Research Article

The use of a multinomial logistic regression model in analyzing the characteristics of married women using family planning methods in Iraq 2018 *

Suhair Jameel Mushrif Al-Neyazy

University of Baghdad

Abstract:

Family planning allows for the spacing of births, which has a positive impact in reducing such cases. We find that about (43.5%) of currently married women in Iraq use family planning methods in 2000 and that percentage rose to (52.8%) in (2018), an increase of about (22%), on the other hand, unmet need rose from (8%) in (2000) to (14.3%) in (2018), (World Bank, 2020). The study aims to identify the determinants of using family planning methods among currently married Iraqi women in the age group (15-49) years, for a sample of (18,306) women through the Multiple Indicator Cluster Survey of (2018) in Iraq. The dependent variable in this study is the use of family planning methods, which has three levels (1 = do not use, 2 = use a traditional method, 3 = use a modern method). Therefore, the Multiple Multinomial Logistic Regression Model was used to find the best prediction of a model describing the relationship between the dependent variable and the independent variables in this study using family planning methods based on independent variables. Where the model parameters were estimated by resorting to the maximum likelihood method, which is the most appropriate method for all linear and nonlinear models, through which two equations parameters were best estimated: the model (using traditional family planning methods versus non-use), and the model (using traditional family planning methods versus non-use). Modern family planning versus no use) of the transactions through which the data were interpreted.

* This paper is derived from a master's thesis entitled "Using a multifaceted logistic regression model in analyzing the determinants of the use of family planning methods in Iraq" by **Suhair Jameel Mushrif Al-Neyazy** / University of Baghdad. Under the supervision of P.Dr. Zuhdi Muhammad Nofal and Dr. Wafaa Abdel Aziz Hussein.

1- Introduction:

According to World Bank data (2020), the total fertility rate for Iraqi married women decreased from an average of (4.3) children per woman in (2011) to reach in (2018) an average of (3.7) children per woman. Studies indicate that childbearing has total effects at the level of the state as a whole, and partial effects at the level of the family and women. The overall effect comes through the fact that the change in reproductive rates leads to a change in the age structure of the population and thus a change in dependency rates, which determines the timing of the country's entry into the demographic endowment stage, as well as the opportunities to benefit from this gift. As for the individual effect, it comes through helping the family and the woman to achieve reproductive desires, and thus the study of reproduction helps determine the extent to which the reproductive pattern matches the healthy and beneficial pattern for the benefit of the family and the woman.

Family planning allows for the spacing of births, which has a positive impact in significantly reducing the risk of health problems and the risk of death as a result of early pregnancy. The use of appropriate family planning methods can reduce the need for unsafe abortion by reducing unwanted pregnancies. The rate of use of modern family planning methods has increased among currently married women in Iraq and in the age group (15-49), where the use rate was (33.8%) in (2011) and reached (36.8%) in (2018) (World Bank, 2020).

Since the role of women in Iraq has gained great importance through their participation in many social, economic and political fields, and because of the urgent need to strengthen this role to ensure that women enjoy their basic rights, it is necessary to provide the possible facilities for them as much as possible through improving health services, especially those related to childbearing (The Bank International, 2020).

In this study, we will shed light with some in-depth analysis on the economic, social, demographic and cultural factors that can affect the use of family planning methods in Iraq, which will be addressed in the study (the factors are the independent variables) and their impact on the use (the dependent variable), which is the use of family planning methods, which It is divided into three levels (non-use, the use of traditional family planning methods, and the use of modern family planning methods), and for the nature of the dependent variable, the Multiple Multinomial Logistic Regression Model was used. Logistic regression is one of the non-linear regression models that have high flexibility. In terms of clarifying the strength of the relationship between the dependent variable (y) and the independent variables, there are several types of logistic regression, including the Binary Logistic Regression and the Multinomial Logistic Regression, which we will adopt in our research. To find the best prediction for a model describing the relationship between the dependent variable and the independent variables, the model parameters were estimated by resorting to the maximum likelihood method, which is the most appropriate method for model estimation.

2- The problem of the study:

Despite the decrease in the total fertility rate to reach an average of (3.7) children per woman in 2018, Iraq still has high fertility rates, and the current use of family planning methods among women who are currently married and of childbearing age reached (52.8%) in (2018) (World Bank, 2020). Therefore, the need to reduce the total fertility rate increases, by raising the rates of using effective and appropriate family planning methods for women and reducing the percentage of unmet need for methods. The problem of the study is not only to know the determinants of the use of family planning methods or not, but to deepen the knowledge and quantitative assessment of the impact of those determinants of modern and traditional methods, each separately, compared to the lack of use in Iraq. In addition, the prevailing method of analysis in the studies that dealt with the determinants of use in Iraq is the two-sided logistic regression method, but what is new in this study is that it used the multi-faceted logistic regression, through which we can know the common factors that affect the use Both traditional and modern family planning methods and what are the factors affecting each of them separately.

3- The importance of studying:

It is divided into two parts:

First: Theoretical importance: detecting and identifying the most important determinants affecting the use of family planning methods in order to focus on and clarify them for policy makers and decision makers to enable them to set appropriate policies and intensify attention to women who are more likely to use modern and traditional methods.

Second: The importance of an applied process: What is distinguished by this research is the use of the Multiple Multinomial Logistic Regression Model. It is a type of logistic regression model commonly used in medical and social studies, due to the nature of the triple dependent variable in this study. It was relied upon to estimate the parameters of the study and obtain the highest predictive results to reach the optimal model for the use of family planning methods.

In general, the importance of this study is in order to enrich the available database on the topic of using family planning methods, and this data can be used to formulate policies that help raise Iraqi women's awareness of family planning matters and enhance responsibility. It will also benefit the National and Arab Library with such specialized studies in the field of family planning. This is done by analyzing the data on the population and family health survey, which was prepared by the Iraqi Ministry of Planning and in cooperation with the Kurdistan Region Statistics Authority.

4- Previous studies:

This part deals with the presentation of a number of selected studies related to the topic of the current research and its variables, which are of great importance, especially as they represent a follow-up to the efforts of researchers in the field of family planning. Accordingly, the current study is distinguished by its connection to the study variables, which the researcher is trying to focus on how to apply the idea of the study and transfer it from the theoretical framework to the practical aspect by employing the multifaceted logistic regression model. This section included the presentation of a number of previous studies related to the topic of using logistic regression models to identify the determinants of using family planning methods in the event that the dependent variable consists of two levels (1 does not use a method and 2 uses a method) or three levels.

The following is a presentation of the most important of these messages, theses and previous studies:

• In the study of Al-Azzawi and others (2005) the aim was to study the determinants of family planning among married women in Diyala Governorate in Iraq. From (150) married women from the regions of Diyala Governorate, through the questionnaire. The study concluded that the main determinants affecting the use of family planning methods are: (age at marriage, current age, number of living children, number of dead children, educational level of the spouses, standard of living and place of residence). Therefore, it is necessary to study and activate the impact of other factors that contribute to improving indicators of the use of family planning methods on a broader level to include all parts of the country.

• Agha and Rasheed (2007) study focused on the study of family planning and the unmet needs of the Iraqi Kurds in the Dohuk governorate in the Kurdistan region in northern Iraq, where a sample was taken of (800) married women, their ages ranged between (49-15) years, and the data was analyzed using descriptive analysis the simple. The study found that the current use of family planning methods for women was (60.6%), as the percentage of women who use modern methods is (26.5%), while the percentage of women who use traditional methods (34.1%).

The study showed that the women least likely to use family planning methods are: (women with low socio-economic and educational status, increased maternal age, number of live births, and date of death of a child under the age of five), while the women most likely to use family planning methods are: (with social level The study recommended developing a comprehensive and decentralized family planning program, and educating the community about the use of family planning methods in Dohuk governorate within the Kurdistan region.

• Makau et al. (2016) used a multiple logistic regression model in the use of modern family planning among women in Kenya, where the study was conducted on a group of women of reproductive age for the age group of (15-49) years for a sample of (8220) women for the year 2008-2009; To determine the rate of use of family planning methods and the factors affecting their use (the dependent variable), which takes in this study three levels, namely: (a modern method is used, a traditional method is used, and a folkloric method is used).

The data was analyzed using the multifaceted logistic model analysis of the SPSS statistical package, and the study showed that the percentage of women using modern methods was (87.5%), which is the best among women from the wealthy class and age group (34-30) years, and the percentage of women using traditional means was (10.8) and they are from the poor class and from the age group (39-35) years. The study found influencing factors for the use of family planning methods and determining the type of use (wealth index, educational level, place of residence and the number of children the woman gave birth to) are significant factors. As for the factors (the woman's age, religion, and access to the health center) non-significant factors.

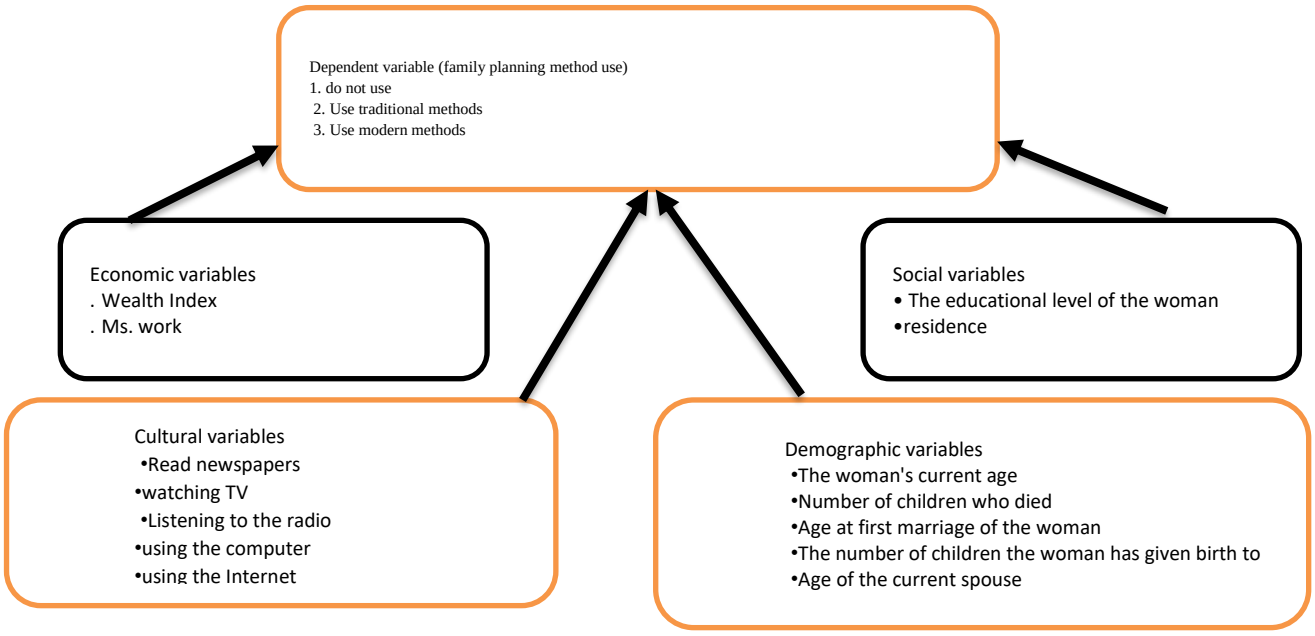
• In the study of Mlinga and Anasel (2014), it sought to identify the determinants of contraceptive use among married women in Tanzania: Inclusion of policy, where the study used the Tanzania Demographic Health Survey for the year (2004-2005), and the sample included (1244) families (couples) for demographic and health variables, children alive, child health, wealth index, place of residence, occupation, education level, and religion. As for the dependent variable, it included: (Do not use, use a natural method, use a temporary method, and use permanent

methods). The study found two models: the first two-sided (use or not use any means), and the second model is multi-faceted logistic (do not use, use a natural method, use temporary means, use permanent means), and the study also found the factors affecting the type of use, which (Women's education, wealth index, religion, and husband and wife consent to use family planning methods). The study recommended educating and empowering women about the use of family planning methods.

What is new in the study is that it will use an advanced statistical method (multi-faceted logistic regression model) based on the data of the multi-indicator cluster survey for the year 2018 in Iraq by the Central Bureau of Statistics and the Kurdistan Regional Statistics Authority.

5- The framework of the relationship:

Figure (1): Relationship framework for factors/variables affecting the use of family planning methods



Source: Created by researchers based on previous studies

6- Objectives of the study, the study aims to:

- To test the relationship between the social, economic, demographic and cultural characteristics of the woman and the use of family planning methods.

- Using a multinomial logistic regression model to identify the social, economic, demographic and cultural determinants that influence the use of family planning methods and their relationship to the use of family planning methods (dependent variable).

7- Study methodology

- The first method: simple descriptive analysis using the chi-square test in the case of studying the relationship between two nominal descriptive variables, and to test the relationship between social, economic, demographic and cultural factors and the use of family planning methods among currently married women in the age group (15-49). And the null hypothesis here: that there is no relationship between any of the variables of our study and the use of

family planning methods among currently married women. Test only: First: In the case of tables (2x2) provided that there is no cell whose expected value is less than 5. Second: In the case of tables (RxC) where R (represents the number of rows) or C (represents the number of columns) it is required that the number of cells (whose expected value is less than 5) for 20% of the total cells and there is not a single cell whose expected value is less than one true in the case of tables (RxC) (Rosner, 2011).

- The second method: an in-depth analysis method, where a multifaceted logistic regression model was adopted and used to analyze the determinants of the use of family planning methods, as the aspects of the dependent variable that the study is interested in consist of three aspects that were clarified above.

It is common in humanities and social studies that the dependent variable (Y) is a discrete variable (a qualitative variable), as this variable takes a binary form (Dichotomous) or more than one value, and this in itself is a problem that all researchers face when using linear regression analysis (simple and multiple).), which is restricted on the condition that the dependent variable (Y) is a continuous quantitative variable and not a separate descriptive variable. Therefore, the alternative is to use the logistic regression model, which has several advantages that make it suitable for use in such cases.

8- Logistic Regression Concept:

It is a statistical method used to examine the relationship between one or more independent variables and the dependent variable with a descriptive level, so that the independent variables can be of any type of measurement levels. The logistic regression model is based on a basic premise that the dependent variable (y) is the response variable is A binary variable that follows the Bernoulli distribution, which takes two values, the first value is (1) with a probability (p) and the second value is (0) with a probability q=(1-p), which means that the response occurs or does not occur, and the probability density function is written in the following formula

$$P(Y = yi) = P_i^{yi}(1 - p_i)^{1-yi} \quad \dots \quad (2-1)$$

Whereas:

yi: It is a two-response dependent variable (0,1)

p_i: represents the probability that a response will occur $yi = 1$

also that this leads to a logistic regression is given by the formula:

$$Yi = P_i + \varepsilon_i \quad \dots \quad (2-2)$$

Whereas:

P_i: represents the logistic regression function (response probability)

$$P_i = p(y = 1)\frac{e^{x_i\beta}}{1+e^{x_i\beta}} \quad \dots \quad (2-3)$$

whereas:

β : represents a vector of parameters with a dimension *(p*1)*

: *xi = {xi0, xi1,…xiK}* A class vector of explanatory variables with a dimension.*(1×K)*

ε_i : represents the random error term

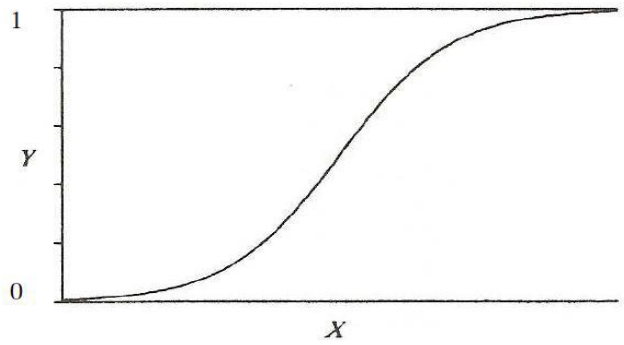


Figure: (2) represents the relationship between two logistic regression variables

$$y = B_0 + B_1 x + \in \quad \ldots\ldots \quad (2-4)$$

Since (y) represents an independent variable, and assuming that the average of the observed or actual (y) values at a certain value of the variable (x) is E (y), the model can be rewritten as follows:

$$E(y \mid x) = \beta_0 + \beta_1 x \quad \ldots \quad .(2-5)$$

As it is known in regression that the right-hand side of this model takes values from (-∞) to (∞), but when we have two variables, one of them is binary (y), the simple linear regression model is not suitable because:

$$E(y/x) = P_r(y = 1) = \pi \quad \ldots\ldots \quad (2-6)$$

Then, the value of the right-hand side is confined between the two numbers (1,0), so the model is not applicable from the point of view of regression. To solve this problem we use an appropriate mathematical transformation on the dependent variable (y), and it is known that ($0 \leq \pi \leq 1$) and then the ratio $\frac{\pi}{1-\pi}$ It is a positive value whose value ranges between (0 and ∞), i.e. meaning ($0 \leq \frac{\pi}{1-\pi} \leq \infty$) when taking the natural logarithm of the base (e) for the transformation ($\frac{\pi}{1-\pi}$) The range of its value becomes confined between ($-\infty \leq log_e\left(\frac{\pi}{1-\pi}\right) \leq \infty$) Therefore, the regression model can be rewritten in the case of a single independent variable as follows:

$$log_e\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 x \ldots\ldots (2-7)$$

Also the formula (2-7) represents the binary logistic regression model in a linear form in terms of what is known as (logit).

If we have more than one explanatory variable, the multiple logistic regression model becomes as follows:

$$log_e\left[\frac{\pi}{1-\pi}\right] = \beta_0 + \sum_{j=1}^{p} \beta_j x_{ij} \quad \ldots\ldots (2-8)$$

as i=1,2,... ,n j=1,2,...,p

The ratio ($\frac{\pi}{1-\pi}$) is called the "odds of success" ratio, or the "odds of success" ratio for the desired event and the ratio ($\frac{\pi}{1-\pi}$) and it can be called the "odds of failure" ratio. The expression log_e ($\frac{\pi}{1-\pi}$) is called the log odds ratio or logit.

9- Multiple Multinomial Logistic Regression Model:

Logistic regression is considered one of the non-linear regression models, which is characterized by high flexibility in terms of clarifying the strength of the relationship between the dependent variable (y) and the independent variables. There are several types of logistic regression, including the Binary Logistic Regression and the Multiple Logistic Regression model. Which we will adopt in our research because the dependent variable in (y) is of a multifaceted descriptive type, as the multiple logistic regression model is one of the most used models in the analysis of metadata.

So the general form of a polynomial logistic regression model is

$$\pi_J = 1 - \pi_j(x_i)$$

$$\boldsymbol{log_e\left[\frac{\pi_j(x)}{\pi_J(x)}\right] = \beta_{0j} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \cdots + \beta_{pj}x_{pi}} \quad \ldots(\mathbf{2-9})$$

j=1,2,3, …, (k-1) & i= 1,2, 3, …,n

$$log_e[\pi_j(x_i)] = \frac{exp(\beta_{0j} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \cdots + \beta_{pj}x_{pi})}{1 + \sum_{j=1}^{k-1} exp(\beta_{0j} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \cdots + \beta_{pj}x_{pi})} \quad \ldots(2-10)$$

$$logit(y=1) = log\left(\frac{P_r(y=1)}{1-P_r(y=1)}\right) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} \quad \textit{... (2-11)}$$

$$logit(y=2) = log\left(\frac{P_r(y=2)}{1-p(y=2)}\right) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip}$$

$$logit(y=3) = log\left(\frac{P_r(y=3)}{1-P_r(y=3)}\right) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip}$$

for i= 1,2, 3, …, n

where n: is the total of women.

P_r: Represents the probability of the event occurring i.e.as P_r(Y=1), P_r(Y=2), P_r(Y=3)

P_r(Y=1): The possibility of the lady not using

P_r(Y=2): Probably the lady uses a traditional method

P_r(Y=3): The possibility of the lady using a modern method

β_0 **:** Regression constant

β_p **:** represent the logistic regression coefficients for the independent variables, where p represents the number of independent variables.

x_{ip} **:**The independent variables are represented by (i).

e^B: Represents the odds ratio = $\frac{P2/(1-P2)}{P1/(1-P1)}$ It refers to the change that occurs in Odds as a result of the change in the independent variables by one unit

P_r(Y=1)

P_r(Y=2)

$P_r(Y=3)$

The parameters of the multifaceted logistic regression model are estimated by the maximum possible method (Maximum Likelihood Estimation).

$$\frac{\pi}{1-\pi} = e^{\beta_0+\beta_1 x_i} \qquad (2-12)$$

Which can be written as follows:

$$\frac{1}{\frac{1}{\pi}-1} = e^{\beta_0+\beta_1 x_i} \qquad (2-13)$$

Using algebraic methods, the formula for response probabilities of a two-response logistic regression model is written as follows: -

$$\pi = \frac{1}{1+(e^{\beta_0+\beta_1 x_i})^{-1}} \qquad (2-14)$$

So the probability of the response variable (y) taking the value (1) is

$$P[y=1 \mid x] = \frac{1}{1+(e^{\beta_0+\beta_1 x_i})^{-1}} \qquad (2-15)$$

And the probability of the response variable (y) taking the value (0) is

$$P[y=0 \mid x] = \frac{1}{1+e^{\beta_0+\beta_1 x_i}} \qquad (2-16)$$

Note that

$$P[y=1 \mid x] + P[y=0 \mid x] = 1$$

In the same way in the case of a polynomial logistic regression model Who writes like this: (Multiple logistic regression)

$$log_e\left[\frac{\pi}{1-\pi}\right] = \beta_0 + \sum_{j=1}^{p} \beta_j X_{ij} \qquad (2-17)$$

j=1,2,…….,p

=1,……..,n i

The formula for response probabilities is:

$$\pi = \frac{1}{1+(e^{\beta_0+\sum_{j=1}^{p}\beta_j X_{ij}})^{-1}} \qquad (2-18)$$

In the same way, the formula for the response probabilities of the multifaceted logistic regression model can be derived by raising both sides of the equation (2-11) to the base (e) and for a special case when J=3, since (j=0,1,2) and my agencies: $\frac{\pi_1(\underline{x})}{\pi_0(\underline{x})} = e^{\alpha_1+\underline{\beta}_1' \underline{x}}$ $(2-19)$

$$\frac{\pi_2(\underline{x})}{\pi_0(\underline{x})} = e^{\alpha_2+\underline{\beta}_2' \underline{x}} \qquad (2-20)$$

as

$$\sum_{j=0}^{2} \pi_j(\underline{x}) = 1$$

Gets

$$\pi_0(\underline{x}) = 1 - \pi_1(\underline{x}) - \pi_2(\underline{x}) \qquad (2-21)$$

Substituting equation (2-21) into equations (2-19) and (2-20), we get:

$$\frac{\pi_1(\underline{x})}{1 - \pi_1(\underline{x}) - \pi_2(\underline{x})} = e^{\alpha_1+\underline{\beta}_1' \underline{x}} \qquad (2-22)$$

$$\frac{\pi_2(\underline{x})}{1 - \pi_1(\underline{x}) - \pi_2(\underline{x})} = e^{\alpha_2+\underline{\beta}_2' \underline{x}} \qquad (2-23)$$

These two equations can be written as follows:

$$\frac{1 - \pi_1(\underline{x}) - \pi_2(\underline{x})}{\pi_1(\underline{x})} = \frac{1}{e^{\alpha_1+\underline{\beta}_1' \underline{x}}} \qquad (2-24)$$

$$\frac{1 - \pi_1(\underline{x}) - \pi_2(\underline{x})}{\pi_2(\underline{x})} = \frac{1}{e^{\alpha_2+\underline{\beta}_2' \underline{x}}} \qquad (2-25)$$

Using some algebraic methods, the two equations (2-24) and (2-25) can be written in the following form:

$$\pi_1(\underline{x}) = \frac{e^{\alpha_1+\underline{\beta}_1' \underline{x}}}{1 + e^{\alpha_1+\underline{\beta}_1' \underline{x}} + e^{\alpha_2+\underline{\beta}_2' \underline{x}}} \qquad (2-26)$$

$$\pi_2(\underline{x}) = \frac{e^{\alpha_2+\underline{\beta}_2' \underline{x}}}{1 + e^{\alpha_1+\underline{\beta}_1' \underline{x}} + e^{\alpha_2+\underline{\beta}_2' \underline{x}}} \qquad (2-27)$$

The general condition is:

$$\pi_j(\underline{x}) = \frac{e^{\alpha_j+\underline{\beta}_j' \underline{x}}}{1 + \sum_{j=1}^{J} e^{\alpha_j+\underline{\beta}_j' \underline{x}}} \qquad (2-28)$$

Since $\pi_j(\underline{x})$ means the probability that the response variable $y_i$takes the classification j since (j=0,1,2,....,J), and therefore the estimative formulas of equations (2-26), (2-27), (2-28) are:-

$$\hat{\pi}_1 = \frac{e^{\hat{\alpha}_1+\hat{\underline{\beta}}_1 \underline{x}}}{1 + e^{\hat{\alpha}_1+\hat{\underline{\beta}}_1 \underline{x}} + e^{\hat{\alpha}_1+\hat{\underline{\beta}}_1 \underline{x}}} \qquad (2-29)$$

$$\hat{\pi}_2 = \frac{e^{\hat{\alpha}_2 + \hat{\underline{\beta}}_2 \underline{x}}}{1 + e^{\hat{\alpha}_2 + \hat{\underline{\beta}}_2 \underline{x}} + e^{\hat{\alpha}_2 + \hat{\underline{\beta}}_2 \underline{x}}} \qquad (2-30)$$

$$\hat{\pi}_j = \frac{e^{\hat{\alpha}_j + \hat{\underline{\beta}}_j \underline{x}}}{1 + \sum_{j=1}^{J} e^{\hat{\alpha}_j + \hat{\underline{\beta}}_j \underline{x}}} \qquad (2-31)$$

Where $\hat{\alpha}_j$ and α_j represent the capabilities of the greatest potential for the parameter $\hat{\underline{\beta}}_j$ and the vector $\underline{\beta}_j$ of unknown parameters.

10- : Estimating the parameters of the polynomial logistic regression model :

Here the parameters of the multiple logistic regression model are estimated by the maximum possibility (MLE) method, which is described as follows:

The probability density function for a polynomial distribution is:

$$P_r(Y_{i1} = y_{i1} \ldots . Y_{ij} = y_{iJ}) = \binom{ni}{y_{ij} \ldots\ldots y_{iJ}} \pi_{i1}^{y_{i1}} \ldots \pi_{iJ}^{y_{iJ}} \quad (2-32)$$

As:

$\pi_{i1}^{y_{i1}} \ldots . \pi_{iJ}^{y_{iJ}}$: It represents the percentage of response totals in the community.

Taking the logarithm of the maximum possibility function, we get:

Substituting $_j(\underline{x})$into equation (2-32) we get:

By deriving the possible function for the parameter vector (β)

When the derivative is equal to zero, $\frac{\partial LnL(\beta)}{\partial(\beta)} = 0$ We get natural equations, and the roots of these equations represent the values of the estimated parameters resulting from the maximization process, and due to the fact that the equations are non-linear, we resort to using one of the iterative methods (Newton Raphson), which produces appropriate estimates and can benefit from the capabilities available in ready-made application programs such as (SPSS) And others in estimating the parameters of the model, which we will use in the theoretical culprit of this research.

- So the general formula of the polynomial logistic regression model, given that the first category of the dependent variable is the reference category.

$$log_e \left[\frac{p_{ij}}{1-p_{ij}}\right] = x_j \beta_i$$

As:

- j=1,2,3, …, n & i>1

- n : is the total sample
- p_{ij} : Denotes the probability that event i will occur for observation j $(y_j = i)$.
- x_j: It is an array vector of the observed values of the independent variables of observation j.
- β_i: It is a vector of parameters for the classes/facets of the dependent variable that takes (i = 2,3).

p_{ij} can be written as follows:

$$p_{ij} = P_r(y_j = i) = \begin{cases} \frac{1}{1+\sum_{m=2}^{k} exp(x_j\beta_m)}, & if\ i = 1 \\ \frac{exp(x_j\beta_i)}{1+\sum_{m=2}^{k} exp(x_j\beta_m)}, & if\ i > 1 \end{cases}$$

(Greene,2012)in (StataCorp ,2015)

As:

K: is the total number of categories of the dependent variable, in this case K=3, where i=1 if the first category is considered to be the reference category.

x_j : is a class vector of the observed values of the independent variables of observation j.

β_m: m is a parameter vector for the classes/facets of the dependent variable (m) except the reference class for each <1. i.

$exp(x_j\beta_m)$(Odds ratios) : refers to the odds ratio, i.e., the result of the change in the chance of using modern or traditional family planning methods compared to the non-use that occurs when changing the independent variables by the amount of one unit, where .m = 2.3

The parameters of the multifaceted logistic regression model are estimated by the maximum possible method (Maximum Likelihood Estimation.

In this study, (β)Exp refers to the amount of change in the odds ratio (using traditional or modern family planning methods versus not using) when there is a change in the value of the independent variable associated with the parameter β by one unit, given the stability of other factors. For example, The most likely values greater than one indicate an increase in the most likely (using traditional family planning methods versus not using), but if it is less than 1 it indicates that any increase in the independent variable leads to a decrease in the most likely (using traditional family planning methods) Traditional family planning versus non-use) in the model for traditional family planning methods.

11- Study sample:

This study is based on the data of the MICS 2018 multi-indicator cluster survey in Iraq, which was conducted by the Iraqi Ministry of Planning and includes all its governorates, including the Kurdistan region), which is an integrated survey of the social and health conditions of Iraqi women and married women. The data were collected from (70,986) women who were interviewed, and the demographic health survey sample selection was taken into account for the representation process. The sample included (7,910) women, and interviews were conducted with the families of women in the age group (15-49) years and children. The distribution of the population according to the geographical area (rural and urban) and the age structure of married women who used and did not use family planning methods included in the data analysis, for the purpose of representing the reality in Iraq, which increases the degree of reassurance of the validity and accuracy of the data included in the analysis of the study.

It is worth mentioning that the study will depend in the analysis on women who are currently married and of childbearing age, and the study excluded the women who mentioned that they are not able to have children, as the reason for using family planning methods for them is not used, and thus the study sample becomes about (18,306) women.

12- Results of the study:

12-1 The relationship between the social, economic, demographic and cultural factors of the woman and the use of family planning methods

In this part, we review the dependent variable and the independent variables and their different categories in Table (1), which will later test the relationship between them and the dependent variable (use of family planning methods) using the chi-square test, and then the best combination of them will be selected to enter the regression model The multifaceted logistic to identify the most important determinants affecting the use of family planning methods.

Table (1) The dependent variable and the independent variables with their levels

The name of the dummy variables that are likely to be entered in the model	Variable classes	The description
		multiple dependent variable
	1*	Do not use family planning
	2	Uses traditional family planning methods
	3	Use modern family planning methods
		independent variables
X1 takes the value 1 if the woman has no children and zero if the condition does not apply X2 takes the value 1 if the woman has one child and zero if the condition does not apply X3 takes the value 1 if the woman has two children and zero if the condition does not apply X4 takes the value 1 if the woman has three children and zero if the condition does not apply	0 1 2 3 4*	The number of children born there is no children one child two children three children Four or more children
X5 takes the value 1 if the woman does not have a dead child and zero if the condition does not apply	1 2*	The number of children who died She does not have a dead child
X6 takes the value 1 if her age at first marriage (less than 18) and zero if the condition does not apply X7 takes the value 1 if she was her age at first marriage (22-18) and zero if the condition does not apply X8 takes the value 1 if she was her age at first marriage	0 1 2 4*	Age at first marriage of a woman Under 18 18-22 23-27 28+
X9 takes the value 1 if the woman resides in Kurdistan and zero if the condition does not apply	1	Territories Kurdistan

The name of the dummy variables that are likely to be entered in the model	Variable classes	The description
	2*	Central and Southern Iraq
X10 takes the value 1 if the woman is from the poor class and zero if the condition does not apply X11 takes the value 1 if the woman is middle class and zero if the condition does not apply	1 2 3*	wealth index poor class Middle class wealthy class
X12 takes the value 1 if the woman's education is less than primary and zero if the condition does not apply X13 takes the value 1 if the woman's education is primary and zero if the condition does not apply	0 1 2*	The educational level of the woman less than elementary Primary average and above
X14 takes the value 1 if the woman does not use the Internet and 0 if the condition does not apply	1 2*	using the Internet not used Uses
X15 takes the value 1 if the woman does not read newspapers and zero if the condition does not apply	1 2*	reading newspapers No Yes
X16 takes the value 1 if the woman is not watching TV and zero if the condition does not apply	1 2*	watching TV No Yes
X17 takes the value 1 if the woman is not listening to the radio and 0 if the condition does not apply	1 2*	Listen to the radio No Yes
X18 takes the value 1 if the woman is not using the computer and zero if the condition does not apply	1 2*	use the computer no yes
X19 takes the value 1 if the current pair is old (less than 23) and zero if the condition does not apply X20 takes the value 1 if the current pair is old (27-23) and zero if the condition does not apply X21 takes the value 1 if the current spouse's age is (32-28) and zero if the condition does not apply	0 1 2 4 5*	Spouse's current age less than 23 27-23 28-32 37-33 38+

* Reference category.

12-2 :Determinants of the use of family planning methods in Iraq using a multinomial logistic regression model.

The parameters of the model are estimated through the greatest possibility method mentioned in the theoretical side. When estimating, we have two equations, each equation for a specific level of the three levels of the dependent

variable, meaning that the number of equations is equal to (the number of levels -1). Estimates of the model parameters and their significance test are shown in Table (2) and (3)

Several attempts were made to include different combinations of independent variables in the multifaceted logistic regression model and the existing combination of independent variables in (2) and (3), which showed satisfactory results for researchers in the correct classification table and that adding any other variables will negatively effect on the correct classification ratio, especially in traditional methods.

12-2-1 :Results of the first model (determinants of the use of traditional family planning methods versus non-use)

Table (2) indicates that the only variable that is not significant in the first private model (the use of traditional family planning methods versus the non-use) is the middle class category in the wealth index.

With regard to the variable (the number of children who have been born), we find that the likelihood of using traditional methods of family planning by women versus non-use increases with the increase in the number of children born previously. In other words, a woman who has no children born, the odds ratio is (0.013), and her chance is almost zero using traditional family planning methods than a woman who has four children born or more (she has one chance), and a woman who has one child, the odds ratio is (0.283), that is, she has about Slightly more than a quarter chance of using a traditional method versus one chance for a woman with four children or more, and a woman with two children born with an odds ratio of (0.483) has about half the chance of using a traditional method versus one chance for a woman with four children, and a woman with 3 children born to her the odds ratio is (0.765), which is approximately equal to three quarters of the chance of using traditional family planning methods for a woman who has four children or more versus not using it, in light of the stability of other factors.

As for the variable number of previously deceased children, we find that the chance of using traditional methods versus not using any means of family planning is (1.540) chance among women who have no dead children compared to one chance for women who have deceased children.

As for the variable of the woman's age at the first marriage, we find that the likelihood of using traditional methods of family planning versus not using any method increases by (1.32) when the woman is less than 18 years old and continues to increase to (1.45) when the woman is between (18-22) years old and then decreases by Simple to (1.40) at the age of (23-27) against one chance for a woman aged (28) and over.

This means that the woman at the first marriage in the age group of less than 18 years has one and a third chance to use traditional family planning methods compared to not using it for the woman in the age group of 28 years and over and the woman in the age group (18-22) at the time of her first marriage has about a chance and a half For the woman in the age group 28 years and over in exchange for non-use, and for the woman at the first marriage in the age group (23-27) years, she has about a fifty chance that she uses the traditional method for the woman at the first marriage for the age group 28 years and over in exchange for non-use in light of the stability of other variables.

From the (regions) variable, it is clear that the likelihood of using traditional methods of family planning in exchange for non-use increases significantly to reach (5.04) opportunities in the Kurdistan region compared to the center and south. The woman in the Kurdistan region has about five chances of using traditional family planning methods than the woman in central and southern Iraq, in return for not using in light of the stability of other factors.

As for the (wealth) indicator variable, we note that the woman in the poor class has a (0.75) chance of using traditional methods of family planning versus non-use compared to the wealthy woman. That is, her chance is about three-quarters of the chance of using traditional methods of family planning versus not using it, compared to one chance of a wealthy woman.

With regard to the education level variable, we note that the likelihood of using traditional methods of family planning or not is directly proportional to the educational level, as the lower the educational level of the woman, the lower the probability of her use of traditional family planning methods compared to non-use, which amounted to (0.446) chance when her certificate is less than primary and the probability increases with increase Its scientific level is (0.662) for women with primary education, and thus the chance of a woman whose education is less than primary is about half the chance of using traditional methods than for the one with average education or higher (she has one chance) versus not using. As for the woman with primary education, she has about three Fifths of the chance

of using a traditional method for a woman whose education is average and above versus non-use, that is, the higher the level of education, the greater the chance of using family planning methods in light of the stability of other factors

And the variable related to using the Internet, the probability of using traditional family planning methods versus not using 0.694 among women who do not use the Internet compared to those who use the Internet, so that the chance of a woman who does not use the Internet is about two-thirds of the chance of using traditional methods than a woman who uses the Internet (she has one chance) For non-use, with other factors held constant.

Table (2) Parameter estimates for a multifaceted logistic regression model and a significance test Each parameter and odds ratios when (Y=2) of the first equation

the highest rate to trust	minimum to trust	(β)Exp	(Sig)	(β)	Variables
95% confidence level					
			0.000	-729	Constant
					The number of children who have been born
					Reference category (a woman with four or more children)
0.020	0.008	0.013	0.000	-4.358	there is no children
0.327	0.244	0.283	0.000	-1.263	one child
0.549	0.424	0.483	0.000	-0.728	two children
0.867	0.674	0.765	0.000	-0.296	three children
					The number of children who died
					Reference category (the woman with a deceased child)
1.812	1.308	1.540	0.000	0.432	The woman who does not have a child is dead
					Age at first marriage of a woman
					The reference category (the woman's age is 28 and over)
1.607	1.091	1.324	0.005	0.281	under 18 years old
1.754	1.202	1.452	0.000	0.373	18-22 years old
1.716	1.146	1.402	0.001	0.338	23-27 years old
					Territories
					Reference Category (Central and Southern Iraq)
5.673	4.479	5.041	0.000	1.618	Kurdistan
					wealth index
					Reference class (wealthy class)
0.844	0.666	0.75	0.000	0.288-	poor class
1.071	0.822	0.938	0.343	-0.064	Middle class
					The educational level of the woman
					Reference Category (Intermediate Education and Above)
0.521	0.381	0.446	0.000	-0.808	less than elementary
0.737	0.594	0.662	0.000	-0.413	Primary

					using the Internet
					Reference category (the woman using the Internet)
0.772	0.602	0.694	0.000	0.365-	The lady who doesn't use the internet

Source: It was calculated by researcher using the Multiple Indicator Cluster Survey in Iraq in 2018 by the Central Statistics Agency and the Kurdistan Region Statistics Authority in cooperation with the Ministry of Health.

12-2-2 Results of the second model (determinants of using modern family planning methods versus non-use).

The results of Table (2) indicate that the variables are not significant in the second model as follows*:*

- The category of (23-27) years in the variable age of the woman at the first marriage.
- Regions (Kurdistan Region).
- Category (the poor class) in the wealth index.

Regarding the variable (number of children born previously), we find that the likelihood of using modern methods of family planning by women increases with the increase in the number of previously born children, as the odds ratio reaches (0.497) at the highest level for the number of children (three children) compared to non-use, meaning that A woman who has no children has an odds ratio of (003.0) and thus has almost no chance of using modern methods compared to a woman who has 4 or more children (has one chance) versus not using, and a woman who has one child has an odds ratio of (0.124) and thus her chance is slightly lower. out of five chance of using the modern method compared to a woman who has 4 or more born children versus not using it. As for a woman who has two born children, the odds ratio is (0.290), her chance is more than the previous one, reaching about a quarter of the chance of using a modern method versus not using it compared to a woman who has 4 children born. A woman who has 3 children or more has an odds ratio of (0.497), meaning that she has about half the chance of using the modern method than a woman who has 4 or more children (she has one chance) versus not. Use ceteris paribus.

As for the variable number of previously deceased children, we find that the odds ratio of using modern family planning methods versus not using is 1.718 among women who do not have a deceased child compared to women who have deceased children (they have one chance), as the woman who has not had a child has a chance and two-thirds Almost an opportunity to use modern means for the woman whose children died in exchange for non-use in light of the stability of other factors.

And the variable age of the woman at the first marriage, we find that the odds of using modern methods of family planning versus not using it is (1.344) when the age of the woman is less than 18 years, and we increase slightly to reach the odds ratio of (1.349) for women who married for the first time in the age group (18-22) years. A woman in the age group of less than 18 years has about a third chance of using the modern method than a woman in the age group of 28 years (she has one chance) or more in exchange for not using. As for the woman who got married for the first time in the 18-22 age group, she also has about one and a third chance to use The modern method for a woman in the age group of 28 years and over versus non-use in light of the stability of other factors.

From the variable of the wealth index, we note that the probability of using modern methods of family planning versus not using it is (1.133) for a woman in the middle class compared to a woman in the wealthy class. That is, it has a chance and approximately one-fifth of the opportunity to use the modern method for the woman in the wealthy class, versus not using it in light of the stability of other factors.

As for the education variable, we note that the likelihood of using modern methods of family planning or not is directly proportional to the scientific level, as the lower the educational level of the woman, the lower the probability of using modern family planning methods, reaching (0.701) when her education is less than primary, and the probability increases with an increase in her scientific level when Its primary education will be up to (8340). In exchange for non-use.

Thus, a woman whose education is less than primary has about three-quarters of a chance to use the modern method for a woman whose education is average and above (she has one chance) compared to not being employed.

A woman whose primary education has about more than almost three-quarters of a chance to use the modern method for a woman whose education is average and higher versus non-use in light of the stability of other factors.

As for the Internet use variable, we find that the probability of using modern family planning methods versus not using is (0.879) among women who do not use the Internet compared to those who use it, as the woman who does not use the Internet has almost less chance of using the modern method than the woman who uses the Internet versus not. Use ceteris paribus.

Table (3) Parameter estimates for multifaceted logistic regression model and significance test each parameter and the odds ratios at (Y=3) for the second equation

the highest rate to trust	minimum to trust	(β)Exp	(Sig)	(β)	Variables
95% confidence level					
			0.014	0.247	Constant
					The number of children who have been born
					Reference category (a woman with four or more children)
0.005	0.002	0.003	0.000	-5.898	there is no children
0.140	0.109	0.124	0.000	-2.091	one child
0.321	0.262	0.290	0.000	-1.238	two children
0.548	0.450	0.497	0.000	-0.699	three children
					The number of children who died
					Reference category (the woman with a deceased child)
1.938	1.522	1.718	0.000	0.541	The woman who does not have a child is dead
					Age at first marriage of a woman
					The reference category (the woman's age is 28 and over)
1.567	1.152	1.344	0.000	0.295	under 18 years old
1.569	1.159	1.349	0.000	0.299	18-22 years old
1.331	0.957	1.129	0.150	0.121	23-27 years old
					Territories
					Reference Category (Central and Southern Iraq)
1.220	0.965	1.085	0.174	0.081	Kurdistan
					wealth index
					Reference class (wealthy class)
1.046	0.868	0.953	0.308	0.048-	poor class
1.259	1.020	1.133	0.020	0.125	Middle class
					The educational level of the woman
					Reference Category (Intermediate Education and Above)
0.789	0.623	0.701	0.000	-0.355	less than elementary
0.910	0.764	0.834	0.000	-0.182	Primary
					using the Internet
					Reference category (the woman using the

					Internet)
0.958	0.807	0.879	0.000	0.129-	The lady who doesn't use the internet

Source: It was calculated by researcher using the Multiple Indicator Cluster Survey in Iraq in 2018 by the Central Statistics Agency and the Kurdistan Region Statistics Authority in cooperation with the Ministry of Health.

2−2−3 Quality of the model

To determine the quality of the model, the following tests must be carried out

First: the morale test of the model

To find out the significance of the multifaceted logistic regression model, we use the chi-square test and through the value of (x^2) which is (5898.011) at a degree of freedom of (28) and a level of significance of (0.000), which is less than (0.05). This means that the statistical model that has been reconciled is statistically significant (meaningful), which indicates that the variables in the model have a statistically significant contribution and importance.

Second: parameter (R^2 Cox & Snell) and(R^2Nagelkerke)

The results of the model indicated that the value of the coefficient of (R2Nagelkerke) was 32% and the value of (R2 Cox & Snell) was 28%, which means that the model is good as their value exceeded 20%.

Third, the classification table:

The classification table is one of the ways to check the quality of the model's conformity with the data. The results appeared as shown in Table (4).

Table (4) Classification Table

Percent correct	predicted			observed
	Use modern family planning methods	Uses traditional family planning methods	Do not use family planning methods	
56.8%	2841	509	4396	Do not use organizing methods
31.9%	1457	1020	699	Uses traditional organizational methods
72.2%	5055	517	1428	Uses modern means of organization
58.4%	52.2	11.4%	36.4%	total ratios

Source: It was calculated by researcher using the Multiple Indicator Cluster Survey in Iraq in 2018 by the Central Statistics Agency and the Kurdistan Region Statistics Authority in cooperation with the Ministry of Health.

It is clear from Table (4) that the percentage of women who did not use family planning methods and were correctly classified was (56.8%), as well as the percentage of women who used traditional methods and who were correctly rated (31.9%), and the percentage of women who used modern methods they were correctly classified, with a rate of (72.2%) and that the model, when entering the predictive variables, has achieved a correct total classification ratio,

which is the number of correct predictions over the total number of the study sample, their number reached (58.4%), which is a high percentage. From all of the above, we can conclude that it is well classified into the first and second categories, and averagely the second category for the dependent variable.

Multifaceted logistic regression models to study the most important factors affecting the use of family planning methods are as follows:

$log_e\left(\frac{\hat{p}_{2j}}{1-\hat{p}_{2j}}\right)$ model of the use of conventional family planning methods (Y=2)

$$log_e\left(\frac{\hat{p}_{2j}}{1-\hat{p}_{2j}}\right) = \hat{\beta}_0 + \hat{\beta}_1 x_{1j} + \cdots + \hat{\beta}_{14} x_{14j}\,,\ \ if\ i = 2$$

j=1,2,3, …, n where the total sample is n

$$\therefore log_e\left(\frac{\hat{p}_{2j}}{1-\hat{p}_{2j}}\right) = -0.729 - 4.358\,x_{1j} - 1.263\,x_{2j} - 0.728\,x_{3j} - 0.296\,x_{4j} + 0.432\,x_{5j} + 0.281\,x_{6j} + 0.373\,x_{7j} + 0.338\,x_{8j} + 1.618\,x_{9j} - 0.288\,x_{10j} - 0.064\,x_{11j} - 0.808\,x_{12j} - 0.413\,x_{13j} - 0.365\,x_{14j}$$

$log_e\left(\frac{\hat{p}_{3j}}{1-\hat{p}_{3j}}\right)$ model for the use of modern family planning methods (Y=3)

$$log_e\left(\frac{\hat{p}_{3j}}{1-\hat{p}_{3j}}\right) = \hat{\beta}_0 + \hat{\beta}_1 x_{1j} + \cdots + \hat{\beta}_{14} x_{14j}\,,\ \ if\ i = 3$$

j=1,2,3, …, n where the total sample is n

$$\therefore log_e\left(\frac{\hat{p}_{3j}}{1-\hat{p}_{3j}}\right) = 0.247 - 5.898\,x_{1j} - 2.091\,x_{2j} - 1.238\,x_{3j} - 0.699\,x_{4j} + 0.541\,x_{5j} + 0.295\,x_{6j} + 0.299\,x_{7j} + 0.121\,x_{8j} + 0.081\,x_{9j} - 0.048\,x_{10j} + 0.125\,x_{11j} - 0.355\,x_{12j} - 0.182\,x_{13j} - 0.129\,x_{14j}$$

13- Recommendations:

• The study recommends using a multifaceted logistic regression model in classifying data with a three-response dependent variable and large samples due to its high explanatory power and efficiency.

• Preparing cultural awareness programs to educate families about the dangers of early marriage for those less than sixteen years of age, since the girl is not qualified to prepare a family.

• Institutions and organizations concerned with family affairs should publish educational programs on educating women about family planning and the positive effects resulting from this through various media such as radio, television and social networking sites.

• Educating and persuading parents about educating their girls and including them in schools, as the educational situation has a positive impact, whether on the use of modern or traditional family planning methods, as well as through religious and cultural awareness.

• It is necessary to pay attention to the woman who belongs to the poor class, as she is less likely to use traditional family planning methods.

14- conclusion:

The results showed that the woman with intermediate education and above, who does not have a dead child, who is (18-22) years old at first marriage and has four children or more, and women who use the Internet have a greater chance of using traditional family planning methods and modern methods compared to not using. The difference between the two equations is that the woman who belongs to the wealthy class has a greater chance of using traditional family planning methods compared to not using, while the woman who belongs to the middle class has a greater chance of using modern family planning methods. And that women residing in the Kurdistan region have a greater opportunity to use traditional family planning methods compared to women residing in the center and south. Therefore, it is necessary to pay attention to raising the level of education, improving the economic level, and paying more attention to the regions of central and southern Iraq, as well as women who have more than three children, which will result in an increase in the rates of using family planning methods in Iraq.

References:

1- Ahmed, Muntasir Al-Amin Fadl Al-Mawla (2015) Determinants of the use of family planning methods among Sudanese women in the State of Qatar, Master's thesis, Department of Applied Statistics and Demography, Faculty of Economics and Rural Development, University of Gezira.
2- Bakir, Ezzedine Issa (2015) "Using statistical methods to study the determinants of the marital status of women in Palestine, an applied comparative study", Master's thesis, Faculty of Economics and Administrative Sciences, Al-Azhar University - Gaza.
3- Al-Azzawi, Sami Mahdi and Salman, Mahmoud Muhammad and Hamid, Hutham Khalil (2005) Determinants of family planning among married women in Diyala Governorate, Al-Fath Journal, Issue Twenty-third, College of Basic Education, University of Diyala.
4- Autumn, Rushoud Muhammad (2001) The practice of family planning and its determinants among Saudi women: a study of the data of the 1999 demographic survey, No. 4, Volume 29, Journal of Social Sciences, Kuwait University.
5- The National Committee for Population Policies (2012) Analyzing the population situation in Iraq 2012, the second national report on the situation of the population in the framework of the recommendations of the International Conference on Population and Development and the Millennium Development Goals.
6- The Central Statistical Organization and Kurdistan Statistical Authority (2019) Multi-indicator cluster survey in Iraq in 2018 by the Central Statistical Organization and Kurdistan Statistical Commission in cooperation with the Ministry of Health
7- World Bank (2020) World Development Indicators, Data Bank. https://databank.worldbank.org.
8- Eid, Husam Suleiman (2011) Determinants of the use of family planning methods among Palestinian women, University of Sharjah Journal for Humanities and Social Sciences, United Arab Emirates, Volume 8, Issue 2.
9- Abd, A. Y. (2017). Knowledge and Practice of Using Contraception among Iraqi Child Bearing Age Females. American Journal of Pharmacy and Pharmacology, Vol. 4, No. 6, 2017, pp. 45-49.
10- Agha, S. Y. and Rasheed, B. O. (2007). Family planning and unmet need among Iraqi Kurds. EMHJ-Eastern Mediterranean Health Journal, 13 (6), 1382-1391, 2007.
11- Aldabbagh, R. O. and Al-Qazaz, H. K. (2020). Knowledge and Practice of Contraception Use Among Females of Child-Bearing Age in Mosul, Iraq. International Journal of Women's Health, 12, 107.
12- Ebrahim, S.M. and Muhammed, N.K. (2011). Knowledge, attitude and practice of family planning among women in Basrah city South of Iraq. The Medical Journal of Basrah University, 29(1), 70-76.
13- Greene, W.H. (2012). Econometric analysis, 7th ed, Upper saddle River, NJ: Prentice Hall.
14- Rosner, B. (2011). Fundamentals of biostatistics, 2011. Brooks/ Cole, Boston.