

# **Risk Factors of Meningitis in Children Under Five Years in Al-Ramadi Maternity and Children Hospital**

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## **Abstract**

**Objective:** The main objective of the present study was to find out risk factors of meningitis in children below 5 years in Al-Ramadi Maternity and children Hospital in a trial to control this important disease.

**Materials and Methods:** Over a period of 3 years (from 1st.January/2005 to 31/December 2007) , 336 children under 5 years of age were admitted to the Maternity and children hospital in Ramadi city with symptoms and signs suggestive of meningitis.

Cerebrospinal fluid(CSF) general examination for cells, protein and sugar, as well as CSF culture were done for all suspected cases for searching of meningitis.

Each child with positive CSF finding(increase cells more than 25 in neonate and more than 5 beyond neonate) was studied for the following: Age of patient, Sex, Residency, Type of feeding, Recent upper respiratory tract infection, History of head trauma, History of antibiotics during illness, Family history for Crowding, Education, Economic status, Animal breeding, Smoking, Water supply, and Family history of meningitis.

**Results:** One hundred twenty cases proved to be cases of meningitis according to CSF result ( increase cell count more than 5)

Sixty - six (55%) case had positive culture while 54 (45%) were culture negative(48 of culture negative received antibiotics).

Age, urban residency, crowding, low economic state, bottle feeding, passive smoking, recent upper respiratory tract infection were found to be significant risk factors for developing meningitis, while sex, water supply, Maternal education, head trauma, Family history of meningitis, and animal breeding were found not to be significant risk factors.

**Conclusion:** meningitis is an important problem in Al-Ramadi city, age, urban residence, over crowding, recent Upper Respiratory Tract Infections, bottle feeding, passive smoking, and poverty are important risk factors for meningitis.

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**Key words :** Risk Factors ,Meningitis , Children , Ramadi

## **Introduction**

Meningitis is an inflammation of the membranes (meninges) and cerebrospinal fluid surrounding the brain and spinal cord.<sup>1</sup>

The incidence of meningitis during the first year of life is 20 times higher than in older children and adults ,<sup>2</sup> and 70% of cases occurring in children under age of 5 years.<sup>3</sup>

The most common causes of meningitis are viral infections that are usually resolved without treatment. However, bacterial infections of the meninges are extremely serious illnesses, and may result in death or brain damage even if treated.<sup>4</sup>

Meningitis is also caused by fungi, chemical irritation or drug allergies and tumors.<sup>3,4</sup>

The human infection with meningitis has seasonal variation and this differs from one country to another, however, in hot areas it occurs in late winter and early spring.<sup>5</sup>

Factors that may increase the risk of meningitis include: inherited family tendency for meningitis, male sex, age of infancy, history of head injury and brain surgery, bottle feeding, recent upper respiratory infection, mumps, tuberculosis and otitis

media,<sup>6</sup> crowding living conditions, <sup>6, 7</sup> low socioeconomic state, <sup>8</sup> passive smoking, <sup>9</sup> compromised immune system, <sup>10</sup> splenectomy and Sickle cell disease which increase risk of meningitis secondary to encapsulated organisms.<sup>11</sup>

The aim of the present study was to find out risk factors of meningitis in children below 5 years in Al-Ramadi Maternity and children Hospital in a trial to control this important disease.

## **Materials And Methods**

All children under five years of age with symptoms and signs suggestive of meningitis who were admitted to the Maternity and children hospital in Ramadi for treatment during a period of 3 years (from 1st.January / 2005 to 31/ December 2007) were included in the study. Lumbar puncture (L.P) was done for them under aseptic technique, 2-3 ml of cerebrospinal fluid were collected and sent directly to the hospital laboratory for general CSF ( cells, protein and sugar) and CSF cultured under the supervision of a senior microbiologist. Signs and symptoms obtained by history and physical examination that suggestive meningitis include fever, poor feeding, convulsion, vomiting, head ache, positive meningeal signs, bulging fontanel, focal neurological signs, and skin rash.

Cases were regarded as meningitis according to increase in cell count of CSF more than 25 in neonate and more than 5 in older than neonate, and that for partially treated meningitis according to Nelsons textbook of pediatrics 18<sup>th</sup> edition CSF WBC

count 5-10.000 PMNs or mononuclear cells if antibiotics given for prolonged period, protein from 100-500 mg/dl, glucose level normal or decreased, CSF culture negative and gram stain may or may not be seen by microscopy.<sup>12</sup>

Data collected from parents including the patients age, sex, type of feeding, history of head trauma, previous use of antibiotics during illness, family crowding, residency, education, economic status, animal breeding, smoking, water supply, and family history of meningitis. Patients were grouped into three age groups (under 1 year of age, 1-3 years, and 3-5 years).

Children with suspicion of having meningitis and proved negative (cells less than 5) were used as controls.

Data and risk factors were analyzed statistically by using SPSS version 11 computer software ( statistical package for social sciences). The statistical significance of association between two categorical variables was assessed by Chi-square test. P value less than 0.05 was considered statistically significant.

## **Results**

Out of 336 cases with signs and symptoms suggestive of meningitis, 120 cases were regarded meningitis with CSF cells more than 5. Cerebrospinal fluid culture for meningitis were positive in 66 (55%), while 54 ( 45%) cases had negative results which were either partially treated or non - bacterial meningitis, those with criteria indicated partially treated meningitis were (48) and (6) were regarded as non bacterial ( viral or fungal or parasitic). (**Table1**).

**Table 1. Age distribution of all suspected cases according to CSF laboratory finding .**

Age group (years )	Total	Meningitis(CSF >5 cells)			Non-meningitic ( CSF < 5 cells)  No (%)
		Culture Positive  No (%)	Culture Negative		
			Partially treated meningitis No (%)	Others  No (%)	
<1	189	41 (21.7)	30 (15.9)	2 (1)	116 (61.4)
1-3	92	15 (16.3)	13 (14.1)	3 (3.3)	61 (66.3)
3-5	55	10 (18.2)	5 (9)	1 (1.8)	39 (71)
Total	336	66 (19.6)	48 (14.3)	6 (1.8)	216 (64.3)
		120 (35.7)			

Patients were grouped into three age groups (under1 year of age, 1-3 years, and 3-5 years). The highest number of patients was noticed in the first age group (61%) followed by the second age group (26%) while only (13%) of

cases were recorded in the third age group. Males are more affected than females though the difference was not statistically significant. (**Table 2**).

**Table 2.Results of meningitis according to Sex difference and age groups.**

Age groups (years)	Gender		Total	
	Male No.(%)	Females No.(%)	No.	(%)
< 1	39(53.4)	34 (46.6)	73	60.8
1-3	19(61.3)	12 (38.7)	31	25.8
3-5	11(68.8)	5 (31.2)	16	13.4
Total	69 ( 57.5 %)	51( 42.5%)	120	100%

p.value of sex difference 0.135

p.value among 3 age groups < 0.05

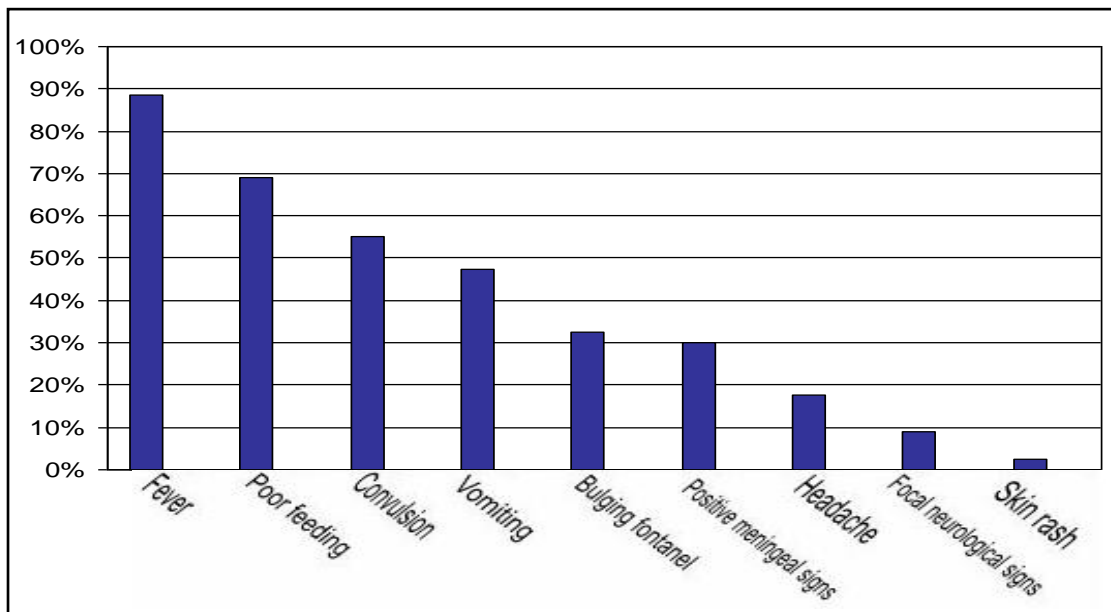
Seventy eight (65%) cases of meningitis had received Antibiotics before admission to hospital. Regarding the clinical status and physical examination of patients, fever represented the most frequent symptom of meningitis 106 (88.5 %) followed by poor feeding 83 (69 %), convulsion 66 (55 %), vomiting 57 (47.5 %), bulging fontanel 39 (32.5 %), positive meningeal signs 37 (30 %), headache 21 (17.5 %), and the least is skin rash 3 (2.5%). (**Figure 1**). Seasonal variation was found to be significantly affecting the

occurrence of meningitis, The majority of cases were noticed in spring. (**Figure 2**).

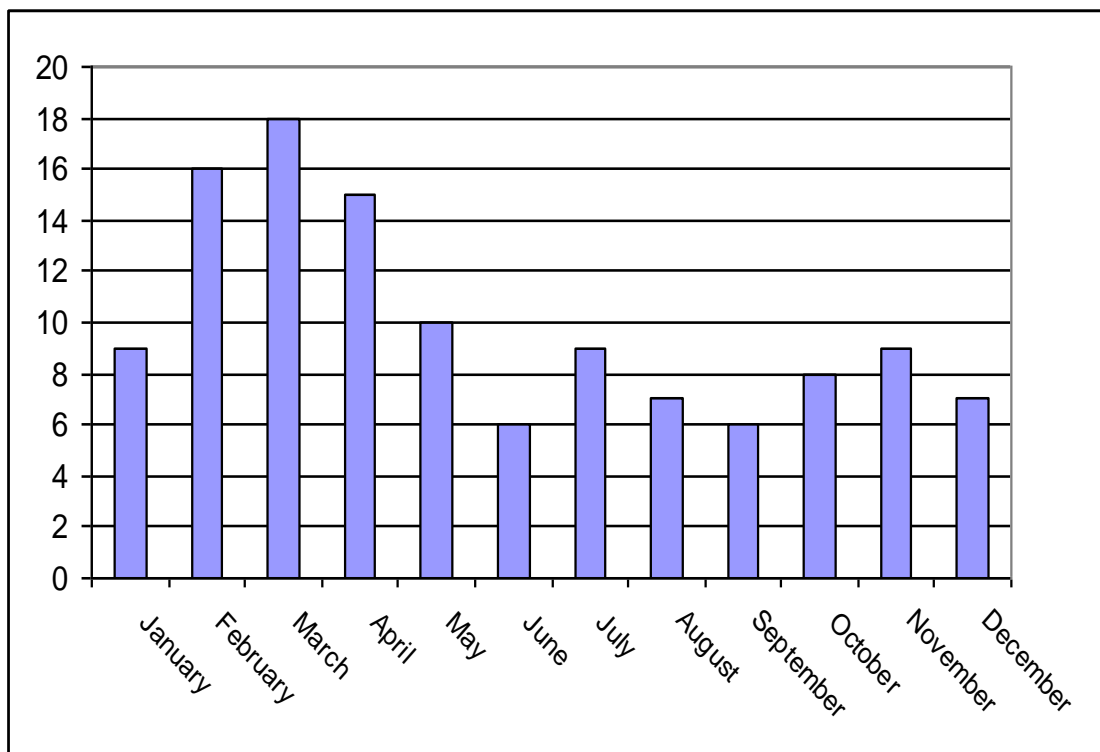
Among risk factors of meningitis urban area, over crowding, low economic state, bottle and mixed feeding, passive smoking , and recent upper respiratory tract infection were found to be significant risk factors for developing meningitis ( P.value < 0.05 for each one ) whereas the water supply, Maternal education , head trauma, family history of meningitis and animal breeding showed no significant difference (P.value 0.115). (**Table 3**).

**Table 3. Risk factors for meningitis by different variables**

Risk factors	variables	Meningitis cases		control		P.value
		No.	%	No.	%	
Gender	Male	69	57.5			>0.05
	Female	51	42.5			
Age	< 1	73	60.8			< 0.05
	1-3	31	25.8			
	3-5	16	13.4			
Residency	Rural	33	27.5	98	45.3	<0.05
	Urban	87	72.5	118	54.7	
Crowding	Over crowded	91	75.8	128	59.3	<0.05
	Non crowded	29	24.2	88	40.7	
Education	Education	69	57.5	124	57.4	>0.05
	Non education	51	42.5	92	42.6	
Economic state	Poor	79	65.8	134	62.1	<0.05
	Medium and rich	41	34.2	82	37.9	
Animals	Animals breeding	52	43	87	40.2	>0.05
	No animals	68	57	129	59.8	
Type of feeding	Beast feeding	32	27	41	18.9	<0.05
	Bottle feeding	39	32.5	95	43.9	
	Mixed	13	10.8	27	12.6	
	others	36	29.7	53	24.6	
Passive Smoking	Smoking	82	68.3	144	66.6	<0.05
	Non smoking	38	31.7	72	33.4	
Water supply	Pipe	63	53	186	86.1	>0.05
	Other source	57	47	30	13.9	
Recent URTI	present	78	65	151	69.9	<0.05
	Not present	42	35	65	30.1	
Head Trauma	History of head trauma	1	0.8	0	0	>0.05
	Non History of head trauma	119	99.2	216	100	
Family history of meningitis	present	2	1.6	5	2.3	>0.05
	Not present	118	98.4	211	97.7	
Use of antibiotics	used	78	65	154	71.3	>0.05
	Not used	42	35	62	28.7	
Total		120		216		



*Figure 1. distribution of symptoms and signs among meningitis cases*



*Figure 2: Mean number of meningitic cases during 3 years*

## Discussion

In the present study, CSF culture results showed that 66 case (55%) of cases of meningitis were culture positive(bacterial) while 54 cases (45%) were culture negative, this may be partially treated or others(viral or fungal or parasitic ), Similar observations were noticed in Saudia Arabia,<sup>14</sup> Oman <sup>15</sup>and Libya<sup>16</sup>.

Sixty five percent of patients had received antibiotics before admission to hospital and this might have cause low bacteriological yield of microorganism in the CSF culture ,A similar observation was reported in Saudi <sup>17</sup> , Yemen<sup>18</sup> .

Males were found to be slightly affected more than females which is statistically not significant(P.Value >0.05) , similar results were reported in Cuba.<sup>19</sup> , North America<sup>40</sup> , Saudia Arabia <sup>14</sup> .

Regarding age groups, the first age group (< 1 year) occupied the highest number No.73(60.8%) which is statistically significant ( P.Value < 0.05), similar results were reported in Jordan. The incidence of bacterial meningitis is higher in developing countries than developed countries and particularly high in children under one year of age <sup>20</sup> The possible causes are immaturity of the immune system , and the lack in the pre –exposure of the body to these organisms , which enhance the memory of the immune system to fight against these invaders. <sup>21,1</sup>

Other studies showed that the incidence of meningitis in tropical areas occurs in dry season and decreases in periods of rains,<sup>22, 23, 24,32</sup> and in temperate regions usually experience epidemics in the winter and spring periods. <sup>25</sup> In our study ,most cases were reported in winter and spring seasons.

Regarding risk factors of meningitis , in our study urban areas showed more risk factor than rural areas , similar result were obtain in developing countries<sup>26</sup>, the predominant of urban residency may be attributed to the high crowding rate in towns which is considered an important risk factor in meningitis. <sup>27</sup>

Overcrowded family was reported as risk factors of meningitis in our study, the same result was obtained in Sudan <sup>28</sup> ,USA<sup>41</sup> , India<sup>42</sup> ,this is due to easily spread of microorganism from person to another. <sup>29</sup>

Our study showed decrease incidence of meningitis in breast feeding babies compared with bottle feeding, a similar result was obtained in inda.<sup>30</sup>

The protective effect of human milk against microorganism may be due to inhibition of colonization with H-influenza by specific secretary IgA antibodies. <sup>31</sup>

The present study showed that low economic status was significant risk factor for meningitis , similar results showed increase incidence of meningitis in poor families <sup>8</sup> .<sup>32</sup> ,this is due to decrease immunity of the body.<sup>33</sup>

Children exposed to smoking were found to get meningitis more that those without exposure to smoking, this is consistent with that found in united state <sup>34</sup> ,this is due to the harboring of passive smokers to greater number of bacteria in the throat and nasal passage.<sup>35</sup>

In our study water supply had no significant risk factor of meningitis ,other studies also showed that the microorganism cannot be picked up from water supply or swimming pools.<sup>36</sup>

Recent upper respiratory tract infection showed significant risk factor for meningitis in our study, other study also showed recent upper respiratory tract

infection as important risk factor for meningitis like in USA<sup>37</sup>, this can be explained by the route of entrance of microorganism to the brain, as one and important route is through otitis media, mastoiditis, sinusitis, and pneumonia.<sup>38</sup>

Significant head injury (skull trauma) or cerebrospinal rhinorrhea (flow of csf from nose after head injury) was regarded as important risk factor for meningitis<sup>38</sup>, in our study only one reported case had history of head trauma.

Family education showed no significant risk factor for getting meningitis in our study, in developed countries this is regarded as significant risk factor of meningitis due to program of vaccination to H-influenza<sup>39</sup>, in our country this vaccine is not applied in the primary program of vaccination.

people who work with domestic animals have a higher risk of contracting listeria monocytogenes which can lead to meningitis.<sup>38</sup> In our study, the animal breeding was not a significant risk factor for meningitis. The same result was noticed by Abdul Khaliq in Yemen<sup>18</sup>.

### ***Conclusions & Recommendations***

From the results obtained in the present study, the following conclusions may be indicated:

1. Meningitis is important in childhood period, and the peak incidence of this disease occurs under one year of age.
2. Urban residence, over crowd, recent upper respiratory tract Infection, bottle feeding, passive smoking, poverty, are important risk factors for meningitis.
3. In our community meningitis occurs mainly in February, March, and April.
4. Families need to be educated about the risk of smoking. Efforts to reduce smoking may reduce incidence of meningitis.
5. Programs of vaccination of H-influenzae and other bacterial and viral agents are required to be applied in our country to control this important disease.
6. Early diagnosis and management of upper respiratory tract infection including otitis media and sinusitis is recommended to reduce risk of meningitis.

### **References**

- 1- Mayo Foundation for Medical Education and Research(MFMER), Mayo Clinic Staff, infectious disease, meningitis; Apr 11, 2007.
- 2- Amir Vokshoor, Viral Meningitis: Article by MD, Staff, Department of Neurosurgery, Woodland Hills, Medical Center, January 9, 2004.
- 3- Wenger JD, Hightower AD, Facklam RR, Gaventa S, Croome CV, and the Bacterial Meningitis Study group: Bacterial meningitis in the United States, 1986: report of a multistate surveillance study. Journal of Infectious Diseases (1990) 162: 1316-1323
- 4- Types and causes of meningitis, Meningitis Research foundation offices, England and Wales, 2007.
- 5- Meningococcal Disease: Nisseria meningitidis, November 1999, Massachusetts Department of Public Health Division of Epidemiology and immunization (617) 983-6800.
- 6- Tunkel AR, Scheld WM (2005). acute meningitis. In GL Mandell et al., eds., Mandell, Douglas, and Bennett's Principles and Practice of infectious Diseases, 6<sup>th</sup> ed., pp.1083-1126. Philadelphia: Elsevier Churchill Livingstone.
- 7- Barbara P. Homeier, MD, Breast Feeding vs. Formula Feeding, July 2005.

- 8- WHO / EMC / BAC / 98.3 , control of epidemic meningococcal disease. WHO practical guidelines. 2<sup>nd</sup> edition.
- 9- Immunization Action Coalition . St. Paul, MN 55104 . (651) 647- 9009., Meningococcal : Question and Answers Information about the disease and vaccines.
- 10- Meningitis-OhioHealth, Mayoclinic . com / Mayoclinic Health Information, BodyMayo-CFM.
- 11-Meningitis-patient uk,www.patient-co.uk / showdoc / 40000765/.
- 12- Haslam R.H.(1996). Meningitis : Nelsons Textbook of Pediatrics . Behrman and Vangan . : 569-573.
- 13- Saih MAM, khaleefa OH, Bushara M, Taha ZB, Musa ZA, Kamil I, Hofvander Y, Olcen P. Long term sequelae of childhood acute bacterial meningitis in a developing country. Scand J Infect Dis 199; 23:175-82.
- 14- Abomelha A.; Vodman S.; Saleh S.A.(1988). Childhood bacterial meningitis. Ann. Saudi. Med. 8:274-278.
- 15- Koul R.L.; Chacko A.(1994). Pattern of childhood meningitis in Oman. Saudi. Med. J. 19(4): 432-436.
- 16- Rao B.N.; Kashbur I.M.; Shembesh N.M. and El-Bargathy S.M. (1998). Aetiology and occurrence of acute bacterial meningitis in children in Benghazi , Libyan Arab Jamahiriya. East. Meditterr. Health.J.4(1): 50-57.
- 17- Murphy PA. Bacterial infection of the nervous system with special reference to tuberculosis. Saudi Med J 1988-9 : 569-79.
- 18- Abdul Khaliq A. Sallam, Etiology and presentation of Acute bacterial Meningitis in children at Al-Thawrah hospital, SANAA, YEMEN.
- 19- Grimwood K. legacy of bacterial meningitis in infancy. BMJ. 2001; 323 ; 523-524. Doi; 10.1136/ bmj. 323.7312.523.
- 20- Al-Aun M.; Saleh F.; Ajlouni M.B.; Hazza I .; Ahmed M.; Momani N.(1994). Bacterial Meningitis in children. J. Roy.Med. Serv.1(2): 23- 25.
- 21- Schuchat A.; Wenger J, (1997). Epidemiology of bacterial meningitis. Annual Nestle 55: 79-91.
- 22- Molesworth AM, Thomson MC, Connor SJ, Cresswell MC, Morse AP, Shears, etal. Where is the meningitis belt?Defining an area at risk of epidemic meningitis in Africa. Trans R soc Trop Med Hyg 2002; 96: 242-9.
- 23- Moore PS.meningococcal meningitis in sub-saharan Africa: amodel for the epidemic process. Clin infect Dis 1992; 14: 515-25.
- 24- Greenwood B. Meningococcal meningitis in Africa. Trans R soc Trop Med Hyg 1999; 93: 341-53.
- 25- Meningococcal disease, Public Health agency of Canada, May 2005.
- 26- Cochi S.L.; fleming D.W.; Higtower A.W.(1986). Primary invasive Hib disease: A Population –based assessment of risk factors. J. Pediatr. 108: 887-896.
- 27- Tappero J.w.; Reporter.; Wenger J.D.(1996) Meningococcal disease in Los Angeles County, California, and among men in the county Jails.N. Eng. Med. 325: 833-840.
- 28- Now Public, crowd Powered Media, Meningitis out break kills 1000 in Sudan last week., Health new.2007.
- 29- Richard E. Behrman, MD. (2000). Central Nervous System infection in Nelsons textbook of Pediatrics.: 751-752.
- 30- Neil Izenberg, MD, Breast feeding vs. Formula feeding. 2005.



- 31- Harabuchi, Y. et al. Human Milk Secretory IgA antibody to nontypeable *Haemophilus influenza*, possible protective effects against nasopharyngeal colonization. *J. pediatr* 124; 193-98(1994) .
- 32- Rosenstein NE, Perkins BA, Stephens DS et al. The changing epidemiology of meningococcal disease in the United States, 1992-1996. *J Infect Dis* 1999;180:1894-901.
- 33- Mayo Foundation for Medical Education and Research(MFMER), Mayo Clinic Staff, infectious disease , meningitis ; 2007.
- 34- Imrey PB; Jackson LA; *J Clin Microbiol*, 33(12): 3133-7 1995 Dec, Barworkars – second hand smoke and increased risk of Meningococcal meningitis.
- 35- Caroline Blackwell, Smokers babies, risk meningitis, *Medical Microbiology*, 2000.
- 36- Travel Medicine, university health care, Meningitis, 2003.
- 37- Hilary M. Babcock, M.D., university of Pennsylvania Health system, meningitis-Meningococcal, 2006.
- 38- Coyle pk. overview of acute and chronic meningitis. *Neurol clin.* 1999, 17 (4): 691-710.
- 39- Grantham-MC Gregor S, Cheung YB, Cue to S, Glewwe P, Richter L, Strupp B. Developmental Potential in the first 5 years for children in developing countries, *Lancet* 2006; 369: 60-70.
- 40- Orin S. Levine, Monica Farley, Lee H. Harrison, Lewis Lefkowitz. Risk factors of pneumococcal meningitis in children, case-control study in North America. *American Academy of Pediatrics* 1999; 103: 1-5.
- 41- J Filka, M Huttova, J Tunarsky, T Sagat, et al. Nosocomial meningitis in children . *American Academy of Pediatric* 1999; 88 (5): 576-78.
- 42- Amitava Donhari, Canvery Pal, Hermione Lyall. Recurrent meningitis. *Indian pediatrics* 2004; 41: 1152-54.