MINISTRY OF TRAINING & EDUCATION

MINISTRY OF HEALTH

NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY

NGUYEN NGOC QUYNH

EPIDEMIOLOGICAL CHARACTERISTIC OF MEASLES IN HANOI PERIOD 2006 - 2015 AND THE STATUS OF MEASLES IGG ANTIBODIES IN MOTHER AND THEIR CHILDREN UP TO 9 MONTHS OF AGE AND SOME RELATED FACTORS

Specialization: Epidemiology

Code: 62 72 01 17

SUMMARY OF PHD DISSERTATION

Hanoi - 2020

The dissertation complete at:

NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY

Supervisors:

1. Assoc Prof. Nguyen Nhat Cam, PhD

2. Assoc Prof. Le Thi Quynh Mai, PhD

Reviewer 1: …

Reviewer 2: …

Reviewer 3: …

This dissertation will be defended at the Institute level Committee of Dissertation Assessment at National Institute of Hygiene and Epidemiology

Time: …… date …… month …., 2020

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LIST OF

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1. **Epidemiological characteristic of Measles in Hanoi 2014** (2015), *Journal of Preventive Medicine*, XXV, vol 3 (163), pp 45-51.
2. **Attack rate of measles outbreak in Hanoi, 2013-2014** (2018), *Journal of Preventive Medicine*, XXVIII, vol 11 - 2018, pp 53-59.
3. **Measles immunity gap in pregnant woman and risk of measles in infant** (2018), *Journal of Preventive Medicine*, XXVIII, vol 5 - 2018, pp 15-28.
4. **Association between measles antibodies in vaccinated and naturally infected mothers with protective antibodies and the occurrence of measles in their children: A cross-sectional study in Ba Vi district of Hanoi** (2019), *Asian Pacific Journal of Tropical Medicine*, Vol 12, Sep 2019, pp 404-408.
5. **Some epidemiology characteristic of measles in hanoi from 2006 to 2015** (2019), "*Journal of Preventive Medicine*, XXIX, vol 10 – 2019, pp 38-44

INTRODUCTION

Measles is one of the most common communicable diseases in children, easily spreads into epidemics and causes many sequelae or deaths. There are 2 million deaths and 15.000-60.000 children are blind from measles worldwide yearly. Measles vaccination is known as the most effective preventive measure with over 100 million newborns being vaccinated and saving 2-3 million lives each year. Measles is also the leading cause of death in young children in Vietnam.

In 2012, the World Health Organization (WHO) and member countries had agreed to set a goal to eliminate measles in 5 regions by 2020, but recent years, measles outbreak has reappeared again, the goal of eliminating measles in 5 regions of the world by 2020 is seriously threatened in the world as well as in Vietnam, of which the commitment of measles elimination in Vietnam could also not to perform.

Hanoi's population is equal to one tenth of the national population, the measles situation in Hanoi plays an important role in the measles situation of both the country and the region. Measles outbreak has become more complicated in recent years, with many cases of measles being children younger than 9 months of age - who did not yet to be vaccinated. Before that situation, the question are:

- How are the epidemiological characteristics of measles in Hanoi over the past 10 years? What are the characteristics different from other provinces and cities, and in compared to other regions in the world?
- How is the immune status of measles virus in pregnant women currently? How is the antibodies against measles virus which is due to mother-to-child transmission of children under 1 year old? Is there a correlation with maternal antibody status? Is it affordable to protect children from measles disease? Do immunization strategies need to be changed?

Study on ***"Epidemiological characteristic of Measles in Hanoi period 2006 - 2015 and the status of Measles IgG antibodies in mother and their children up to 9 months of age and some related factors"*** was conducted with the following objectives:

1. To describe some epidemiological characteristics of measles disease in Hanoi city from 2006 to 2015
2. To determine the status of IgG antibody against measles virus in mother and their children up to 9 months of age and some related factors in Ba Vi district, Hanoi city 2016 - 2017

Findings and contributions of dissertation

The study summarized some epidemiological characteristics of measles disease in Hanoi for 10 years from 2006 to 2015, during this period there were 2 measles outbreaks in 2008-2009 and 2014, the finding of this study was the age groups which most affected by measles, notably children under 9 months of age who have not been vaccinated. Therefore, the study evaluated the status of antibodies against measles virus of pregnant women, the status of antibodies due to mother-to-child transmission and monitored the process of antibody reduction from mother to child until the end of 9 months of age. The research results are consistent with the proposed hypotheses, answering a number of questions related to the occurred measles outbreak again, thereby making important recommendations in prevention interventions, treatment measles epidemic in Hanoi particularly, as well as nationwide in generally, towards eliminating measles disease on a national and regional scale.

The structure of thesis

This thesis consists of 139 pages, include: Introduction 03 pages, Overview 41 pages, Method 12 pages, Results 39 pages, Discussion 41 pages, Conclusions 02 pages and Recommendations 01 page. The thesis includes 28 tables, 11 figures and diagrams, 17 charts. There are 167 references (including 35 in Vietnamese and 132 in English).

Chapter I.
LITERATURE REVIEW

1.1. Epidemiological characteristics of measles disease

Measles is an acute infectious disease spread through the respiratory tract by the measles virus (Measles virus) of the genus Morbillivirus, family Paramyxoviridae. The virus has only a single serotype and stable. As a result, the effectiveness of the vaccine in prevention is high, the herd immune with measles can reach over 95% if the population have fully vaccinated with two doses of vaccine.

Human is the only natural reservoir of measles virus, of which the infected person is the only source of transmittion. The healthy carriers or chronic virus infections were not recorded. Vaccine-derived viruses are not contagious. From exposure to occurrence of rash is 14 days, with an interval of 7-21 days. It is rare for longer or shorter incubation times. The disease has a human-to-human transmission route mainly through direct contact with the patient's nasopharyngeal secretions (saliva or suspended saliva). The virus in saliva can last up to 2 hours in the outside environment. The disease can be transmitted indirectly through contact with contaminated objects by a patient's nose and throat secretions. The immune response to measles virus plays an important role in eliminating

the measles virus from the body, restoring clinical symptoms and providing long-term protection for measles virus. The immune response after natural measles virus infection is usually stronger than the post-vaccination immune response. Babies who are protected in the first months of life do not get measles mainly by maternal IgG antibodies passed through the placenta. This happens from the 28th week of pregnancy until the baby is born.

1.2. Measles disease situation in the world and in Vietnam

Before the measles vaccine era, there were about 100 million cases and 6 million deaths from measles each year. More than 95% of measles deaths occur in countries with low per capita income and poor health infrastructure. Up to 10% of measles deaths occur in populations with high rates of malnutrition and without adequate medical care.

Measles vaccine has been implemented since 1963 and has been introduced to The Expanded Programme on Immunization (EPI) in many countries since 1974. By 1990, about 80% of children under 1 year of age were vaccinated against measles, and it is estimated to prevent about 2 million measles deaths each year; however, the number of measles cases remains high at about 45 million and 1 million deaths in developing countries.

In 1994, countries in the Americas set a goal to eliminate measles in the region by the end of 2000. To achieve this goal, the Pan American Health Organization (PAHO) implemented strategies of vaccination which include supplementary immunization strategies, vaccinations, and implementation of a laboratory measles surveillance system. The goal of the strategy is to achieve and maintain a high level of immunity in infants and young children, monitor and detection of all sources of disease transmission concurrently. Since 1980, a number of European countries have begun to develop the routine schedule of 2 doses of measles vaccine. In 2000, WHO issued a recommendation for the implementation of two dose of measles vaccination strategy to progress towards eliminating measles disease. Up to now, the two dose of measles vaccination has been deployed in the EPI in more than 150 countries, accounting for 53%. Several countries in the Western Pacific, Africa, Eastern Mediterranean and Southeast Asia also completed supplementary immunization campaigns before 1997. In 1997, the supplementary immunization campaigns were launched in countries with high risk of measles (5 countries in Africa, 4 countries in Southeast Asia and 1 country in the Western Pacific), over 5.8 million children were covered by the vaccine in those campaigns. Until 1998, the immunization campaigns continued in Australia, the Philippines, the Syrian Arab Republic and Tunisia. From 2000 to 2013, by the coverage of two dose of measles vaccine for young children in routine immunization combined with supplementary immunization

campaigns, the 73% reduction in measles worldwide has been achieved (from 59 to 16/1 million people), the measles mortality rate also decreased by 63%. The global prevalence of measles in 2012 (33.3 / 1 million) decreased by 4.4 times in compared to 2000 (146 / million). The estimated number of measles deaths in 2012 (122,000) decreased by 4.7 times in compared to 2000 (562,400 cases). By 2016, the global prevalence of measles continues to decline to 19 cases per 1 million people, with an estimated 89,780 deaths (45,700-269,600).

However, due to the weakness and neglect of immunization activities in recent years, the actual decline in measles vaccine coverage has led to outbreak of this contagious disease in many countries in the world. In 2014, WHO reported that 178/194 countries in 6 regions of the world had identified measles cases. A total of 191,343 cases of measles have been recorded, with the largest number in the Western Pacific (113,944 cases). The strategy for eliminating measles in the world has once again proved to be difficult to reach.

Measles disease situation in Vietnam before the time of 1 dose of measles vaccine in the EPI is similar to that in other countries in the world. According to WHO, the incidence of measles in unvaccinated areas is estimated at 500 / 100,000 population. The number of infants infected and killed by measles is very high. According to the annual report of the National Institute of Hygiene and Epidemiology between 1979 and 1984, the prevalence of measles varies from 69.4 to 137.7 / 100,000 population, the average annual measles prevalence during this period is 102.3 / 100,000 population. The measles mortality in period from 1979 to 1984 was 0.44 / 100,000, ranging from 0.23 to 0.6 / 100,000. The EPI in Vietnam started to administer one dose of measles vaccine for children aged 9 - 11 months from 1981, implemented nationwide since 1985. Along with expanding the deployment area and increasing the coverage rate the measles vaccine over the years, the measles incidence in Vietnam has decreased from 150.5 / 100,000 population in 1984 to 8.5 / 100,000 population in 2002, down 17.7 times. Measles remains the ninth-leading fatal disease between 1996 and 2000. In the 2006-2010 period, Vietnam introduced second dose of measles vaccine for 8 million 6-year-old children as part of their regular national immunization schedule at schools with coverage rate of over 90% annually. From 2012, based on the characteristics of the epidemic lasting from late 2008 to June 2010, Vietnam decided to give second dose of measles vaccine earlier (for children 18 months of age) to enhance immunity for children who have not been protection after first dose. The shortening of the injection schedule helps young children be able to prevent the disease earlier. From 2011 to 2012, the number of measles cases dropped sharply, showing the validity of the measles vaccination strategies. In the years of 2013-2014, measles disease

in Viet Nam continued to cycle. Measles outbreak spread quickly, occurring on a large scale with 17,000 measles cases nationwide, 63/63 provinces / cities recorded measles cases during this period.

1.3. Immune status against measles virus in the community

1.3.1. Methods for assessing antibodies against measles virus

There are several methods used to quantify antibodies against measles virus, but not all methods can accurately quantify antibody concentrations or assess the level of protection. Plaque reduction neutralization test (PRNT) is the gold standard for quantifying neutralizing antibodies against measles virus. A neutralizing antibody concentration over 200 mIU/ml is likely to protect against measles virus. However, this is an expensive and labor-intensive technique, requiring a laboratory to perform cell culture techniques and a standard strain of viruses and antibodies, so it is not widely implemented. EIA or ELISA is widely used techniques for quantifying IgM or IgG antibodies because they can be obtained quickly by using commercial kits, cheaper cost and the techniques is simpler, and can make multiple samples at the same time.

1.3.2. The status of antibody persistence against measles virus in pregnant women and affected factors

There is a difference in antibody persistence against measles virus in pregnant women, which varies between country, region and time of evaluation. A study in 2013 by Cesario Martins and colleagues in India showed that 96% of pregnant women with antibodies reached the protective threshold for measles virus. A study in Catalonia in 2013 (Spain) found that 89% of pregnant women reached the protective antibody level against the measles virus. A study of Qian XH in Shanghai, China found that 88.68% of women were able to reach the protective threshold, while the rate of protection against measles virus decreased with age but the latest research in Guangzhou, China's Lu. L which published in 2016 showed a positive maternal antibody ratio of 87.3%. In Dong Anh, Hanoi, Vietnam, the percentage of pregnant women with positive measles antibody was only 71.7%.

Some factors influencing the measles virus antibody levels in pregnant women are the age group, the previous status of measles disease of woman; there were not relation to occupation, qualification, socio-economic factors.

1.3.3. The persistence of antibodies against measles virus transmitted from mother to child in the newborn after birth and the influencing factors

Young children who are protected in the first months of life do not get measles mainly by maternal IgG antibodies passed through the placenta. This happens from the 28th week of pregnancy until the baby is born. Mother-to-child antibodies decrease slowly

in the first months, then abruptly decrease rapidly in the following months, and most of the mother-to-child antibody curve is lowest at 7-9 months, then in some other areas, the curve of antibody tended to increase at 10 months of age, this could be due to measles virus infection. A study in Spain showed that 98.5% of newborns had antibodies that reached the protection threshold against measles virus and their antibody concentration increased with mother age. Hayley Gans et al report in a study evaluating the response to measles vaccine at 6, 9 and 12 months in the US before using measles vaccine, which assessed antibody level for measles in children, the results showed that the ratio of protective antibody to measles virus is found 64% of children 6 months, 39% of children 9 months and only 2% of children 12 months. In Vietnam, the assessments of antibody residues against measles virus in newborns are still very rare. Recent studies by Trinh Quang Tri and colleagues in Dak Lak by collection umbilical cord blood samples, the number of samples with positive measles antibody was 135 children (71.81%); the number of antibodies negative was 29 (15.43%). Trinh Quang Tri et al also studyed the evaluation of antibodies against measles in children 3-9 months of age, the results showed that the proportion in children 3-4 months with antibodies against measles IgG was 15.69%, the proportion in children 5-6 months was 6.02% and the proportion children over 6 months did not see IgG antibodies.

Some factors that affect the decline of antibodies against measles from mother to child are mainly from the mother: the mother has high level of antibody concentration, more likely the child will be born with high and long lasting antibody levels; The older the mother, the higher the antibody concentration. No correlations were found such as gestational age, method of birth, birth weight, infant sex, nurturing status, breastfeeding status, socioeconomic status.

Chương II.
METHODS

2.1. Research methods for objective 1

2.1.1. Objects

The objects of the study were cases recorded in the measles surveillance system throughout Hanoi, discovered and investigated according to the measles surveillance form of the Ministry of Health from 2006 to 2015

2.1.2. Study places

30/30 districts in Hanoi city.

2.1.3. Period of study

- Data of measles case were collected from January 1, 2006, to December 31, 2015;
- Duration of conduct study is from January 2016 to December 2017.

2.1.4. The study design

Descriptive cross-sectional study

2.1.5. Sample size

Sampling all cases satisfying the definition of cases which occurred in Hanoi between January 1, 2006 and December 31, 2015.

2.1.6. The method of data collection

- Patient information: retrospective survey by questionnaire for rash fever suspected measles which was collected by active measles surveillance system at Hanoi Preventive Medical Center.
- Clinical and epidemiological information on suspected measles cases were based on the measles investigated form of the EPI program - Ministry of Health.
- Information about sampling of tested specimens: Through the results of IgM antibody test from the Institute of Hygiene and Epidemiology and Hanoi Preventive Medicine Center.
- Information on mortality: Get all measles deaths recorded during the study period.

2.1.7. Indicators, main variables in the study

Indicators of study build on the analysis of basic epidemiology of infectious diseases.

2.1.8. Management and analyzing data

The data was read and cleaned, entered into the computer with Epidata software 3.1. Analysis by Statistical software Stata 12. Both descriptive statistics and statistical analysis are performed. The map was created with ArcGIS 9.3 software to show the distribution of measles cases from 2006 to 2015.

2.2. Research methods for objective 2

2.2.1. Objects

- Pregnant women and their children, living in Ba Vi district, Hanoi from birth.
- Selected pregnant women were divided into 2 groups according to their immune status against measles virus. Based on the time of implementing the EPI program (in 1985) to calculate the age of pregnant women in the group as follows:

+ Group 1: Group of women with natural immunity was women over 30 years old

+ Group 2: The group of immunized women was women under 25 years old.

2.2.2. Study places

22 communes in Ba Vi district, Hanoi where where there were no measles patients

for years.

2.2.3. Period of study

From Jul. 2015 to Dec. 2017

2.2.4. The study design

Descriptive cross-sectional study

2.2.5. Sample size

The sample size for each group of pregnant women was calculated according to the formula for calculating the sample size of the descriptive study to compar two proportions in the community, after calculating and rounding the sample size for each group was 200 pregnant women. The total number of pregnant women in study was 400.

2.2.6. Sample selection

Step 1: Pregnant women selection:

Selection of pregnant women according to age groups, often living in selected communes in Ba Vi district, Hanoi to visit and give birth at commune health stations and Ba Vi Hospital; There are no plans to transfer within 1 year of birth and agree to participate in the study.

Step 2: Proceed to select and first sample in pregnant women right before birth and take newborn blood (umbilical cord blood).

Step 3: Monitor child and conducted test for antibodies against measles virus at 3 months, 6 months and 9 months of age.

2.2.7. The main variables in the study

2.2.7.1. Variables for test results

No.	Variable	Definition	Classification of variables	Method of collection
1	Quantification of maternal antibodies against measles virus	Result of quantifying antibody of mother against measles virus	Continuous	Serum test
2	Mother has sufficient antibodies against measles virus	In the case when the mother has antibody test result was higher or equal to the protection threshold	Binary	Serum test
3	Quantification of antibodies of child against measles virus at birth, 3 months, 6 months and 9 months of age	Results of quantifying antibodies against measles virus at birth, 3 months, 6 months and 9 months of age	Continuous	Serum test
4	Child has sufficient	In the case when the child has	Binary	Serum test

No.	Variable	Definition	Classification of variables	Method of collection
	antibodies against measles virus	antibody test result was higher or equal to the protection threshold		

2.2.7.2. The variables to examine the relation with the degree of antibody persistence against measles virus

The group of variables include the characteristics of subjects, immunization status, nutritional status, status of infants at birth, infant feeding status.

2.2.8. Organization of implementation

- After pregnant women selection to be included in the study, quantitative testing of IgG antibody concentration against measles virus will be conducted.

- When these women give birth, they will conduct quantitative tests of the infant IgG antibody concentration from the above mothers at the time of birth, 3 months, 6 months, and 9 months.

- Interview mother according to available questionnaires to collect information about childhood immunization status, disease status, living conditions ...

- Observe the health status of children, their nurturing status and living conditions throughout the research process.

2.2.9. Sample collection and testing techniques used in the study

Sampled subjects: Pregnant women who came to the hospital after agreeing to participate in the study will be given a venous blood sample once before delivery. Newborn: Umbilical cord blood drawn. When children are full 3 months, 06 months, 09 months: Collect venous blood

Testing technique: Quantifying IgG antibody concentration by indirect ELISA technique, following the procedure of Siemens Enzygnost anti-measles IgG test kit (Germany)

2.2.10. The method of data collection

- Interview pregnant women / mother of child with the questionnaire.

2.2.11. Management and analyzing data

Data entry systems will be developed to store, manage and analyze the research database. Collected data is entered by software such as EpiData 3.1, which is entered independently twice into the computer to check errors. Use the multivariate logistic regression method to calculate the odds ratio (OR, 95% CI) for the research on risk factors of interest.

2.2.12. Control errors

Investigator involved in the survey are carefully trained according to the questionnaire, methods of sampling, storage and transport of samples. Biological IgG bio-

product using Siemens-Germany biological kit with high sensitivity and specificity, which recommended by WHO; Collected data is cleaned and entered twice, comparing to ensure accuracy of data

2.2.13. Some definitions and concepts

- Antibody titre against measles: is a quantitative value of anti-measles virus IgG antibody, calculated in international units mIU / ml.
- The geometric mean titer (GMT): The mean of the antibody titer values for serum samples.
- Qualitative results: based on the adjusted value ΔA according to the manufacturer's instructions, with a sensitivity of 99.6%:

  + Anti-Measles virus/IgG **Negative**: $\Delta A < 0.100$ (cut-off)
  + Anti-Measles virus/IgG **Positive**: $\Delta A > 0.200$
  + Anti-Measles virus/IgG **Equivoval**: $0.100 \leq \Delta A \leq 0.200$

- The antibody concentration is sufficient to protect: It is the antibody concentration at the level that ensures the body does not have any symptoms when infected with measles virus. To ensure that symptoms do not occur, antibody concentration must be 200mIU / ml quantified by the plaque reduction neutralization test (PRNT), equivalent to 636mIU / ml when using ELISA method using biological kit products of SIEMENS

2.2.14. Ethical aspects

The research was approved by the Hanoi Medical Department's Research Ethics Committee and the Research Ethics Committee of the Institute of Hygiene and Epidemiology.

Chapter III.
RESULTS

3.1. Measles epidemiological characteristics in Hanoi during 2006-2015

3.1.1. Measles cases distribution by time

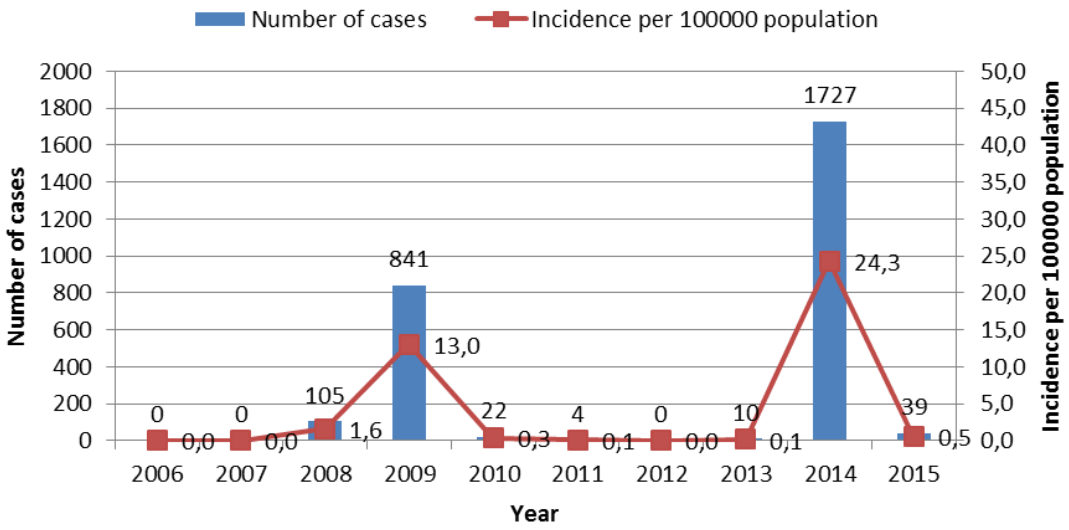

Chart 3.1: Distribution of measles cases and the incidence of measles in Hanoi during 2006-2015

From 2006 to 2015, there were 2 measles outbreaks in Hanoi: there was a total of 946 measles cases identified in laboratories in 2008 - 2009 outbreak, the incidence rate of 13.0 cases / 100000 population, no death case was recorded; In 2014 outbreak, there were 1,727 measles cases identified in laboratories, with 24.3 cases / 100000 population, 14 deaths in 13 districts and case fatality rate was 0.2%.

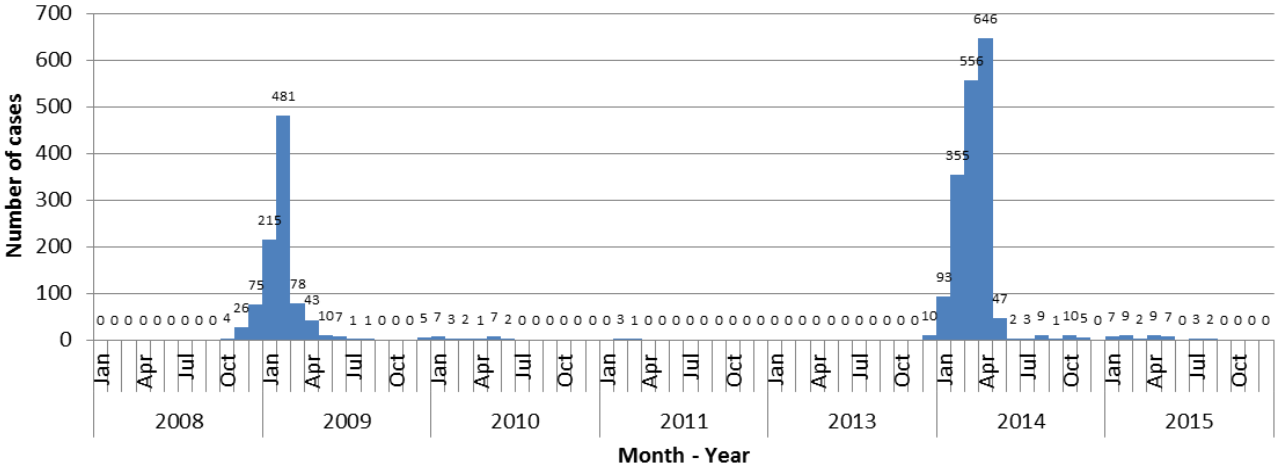

Chart 3.3: Distribution of measles cases in Hanoi by month and year, 2006 - 2015

Measles cases mainly appear in the winter-spring season, starting to increase from Dec., reaching the highest in the Feb. to Apr., some cases only scattered in other months .

3.1.2. Measles cases distribution by geography

Table 3.2: Situation and prevalence of measles disease by district, 2006 - 2015

Districts	Year 2008		Year 2009		Year 2010		Year 2011		Year 2013		Year 2014		Year 2015		Total measl-es Cases
	No of cases	*Incidence per 100000 Pop*	No of cases	*Incidence per 100000 Pop*	No of cases	*Incidence per 100000 Pop*	No of cases	*Incidence per 100000 Pop*	No of cases	*Incidence per 100000 Pop*	No of cases	*Incidence per 100000 Pop*	No of cases	*Incidence per 100000 Pop*	

Districts	Year 2008		Year 2009		Year 2010		Year 2011		Year 2013		Year 2014		Year 2015		Total measl-es Cases
	No of cases	Incidence per 100000 Pop	No of cases	Incidence per 100000 Pop	No of cases	Incidence per 100000 Pop	No of cases	Incidence per 100000 Pop	No of cases	Incidence per 100000 Pop	No of cases	Incidence per 100000 Pop	No of cases	Incidence per 100000 Pop	
Ba Dinh	**8**	***3.6***	**58**	***26.1***	**1**	***0.4***	**0**	**-**	**1**	***0.4***	**83**	***34.1***	**1**	***0.4***	152
Ba Vi	0	-	8	*3.3*	1	*0.4*	0	-	0	-	17	*6.3*	0	-	26
Noth Tu Liem	0	-	45	*18.5*	0	-	0	-	0	-	49	*15.5*	5	*1.6*	99
Cau Giay	17	*7.5*	43	*18.6*	0	-	0	-	0	-	70	*27.6*	0	-	130
Chuong My	0	-	18	*6.3*	1	*0.3*	0	-	0	-	28	*9.0*	0	-	47
Dan Phuong	0	-	5	*3.6*	0	-	0	-	0	-	15	*9.7*	1	*0.6*	21
Dong Anh	4	*1.2*	21	*6.2*	0	-	0	-	0	-	72	*19.1*	4	*1.0*	101
Dong Da	**19**	***5.2***	**111**	***30.1***	**1**	***0.3***	**0**	**-**	**0**	**-**	**156**	***38.5***	**0**	**-**	287
Gia Lam	2	*0.9*	16	*6.9*	2	*0.8*	0	-	0	-	50	*19.5*	0	-	70
Ha Dong	11	*4.8*	26	*11.1*	0	-	0	-	0	-	**100**	***34.7***	1	*0.3*	138
Hai Ba Trung	10	*3.4*	48	*16.2*	1	*0.3*	0	-	0	-	**174**	***55.4***	2	*0.6*	235
Hoai Duc	0	-	31	*16.1*	0	-	0	-	0	-	30	*14.0*	1	*0.5*	62
Hoan Kiem	**0**	**-**	**30**	***20.7***	**0**	**-**	**0**	**-**	**3**	***1.9***	**74**	***47.2***	**0**	**-**	107
Hoang Mai	**13**	***3.9***	**62**	***18.4***	**1**	***0.3***	**0**	**-**	**3**	***0.8***	**149**	***40.9***	**2**	***0.5***	230
Long Bien	**5**	***2.2***	**29**	***12.7***	**3**	***1.3***	**1**	***0.4***	**0**	**-**	**82**	***30.2***	**1**	***0.4***	121
Me Linh	0	-	16	*8.3*	3	*1.5*	0	-	0	-	24	*11.3*	2	*0.9*	45
My Duc	1	*0.6*	11	*6.5*	0	-	0	-	0	-	16	*8.6*	1	*0.5*	29
South Tu Liem	1	*0.6*	31	*18.6*	1	*0.6*	0	-	0	-	62	*29.1*	0	-	95
Phu Xuyen	1	*0.6*	32	*17.9*	1	*0.5*	0	-	0	-	32	*17.1*	1	*0.5*	67
Phuc Tho	0	-	0	-	5	*3.1*	0	-	0	-	0	-	0	-	5
Quoc Oai	0	-	2	*1.2*	0	-	0	-	0	-	15	*8.5*	2	*1.1*	19
Soc Sn	0	-	10	*3.5*	0	-	1	*0.3*	0	-	46	*14.4*	2	*0.6*	59
Son Tay	0	-	22	*17.6*	0	-	0	-	0	-	25	*18.2*	1	*0.7*	48
Tay Ho	1	*0.8*	26	*19.5*	0	-	0	-	0	-	42	*27.1*	0	-	69
Thach That	0	-	5	*2.8*	0	-	0	-	0	-	21	*10.7*	5	*2.5*	31
Thanh Oai	1	*0.6*	22	*13.2*	0	-	0	-	0	-	26	*13.9*	0	-	49
Thanh Tri	1	*0.5*	10	*5.1*	0	-	0	-	0	-	**77**	***34.0***	2	*0.9*	90
Thanh Xuan	9	*4.0*	**69**	***30.3***	0	-	0	-	3	*1.1*	**82**	***30.5***	2	*0.7*	165
Thuong Tin	0	-	27	*12.3*	1	*0.4*	2	*0.9*	0	-	47	*19.7*	3	*1.2*	80
Ung Hoa	1	*0.6*	7	*3.9*	0	-	0	-	0	-	**63**	***32.7***	0	-	71
Total	**105**	***1.6***	**841**	***13.0***	**22**	***0.3***	**4**	***0.1***	**10**	***0.1***	**1.727**	***23.8***	**39**	***0.5***	**2748**

In the 2009 outbreak, measles cases were highly concentrated in some urban districts of Thanh Xuan with 69 cases accounting for 30.3 cases / 100000 population. Dong Da with 111 cases accounts for 30.1 cases / 100000 population. Hoan Kiem with 30 cases accounted for 20.7 cases / 100000 population.

In the 2014 outbreak, measles cases recorded in 29/30 districts in which the number of infected cases in Hai Ba Trung highly with 175 cases accounted for 55.4 cases / 100000 population. Hoan Kiem with 74 cases accounted for 47.2 cases / 100000 population. Hoang Mai with 149 cases accounted for 40.9 cases / 100000 population and Dong Da with 156 cases accounted for 38.5 cases / 100000 population.

3.1.3. The distribution of measles cases and the incidence per 100000 population by age and gender

Table 3.4: Distribution of measles cases by age group

Age group	Number of cases	Propotion	Incidence per 100.000 Population
Under 1 year	664	24.2%	553.4
From 1-5 years	608	22.1%	137.2
From 6-10 years	89	3.2%	20.3
From 11-15 years	154	5.6%	36.1
From 16-20 years	268	9.8%	42.5
From 21-25 years	443	16.1%	61.6
From 26-30 years	350	12.7%	55.2
From 31-35 years	125	4.5%	24.1
From 36-40 years	35	1.3%	7.8
Over 40 years	12	0.4%	0.6
Total	2748	100%	42.6

From 2006 to 2015, the highest incidence of measles was recorded among children under 1 year of age (accounting for 24.2% and an attack rate of 553.4 cases / 100000 population). the incidence in children aged 1-5 year of age also accounted for a high proportion, but the attack rate was lower than that of the group less than 1 year old (accounting for 22.1% and the rate of attack is 137.1 cases / 100000 population). The age group of 21-25 and 26-30 also accounts for a high proportion (16.1% and 12.7%).

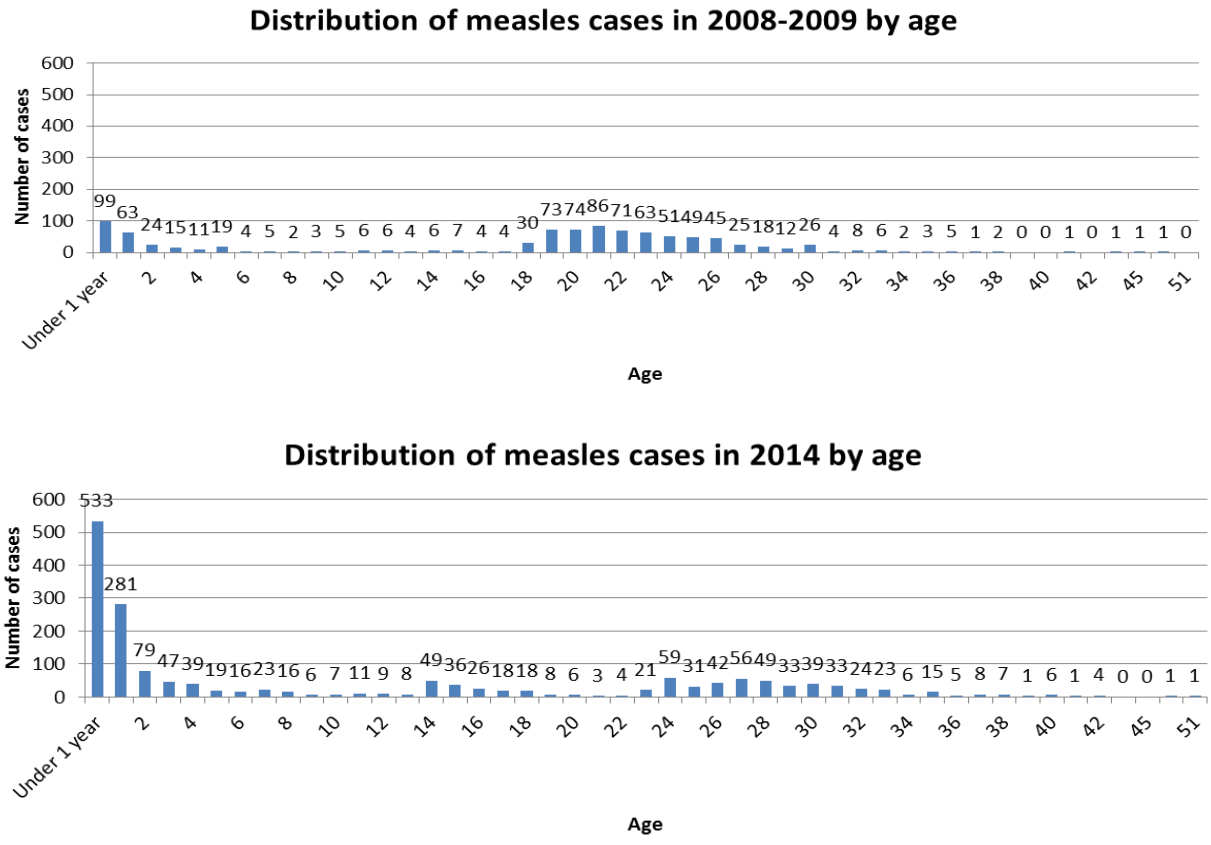

Chart 3.6: Distribution of measles cases in outbreaks 2008 - 2009 and 2014 by age

In the 2008-2009 outbreak. high number of cases recorded in the age group of children under 1 year of age and the age group from 18-28 years old youth. In the 2014 outbreak major morbidity recorded only in children under 5 years and also noted the high number of cases in children under 1 year of age.

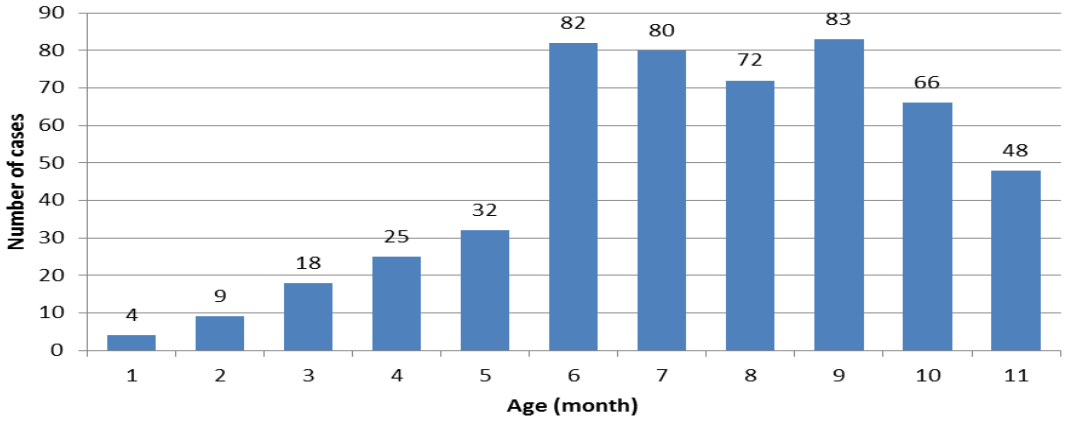

Chart 3.7: Distribution of measles cases in patients under 1 year old by month

Among 565 measles cases identified over 10 years in Hanoi, many cases in the age group of 6 months and older. The number of cases was quite small in child less than 5 months of age.

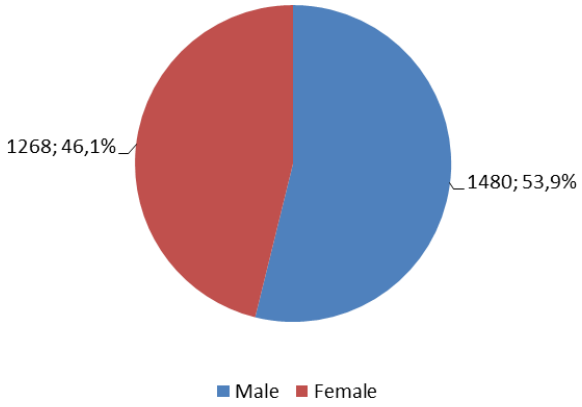

Chart 3.9: Distribution of measles cases by gender (n = 2706)

Measles cases were higher in males than female. The proportions were 53.9% and 46.1% respectively. The difference was statistical significance with p <0.05.

3.1.4. Distribution of measles cases by vaccination status

Table 3.6: Distribution of measles cases in Hanoi by age group and vaccination status, 2006-2015

Age group (year)	Fully vaccinated		Not fully vaccinated		No vaccinated		Unknown		Total	
	n	*Propotion (%)*	n	*Proportion (%)*	n	*Proportion (%)*	n	*Proportion (%)*	n	*Proportion (%)*
<1	29	*4.4*	3	*0.5*	628	*94.6*	4	*0.6*	664	*100*

1-5	147	*24.2*	113	*18.6*	325	*53.5*	23	*3.8*	608	*100*
6-10	22	*24.7*	33	*37.1*	21	*23.6*	13	*14.6*	89	*100*
11-15	63	*40.9*	49	*31.8*	14	*9.1*	28	*18.2*	154	*100*
16-20	50	*18.7*	148	*55.2*	49	*18.3*	21	*7.8*	268	*100*
21-25	24	*5.4*	274	*61.9*	106	*23.9*	39	*8.8*	443	*100*
26-30	4	*1.1*	126	*36.0*	167	*47.7*	53	*15.1*	350	*100*
31-35	1	*0.8*	25	*20.0*	86	*68.8*	13	*10.4*	125	*100*
36-40	0	*0.0*	8	*22.9*	22	*62.9*	5	*14.3*	35	*100*
> 40	0	*0.0*	5	*41.7*	5	*41.7*	2	*16.7*	12	*100*
Total	**340**	***12.4***	**784**	***28.5***	**1423**	***51.8***	**201**	***7.3***	**2748**	***100***

The results in the table above showed that up to 80.3% of measles cases were not vaccinated or incomplete. The number of unvaccinated individual accounted for 51.8% and the incomplete number was 28.5%. In the group of 11-15 years old, 40.9% of cases have been fully vaccinated but still infectious with measles.

3.2. The status of IgG antibody against measles virus in pairs mother - infant to 9 months of age in Ba Vi district, Hanoi

3.2.1. The status of IgG antibody against measles virus in pairs mother - infant to 9 months of age

Table 3.14: Proportion of mother and child antibody against measles virus

Measles IgG antibodies	**All women (n=401)**		**Woman < 25 years old (Born after 1990) (n=200)**		**Woman > 30 years old (Born before 1985) (n=201)**		**p (Chi²)**
	n	**%**	**n**	**%**	**n**	**%**	
Measles IgG antibodies in woman							
Positive	309	77.06	132	66.00	177	88.06	<0.001
Equivocal	38	9.48	29	14.50	9	4.48	
Negative	54	13.46	39	19.50	15	7.46	
Measles IgG antibodies in newborn (cord blood)							
Positive	332	82.79	144	72.00	188	93.53	<0.001
Equivocal	39	9.73	35	17.50	4	1.99	
Negative	30	7.38	21	10.50	9	4.48	
Measles IgG antibodies in children 3 moths of age							
Positive	314	78.70	134	67.68	180	89.55	<0.001
Equivocal	27	6.77	18	9.09	9	4.48	
Negative	58	14.54	46	23.23	12	5.97	
Measles IgG antibodies in children 6 moths of age							
Positive	252	62.84	100	50.00	152	75.62	<0.001
Equivocal	38	9.48	26	13.00	12	5.97	
Negative	111	27.68	74	37.00	37	18.41	
Measles IgG antibodies in children 9 moths of age							
Positive	93	23.97	37	19.17	56	28.72	0.068
Equivocal	32	8.25	15	7.77	17	8.72	
Negative	263	67.78	141	73.06	122	62.56	

The study results showed that the proportion of mothers with measles virus antibody (positive) in both groups was 77.06%, of which the mother group under 25 years old was 66.00%, lower than the mother group over 30 years old (88.06%).

For newborns, the proportion of children with antibody against measles virus (positive) combination of the two groups was 82.79%; in which the group of children from mothers under 25 years old reached only 72.00%. It was lower than group of children from mothers over 30 years old (93.53%). At 3 months of age, 6 months old and 9 months old, the proportion of children with antibody against measles virus (positive) tended to decrease over time. It were 78.70%. 62.84% and 23.97% respectively. Besides, the proportion of children with antibody against measles virus (positive) was lower in group of mothers under 25 years old than group of mothers over 30 years old.

Table 3.15: Proportion of level protection against symp- tomatic disease (titers of >636mIU/ml)

Measles IgG antibodies	**All women (n=401)**		**Woman < 25 years old (Born after 1990) (n=200)**		**Woman > 30 years old (Born before 1985) (n=201)**		**p (Chi^2)**
	n	**%**	**n**	**%**	**n**	**%**	
Measles IgG antibodies in woman							
Protection against symp-tomatic disease (titers of >636mIU/ml)	229	57.11	81	40.50	148	73.63	<0.001
Measles IgG antibodies in newborn (cord blood)							
Protection against symp-tomatic disease (titers of >636mIU/ml)	257	64.09	103	51.50	154	76.62	<0.001
Measles IgG antibodies in children 3 moths of age							
Protection against symp-tomatic disease (titers of >636mIU/ml)	185	46.37	67	33.84	118	58.71	<0.001
Measles IgG antibodies in children 6 moths of age							
Protection against symp-tomatic disease (titers of >636mIU/ml)	90	22.44	36	18.00	54	26.87	<0.001
Measles IgG antibodies in children 9 moths of age							
Protection against symp-tomatic disease (titers of >636mIU/ml)	14	3.61	2	1.04	12	6.15	<0.001

The study results showed that the proportion maternal antibodies afford protection in both the 2 groups was 57.11%, while the group of mothers under 25 years was 40.50% lower than that of mothers over 30 years old (73.63%).

For newborns, the proportion of children with sufficient antibodies to protect them combination of the two groups was 64.09%; in which the group of children with mothers under 25 years old reached only 51.5%, lower than the group of children with mothers over 30 years old (76.62%). At the time of 3 months of age, 6 months of age and 9 months of age, the proportion of children with antibodies that can provide protection tended to decrease over time. it were 46.37% 22.44% and 3.61% respectively. In addition, the proportion of babies from mothers under 25 with sufficient antibodies were lower than those from mothers over 30 years old.

Table 3.16: Results of the geometric mean titer of mother - child

Classifications	**All woman GMT mIU/ml (95% CI)**	**Woman < 25 years old GMT mIU/ml (95% CI)**	**Woman > 30 years old GMT mIU/ml (95% CI)**	**p**
Mother	705.0 (604.7 - 822.1)	452.7 (370.2 -553.6)	1095.6 (881.9 -1361.0)	<0.001
Cord blood	938.9 (809.2 -1089.2)	622.6 (510.3 -759.7)	1412.8 (1148.4 -1738.0)	<0.001
Ratio of GMT newborn/mother	*1.3*	*1.4*	*1.3*	*<0.001*
3 months of ages	503.8 (441.7-574.5)	346.0 (284.8 -420.2)	729.4 (619.6 - 858.7)	<0.001
6 months of ages	217.3 (187.8 -251.4)	157.3 (127.1 -194.7)	299.7 (247.6 - 362.8)	<0.001
9 months of ages	45.22 (38.3 - 53.5)	48.5 (39.9 - 59.0)	42.2 (32.1 - 55.4)	>0.05

The pregnant woman's GMT was 705.0 mIU/ml lower than the newborn's GMT (938.9 mIU/ml). There is a big difference in GMT between the two groups: pregnant women under 25 and their babies have GMT much lower than group of pregnant women over 30 and their babies; The difference was statistical significance with p <0.001. In addition, over time from 3 months, 6 months to 9 months, GMT of children tended to decrease sharply, 503.8 mIU/ml, 217.3 mIU/ml and 45.22 mIU/ml respectively. Moreover, this index of children with mothers over 30 is usually higher than mothers under 25. However, the opposite was at 9 months of age, the GMT of children with mothers under 25 was 48.5 mIU/ml. higher than children with mothers over 30 years old (42.2 mIU/ml).

The correlation about antibody titers against measles virus between mother and child:

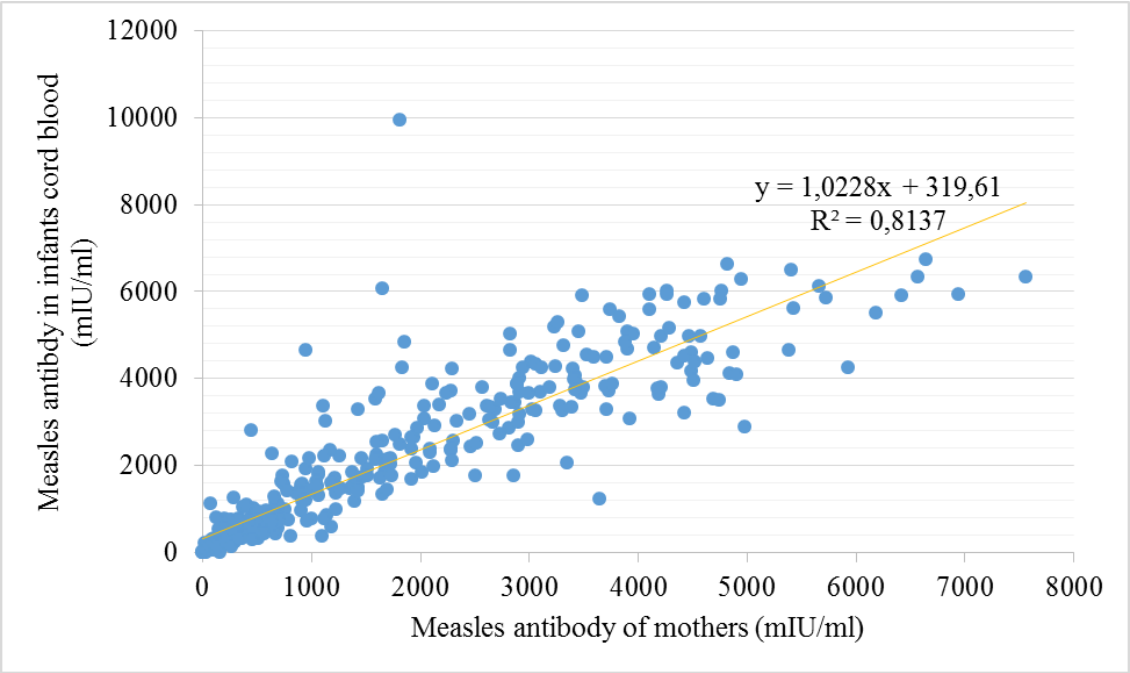

Figure 3.3: The correlation about antibody titers against measles virus between child and mother

3.2.2. Factors related to the status of IgG antibody against measles virus in pairs of mother - infant until 9 months of age

Table 3.18: Multivariate analysis of factors related to maternal antibody status

Factors	OR	95% CI	p
Age group			
> 30 years old	**3.32**	**1.73 – 6.36**	**<0.001**
< 25 years old			
Acute diseases of mothers during pregnance			
Yes	1.31	0.65 – 2.65	0.450
No			
Have ever had measles			
Yes	0.87	0.23 – 3.19	0.829
No			
Measles vaccination status			
Vaccinated	1.08	0.34 – 3.42	0.900
No Vaccinated			

After multivariate analysis, one factor that was statistically significance related to the mother's antibody status (positive) was the mother's age group. Specifically, women over 30 years of age might have 3.32 times more positive with antibody against measles virus than women under 25 years old (95% CI: 1.73 - 6.36).

Table 3.20: Multivariate analysis of factors related to infant's antibody status immediately after birth

Factors	OR	95% CI	p
Age group			
> 30 years old	**3.36**	**1.47 – 7.70**	**<0.001**

Factors	OR	95% CI	p
< 25 years old			
Acute diseases of mothers during pregnance			
Yes	0.77	0.28 – 2.16	0.624
No			
Have ever had measles			
Yes	-	-	-
No			
Family status			
Poor	0.45	0.09 – 2.23	0.327
No			
Measles vaccination status			
Vaccinated	-	-	-
No Vaccinated			

The results of multivariate analysis showed that one factor was statistically significance in the positive with antibody status of the newborn immediately after birth which was the age group of the pregnant mother. Specifically, children with sufficient antibodies against measles virus can have 3.36 times higher in mothers over 30 years old than mothers under 25 years old (95% CI: 1.47 - 7.70).

Table 3.23: IgG changes of child at newborns and 3, 6 and 9 months of age

Characteristics	OR	95% CI	p
Month of age			
3 month	**0.28**	**1.73 – 6.36**	**<0.001**
6 month	0.03	0.01 – 0.07	
9 month	0.0002	0.00	
Gender			
female	2.58	1.12 – 5.97	0.026
male			
Age group of mother			
Over 30	2.66	1.12 – 6.28	0.026
Under 25			
Measles IgG antibody of mother			
IgG antibody	1.00	1.00	0.000

After analysis of IgG changes in the newborn after birth, the dependent variable was the amount of IgG in the child with positive / negative when compared to the protective threshold. The results showed that in compare with time of birth, the ability of IgG in children to reach the protection threshold at 3 months was only 0.28 times, at 6 months it was only 0.03 times and at 9 months it was only 0.0002 times. This means that the likelihood of the child having a protective IgG threshold decreases after birth and is significantly reduced by 9 months of age.

In addition, gender was related to postpartum IgG. the girls were more likely to have IgG protection threshold, which was 2.58 times higher than the boys. And maternal age groups were also associated with the postpartum IgG. Children of mothers over 30 years

of age were 2.66 times more likely to be protected than those of mothers under 25 years of age. The level of maternal IgG antibody at the time of delivery was also associated, the higher the mother's IgG might lead to the higher the chance that the IgG of their child will reach the protective threshold.

Chapter IV.
DISCUSSION

4.1. Measles epidemiological characteristics

Within 10 years from 2006 to 2015, the occurred outbreaks in Hanoi coincided with a strong outbreak of measles in Vietnam as well as in the world.

After years without measles outbreak, from 2008 to 2009, an outbreak was reported in Hanoi. The peak was in 2009 with a total of 946 measles cases identified in the laboratory, the incidence was 13.0 cases / 100000 population. No deaths have been recorded. During the same period, measles outbreaks occurred across the country in which the Northern region of 28 provinces and cities recorded cases. Measles incidence in the Northern region in 2009 was 9.1 cases / 100000 population [16]. A research by Dang Thi Thanh Huyen. Pham Ngoc Dinh showed that in the Northern region, the five-year period from 2008 to 2012 was a progressive period of measles with the peak in 2009. During this period, the Northern region experienced an average of 1,000 measles cases a year. However, there was a big difference in the incidence rate between years. The first year (2008) and the last year (2012) had a low incidence of <1 / 100000 population while in the years between 2009 and 2010 the incidence increased > 1 / 100000 population. Comparision to other provinces in the Northern region, it was lower incidence in the period 2008-2012 in Hanoi than many provinces such as Hoa Binh (60.1 cases per 100000 population), Vinh Phuc (57.4 / 100000 population).

Many countries without measles outbreak in the previous years, the measles outbreak was also occured in 2008-2009. In the Netherlands, from June to October 2008, there were 99 cases reported. This is the largest epidemic in this country since the 1999-2000 outbreak. By 2009-2010, many other European countries reported measles. From 2009 to 2010, Europe reported that the number of measles cases increased from 7,175 to 30,367. Many other countries in the world had also reported measles outbreaks during this period such as Australia, China, Burkina Faso and other African countries. In 2008, there were countries with a high incidence of measles in the Western Pacific region such as

Cambodia with 12 cases / 100000 population, China with 9.8 cases / 100000 population and Japan with 8.5 cases / 100000 population.

A research by Dang Thi Thanh Huyen, Duong Thi Hong (2016) on the epidemiological characteristics of measles in the Northern region showed that during the period 2008-2014, the number of measles cases accounted for 59.1% in 2014. Measles incidence in 2014 was 3.7 times higher than the average annual incidence in this period (4.7 / 100000 population) and 3 times higher than in 2009 (9.1 / 100000 population) which was the peak of the previous epidemic cycle.

According to a report of the World Health Organization, in 2014, 181/194 countries in the world recorded measles cases with a total of 296629 cases, of which 124782 cases of clinical measles and 66982 cases of measles epidemiologically relevant and 104861 measles cases identified the laboratory.

Measles research results in the world recently showed that the pattern of case distribution by age group varied from country to country. This was also due to the implementation of vaccination strategies and the vaccination coverage at different levels. In China, vaccination started in 1978. From 2000 to 2004, the incidence ranged from 3.6 cases / 100000 to 61.5 cases / 100000 population and from 1.1 cases / 100,000 to 11.9 cases / 100,000 population of the age group over 15 years old, two age groups with high incidence were children under 1 year old and adults 20-30 years old; from 2005 to 2010, the predominant age group was children under 1 year of age; after the introduction of supplementary measles - rubella vaccine in 2010. The age group with high incidence was children under 1 year old and children aged 1-2 years [92]. In Africa region, from 2002 to 2009, the number of measles cases was 10% for children under 9 months old. 51% were in group aged 9 months to 4 years and 18% were aged 5-9 years [74]. Measles outbreak in Italy from 2010 to 2011, the age group with high incidence was 15-19 years old (38.5%) and children under 1 year (32.6%).

Measles research results in Hanoi through chart 3.7 could show that the proporrtion of measles cases in males was higher than females, 53.9% and 46.1% respectively. During the epidemic years, measles incidence was higher in males than in females. In 2009, the male was 54.3% and women account for 45.7%; In 2014, male accounted for 53.6% and female accounted for 46.4%. The difference is statistically significance with $p < 0.05$. The odds ratio of measles among female to male OR was 0.84 (95% CI: 0.75 - 0.93). Female were at risk of measles only 0.84 times that of male with 95% confidence. Each study found a different conclusion about the incidence of gender. Virtually all of these studies

were based on national surveillance surveillance data, and none of the studies highlighted and investigated the causes of gender incidence differences.

Almost disease cases were caused by not being immunized or not being fully immunized; This is similar to the classical theory and the characteristic of measles outbreak in many different continents in the world and Vietnam.

4.2. The status of IgG antibody against measles virus in pairs mother - infant to 9 months of age

Measurements of antibodies against measles virus showed that only 77.06% of the mothers had sufficient antibodies and 13.46% of the remaining pregnant women had absolutely no antibodies. The group of women under 25 with antibodies against measles virus was only 66.0% lower than the group of women over 30 years old with the proportion of protective antibody up to 88.0%. For women over 30 years of age who were born before the launch of the EPI in 1985, this acquired antibody was caused by childhood measles infection; For women under the age of 25 who were born after a high coverage of immunization was implemented by EPI, the antibody produced by immunization was obtained through the years without measles. The results of study in Ba Vi were slightly higher than those of Dang Thi Thanh Huyen et al in Dong Anh, Hanoi in 2016. The results showed that 71.7% of pregnant women had antibodies against measles virus, especially the antibody was higher in women over 30 years old, reaching 90.5%. In the study of Nguyen Minh Hang et al in 2013, the proportion of women aged 16-30 in some northern provinces of Vietnam with antibodies against measles virus was 70.1% of which women over 30 years old also had higher antibody, reaches 94.2%. A number of research results in the world, such as those of Lauri E and colleagues in the US, it showed that 99% of pregnant women had sufficient antibodies to protect them against measles virus [90]. Women who were born after the implementation of the EPI had lower antibody levels than women who gave birth before the implementation of the EPI. A study by Brugha R and colleagues in the UK showed that up to 23% of women vaccinated against measles from childhood which did not have sufficient protective antibodies against measles virus (antibody level <200 mIU / ml) while in group of unvaccinated women (with measles infection naturally) only 7% of the antibody is below the protection level [47]. Recent study in Belgium showed similar results to those in the UK, in the women vaccinated group, 26% did not have sufficient protective antibody, while in the natural measles infection group, only 8% did not have sufficient protective antibody.

Results of quantifying the anti-measles virus antibody immediately after birth (umbilical cord blood) showed 82.79% of newborns with protective antibodies against

measles virus. 72.00% of children with mothers under 25 years of age had antibodies, while 93.5% of children with mothers over 30 years have protective antibodies; The difference was statistically significance with p <0.001. The proportion of newborn in Ba Vi with antibodies against measles virus was also higher than that in Dong Anh district (reaching 75%) and in Dong Anh, babies with mothers over 30 years old had antibodies 8.1 times higher in babies with mothers 18-19 years old. The proportion of babies born with antibodies in Ba Vi, Hanoi was also higher than in Dak Lak, a research by Trinh Quang Tri and colleagues showed that only 71.8% had protective antibodies in umbilical cord blood. The highest proportion in children with mothers over 30 years old (89.7%), the lowest in children with mothers under 20 years old. The proportion of newborns who had sufficient protective antibody against measles virus in this study was also higher than that of Mentintas .S et al in 2002 in Turkey (the proportion of 0 month old babies with antibodies accounts for only 78.4%).

At 3 months of age, the proportion of children with anti-measles virus antibody decreased to 78.07%, of which the group of babies with mothers under 25 years old had antibodies of 67.68% lower than those with mothers over 30 years old (89.55%). This research result was much higher than that in Tu Ky and Hai Duong in 2016, only 21.3% of children had protective antibodies. Or in Dak Lak, children aged 3-4 months only 15.69% had antibodies against measles virus. The results of this study were also higher than those in Turkey in 2005, the proportion of children from 2-5 years old with antibodies reached 42.3%.

At 6 months of age, the proportion of children with anti-measles virus antibody continued to decline to 62.64%, of which the group of babies with mothers under 25 years old had antibody of 50.0% lower than that of babies with mothers over 30 years old (75.62%). This result was much higher than the study in Tu Ky, Hai Duong, of the 198 children aged 6-9 months old, only 1 child at 6.7 months old still had protective antibodies. In Dak Lak, children from 5-6 months old only 6.02% had antibodies against measles virus. This result was equivalent to a study in the US in 1996, the proportion of children 6 months old with antibodies reached 63%. In Turkey in 2005, children aged 6-10 months only 43.8% had antibodies against measles virus. While a study in the Belgian , 6-month-old babies had only 11/72 (15%) antibodies positive.

At 9 months of age, the proportion of children with antibodies decreased to 23.97%. 19.17% of children with mothers under 25 years old had antibodies lower than those with mothers over 30 years old (28.72%). However, this difference was not statistically significance. In the study of Trinh Quang Tri and colleagues in Dak Lak, children over 6

months of age were free of antibodies against measles virus. This result was similar to the study of Leuri E and colleagues in the US in 1996 also showed that 30% of 9-month-old children had antibodies to protect against measles virus.

Research results indicated that from 6 months of age and older, the antibodies against measles virus which transmitted from mother to child had decreased significantly in comparision to immediately after birth. This explains that children under 1 year of age are susceptible to measles, especially children 6 months and older, it is similar to the epidemiological analysis results in Part 1 of this study.

Understanding the factors associated with antibody persistence in women resulted in age-related anti-measles virus antibody concentrations. Pregnant women under 25 years of age had lower rates of protective antibody and antibody titre was lower than that of pregnant women over 30 years old; This might because the pregnant women over 30 years of age were born before the implementation of the EPI, so the antibody acquired was mainly due to natural measles infection and the group of women under 25 years of age born after the implementation of the EPI and without measles infection, it should be acquired due to immunization. This result was similar to the results of some previous studies.

CONCLUSION

1. Some epidemiological characteristics of measles in Hanoi in the period 2006 - 2015

During the period 2006-2015, Hanoi recorded 2,748 cases of measles which were confirmed by laboratory, 14 deaths in 2014. The incidence was uneven across years. in 2008-2009 and 2014, two major outbreaks occurred throughout the city. The epidemic cycle was 5 - 6 years. The disease appeared mainly in winter-spring season. the peak epidemic occurred from February to April and withdraw after that. Measles was concentrated in urban districts. Districts with a small area but high population density had a higher number of measles cases than other districts.

The two groups most affected by measles during this period were the group of 20-29 years old and the group of children under 5 years old. Along with that, it is worth noting that in the group under 9 months of age - the group has not yet been vaccinated because this group has not reached the age of immunization - the incidence of measles has increased.

2. The status of IgG antibody against measles virus in pairs mother - infant to 9 months of age

Firstly, among 77.06% of mothers with measles IgG antibody, women over 30 years old (with natural immunity) account for a higher proportion than women under 25 years old (who had immunity from vaccination). Levels of antibody titer were higher in women with natural immunity than in immunized women. The factor related to the antibody status of women in this study was age. Specifically, women over 30 years of age were 3.39 times more likely to had antibodies than women under 25 years of age.

Secondly, the proportion of newborns who had antibodies against measles virus was 82.79%, capable of protecting against measles virus was only 64.09%. In particular, the proportion of children from women with natural immunity had higher antibodies than children from women with immunity by vaccination. The antibody titer of children from mothers with natural immunity was also higher than the antibody titer of children from women with immunity by vaccination. However, in general, newborns with anti-measles virus antibody titer was 1.3 times higher than their mothers. The factors related to the antibody status of the newborn immediately after birth were the age of the mother (children of women over 30 years old were likely to have antibodies 3.05 times higher than the children of women under 25 years old) and the maternal antibodies titer at birth (the higher the maternal antibody titre at birth, the higher the chances a child was born reaching the protection threshold).

Thirdly, the concentration of antibody titer in children decreased from birth to 9 months of age. In particular, the decline in the period from 6 months to 9 months of age. The proportion of children after 9 months of age with protected antibody against measles virus was only 23.97%. The proportion of children who still had protective antibody and the decrease in their anti-measles virus antibody titre had no significant difference between the group of women with natural immunity and women with immunity by vaccination.

RECOMMENDATIONS

For measles surveillance system in Hanoi: Need to strengthen measles surveillance capacity in the city. Strengthen monitoring of high-risk subjects such as children under 1 year old, especially children under 9 months of age. Both clinical and epidemiological surveillance can be monitored for a holistic and accurate overview of the epidemic. From there it is possible to detect trends, levels and factors affecting the epidemic and take timely and effective measures.

Strengthen communication on the seriousness of measles and the need for measles vaccination, so that mothers understand the benefits of vaccination and fully vaccinate

their children. It is important to vaccinate the measles vaccine at 9 months for children to reduce the risk of measles infection in children under 1 year of age.

For relevant departments: Strengthen research on interventions to reduce the risk of measles disease and measles outbreaks. Therein, intervention research for high-risk groups of children under 1 year of age, especially children under 9 months of age. needs special attention. The measles vaccine should be given again to women of childbearing age before pregnancy and vaccinations for children aged 6 months should be considered.

Researchers need to continue research in this topic. Provide objective and reliable overview to assess measles immunity gap in different risk groups, as well as study on effective interventions.