Infant mortality by congenital malformation among the mother's age groups

Age of mother	Heart and brain malformation	Other malformation
≥ 40	a = 121	c =14
< 40	b =267	d = 47

the relative risk $\hat{RR} = 1.05$, with confidence interval (.976, 1.13). And

Z-calculated = 1.3

$\hat{P}_1 = .897$

$\hat{P}_2 = .850$

SUMMARY AND MAIN CONCLUSIONS

The number of the affected children by multifarious malformations is continuously increased and all the born children have the danger to affect by many congenital defects. In Libya, the congenital malformations are the common cause of death between born children. In Benghazi and its suburbs, a simple random samples of deaths under one year of age (is selected 1155 death from the total mortality cases which is 4803) (1995-2005), the sample showed that most of deaths were by the congenital malformation especially the malformations of the heart and brain. Therefore, is necessary to study this phenomenon, in order to known its causes and the factors which affect it from the statistical side. The main objectives of the study are: `To identify of the demographic and maternal-infant factors which influencing congenital malformation, To compare for the factors which affect the two groups.

This study is based on the simple random sample of 449 deaths by congenital malformation (2000-2005), where 299 of them from Benghazi pediatric hospital of Benghazi and its suburbs, and the other 150 is deaths from El-Marj central hospital (which denoted the Eastern area). The total number of variables in this study was 15; some of these variables are quantitative and the other qualitative with two or more distinct categories. The quantitative variables included in the analysis directly while the qualitative variables included in the analysis with help of the use of dummy variables. In order to achieve the first aim of the present study the logistic regression analysis is used to develop a model which describes the relationship between the demographic, maternal-infant factors and the type of malformation. The analytical results which revealed from the analysis are as follows:

1. Big size baby affects the type of malformation. i.e., the infant mortality by congenital malformation increases in the case of big size baby.
2. Infant mortality by congenital malformation increases in the case of normal delivery and decreases with cesarean section. (Type of delivery has negative effect on the infant mortality by congenital malformation)

3. Deaths by congenital malformation, increased in the case of identification of the blood groups of mother and the child.
4. The residence has positive effect on infant mortality by congenital malformation, i.e., increase in Eastern area.
5. The mortality by congenital malformation increases as age of infant increase.
6. The probability of death by congenital malformation increases as the weight of the child increases.
7. Mother frequently delivery increase the chance of heart and brain malformation occurrence.

- Comparison between (Benghazi, its suburbs area and Eastern area).

1. Infant mortality in Eastern area is more than Benghazi and its suburbs, in side Benghazi area the infant mortality in center of Benghazi more than (Al-berka – Al-sahel and Agoreia – Al-slawee), in Eastern area the infant mortality in El-marj is more than (bida – darna).
2. Infant mortality in the case of normal delivery more than cesarean section, this result in Benghazi and its suburbs and Eastern area.
3. Infant mortality proportions by congenital malformation when parent's is presents more than when it's absent in the two group (Benghazi and its suburbs area, Eastern area).
4. Infant mortality in the age groups less than 40 more than the other ages.

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