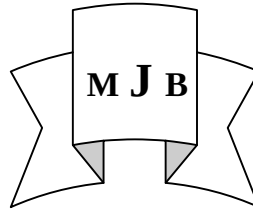


Evaluation of Anti-RubellaAntibodies Among Childbearing Age Women in Babylon Governorate

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Abstract

A study was conducted from 1st June 2005 to 30th July 2006, in which a sample of 250 women in childbearing age (15-45) years, were selected randomly from urban and rural regions of Babylon Governorate. These women were selected from those attending Babylon Maternity and Children Hospital, and Public Health Laboratory. This study has been carried out to determine anti-rubella antibodies among women in childbearing age.

The women included in this study were tested by enzyme-linked immunosorbent assay for IgG antibodies giving an overall prevalence of (77.6%), and hemagglutination-inhibition test for rubella IgG and IgM antibodies giving an overall prevalence of (80.0%).

Regarding the sociodemographic variables, the study revealed that the highest rate of seropositivity was in age group (25-29) years by ELISA and HAI tests (85.96% and 87.71% respectively), while the lowest rate was in older age group ≥ 40 years (66.7%) for both tests. Also the study revealed that the rate of seropositivity was higher among women who lives in urban areas by ELISA and HAI tests (82.56% and 83.48% respectively), women with high educational level (88.9%) for both tests, and employees women (94.44%) for both tests. Also, pregnant women had higher rate of seropositivity (78.33%) than non-pregnant ones. However, pregnant women in the first trimester had highest rate of seropositivity by ELISA and HAI tests (79.6% and 81.63% respectively) than women in the second and third trimester. Regarding the parity, the study revealed that the multipara women with three children had the highest rate of seropositivity (85.0%) for both tests than others.

The present study showed that the mean of the titer of anti-rubella antibodies by hemagglutination-inhibition test, was high (1952 ± 1641.9) in women with age group (25-29) years, and low (280 ± 80) in the older age women ≥ 40 years. Also, the mean of the titer was higher among women who live in urban areas (1262.4 ± 1375.4), women with secondary educational level (1307.9 ± 1350.2), and employees women (1496.5 ± 1683.3). While in pregnant women and non-pregnant ones, there is no significant difference in the mean of the titer between them. However, the pregnant women in the second trimester show high mean of the titer (1014.4 ± 1352.9) than others, and multipara women with two children had high mean of the titer (1124.5 ± 1383) than others.

الخلاصة

أجريت دراسة للفترة من الأول حزيران عام 2005 إلى الثلاثين من تموز عام 2006, فحصت خلالها عينة مكونة من 250 امرأة في سن الحمل (15-45) سنة, وقد اختيرت هذه العينة عشوائيا من المناطق الحضرية والريفية من محافظة بابل. وقد أجريت هذه الدراسة لتحديد الحالة المناعية للنساء في سن الحمل ضد مرض الحصبة الألمانية.

فحصت النساء بواسطة فحص المقايضة المناعية الماصة والرابطة للأنزيم للكشف عن الأجسام المناعية المضادة نوع (IgG) وكانت نسبة الانتشار الإجمالية (77.6%). و فحص اثباط التلازن الدموي للكشف عن الأجسام المناعية المضادة (IgG and IgM) وكانت نسبة الانتشار الإجمالية (80.0%).

وبالنسبة للعوامل الديموغرافية، فقد أظهرت الدراسة أن أعلى نسبة للإيجابية بواسطة فحصي ELISA و HAI (85.96% و 87.7% على التوالي) كانت في المراحل العمرية (25-29) سنة بينما أوطأ نسبة (66.7%) كانت في النساء اللواتي أعمارهن أكبر أو يساوي أربعين سنة. كما أظهرت الدراسة أن أعلى نسبة الإيجابية كانت بين مجاميع النساء اللواتي يسكن المناطق الحضرية (82.56%)، عاليات التعليم (88.9%)، و النساء العاملات (94.44%). وكذلك أن أعلى نسبة للإيجابية كانت بين النساء الحوامل عنها دون غير الحوامل (78.33%)، مع ذلك فالنساء الحوامل في الثلاثة اشهر الأولى من الحمل اظهرن أعلى نسبة ايجابية (79.6%) من النساء الحوامل في الثلاثة اشهر الثانية والثالثة. وفيما يخص الإنجابية فان الدراسة أظهرت أن أعلى نسبة للإيجابية كانت بين النساء اللواتي لهن 2-3 أطفال (85.0%).

وقد أشارت الدراسة أن وسط عيار الأجسام المضادة للحصبة الألمانية بواسطة فحص اثباط التلازن الدموي كان عاليا (1952) في النساء اللواتي يتراوح أعمارهن (25-29) سنة وواظناً (280) في النساء اللواتي أعمارهن أكبر أو يساوي 40 سنة. أن وسط العيار كان أعلى في النساء اللواتي يسكن المناطق الحضرية (1262.4)، اللواتي لديهن تعليم ثانوي (1307.9) و النساء العاملات (1496.5)، بينما لم يكن هنالك فرق مهم في وسط العيار بين النساء الحوامل وغير الحوامل. على الرغم من ذلك، فان النساء الحوامل في الثلاثة اشهر الثانية من الحمل أظهرت وسطاً أعلى من غيرهن (1014.4). كما أن النساء اللواتي لديهن طفلين اظهرن وسطاً أعلى من النساء الأخريات (1124.5).

Introduction

Rubella is an acute febrile illness, which is caused by rubella virus, from Togavirus family genus Rubivirus. The disease is characterized by a rash and lymphadenopathy that affects children and young adults. It is the mildest of common viral exanthems (Brooks et al., 2004). However, infection during early pregnancy may result in serious abnormalities of the fetus, including congenital malformations and mental retardation. The consequences of rubella in utero are referred to as the congenital rubella syndrome (CRS) (Creasy et al., 2004). With a rare exception, the mother is the source of infection for the fetus or neonates; thus, virtual infection is said to be vertically transmitted (Hanshaw and Dudgeon, 1978).

Rubella was known as German measles, because it was first described by two German physicians in the mid-eighteenth century. For many years

German measles was confused with other diseases causing a rash (such as measles and scarlet fever). It was eventually recognized as a distinct disease by an International Congress of Medicine in London in 1881, and the name rubella was accepted at about that time (Zuckerman et al., 2000). Although maternal viral illness is a common event during pregnancy, many viral infections are limited to a localized site, such as the respiratory epithelium, gastrointestinal epithelium, or skin. Only viruses that produce a maternal viremia are capable of infecting the placentofetal unit (Modlin, 1986). However, the list of viruses that may cause congenital infection is growing. In addition to rubella viruses, cytomegalovirus, varicella zoster virus, the human immunodeficiency viruses, and human parvovirus B19 may infect the developing fetus.

Transplacental infections with Japanese encephalitis and Lassa fever viruses have also been reported, as has

occasionally been the case with hepatitis B virus and Herpes simplex virus (Best and Banatvala, 1990).

Before use of rubella vaccine, rubella epidemics involved about 5% of the population, although only nearly 10% of these cases were reported to public health authorities (Horstmann, 1971). Since the licensure of rubella vaccine in 1969, the number of CRS cases has declined (CDC, 1997). The goal of the rubella vaccination program is to prevent the consequences of infection during pregnancy. Many countries do not have rubella vaccination programs or have only recently implemented such programs, and many adults throughout the world remain susceptible (CDC, 2001). In 1996, the World Health Organization (WHO) estimated that 36% of member countries offered routine rubella vaccination (Robertson et al., 1997). In 1999, WHO estimated that 52% of countries offered routine rubella vaccination, in the region of the Americas, 89% of countries used rubella vaccine (WHO,2000).In the united states of America ,endemic rubella has been eliminated.However ,since 2005 ,an average of ten cases is reported each year .Of

These cases , approximately33% are imported or linked to importation. (CDC, 2008). Many illness can mimic rubella and up to 50% of rubella infections are asymptomatic. Therefore , the only reliable evidence of acute rubella virus infection is laboratory diagnosis:

- Serologic testing for rubella specific IgM antibody is the most commonly used for diagnosis of rubella.
- Diagnosis can also be made by demonstration of sero-conversion of rubella-specific IgG antibody titers and

by detection of virus either through virus culture or PCR.(Reef et al 2006).

In Iraq, some aspects of the rubella antibodies have been studied by researchers (Al-Moslih et al., (1988); Yaseen (1992); and Al-Heety (2000).

In Babylon, no study was conducted on rubella antibodies, therefore; this study was conducted with the following aims:

1-Determination of anti-rubella antibodies among women in childbearing age.

2-Study of sociodemographic variables: age, residency, level of education, occupation, pregnancy (pregnant or non-pregnant), trimester, and parity.

3-Study the titer of anti-rubella antibodies in relation to sociodemographic variables.

Materials and Method

This study was conducted from 1st June 2005 to 30th July 2006, a total of 250 women in childbearing age (15-45) years, were selected randomly from urban and rural region of Babylon Governorate. Blood samples (5 ml) were drawn from women attending Babylon Maternity and Children Hospital, and Public Health Laboratory seeking premarital checking.

A questionnaire form was filled for each woman by direct interview. The data requested include age, residence, level of education, occupation, pregnancy (pregnant and non-pregnant), trimester, parity. We excluded the women who have had history of recent illness with rash, or contact with a known case of rubella.

The women included in this study were tested by enzyme-linked immunosorbent assay (ELISA)

technique for IgG antibodies Bioelisa rubella IgG kit produced by Bio-kit Barcelona-Spain, and hemagglutination inhibition test (HAI) for IgG and IgM antibodies the method discussed by Collee,etal,1996.

Chi-square was used to test the statistical significance of association between the categorized variables. P value less than 0.05 level of significance was considered statistically significant.

Results

The number of women included in this study was 250, their ages ranged from 15 to 45 years (Mean $\pm$ SD= 24.08 $\pm$ 10.07). The Distribution of the studied sample are presented in figures (1, 2, 3 and 4). In figure (1) we can see that (23.2%) of the

studied women were (15-19) years of age group. The next group which may represent the most common age of childbearing that is 20-24 years represent (32.0%) of our studied sample. The random selection had resulted that (22.8%) fall in the third age group of 25-29 years. The three groups collectively with the fourth age group of 30-34 years may represent ($\geq 92.0\%$) of our studied sample and may represent the most selected age for marriage. The other two groups 35-39 and ≥ 40 years were only (7.6%) of our sample and possibly enough to give an idea about the anti-rubella antibody titer in the population at that age group.

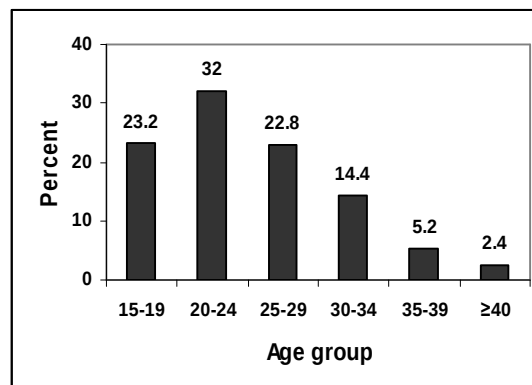
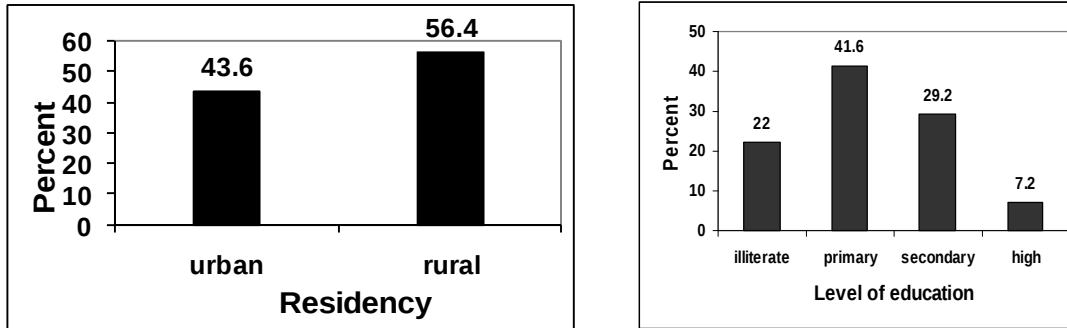


Figure 1 distribution of the sampled women according to age.

Figure (2-A) shows that 109 (43.6%) women were from urban areas and 141 (56.4%) were from rural areas. Regarding the level of education, 55 (22.0%) women were illiterate, 104

(41.6%) had primary school qualification, 73 (29.2%) were secondary school graduate, and 18 (7.2%) with high education (figure 2B).



(A)

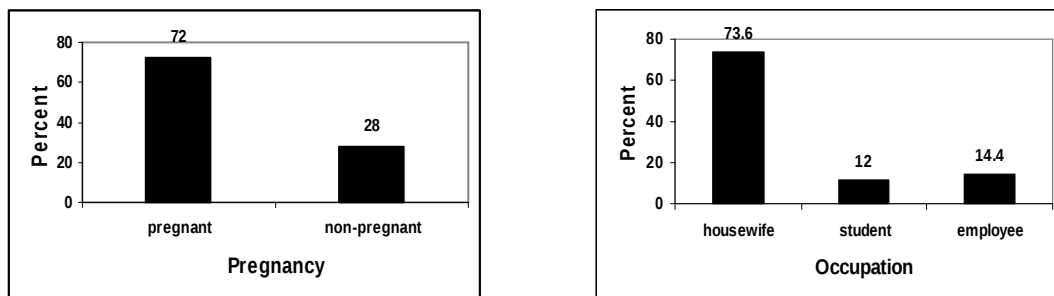
(B)

Figure 2 Distribution of the sampled women according to:

A) Residency. B) Level of education

In respect to occupation, one hundred eighty four (73.6%) of the women were housewives, 30 (12.0%) were students and 36 (14.4%) were

employees (figure 3-A). One hundred and eighty (72.0%) of studied women were pregnant and 70 (28.0%) were not (figure 3-B).



(A)

(B)

Figure 3 Distribution of the sampled women according to:

A) Occupation. B) Pregnancy.

Regarding pregnant women, 49 (27.22%) of them were in first trimester, 64 (35.5%) were in second trimester and the rest 67 (26.8%) were in third trimester (figure 4-A). In respect to parity, 65 (36.11%) have no children, 39 (21.66%) were have one child, 44 (14.0%) have two children, 20 (11.1%) have three children, 7 (3.8%) have four children and 5 (2.7%) have five children (figure 4-B).

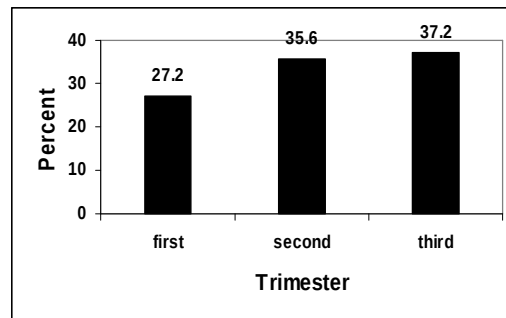


Figure 4 Distribution of the sampled women according to: Trimester. .

Figure 5 shows that 194 out of 250 women had positive anti-rubella antibodies by ELISA (IgG) test giving an overall prevalence of (77.6%),

whereas 200 out of 250 women had anti-rubella antibodies by HAI test (IgG and IgM) giving an overall prevalence of (80.0%).

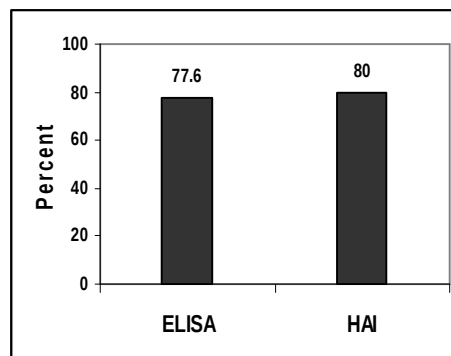


Figure 5 The rate of anti-rubella antibodies by ELISA and HAI tests.

Figure (6-A) shows that the highest rate of seropositivity of anti-rubella antibodies was among women at age group 25-29 years by ELISA and HAI tests (85.96% and 87.71% respectively), whereas the lowest rate among women aged ≥ 40 years by both

tests (66.7%) for both tests. Regarding the residency, the rate of seropositivity was higher among women who live in urban areas than those who were live in rural areas by ELISA and HAI tests (82.56% and 83.48% respectively) (figure 6-B).

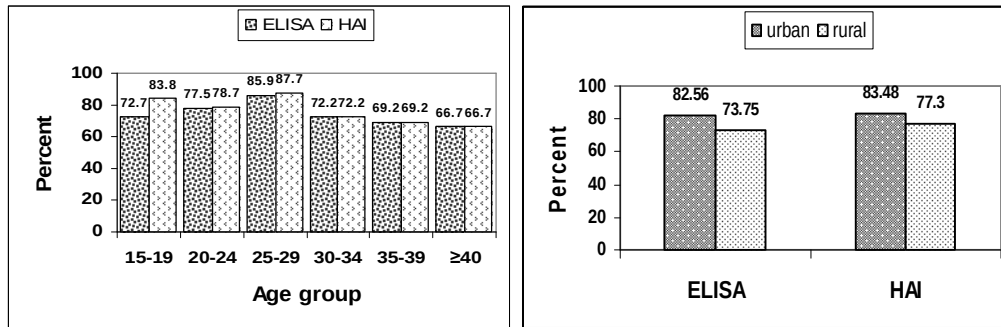


Figure 6 The rate of seropositivity of anti-rubella antibodies by ELISA and HAI tests according to: A) Age. B) Residency.

(A)

The rate of seropositivity was highest among women who were highly educated by ELISA and HAI tests than others (88.9%) for both tests. The lowest rate of seropositivity was among illiterate women (69.1%) by ELISA, whereas among primary

(B)

educated women (75.0%) by HAI test (figure 7-A). In respect to occupation, the employees women have the highest rate of positivity (94.44% by both tests) than students and housewives (figure 7-B).

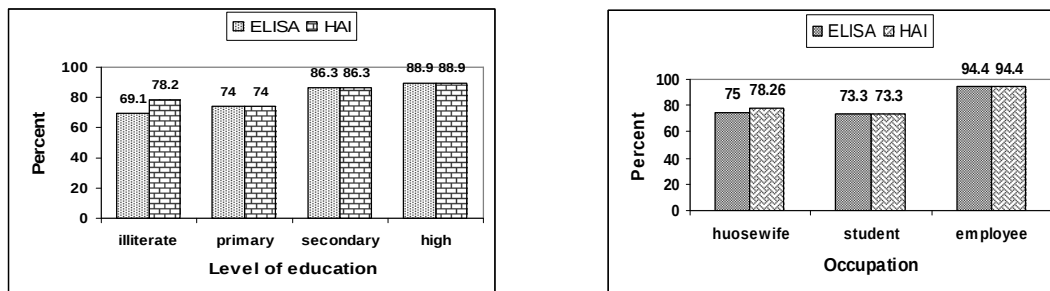


Figure 7 The rate of seropositivity of anti-rubella antibodies by ELISA and HAI tests according to: A) Level of education. B) Occupation.

(A)

Pregnant women were have higher rate of positivity (78.33%) than non-pregnant ones by ELISA test, whereas non-pregnant women have higher rate of positivity than pregnant ones (82.85%) by HAI test (figure 8-A).

(B)

Pregnant women who were in first trimester have the highest rate of seropositivity by ELISA and HAI tests (79.6% and 81.63% respectively) than the women in second and third trimester (figure 8-B).

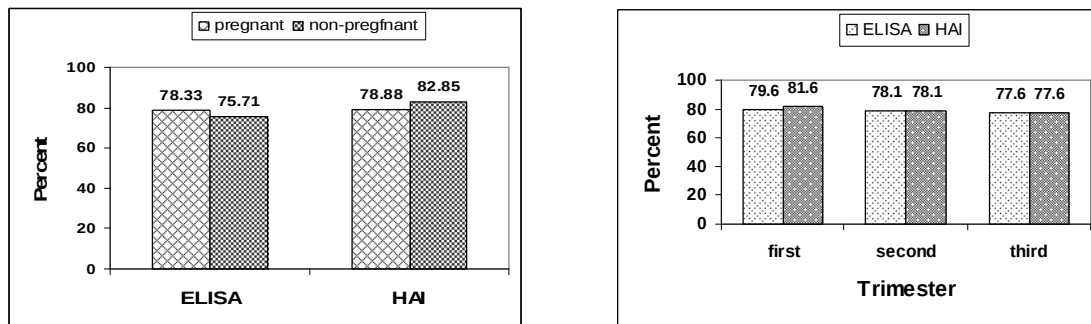


Figure 8 The rate of seropositivity of anti-rubella antibodies by ELISA and HAI tests according to: A) Pregnancy. B) Trimester.

(A)

(B)

The highest rate of seropositivity by ELISA and HAI tests was among multipara women with three children (85.0%) for both tests than others, and the lowest rate among women who have four children (57.14%) for both tests (figure 9).

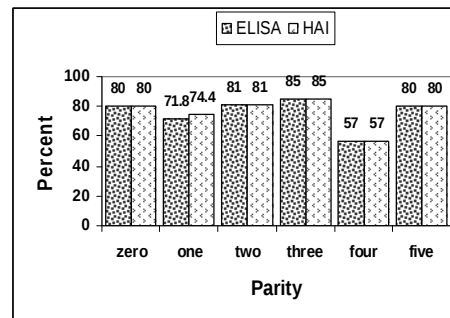


Figure 9 The rate of seropositivity of anti-rubella antibodies by ELISA and HAI tests according to Parity.

The rate of positive anti-rubella antibodies by ELISA (IgG) was significantly associated with (age and residency) ($P=0.02$ and 0.023 respectively). The rate of positive anti-rubella antibodies by HAI was also significantly associated with (age and residency) ($P = 0.02$ and 0.025 respectively).

Table no. (1) shows that the highest mean of anti-rubella antibodies titer by HAI test (1952 ± 1641.9) was among women in age group 25-29 years, and the highest percentage (36.0%) of them were presented with a titer of (1280). Whereas the lowest mean titer ($280 \pm$

80) among age group ≥ 40 years and (75.0%) of them were presented with a titer of (320). Women at age group 15-19 years, show the mean titer of (431.7 ± 435) and (33.3%) of them were presented with a titer of (160). Women at age group 20-24 years, show the mean titer of (609.2 ± 417.4) and (44.4%) of them were presented with a titer of (640). Women at age group 30-34 years, show the mean titer of (412.3 ± 478.8) and (34.6%) of them were presented with a titer of (320). Women at age group 35-39 years, show the mean titer of (302.2 ± 148.5) and (55.5%) of them were presented with a titer of (320).

Table 1 Anti-rubella antibodies titer by HAI test according to age.

Age No.(%)	Titer								P value
	80	160	320	640	1280	2560	5120	Mean $\pm$ SD	
	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)		
15-19 48 (24.0)	3 (6.2)	16 (33.3)	14 (29.1)	11 (22.9)	3 (6.2)	1 (2.0)	0	431.6 $\pm$ 435	<0.05
20-24 63 (31.5)	0	7 (11.1)	18 (28.5)	28 (44.4)	9 (14.2)	1 (1.5)	0	609.2 $\pm$ 417.4	
25-29 50 (25.0)	0	2 (4.0)	2 (4.0)	11 (22.0)	18 (36.0)	8 (16.0)	9 (18.0)	1952 $\pm$ 1641.9	
30-34 26 (13.0)	2 (7.6)	8 (30.7)	9 (34.6)	6 (23.0)	0	1 (3.8)	0	412.3 $\pm$ 478.8	
35-39 9 (4.5)	0	3 (33.3)	5 (55.5)	1 (11.1)	0	0	0	302.2 $\pm$ 148.5	
≥ 40 4 (2.0)	0	1 (25.0)	3 (75.0)	0	0	0	0	280 $\pm$ 80	

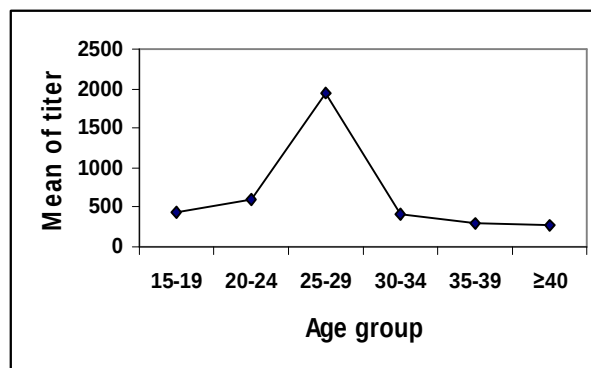
**Figure 10** The mean of titer of anti-rubella antibodies of different age groups.

Table no. (2) shows that the mean of anti-rubella antibodies titer by HAI test was higher among women who live in urban areas (1262.4 ± 1375.4), and (31.8%) of them were presented with a

titer of (640). While the women who live in rural areas showed a lower mean of titer (521.8 ± 621.7) and (31.2%) of them were presented with a titer of (320).

Table 2 Anti-rubella antibodies titer by HAI test according to residency.

Residency No. (%)	Titer								P value
	80	160	320	640	1280	2560	5120	Mean $\pm$ SD	
	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)		
Urban 91 (45.5)	0	8 (8.7)	17 (18.6)	29 (31.8)	20 (21.9)	9 (9.8)	8 (8.7)	1262.4 $\pm$ 1375.4	<0.05
Rural 109 (54.5)	5 (4.5)	29 (26.6)	34 (31.2)	28 (25.6)	10 (9.1)	2 (1.8)	1 (0.9)	521.8 $\pm$ 621.7	

Regarding the level of education, table no. (3) shows that the highest mean titer of anti-rubella antibodies by HAI test (1307.9 $\pm$ 1350) was among women who had secondary level of education and (31.7%) of them were presented with a titer of (640). While the women who were illiterate have the lowest mean of titer (465.1 $\pm$ 388.3) and (32.5%) of them were presented

with a titer of (160). The women with primary and high level of education shows that the same mean titer (624.6 $\pm$ 839.7 and 1290 $\pm$ 1550.7 respectively). (30.7%) of women with primary education level presented with a titer of (640) and (31.2%) of women with high education level presented with a titer of (1280).

Table 3 Anti-rubella antibodies titer by HAI test according to level of education.

Level of education No. (%)	Titer								P value
	80	160	320	640	1280	2560	5120	Mean $\pm$ SD	
	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)		
Illiterate 43 (21.5)	2 (4.6)	14 (32.5)	13 (30.2)	9 (20.9)	4 (9.3)	1 (2.3)	0	456.1 $\pm$ 388.3	>0.05
Primary 78 (39.0)	3 (3.8)	17 (21.7)	23 (29.4)	24 (30.7)	8 (10.2)	1 (1.2)	2 (2.5)	624.6 $\pm$ 839.7	
Secondary 63 (31.5)	0	5 (7.9)	11 (17.4)	20 (31.7)	13 (20.6)	9 (14.2)	5 (7.9)	1307.9 $\pm$ 1350	
High 16 (8.0)	0	1 (6.2)	4 (25.0)	4 (25.0)	5 (31.2)	0	2 (12.5)	1290 $\pm$ 1550.7	

Table no. (4) shows that the employees women had the highest mean titer of anti-rubella antibodies by HAI test (1496.5 ± 1683.3) and (29.4%) of them were presented with a titer of (320).

The students and housewives had a mean titer of (814.5 ± 545.2 and 715 ± 925.3 respectively). (45.4%) of students and (27.0%) of housewives presented with a titer of (640).

Table 4 Anti-rubella antibodies titer by HAI test according to occupation.

Occupation No. (%)	Titer								P value
	80	160	320	640	1280	2560	5120	Mean ± SD	
	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)		
Employee 34 (17.0)	0	2 (5.8)	10 (29.4)	8 (23.5)	5 (14.7)	4 (11.7)	5 (14.7)	1496.4 ± 1683.3	>0.05
Student 22 (11.0)	0	2 (9.0)	3 (13.6)	10 (45.4)	6 (27.7)	1 (4.5)	0	814.5 ± 545.2	
Housewife 144 (72.0)	5 (11.3)	33 (22.9)	38 (26.3)	39 (27.0)	19 (13.1)	6 (4.1)	4 (2.7)	715 ± 925. 3	

Table no. (5) shows that the mean of anti-rubella antibodies titer by HAI test was slightly high in pregnant women than non-pregnant ones (907.6 ± 1136 and 717.2 ± 991.7 respectively), but

(30.9%) of pregnant women were presented with a titer of (640) and (29.3%) of non-pregnant ones presented with a titer of (320).

Table 5 Anti-rubella antibodies titer by HAI test according to pregnancy.

Pregnancy No. (%)	Titer								P value
	80	160	320	640	1280	2560	5120	Mean ± SD	
	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)		
Pregnant 142 (71.0)	3 (2.1)	24 (16.9)	34 (23.9)	44 (30.9)	21 (14.7)	9 (6.3)	7 (4.9)	907.6 ± 1136	>0.05
Non- pregnant 58 (29.0)	2 (3.4)	13 (22.4)	17 (29.3)	13 (22.4)	9 (15.5)	2 (3.4)	2 (3.4)	717.2 ± 991.7	

Table no. (6) shows that the mean titer of anti-rubella antibodies by HAI test of pregnant women in first and third trimester was (830 ± 945.8 and 864.6 ± 1226.3 respectively). (35.0%) of pregnant women in first trimester presented with a titer of (640) and

(26.9%) of pregnant women in third trimester presented with a titer of (320). While the pregnant women in second trimester had the mean titer of (1014.4 ± 1352.9), and the highest percent (34%) of them presented with a titer of (640).

Table 6 Anti-rubella antibodies titer by HAI test according to trimester.

Trimester No. (%)	Titer								P value
	80	160	320	640	1280	2560	5120	Mean $\pm$ SD	
	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)	N.(%)		
First 40 (28.2)	1 (2.5)	7 (17.5)	8 (20.0)	14 (35.0)	6 (15.0)	3 (7.5)	1 (2.5)	830 ± 945.8	>0.05
Second 50 (35.2)	0	9 (18.0)	12 (24.0)	17 (34.0)	5 (10.0)	3 (6.0)	4 (8.0)	1014 ± 1352.9	
Third 52 (36.6)	2 (3.8)	8 (15.3)	14 (26.9)	13 (25.0)	10 (19.2)	3 (5.7)	2 (3.8)	864.6 ± 1226.3	

Table no. (7) shows that the mean titer of anti-rubella antibodies by HAI test of nullipara women was (815.4 ± 100.9) and the highest percent of them (36.5%) were presented with a titer of (640). The women with a parity of 1, 2 and 3 had a mean titer of (1056.5 ± 1085.7 , 1124.5 ± 1383 , and 856.4 ± 1008.9 respectively), and the highest percent of them (27.5%, 25.0%, and 47.0% respectively) had a titer of (640). The women high parity (4 and 5) had a mean titer of (200 ± 80 and 240 ± 92.4 respectively), and (75.0%) multipara women (4) had a titer of (160) and other multipara women (5) were that equally (50.0%) had (160) and (320) titer.

Discussion

The evaluation of anti-rubella antibody profiles among females in childbearing age and in various geographical areas is essential for effective administration of rubella vaccine to lessen congenital rubella syndrome in non-immunized women during pregnancy.

The study revealed that the overall prevalence rate of anti-rubella antibodies by ELISA technique was (77.6%), whereas the study revealed that the overall prevalence by HAI test was (80.0%), this might be due to that ELISA test is more sensitive and specific than HAI test (Best et al., 1980). Similar results were reported in Pakistan (77.0%) (Azmi et al., 1987);

in Thailand (75.0%) (Boonruang and Buppasiri, 2005); and in the southern of Iraq (Basrah) (79.0%) (Yaseen, 1992). Higher result were reported in Al-Doora, Baghdad (94.8%) (Al-Heety, 2000).

Higher results were reported in other Arab countries, in Kuwait (92.3%) (Makhseed et al., 2001); in Jeddah, Saudi Arabia (93.0%) by HAI test (Basalamah and Serebour, 1982); also in Saudi Arabia (93.3%) by ELISA (Hani, 2001); in Sana'a, Yemen (85.4%) (Sallam et al., 2006); and in other parts of the world, in Tehran (98.1%) (Soleimanjahi et al., 2005); in Catalonia, Spain (98.1%) (Domingues et al., 2005); in Switzerland (94.3%) (Zufferey et al., 1995); in Dakar, Senegal (90.1%) (Dromigny et al., 2003); in Malaysia (92.3%) (Sekawi et al., 2005); in Maputo, Mozambique (95.3%) (Barreto et al., 2006); and in Taiwan (85.1%) (Tsenq et al., 2006); in Cameron (83.9%) (bioELISA rubella IgG kit literature). This explained by an efficient vaccination programs or there is high rate of clinical or subclinical infection. While lower results of seropositivity were reported in Leon, Guanajuato, Mexico (71.0%) (Macias-Hernandes et al., 1993); in Korea (73.1%) (Park and Kim, 1996); in Amritsar, Punjab (68.8%) (Singla et al., 2004); in Thrace, Greece (67.0%) (Mela, 2004); and in Mersin, Turkey (55.0%) (Sasmaz et al., 2006). In India the rate of anti-rubella antibodies increasing from (49.0%) in 1988 to (87.0%) in 2002 (Gandhoke et al., 2005).

Regarding the age, the present study revealed that the highest rate of seropositivity (85.96%) was in age group (25-29) years, while the lowest rate (66.7%) was in age group (≥ 40) years (figure 6-A). Similar results were reported by others (Boonruang and Buppasiri, 2005); (Singla et al., 2004);

(Al-Heety, 2000); and (Yaseen, 1992). This could be explained by that increase chance of exposure to the virus which could be either in form of vaccine or infection, or due to that the antibody response declines, overtime, to below the protective level. Prospective serological surveillance has shown that vaccine induced antibodies would persist in the majority of persons over a period of 7-10 years (Horstmann, 1982), and might persist for as long as 18 years after vaccination (Kudesia et al., 1985).

Regarding the residency, the present study revealed that the rate of seropositivity was higher among women who live in urban areas than those who live in rural areas. This could be explained by that the knowledge about the rubella as a preventable disease in urban areas is more likely, and more contact with information regarding it than in rural areas. Similar results were reported by (Barreto et al., 2006); (Singla et al., 2004); and (Macias-Hernandes, 1993).

Although education should have an effect on knowledge about rubella and its prevention by vaccination program. The present study revealed that the level of education had no-significant effect on the prevalence of anti-rubella antibodies. Similar results were reported by (Boonruang and Buppasiri, 2005); and (Yaseen, 1992).

In respect to pregnancy, the study revealed that the rate of seropositivity was higher in pregnant women, than non-pregnant ones. But the difference between them was not significant. Similar results were reported by (Al-Heety, 2000); and (Barreto et al., 2006). While Singla et al., (2004) reported that the prevalence of rubella antibodies in pregnant women was less than that observed in non-pregnant ones. Also the highest rate of

seropositivity was among women in the first trimester of pregnancy than other period of pregnancy, but there is no significant difference. Similar result was reported by (Boonruang and Buppasiri, 2005). While Al-Heety (2000), reported that the prevalence of rubella antibodies was high among women in the second trimester than those in the first and third trimester. The reason for this is not clear, but we are in need for further studies stressing on non-pregnant women, then to follow them in pregnancy through the three trimesters to give an exact explanation for this finding.

The present study revealed that the mean of the titer of anti-rubella antibodies by HAI test was elevated with age as the mean of the titer was (431.7) in age group (15-19) years, then (609.2) in age group (20-24) years, until reach its maximum level (1952) in age group (25-29) years, after that, it started to decrease gradually with increasing age (table-1). This could be explained by that the immunoglobulin level had been maximum in the first ten years after vaccination or exposure, and persist for life in lower levels.

The study, also, revealed that the mean of the titer was higher among women who live in urban areas (1262.4 ± 1375.4), than those residing in rural areas (table-2). This might be related to fact that the women who live in urban areas had more chance to expose to infection because of more likely contact with infected persons. The mean of the titer was higher among women with secondary education level (1307.9 ± 1350) than others (table-3), which is related to the age factor. Also the mean of the titer was higher among employees women (1496.4 ± 1683) than students and housewives (table-4), this could be explained by that the employees

women had more contact with individuals, so higher chance of exposure to infection, while the mean of the titer shows no significant difference between pregnant and non-pregnant ones (table-5). However, the pregnant women in the second trimester shows high mean of the titer (1014 ± 1352.9) (table-6) (similar result was reported by Al-Heety, 2000). The study revealed that the mean of the titer was high in multipara women with two children (1124.5 ± 1383), which is commonly young than women with a multipara until it reach its lowest level at older women who were with a parity of four and five children (table-7), this mean that this effect of parity on the titer is related to age factor.

According to figure (10), the least protective level of anti-rubella antibody titer were assessed to be 1:320, and in this category all women have had ≤ 320 titer of antibody should be revaccinated to maintain a protective level of immunity against rubella. About 68.6% of women 15-19 years of age, 39.6% of women 20-24 years, 8.0% of women 25-29 years, 72.9% of women 30-34 years, 88.8% of women 35-39 years, and all women ≥ 40 years had a titer of ≤ 320 have to be revaccinated. According to table (2), about 27.0% of the urban and 62.0% of the rural women have to be revaccinated against rubella to reach a protective level of antibodies. In the same sequence, $\geq 67.0\%$ of the illiterate, about 55.0% of the primary educated, 25.0% of the secondary educated and 30.0% of high educated have to be revaccinated. About 35.0% of the employees women, 20.0% of the students and 60.0% of the housewives have to be revaccinated to have a protective level of immunity. In respect to pregnancy, about 43.0% of pregnant women, and 55.0% of non-pregnant ones have to be revaccinated.

Those who were pregnant, 40.0% of them in first trimester, 42.0% in second trimester, and 46.0% in third trimester have to be revaccinated to reach a protective level of immunity. About 49.0% of nullipara women, 34.0% of women with one child, 37.0% with two child, 41.0% with three child, and all multipara women with four and five child have to be revaccinated against rubella.

Conclusions

1-There were a fair number of women in childbearing age still at high risk for acquiring rubella virus infection.

2-Women who lives in urban areas show high possibility to develop seropositivity, which may be due to exposure or vaccination.

3-The titer of anti-rubella antibodies mainly affected by age and residency than other factors

Recommendations

1-Examining of women in premarital stage and pregnancy for anti-rubella antibodies is recommended.

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2-Rubella immunization program in secondary schools should be continued to ensure that all girls are immunized to rubella before they reach childbearing age.

3-Encouragement the health education for the public about the hazard of rubella, the importance of vaccination for prevention this disease and other information regarding rubella.

4-Health worker should be educated to the importance of proper handling and storage of rubella vaccine to avoid the failure of vaccination.

5-For non immune women, vaccination at premarital visits, post abortion, post partum, or during any contact with the health care system with warning to avoid pregnancy for three month following vaccination will be very useful.

6-A continuous serosurveillance is needed to monitor vaccine efficacy in the field and to ensure that a protective level of antibody is maintained throughout the female reproductive period.

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