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Rubella seroprevalence in women with bad obstetric history

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ABSTRACT

Objective: To determine rubella seroprevalence in women with bad obstetric history (BOH). **Patients and methods:** A case control study was conducted in Kirkuk, Iraq, which included 538 women with age range from 15 to 48 years. A structured questionnaires were used to gather sociodemographic data and ELISA was used to detect rubella infection using IgG and IgM kits. **Results:** Out of the 538 women, 435 (80.9%) and 18 (3.3%) were rubella IgG and IgM positive respectively. Women age, occupation, education and family size were significantly associated with serpositive rubella IgG. Women with BOH were with high rubella IgG seropositivity than that in women with normal pregnancy. Current infection was higher in women with normal pregnancy outcomes as compared to that with BOH. **Conclusion:** This study provides important and highly useful information on baseline seroprevalence data on rubella in Iraq. A 19.1% of our women study population were non rubella immune and were susceptible for rubella infection. In addition, rubella seroprevalence associated with BOH.

KEYWORDS

BOH;
Rubella;
IgG;
IgM;
Pregnant women;
Socio-demographic variables;
Iraq.

INTRODUCTION

Rubella infection is generally an asymptomatic childhood disease but during the first trimester of pregnancy it can cause fetal death or severe congenital defects[1]. Risk of rubella defects is high in infants whose mothers are infected by rubella virus in the first 16 weeks of pregnancy[2].

Rubella IgG antibodies in a studies performed in Baghdad and Babylon, Iraq, detected in 34.2% and 100% of aborted women respectively[1,3]. The above findings indicated that about 2/3 of the population were at risk for getting rubella infection during their pregnancy. These findings also highlight the need for rubella screening for pregnant women at their first prenatal visit, with standing orders for rubella vaccination after delivery together with reinforcement of the rubella vaccination program.

Rubella has a worldwide distribution[4]. Before the introduction of vaccination outbreaks tend to occur in spring and summer[4]. Infection is uncommon in preschool children but outbreaks involving school children and young adults are common[5,6]. In general, about 50% of 10 year olds have rubella antibodies. About 80% of women of childbearing age were found to be immune in the pre-vaccination era[7].

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The aim of the present study is to determine the seroprevalence of rubella IgG and IgM and the rate of non rubella immune in women with bad obstetric history compared to that with normal pregnancy outcomes.

PATIENTS AND METHODS

Study design

The study design is a Descriptive Case Control Study was conducted at the antenatal clinic of Kirkuk General Hospital and Primary Health Care Centre in Tessean. Women (Pregnant or Non pregnant) with bad obstetric history are to be recruited from those attending outpatient Gynaecology Clinic Kirkuk General Hospital or the outpatient Clinic at Tessean PHC.

Study population

The study population is women with childbearing age. Study population was recruited from Primary Health care Centers located in urban and rural areas in Kirkuk Governorates. In addition, one of the study population group was recruited from pregnant women who are in labor to select the group of pregnant with risky outcomes.

Group 1 : Pregnant women with age range of 15-48 years, and with normal pregnancy.

Group 2 : Non pregnant women with age range of 15 – 48 years, and with normal pregnancy.

Group 3 : Pregnant women with Risk factor (BOH) depending on their previous pregnancy and / or delivery outcome which include pregnancy loss, intrauterine deaths, preterm deliveries and intrauterine growth retardation. Their age range from 15 t0 48 years.

Group 4 : Non- pregnant women with Risk factor depending on their previous pregnancy and /or delivery outcome which include pregnancy loss, intrauterine deaths, preterm deliveries and intrauterine growth retardation. Their age range from 15 t0 48 years.

The demographic information of these groups are shown in TABLE 1. The target number recruited for each group was 150 women. However, the total number of women included in the study was 538, of them 293 (54.5%) were with BOH, and 245 (45.5%) were with normal pregnancy history. In the BOH group, 144 (49.1%) women were pregnant, while in the normal pregnancy group, 117 (47.7%) were pregnant.

TABLE 1 : Study population

Group		Number	Mean age ± SD in years
Women with bad obstetric history	Pregnant	144	27.38 ±7.5
	Non pregnant	149	28.56 ± 6.7
	Total	293	27.97 ± 7.1
Women with normal pregnancy	Pregnant	117	26.00 ± 6.2
	Non pregnant	128	30.16 ± 10.9
	Total	245	28.16 ± 9.2
Grand total		538	28.06 ± 8.1
P value	ANOVA NS		

Collection of data

The designated investigators visited the outpatient department daily, selected the study subjects, and screened them using a predesigned pretested schedule considering the inclusion and exclusion criteria till the study subjects recruitment could be identified. The next available age-matched multiparous antenatal woman without BOH was included in the control group subjects.

Clinical examination and laboratory investigations are to be carried out for the study subjects to exclude other causes of foetal wastage, such as hypertension, diabetes mellitus, syphilis, Rh (rhesus) incompatibility, physical causes of abortion, and consanguinity. Subjects with known causes of foetal wastage are to be excluded from the study. All of them were interviewed to ascertain age, medical and obstetric information.

Sample collection

For serological analysis, 5-10 mL of venous blood is to be collected in a sterile container with strict aseptic precautions from each study subject. The serum was separated and stored in numbered aliquots at -20 ^{o}C till assayed. All the serum samples collected from the study and control groups were tested for rubella IgM and IgG antibodies by commercially- available (ELISA) kits. The results read by a Microwell reader and compared in a parallel manner with controls; optical density read at 450 nm on an ELISA reader.

Ethical approval

The ethical committee of the concerned institute approved the research protocol. The purpose and procedures of the study are to be explained to all the study

subjects, and informed consent is to be obtained from them. The study design was approved by the ethical committee of Tikrit University College of Medicine.

Methods

ELISA was used for determination of IgM and IgG for HSV-2 and the test was performed according to manufacturer instructions. The kit purchased from BioCheck, Inc, 323 Vintage Park Dr, Foster City, CA 94404.

Analysis of data

Collected data are compiled in Microsoft Excel spreadsheet. The proportion and the odd ratio value were computed in appropriate situations. To find out any association between categorical data, Chi square test is to be employed using the SPSS (Version 16). If the sample size in BOH group not reach the targeted number Power Analysis are to be performed to determine the accuracy of findings.

The study finding data are presented as frequency ± SD and 95% Confidence Interval. Bivariate Regression Line Analysis to calculate Odd Ratio for determination of association between two variables. The determinants for rubella infection is determined by calculation of Odd Ratio using Logistic Regression Line Analysis. Confounding factors such as age, socio-economic status, e.t.c are standardized when serological determinants are calculated.

RESULTS

The overall rubella seroprevalence in our study population women was 80.9%, indicating a 19.1% susceptibility rate to rubella infection in women with age of 17 to 48 in Kirkuk community. In addition, rubella IgG seroprevalence was significantly ($X^2 = 28.1$, $P = 0.000$) in women with bad obstetric history (BOH) (89.1%) as compared to women with normal pregnancy (71%) outcomes. TABLE 2.

Current rubella infection was 3.3% (18/538) in our study population and it was significantly higher ($X^2 = 5.346$, $P = 0.021$) in women with normal pregnancy outcomes (5.3%) as compared to those with BOH (1.7%), TABLE 2. Unfortunately, the current rubella infection was significantly ($X^2 = 15.73$, $P = 0.000$) higher in pregnant (6.5%) than in non pregnant (0.4%) women, indicating high risk of mother-to-child transmission of rubella. Furthermore, rubella IgG seropositivity was more in non-pregnant women (82.7%) than in pregnant (78.9%), which increased the hazard of exposure to rubella infection in pregnant women (21.1%), TABLE 3.

TABLE 2 : Rubella seroprevalence in women with bad obstetric history.

Group [Number]		Number positive [Percent]	
		IgM	IgG
Bad obstetric history	Pregnant [144]	4 [2.8]	128 [88.9]
	Non- pregnant [149]	1 [0.7]	133 [89.3]
	X^2	1.937	0.01
	P value	NS	NS
	Total [293]	5 [1.7]	261 [89.1]
Normal pregnancy	Pregnant [117]	13 [11.1]	78 [66.7]
	Non- pregnant [128]	0 [0]	96 [75]
	X^2	15.02	2.062
	P value	0.000	NS
	Total [245]	13 [5.3]	174 [71]
Grand total [538]		18 [3.3]	435 [80.9]
X^2 BOH versus Normal Pregnancy		5.346	28.1
P value BOH versus Normal Pregnancy		0.021	0.000

TABLE 3 : Herpes Simplex virus seroprevalence in pregnant compared to non-pregnant women.

Group [Number]	Number positive [Percent]	
	IgM	IgG
Pregnant [261]	17 [6.5]	206 [78.9]
Non- pregnant [277]	1 [0.4]	229 [82.7]
X^2	15.73	1.217
P value	0.000	NS

Rubella IgG and IgM significantly varied with age (for IgG, $X^2 = 19.6$, $P = 0.000$; for IgM, $X^2 = 9.72$, $P = 0.021$). The majority (77.8%, 14/18) of current infection cases was in women win age of 20 - 29 years, and IgM not detected in the age groups of 15 - 19 and 40 - 48 years. Rubella IgG seropositivity was 81.1% in women with age of < 20 years, then decline to reach 73.5% in the age of 20 - 29 years, but increased in the subsequent age groups and reach the plateau of 96.3% in women with age of 40-48 years, TABLE 4. OR confirmed the association between rubella IgG

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TABLE 4 : Rubella seroprevalence in regard to age

Age group in years	Number	HSV -2 Number [%]	
		IgM	IgG
15 – 19	74	0 [0]	60 [81.1]
20-29	238	14 [5.9]	175 [73.5]
30-39	172	4 [2.3]	148 [86]
40 -48	54	0 [0]	52 [96.3]
Chi Square		9.72	19.6
P value		0.021	0.000

TABLE 5 : Odd ratio of Rubella in regards to age of women lower than 30 years

Variable	Odd ratio [95% Confidence interval]	P value
Rubella IgM	0.3835 [0.1245 – 1.181]	NS
Rubella IgG	2.5205 [1.5551 – 4.0851]	<0.0001

seroprevalence and women age of more than 30 years (OR= 2.5205, P < 0.0001), but not for IgM, TABLE 5.

Rubella IgG seroprevalence was higher in rural (85.7%) than in urban (79.1%), but the difference not statistically significant (X^2 = 2.88, P > 0.05). In contrast, current rubella infection was significantly (X^2 = 6.55, P = 0.01) higher in urban women (4.5%) than in rural (0%) living women. OR not confirmed the association between residence and rubella IgG and IgM seroprevalence, TABLES 6 & 7.

Rubella IgG seroprevalence was significantly (X^2 = 8.71, P = 0.003) higher in housewife women (82.3%) as compared to working (63.4%) women. In addition, rubella IgM (current infection) was higher in housewife women (3.6%) than in working (0%) women (OR = 2.6814, P = 0.004), but not for IgM (OR = 0.3223, P > 0.05), TABLES 6 & 7.

Women education was significantly influenced rubella IgG (X^2 = 166.7, P = 0.000) and IgM (X^2 = 84.28, P = 0.000) seroprevalence. Rubella IgG seropositivity was 50% in uneducated women and increased gradually to reach 99% in women with secondary school education level, but then decline to reach 33.3% in graduated women. However, current infection detected in 2.9% of uneducated women and declined gradually to reach 0% in secondary school educated women but then increased to reach highest rate (19.1%) in graduated women. The pattern of IgG is inverse to that of IgM. OR confirmed the association between education levels and rubella IgG seropositivity (OR = 16.78 - 203.478, P < 0.05 - < 0.0001), TABLES 6 & 7.

TABLE 6 : Rubella IgG and IgM seroprevalence in regard to sociodemographic characteristics

Variable	[Number]	Number positive [Percent]	
		IgM	IgG
Residence	Rural [140]	0 [0]	120 [85.7]
	Urban [398]	18 [4.5]	315 [79.1]
	X^2	6.55	2.88
	P value	0.01	NS
Occupation	House wife [497]	18 [3.6]	409 [82.3]
	Working [41]	0 [0]	26 [63.4]
	X^2	1.53	8.71
	P value	NS	0.003
Education	Uneducated [34]	1 [2.9]	17 [50]
	Primary [331]	4 [1.2]	291 [87.9]
	Secondary [105]	0 [0]	104 [99]
	College & above [68]	13 [19.1]	23 [33.8]
	X^2	84.28	166.7
	P value	0.000	0.000
Crowding Index	≤ 3 [478]	18 [3.8]	378 [79.1]
	3.1 – 8 [60]	0 [0]	57 [95]
	X^2	2.34	8.73
	P value	NS	0.003

Rubella IgG seroprevalence was significantly (X^2 = 8.73, P = 0.003) predominant in large size (crowding index > 3) family (98.3%) and this association was confirmed by OR (OR = 0.1989, P = 0.007). However, current infection was in women of small family size (3.8%), but this associated was not confirmed by OR, TABLES 6 & 7.

DISCUSSION

In the present study, the seroprevalence of the rubella virus was found to be 80.9%, thus 19.1% of our women study population were non rubella immune [NRI] and were susceptible for rubella infection. Rubella is transmitted by the respiratory route and the incubation period is 13 to 20 days, during which a viraemia occurs and virus disseminates throughout the body[8], make its transmission from human to others simply. The NRI prevalence rate was higher to that expected in society conducting rubella immunization pro-

TABLE 7 : Association of Rubella seropositivity with sociodemographic characteristics using Bivariate analysis.

Variable			Odd ratio [95% Confidence interval]	P value
Occupation [Housewife versus. Official]	IgM		0.3123 [0.0185-5.2713]	NS
	IgG		2.6814 [1.3639-5.2713]	0.004
Crowding Index [< 3 versus >3]	IgM		4.861 [0.2892-81.7016]	NS
	IgG		0.1989 [0.061-0.6486]	0.007
Education	Uneducated	IgG	1.9565 [0.8453-4.5286]	NS
	Primary		14.2337 [7.801-25.9708]	<0.0001
	Secondary		203.478 [26.658-1553.13]	<0.0001
	College & above		23.00 [2.7829-190.09]	0.003
	Uneducated vs. Educated	IgM	1.1520 [0.1487-8.9251]	NS
Residence [Rural versus Urban]	IgM		13.662 [0.8178-228.2318]	NS
	IgG		1.5810 [0.9291-2.6902]	NS

gram. Despite the vaccination program 5 to 10 % of women of child bearing age are susceptible to Rubella infection[9]. The increase of NRI may be due to disruption of the vaccination program during the period from 1992 to date. Statistics from the World Health Organization (WHO) show that this virus is present in Iraq with confirmed cases of 15 cases in 2010 year[10]. As known that 10 -15% escaped rubella infection in childhood, thus it seems that NRI rate that this study shows was high. In addition, the presence of such low incidence which associated with vaccination program disruption may explain such NRI rising rate.

The seroprevalence of rubella IgG reported in 59 reviewed studies was from 57% in Nigeria[11] to 97.9% in Nigeria[12] also in pregnant women, while the range in BOH was from 29.06% in India[13] to 78.9% in India[14]. The present study IgG rubella prevalence was in the upper range of the reported range, and it was higher than prevalence rate reported 18 of the 59 (30.5%) global studies. In addition, this study IgG seroprevalence was higher to that reported for Sudan[15], Morocco[16], Qatar[17] and Tunisia[18]. However, our seroprevalence rate was lower to that reported for Saudi Arabia[19], Libya[20], and Syria[21]. Furthermore, the present study seroprevalence was higher to that reported for Baghdad[1,22], Waset[23], Thi Qar[24], Kirkuk[25], Babylon[26,27], and Najaf[28], but lower than that reported by other studies for Diyala[29], and Babylon[3].

The prevalence rate of NRI demonstrated in this study was higher to that reported for Taiwan[30,31], Turkey[32-38], Malaysia[39,40], Iran[41-43], Mozambique[44], South Africa[45,46], Haiti[47], Bangladesh[48], Nigeria[12,49], Cameroon[50], Italy[51], Colombia[52], Canada[53], USA[54], Switzerland[55], Nepal[56], Croatia[57], and Brazil[58]. However, our finding was lower to that reported for India[13,59,60], Iran[61,62], Nigeria[11,63,64], Brazil[65,66], Russia[67], Burkia Faso[68], Sri Lanka[69], Nepal[70]. The susceptibility rate to rubella infection in Kirkuk women was about similar to studies reported for Sri Lanka[71], Bangladesh[72], Italy[73], India[14] and Singapore[74].

In Arab Countries, 19 studies reviewed, which revealed that NRI of this study was similar to that reported for Babylon, Iraq[27], and Tunisia[18]. In addition, NRI prevalence rate was higher to that reported for Libya[20], and Syria[21], but lower than that reported for Baghdad[1,22], Waset[23], Thi Qar[24], Kirkuk[25], Babylon[26,27], and Najaf[28].

The present study showed that women in the younger age group were more likely to be seronegative than the older women. Women who were 29 years age and younger had the lowest serological protection, as assessed by rubella serology (24.5% seronegative), while only 12.5% of the older women were seronegative. OR in bivariate analysis confirmed that women with age lower than 30 years were two times more susceptible to rubella infection than older women (OR = 2.52,p = 0.0001).

Rubella IgG seroprevalence was significantly varied between the age group, the lowest rate (73.5%) was in women 20 to 29 years of age, while the highest rate (96.3%) was in women 40 to 48 years of age. This trend is not consistent with that reported for other geo-

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graphical areas in Iraq[26,27,29] and Morocco[16]. In a study performed in Diyala[29], the highest rate of seropositivity was in the age of > 40 years, while the lowest rate was in the age of < 20 and 30 to 39 years. In Babylon, two study reported[26,27], in the 1st one[26], the highest seroprevalence was in age of < 20 years, while in the 2nd one the highest rate was in 20 to 29 years age. Unexpectedly, the seroprevalence in the two studies reduced with advancing age and the rate is low (2.4% - 45.4%). In Morocco[16], the highest seroprevalence in age of 25 to 29, while the lowest was in age 35 to 39 years.

The higher seroprevalence among older women as this study shows may be a result of more durable IgG titers from natural disease combined with boosting from circulating virus than the titers resulting from immunization[75]. It is also possible that older women were more likely to have received postpartum immunization.

One of the important findings of this study is the reduction of rubella IgG seroprevalence from 85.2% as determined for 3 years [2010-2012] to 80.9 in the prospective part of the research ($X^2 = 6.36$, $P = 0.01$). Given that rubella titers wane over time in the absence of circulating wild virus, there will be a cohort effect representing the waning of vaccine induced immunity among women who had received only one dose of vaccine[76]. Another possibility for the high seronegativity in the prospective study as compared to retrospective may be a high incidence of immigrants from other governorates to Kirkuk without rubella immunization.

The prevalence rate of NRI was more in urban (20.9%) as compared to rural (14.3%) indicating that urban women are more at risk of rubella infection. However, OR calculation in bivariate analysis not indicated that residence was with a significant correlate ($X^2 = 1.58$, $P = 0.09$) for seroreactivity. The proportion of immigrants was more in urban areas than in rural, which may influence such seroreactivity. The trend of high seropositivity in rural area was reported for study performed in Babylon, Iraq[26]. However, our finding was not agreed with study reported for Diyala, Iraq[29] and Morocco[16] which indicated that seropositivity was more in urban area.

Occupation seems to play significant role in rubella IgG seroprevalence determination as this study indicated. The seroprevalence was more predominant in housewife women (82.3%), while it was 63.4% in officials. This finding was in consistent with previously reported for Kirkuk[25] and Babylon[27], however, the seroprevalence was very low for housewife (7.28%) and officials (2.01%) in the study reported for Kirkuk[25]. In a bivariate analysis, OR confirmed the significant association between seroprevalence of rubella IgG and housewife occupation (OR=2.6814, P=0.0004). This high seropositivity in housewife could be attributed due to that rubella mostly transmitted through droplet and housewife spent most of their time in house in contact with children, which may lead to increase in natural infections between family member. OR calculation confirm this explanation since it indicated a significant association between IgM and IgG seroprevalence and increased family size. Secondly, rubella titers wane over time in the absence of circulation wild virus, may lead to low seropositivity rate in officials population, while this is not occurred due to high natural transmission in housewife.

Education was with highly significant relationship with rubella IgG seropositivity ($X^2 = 166.7$, $P = 0.000$), the highest rate was in secondary school educated women, followed by primary school education. However, the lower seropositivity rate was highly educated women. One study in Diyala, Iraq[29] reported the frequency of rubella IgG in regards to education, which shows higher rate in highly educated women, followed by primary educated women. The differences between the two studies may be a reflection of differences in study design as in Diyala study, the sample size was lower than halve of ours. OR confirm a significant association of rubella IgG seropositivity with primary educated (OR = 14.2337, $P < 0.0001$) and secondary educated (OR = 203.478, $P < 0.0001$) women.

The present study indicated that rubella IgG seroprevalence was higher in non-pregnant (82.7%) as compared to pregnant (78.9%) women, but the difference no reach a significant level. This finding was consistent with that reported for other area in Iraq[29], and in contrast to that reported for Babylon[27], which reported higher rate in pregnant women.

Rubella acute infection as indicated by presence of specific rubella IgM in serum was demonstrated in 1.7% of women with BOH and the incidence rate was higher in pregnant BOH (2.8%) as compared to non-pregnant BOH (0.7%), but the difference not reach significant level. This finding was 2.64 times lower than mini-

mum reported global figure[2]. Rubella IgM seropositivity range globally was from 4.49% in India[2] to 31.58% in India also[14] in women with BOH. When the finding of the present study compared to 19 studies performed for Arabian countries in women with BOH, still the incidence rate was lower than the range reported. The lower rubella IgM seropositivity rate was 2.9% in Baghdad, Iraq[22] to 62.3% in Waset, Iraq[23]. Our figures indicated a low incidence rate of rubella in Kirkuk for the year 2012, a findings that goes with retrospective study for Kirkuk, which indicated a significant reduction ($X^2 = 189$, $P = 0.000$) of rubella incidence from 20.25% in 2010 to 3.86% in 2012. However, the present study finding was not agreed with that reported for Kirkuk[25], who reported > 3 times higher incidence rate for the year 2006-2007.

This study shows that rubella IgM seropositivity in women with normal previous pregnancy was 3.3% with a significant differences ($X^2 = 15.02$, $P = 0.000$) between pregnant (11.1%) and non-pregnant (0%) women. Reported studies in Arabian countries indicated a range of 3.4% for Sudan[15] to 53.9% for Babylon, Iraq[26] in pregnant women with previous normal pregnancy. Globally, the range of rubella IgM seropositivity was with a range from 0% for Turkey[77] in pregnant women and Croatia[57] in pregnant and non-pregnant women to 91.3% for Nigeria[11] in pregnant women. Thus the present study shows that current infection was significantly higher ($X^2 = 5.346$, $P = 0.021$) in women with normal previous pregnancy, indicating a hazard of congenital rubella syndrome development in such hidden cases. In addition, IgM seropositivity was significantly ($X^2 = 15.73$, $P = 0.000$) higher in pregnant as compared to non-pregnant women. This association confirmed by OR calculation which indicated that pregnancy was a significant risk factor for development of rubella congenital infection (OR = 19.2295, P = 0.004) using a multiple regression analysis. However, bivariate analysis of only BOH women, indicated a non significant association, but we rely on a multivariate analysis.

Current rubella infection was significantly ($X^2 = 6.55$, $P = 0.01$) more predominant in urban women population as this study indicated. In addition, all positive cases were housewife women, however, the difference was not significant. Furthermore, current rubella infection was with significant variation ($X^2 = 84.28$, $P = 0.000$) between the education level group. In contrast to previous infection, the current infection was predominant in higher educated women, and this could be attributed to that previous infection was more predominant in housewife due to natural infection. In addition, compliance with the recommendation of giving rubella vaccine booster dose at the first visit physician contact in antenatal program for pregnant women who had waning immunity been recognized in a previous pregnancy. Uneducated women may be more prone for natural infection and thus were with less rate of susceptibility, thus the highly educated women were with high rate of current infection. Thus strategies that offer immunizations to women with childbearing age are to compulsory when women access the health care system for other reasons (such as hospitalization or postpartum visit) would be applied to improve the level of rubella immunity. However, the best effective approach for the prevention of congenital rubella syndrome was the use the WHO that called combined strategy[78].

Rubella vaccine was incorporated into the national immunization program in Iraq through MMR vaccine, however, still there were a 1.7% of current rubella infection and 19.1% susceptibility rate for infection. This findings indicated that there was a need for better follow up of the immunization. In the last decade the health system disrupted due to violation and thus the current rubella infection was twice (24.5%) in age of < 30 years as compared to 12.5% in the age of > 30 years. OR confirmed (OR=2.5205, P=0.0001) such association and about half of the seropositive samples were in women with < 30 years of age.

Unfortunately, rubella screening of pregnant women is not routinely carried out in Iraq. The vaccine failure cases and improper access of targeted group to vaccine receiving or decreasing of the protective level of antibodies may occur in the next few years. Therefore, future screening for rubella antibodies will be more important in childbearing age. In addition, in Iraq, there was no community based rubella seroepidemiological study reported, and this type of study is warranted since it gave the sound data basis of rubella epidemiology. These are of importance since rubella vaccination has been reported to be very efficient and cost effective in preventing CRS[79].

A key strategy for preventing rubella and CRS is ensuring sufficient population immunity through natural disease or through vaccination programs that achieve

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high coverage[80]. But the vaccination coverage cannot be kept high in the last decade, there is a risk of the resurgence of CRS as was expected in Turkey[80] and experienced in Greece after subsequent years of low coverage scores in infant immunization[81]. The universal rubella immunization coverage provided for 12-months-old and 6 year old children should be therefore be kept high to minimize this risk[80]. Also, vaccination policy should be implemented for women at risk, which may be carried out either through the vaccination of the whole cohort (e.g. 14 - 44 years) or cohorts of particular groups of women such as health care workers, school girls, government workers, college students, postpartum women, premarital couples[82] or rubella susceptible women. However, re-infection can occur which is generally asymptomatic and in pregnancy it poses minimal risk to the fetus[83]. It is important that women are vaccinated prior to their first pregnancy[8]. The vaccine is contraindicated for pregnant women, but when unwittingly used, no problems have been seen[84]. If the patient is pregnant and seronegative, the pregnancy should be monitored carefully and the patient vaccinated postpartum[85].

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