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# Etiologies of Fever in Children Under 3 Months of Age at The University Teaching Hospital of Bouaké (Côte D'ivoire)

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## Abstract

***Introduction:*** *Fever poses a problem of diagnosis and management in infants under three months of age in an emergency setting. The objective of the study was to identify the causes of fever for early management and improved prognosis.*

***Methods:*** *This was a retrospective and descriptive study conducted in pediatrics at the Bouaké University Teaching Hospital from January to December 2018. It included all children under 3 months of age hospitalized in the department for fever confirmed by a thermometer. The variables studied were epidemiological and diagnostic.*

***Results:*** *2619 children under 3 months of age were recorded, of whom 771 (339 boys, 372 girls) had fever, i.e. 29.4%. Fever had been present for less than 5 days in 79.7% of the children, and the main associated signs were refusal to suckle (16.5%), respiratory difficulty (14.2%), and constant crying (11.8%). The causes of fever identified in newborns were infection (97.6%) and induced fever (2.4%). The main bacteria of maternal-fetal infection were Streptococcus agalactiae 58.3% and Escherichia coli 36.7% and those of postnatal infection were Staphylococcus aureus (46.4%) and Klebsiella sp and Klebsiella pneumoniae (25%). In infants aged 1-3 months the cause of fever was acute respiratory infection in 46.5% and malaria in 20.4%. The bacteria found in respiratory infections were Staphylococcus aureus (38.5%), Streptococcus pneumoniae (30.8%), Klebsiella pneumoniae (15.4%) and Haemophilus influenzae (7.7%).*

***Conclusion:*** *In the febrile infant of less than three month, it is necessary to think in priority of a bacterial infection and malaria. The probabilistic treatment must take into account the main germs identified according to age group. Pregnancy monitoring, hygiene education of parents, use of the long-lasting insecticide-treated mosquito net, strengthening the capacity of the service for diagnosis, adherence to asepsis and hospital hygiene by health personnel are priority measures to be undertaken to improve the diagnosis and prognosis of febrile infants.*

**Keywords:** *Infant, Fever, Etiologies, Ivory Coast.*

## Introduction

Fever is defined as a rise in body temperature above 37.5°Celsius in the morning and 38°Celsius in the evening [1]. In children under 3 months of age, fever is defined as body temperature greater than two standard deviations from the mean of 37°Celsius [2]. High fever is likely to lead to serious complications such as convulsions, dehydration and major hyperthermia in these young infants. In an emergency situation, it poses a problem for the physician in terms of etiological diagnosis [3] in view of the associated symptoms, which are often not very specific, the poor physical examination and the

diversity of causes, which vary according to age [2]. In developed countries, where the technical facilities are efficient, the causes of fever in newborns are sepsis (63%), infections (45%), unexplained fever (37%), dehydration (36%) and overcovering (1%) [4-6] and in young infants, acute respiratory infection (88%), urinary tract infection (46%), bacterial meningitis (5%) and sepsis (2.4%) [7]. In Côte d'Ivoire, the 1997 study by Oulai et. *al*. [8] in Abidjan indicated a prevalence of fever in children under 3 months of age of 15.12%. In the Gbêkê region, studies [7, 9, 10] conducted in the pediatrics department of the Bouaké University Teaching Hospital revealed that fever was the primary reason for consulting children of all ages. These Ivorian studies are old and did not specifically look for the cause of fever in children under 3 months of age. Knowledge of these etiologies is however fundamental to guide the therapeutic decision. The objective of the study was to identify the causes of fever in these young infants in order to provide early treatment and improve the prognosis.

## Patients and Methods

### Type, Time Period, Location and Study Population

This was a retrospective descriptive study conducted in the pediatrics department of the Bouaké University Teaching Hospital from January to December 2018. This service with a capacity of 54 beds is the only tertiary level service in the central and northern regions of Côte d'Ivoire. It receives all children between the ages of 0 and 15 years old, coming for curative or preventive care. According to the 2018 activity report published by the General Management of the Bouaké University Teaching Hospital, the pediatric service registered 10832 children distributed as follows: 1809 in pediatric emergencies, 2098 in neonatology, 4411 in hospitalization and 2514 in consultation. The study population consisted of all children admitted to the department during the study period for fever confirmed by a thermometer.

### Inclusion and Non-Inclusion Criteria

Included in the study were all children aged 0 to 3 months hospitalized for fever with a complete usable medical record and having performed, depending on the clinical context, at least one of the following paraclinical examinations: thick drop and blood smear or a rapid diagnostic test for malaria, C-reactive protein, blood count, blood culture, chest X-ray. Not included were all children aged 0 to 3 months who were hospitalized but died before the paraclinical investigations were performed.

### Sample Size

The sample size was calculated according to the following Schwartz formula $n = \frac{t^2 p\,(1-p)}{m^2}$ *[n (minimum sample size required); t (95% confidence level (t=1.96); p (incidence of fever in pediatric settings); m (5% margin of error)*]. In the absence of recent data on the prevalence of fever in children under 3 months of age in Côte d'Ivoire, the value of p chosen to determine the sample size is the 15.12% reported by Oulaï et. *al*. [8]. The calculated sample size was 198. Since the study duration was set for 12 months, we included exhaustively all children under 3 months of age who were feverish during this period. After eliminating incomplete records, 634 records were retained for the study.

### Study Design, Data Collection and Study Variables

A child under 3 months of age admitted for fever was received with the parents in an emergency in an air-conditioned room by the consulting physician. The latter quickly looked for signs of intolerance. When the child had one or more signs of intolerance, the physician undressed the child and administered paracetamol (60mg/kg/day) intravenously to normalize the temperature before beginning the etiological investigation. The etiologic investigation was based on careful questioning, a rigorous physical examination and the prescription of paraclinical examination according to the etiologic orientation. These included, according to the etiological orientation of the blood count, C-reactive protein, thick drop and blood smear for *Plasmodium*, blood culture, cytobacteriological and chemical analysis of cerebrospinal fluid, cytobacteriological examination of urine, cytobacteriological examination of pus sampling and coproculture. All additional bacteriological examinations were performed at the Biology Laboratory of the Bouaké University Teaching Hospital. The information collected was recorded in the patient's medical file. This medical record served as the basis for data collection. For data collection, a structured and standardized anonymous form was developed. This form included the sociodemographic and diagnostic variables studied. The sociodemographic characteristics concerned the

child's age, sex and place of residence and the mother's age, level of education and activity. Diagnostic characteristics included mode of admission, reason for admission, history, clinical signs, paraclinical examinations and etiology. In the present study, the medical record was defined as complete and usable if it included at least 80% of the parameters to be filled in on the survey form, the low level of education or instruction grouped people with no schooling or with primary schooling. The informal sector included traders, farmers, hairdressers and dressmakers. To evaluate the socio-economic status of the mother, we developed a rating (Table I) whose variables are the level of education, activity, number of people per room in the home, drinking water supply and electricity, the existence of reserves and the daily family budget

**Table1.** *Assessment of socio-economic conditions*

| Variables | Score |
|---|---|
| Mother's level of education | |
| - Not attending school | 0 |
| - Primary | 1 |
| - Secondary | 2 |
| - Superior | 3 |
| Mother's activity | |
| - Unemployed | 0 |
| - Pupil / Student | 1 |
| - Informal sector | 2 |
| - Civil servant | 3 |
| Number of persons per room | |
| - > 3 | 0 |
| - ≤ 3 | 1 |
| Water and electricity supply | |
| - No | 0 |
| - Yes | 1 |
| Existence of reserve | |
| - No | 0 |
| - Yes | 1 |
| Daily family budget | |
| - < 2000 FCFA | 0 |
| - Mother's level of education | 1 |

The score is between 0 and 10. The mother's socioeconomic status was considered satisfactory if the score was between 8 and 10, unsatisfactory between 5 and 7, and unsatisfactory or unfavourable between 0 and 4.

## Ethical Considerations

The study has been approved by the Medical and Scientific Direction of the Bouaké University Hospital. In addition, the confidentiality of the information collected during the survey was guaranteed by assigning an anonymity number to each survey form.

## Statistical Analysis

The data was entered and analyzed using Microsoft Office Excel 2019. The data collected was aggregated and presented in the form of frequency tables and figures (histogram, pie chart, bar graph). Quantitative variables were expressed as median, mean with standard deviation and extreme values. Qualitative variables were expressed as proportions.

# Results

## Socio-Demographic Characteristics

Out of a total of 2,619 children aged 0-3 months registered, 771 had fever, a prevalence of (29.4%). Among the febrile infants, 634 were selected for the study. The selection process of the cases retained for the study is presented in Figure 1.

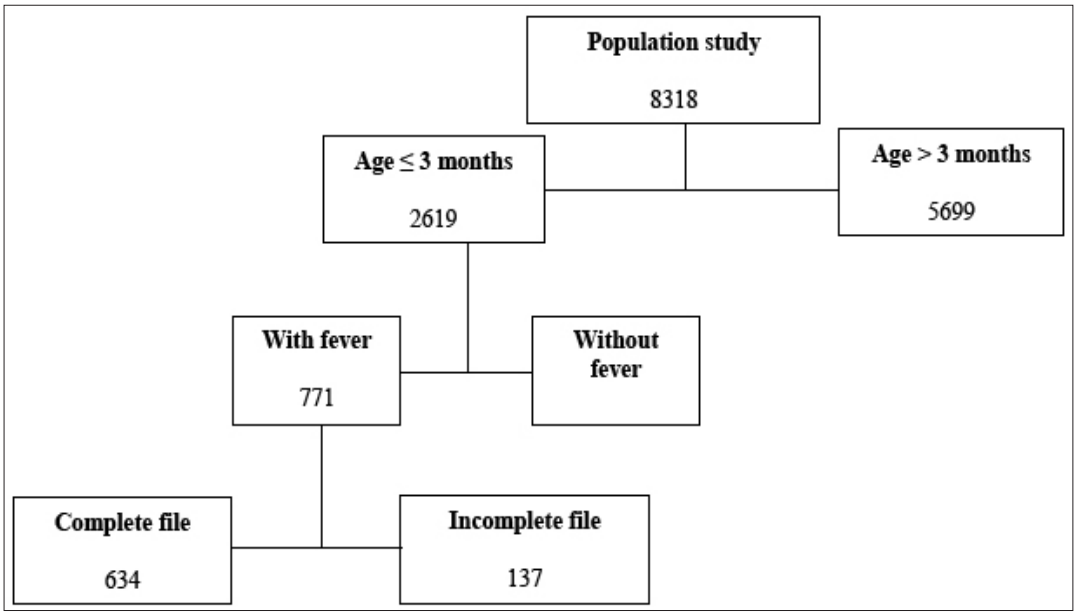


**Fig1.** *selection process for the 634 files selected for the study*

The child was male in 51.4% of cases and was between 0 and 28 days old in 66.7% of cases. The mother's age was less than 20 years old in 16.8% of cases and between 20 and 34 years old in 65.5% of cases. She was a housewife (52.8%), had a low level of education (70.4%) and poor to unfavorable socioeconomic conditions (94.6%). Details of the socio-demographic characteristics are given in Table II.

**Table2.** *socio-demographic characteristics of the 634 children and their mothers.*

| Socio-demographic characteristics | Number | Percentage |
|---|---|---|
| Age of the child | | |
| - 0 - 28 days | 423 | 66.7 |
| - 29 - 60 days | 122 | 19.2 |
| - 61 - 90 days | 89 | 14.1 |
| Gender of the child | | |
| - Male | 326 | 51.4 |
| - Female | 308 | 48.6 |
| Mother's age (years) | | |
| - ≤ 15 | 12 | 1.9 |
| - [16 -19] | 93 | 14.7 |
| - [20-24] | 147 | 23.2 |
| - [25 -29] | 131 | 20.7 |
| - [30-34] | 137 | 21.6 |
| - [35-39] | 83 | 13.1 |
| - ≥40 | 31 | 4.9 |
| Mother's level of education | | |
| - Illiterate | 325 | 51.3 |
| - Primary | 121 | 19.1 |
| - Secondary | 139 | 21.9 |
| - Superior | 49 | 7.7 |
| Mother's activity | | |
| - Housewife | 335 | 52.8 |
| - Informal sector | 122 | 19.2 |
| - Pupil / Student | 109 | 17.2 |
| - Civil servant | 68 | 10.7 |

| | | |
|---|---|---|
| Socio-economic conditions of the mother | | |
| - Satisfactory (favourable) | 34 | 5.4 |
| - Unsatisfactory | 229 | 36.1 |
| - Unsatisfactory (unfavourable) | 371 | 58.5 |

## Diagnostic Aspects

The fever had been present for less than 5 days in 79.7% of cases and the parents consulted the pediatrics department of Bouaké University Teaching Hospital in 64.8% of cases. Pre-hospital treatment was an antipyretic in 29.9%, an antimalarial in 19% and traditional treatment in 18.3%. The functional signs associated with fever were refusal to suckle (16.6%), respiratory difficulty (14.4%), and constant crying (11.8%). The physical signs associated with fever are shown in Table III.

**Table3.** *clinical aspects of the 634 children selected for the study*

| Variables | Number | Percentage |
|---|---|---|
| Duration of fever progression | | |
| - <5 days | 505 | 79.7 |
| - ≥5 days | 129 | 20.3 |
| Therapeutic Itinerary | | |
| - Comes directly from the house | 431 | 64.8 |
| - Consulted a health center prior to admission | 203 | 35.2 |
| Pre-hospital treatment | | |
| - Antipyretic | 563 | 29.9 |
| - Antimalarial | 357 | 19.0 |
| - Conventional treatment | 344 | 18.3 |
| - Antibiotic | 326 | 17.3 |
| - Antianemic | 291 | 15.5 |
| Physical signs associated with fever | | |
| - Tachycardia | 431 | 12.4 |
| - Bad general impression | 427 | 12.3 |
| - Polypnea | 397 | 11.4 |
| - Pale skin tone | 228 | 6.6 |
| - Convulsions | 209 | 6.0 |
| - Signs of Respiratory Struggle | 203 | 5.9 |

The diagnosis retained at the end of the etiological research was confirmed in 60.7% (385/634) and presumptive in 39.3% (249/634). Of the 423 newborns, the diagnosis was confirmed in 149 cases (35.2%) and presumptive in 64.8%. Confirmed diagnoses in newborns were 116 cases of bacterial infection (27.4%) and 33 cases of malaria (7.8%). The confirmed bacterial infection was maternal-fetal in 60 cases and postnatal in 56 cases. The bacterial species of maternal-fetal infection identified were *Streptococcus agalactiae* 58.3% (35/60) and *Escherichia coli* 36.7% (22/60) *Streptococcus pneumoniae* 5% (3/60). Those of postnatal infection were *Staphylococcus aureus* 46.4% (26/56) and *Klebsiella sp* 21.4% (12/56), *Streptococcuspneumoniae* 14.3% (8/56), *Pseudomonas aeruginosa* (7/56) *Klebsiella pneumoniae* 3.6% (2/56%) and *Staphylococcus sp* 1.8% (1/56). In the 211 infants aged 1-3 months, the diagnosis was confirmed in 41.2% of cases (87/211). These were *Plasmodium falciparum* malaria in 43 cases, acute bacterial respiratory infection in 13 cases, acute bacterial meningitis in 12 cases, acute bacterial gastroenteritis in 9 cases, septicemia in 7 cases, acute pyelonephritis in 2 cases and cutaneous staphylococcus in 1 case. The main diagnoses used in the study are shown in Table IV.

**Table4.** *confirmed and presumptive diagnoses retained*

| Pathologies | Diagnostics | | Percentage of confirmation |
|---|---|---|---|
| | Confirmed | Presumptive | |
| **Newborn** | | | |
| Induced fever | 0/12 | 12/12 | 0 |
| Neonatal infections | | | |
| - Maternal-fetal infection | 60/178 | 118/178 | 33.7 |
| - Postnatal infection | 56/157 | 101/157 | 35.6 |
| - Malaria* | 33/33 | 0/33 | 100 |
| - Bronchiolite | 0/31 | 31/31 | 0 |
| - Rhinobronchitis | 0/12 | 12/12 | 0 |
| **Children from 29 to 90 days old** | | | |
| Acute respiratory infections | | | |
| - Bronchiolite | 0/48 | 48/48 | 0 |
| - Pneumonia | 7/32 | 25/32 | 21.8 |
| - Pleuropulmonary Staphylococcal Disease | 5/14 | 9/14 | 35.7 |
| - Acute purulent otitis | ¼ | 3/4 | 25.0 |
| - Rhinobronchitis | 0/4 | 4/4 | 0 |
| Malaria | 43/43 | 0/43 | 100 |
| Acute bacterial meningitis | 12/19 | 7/19 | 63.1 |
| Gastroenteritis | | | |
| - Bacterial Gastroenteritis | 9/19 | 10/19 | 47.3 |
| - Viral Gastroenteritis | 0/6 | 6/6 | 0 |
| Sepsis | 7/9 | 2/9 | 77.7 |
| Acute Pyelonephritis | 2/2 | 0/2 | 100 |
| Staphylococcal skin disease | 1/11 | 10/11 | 9.0 |

** Malaria (congenital disease 22 cases, neonatal 11 cases)*

The bacterial infectious agents identified in the infection are shown in Table V.
1 to 3-month age range depending on the site of

**Table5.** *bacterial infectious agents identified in the 1-3-month age group by site of infection*

| Germs by Site of Infection | Nature of Specimen | Number | Percentage |
|---|---|---|---|
| Acute respiratory infection (N=13) | | | |
| - *Staphylococcus aureus* | Pleural fluid | 5/13 | 38.5 |
| - *Streptococcus pneumoniae* | Blood | 4/13 | 30.8 |
| - *Klebsiella pneumoniae* | Blood | 2/13 | 15.4 |
| - *Haemophilus influenzae* | Blood | 1/13 | 7.7 |
| - *Micrococcus sp.* | Pus | 1/13 | 7.7 |
| Acute bacterial meningitis (N=12) | | | |
| - *Streptococcus pneumoniae* | CSF* | 10/12 | 83.3 |
| - *Klebsiella pneumoniae* | CSF* | 2/12 | 16.7 |
| Acute bacterial gastroenteritis (N=9) | | | |
| - *Escherichia Coli* | Stool | 7/9 | 77.8 |
| - *Yersinia sp* | Stool | 2/9 | 22.2 |
| Sepsis (N=7) | | | |
| - *Staphylococcus aureus* | Blood | 4/7 | 57.1 |
| - *Klebsiella pneumoniae* | Blood | 2/7 | 28.6 |
| - *Streptococcus pneumoniae* | Blood | 1/7 | 14.3 |
| Acute pyelonephritis (N=2) | | | |
| - *Escherichia coli* | Urine | 1/2 | 50 |

| | | | |
|---|---|---|---|
| - *Enterobacter sp* | Urine | 1/2 | 50 |
| Skin infection (N=1) | | | |
| - *Staphylococcus aureus* | Pus | 1/1 | |

** CSF: cerebrospinal fluid*

The antibiotic susceptibility of the identified bacterial species is shown in Table VI

**Table6.** *bacteria identified and percentage of antibiotic sensitivity*

| **Bacteria** | **Antibiotic** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **AM** | | **AMC** | | **AMX** | | **CRO** | | **OXA** | | **IPM** | | **GM** | | **CIP** | |
| | **S** | **I+R** | **S** | **I+R** | **S** | **I+R** | **S** | **I+R** | **S** | **I+R** | **S** | **I+R** | **S** | **I+R** | **S** | **I+R** |
| **Enterobacteria** | | | | | | | | | | | | | | | | |
| *Enterobacter sp* | 0 | 100 | 0 | 100 | - | - | 100 | 0 | - | - | 100 | 0 | 100 | 0 | 100 | 0 |
| *Yersinia sp* | 50 | 50 | 50 | 50 | - | - | 100 | 0 | - | - | 100 | 0 | 100 | 0 | 100 | 0 |
| *Escherichia coli* | 92.5 | 7.5 | 77.5 | 22.5 | 77.5 | 22.5 | 45 | 55 | - | - | 100 | 0 | 85 | 15 | 67.5 | 32.5 |
| *Klebsiella pneumoniae/sp* | 4.34 | 95.6 | 4.34 | 95.6 | 4.34 | 95.6 | 30.4 | 69.6 | - | - | 100 | 0 | 69.6 | 30.4 | 39.1 | 60.9 |
| **Other Gram-negative bacilli** | | | | | | | | | | | | | | | | |
| *Haemophilus influenzae* | 0 | 100 | 0 | 100 | 100 | 0 | 100 | 0 | - | - | 100 | 0 | 100 | 0 | 100 | 0 |
| *Pseudomonas aeruginosa/sp* | 14.3 | 85.7 | 14.3 | 85.7 | 14.3 | 85.7 | 57.2 | 42.8 | - | - | 100 | 0 | 42.8 | 57.2 | 28.6 | 71.4 |
| **Gram-positive Cocci** | | | | | | | | | | | | | | | | |
| *Micrococcus sp* | 100 | 0 | - | - | - | - | - | - | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 |
| *Staphylococcus aureus / sp* | - | - | 5.1 | 94.9 | 5.1 | 94.9 | 64.1 | 35.9 | 87.2 | 12.8 | 100 | 0 | 69.2 | 30.8 | 56.4 | 43.6 |
| *Streptococcus agalactiae* | 97.6 | 2.4 | 87.8 | 12.2 | 87.8 | 12.2 | 75.6 | 24.4 | - | - | 100 | 0 | 85.4 | 14.6 | 60.9 | 39.1 |
| *Streptococcus pneumoniae* | 29.3 | 70.7 | - | - | 73.2 | 26.8 | 80.5 | 19.5 | - | - | 100 | 0 | 90.2 | 9.8 | 21.9 | 78.1 |

*AM=ampicillin, AMC=amoxicillin, AMX=amoxicillin + clavulanic acid, CRO=ceftriaxone, GM=gentamycin, OXA=oxacillin, IPM=imipenem, S=sensitive, I=intermediate, R=resistant.*

## Discussion

The objective of this retrospective and descriptive work is to research the etiologies of fever in children under 3 months of age at the Bouaké Hospital and University Center in Côte d'Ivoire. The results of the study must be qualified from the outset because the study is hospital-based, monocentric and retrospective, with all that this implies in terms of potential bias. In addition, the unfavorable socioeconomic level of the parents and the insufficient technical facilities made it impossible to search for viral infectious agents. In spite of the methodological limitation, the study raises the following points of discussion regarding the epidemiological and diagnostic aspects.

### Socio-Demographic Aspects

The study reveals a prevalence of fever in children under 3 months of age of 29.4%. In the literature, the prevalence varies from one author to another between 19% and 72% [11, 12]. This high frequency of fever in this age group can be explained by the immaturity of the immune system in the face of in and ex utero exposure to pathogens as well as the immaturity of the hypothalamic heat-regulating system. In this age group, two thirds of the cases of fever involve a newborn baby without distinction of sex with a median age of 33 days. In the Milcent [3] study in 2015 in France, the male sex predominated and the age range from 31 to 92 days represented 79.5% of cases with a median age of 53 days. The difference between the two studies could be methodological. The present study is a retrospective monocentric study conducted

over a period of 1 year, whereas the Milcent study [3] was prospective, multicentric and lasted 3 years. In the study, mothers had a low level of education in 70.4% of cases. They were housewives (52.8%) and had poor to unfavorable socioeconomic conditions in 94.6% of cases. The low socioeconomic level of mothers is only a reflection of the poverty of the population estimated at 40% in 2015 by the National Institute of Statistics of Côte d'Ivoire. This low socio-economic level of mothers is probably linked for the majority to their low level of education. In fact, according to UNICEF, each year spent in school enables a girl to increase her future income by 10 to 20%. Moreover, investing in girls' ability to complete higher education could contribute to increasing their lifetime income by up to 68% of the annual Gross Domestic Product (GDP) [13].

## Diagnostic Aspects

The study reveals that fever in children under three months of age is often associated with non-specific signs that make syndromic diagnosis difficult. In these conditions, etiological research requires a high-performance technical platform. This is not the case in our working condition and certainly explains the overall rate of confirmation of the etiological diagnosis of 60.7%. This rate is lower in newborns compared to infants aged 1 to 3 months (35.2% versus 41.2%). The presumptive causes of fever are dominated by fever induced by overly hot wrap, acute respiratory infections (bronchiolitis, rhinobronchitis, otitis) and gastroenteritis. Acute respiratory infection and acute gastroenteritis in infants less than three months of age are reserved for viral infectious agents. The main viruses involved are rotavirus for gastroenteritis, and respiratory syncytial virus (60-70%), adenoviruses, metapneumoviruses, and rhinoviruses for neonatal acute respiratory infections [14, 15].

## Newborn

In newborns, the study shows that the confirmed cause of fever is infection in all cases. The infection was due to a bacterium in more than three quarters of the cases (116/149) and *Plasmodium falciparum* malaria in 22.1% (33/149). Neonatal bacterial infection was maternal-fetal in 51% and post-natal in 49% of cases. In maternal-fetal infection, the main infectious agents were *Streptococcus agalactiae* (58.3%) and *Escherichia coli* (36.7%). These two bacteria were reported in the literature in nearly 70% of cases [16]. The presence of these infectious agents in the maternal uro-genito-rectal tract favors the frequent colonization of newborns [17]. In this work, the inadequate monitoring of pregnancies and the inappropriate management of maternal urogenital infections during pregnancy could be cited in view of the high prevalence of these germs in the newborn. For post-natal infection, the three main germs isolated were *Staphylococcus aureus, Klebsiella sp and Streptococcus pneumoniae*. These germs are often involved in nosocomial infections [18]. They are in the study, multi-resistant to the usual antibiotics (ampicillin, amoxicillin, ceftriaxone and gentamicin) but sensitive to imipenem. Our results are comparable to those reported by Talbert et. *al.* [19] in Kenya in 2010 but in different proportions. The sources of these infections are either nosocomial cross-infections due to prolonged hospital stay or contacts of family members or visitors with poor hand hygiene [20, 21]. Hence the importance of observing asepsis and hand hygiene during the management of newborns. The study suggests, in our context, to prescribe amoxicillin and gentamicin as first-line treatment for maternal-fetal infection and imipenem for post-natal infection. In the case of malaria, this was the congenital form of the disease in two-thirds of cases and the neonatal form in one-third of cases. The species identified in all cases was *Plasmodium falciparum*, the *Plasmodium* species most commonly found in sub-Saharan Africa [22]. In an earlier study conducted in the same department in 2017, Asse et. *al.* [23] reported a prevalence of congenital malaria of 10.5%. The congenital form of the disease accounted for 28.6% of cases in this study. In the systematic review and meta-analysis by BilaL et. *al.* [24] of 24 scientific studies published in 2020, the overall incidence of malaria in newborns was 6.9%. This low prevalence of malaria in the newborn in a context of high malaria endemicity could be explained by the presence of maternal anti-malarial antibodies, fetal hemoglobin, and maternal milk due to its deficiency in para-amino-benzoic acid (PABA), lactoferrin and IgA that inhibits the growth of the parasite [25, 26].

## Infant From 1 To 3 Months of Age

In infants aged 1-3 months, the etiologies of fever in this study are dominated by acute respiratory infections (46.5%), malaria (20.4%), gastroenteritis (11.7%), acute bacterial meningitis (8.9%) and sepsis (4.3%).

### *Acute Respiratory Infections*

Concerning acute respiratory infections, these are mainly bronchiolitis and rhinobronchitis (24.7%), pneumonia (15.2%), pleuro-pulmonary staphylococcus (6.6%). They are most often caused by viruses such as *Respiratory Syncytial Virus, parainfluenzae viruses, rhinovirus* and *coronavirus* [1]. In the present study, due to the lack of technical facilities the viruses could not be isolated. When bacteria were involved, the main ones were *Staphylococcus aureus* (38.5%), *Streptococcus pneumoniae* (30.8%), *Klebsiella pneumoniae* (15.4%) and *Haemophilus influenzae* (7.7%). The presence of these infectious agents on the skin of the infant and of these relatives [27, 28] on the breast of the mother [27] could explain their high proportion in the study. In the study *Staphylococcus aureus* still retains good sensitivity to Oxacillin. The same applies to *Streptococcus pneumoniae* for amoxicillin. On the other hand, *Haemophilus influenzae* is resistant to amoxicillin but sensitive to Ceftriaxone. *Klebsiella pneumoniae* is multi-resistant to the usual antibiotics and is only sensitive to Imipenem. For Sharon [29] empirical antibiotic therapy for febrile infants in this age group should include coverage for the usual neonatal pathogens as well as the three most common pathogens in the age group (S. pneumoniae, H. influenza and S. aureus). [29]. The study suggests that the first-line antibiotic in our context should be oxacillin for *Staphylococcus aureus*, amoxicillin for *Streptococcus pneumoniae*, amoxicillin, ceftriaxone for *Haemophilus influenzae* and imipenem for *Klebsiella pneumoniae.*

### *Malaria*

In the study, malaria was the second cause of fever in this age group with a frequency of 20.4%. This result is lower than that reported by Asse et. *al.* [10] in the same service in 2015 with a prevalence of 52%. Mbonye et. *al.* [30], in 2015 in Uganda, reported an overall malaria prevalence of 36.1% in infants aged 1-6 months, of which 54.3% were under 3 months. The low proportion in the study could be explained by methodological differences. However, these studies show that malaria in infants under six months of age is not uncommon in malaria endemic areas and the prevalence seems to be underestimated. Therefore, there is a need to collect reliable data on the prevalence of malaria in this population [30].

### *Acute Gastroenteritis*

In the study, it is bacterial in 8.9% and probably viral in 2.8% of cases. The two bacteria identified were *Escherichia coli* (66.7%) and *Yersinia sp*. Infant gastroenteritis is 70% viral, 20% bacterial and 10% parasitic [31]. The low proportion of viral gastroenteritis in the study could be explained by the efficacy of the vaccine against *Rotavirus*, the primary pathogen of viral gastroenteritis, introduced in the Expanded Program on Immunization (EPI) in Côte d'Ivoire in June 2015 [32].

### *Acute Bacterial Meningitis*

The study shows that acute bacterial meningitis accounts for 8.9% of the etiologies of fever in infants up to 3 months of age. The main bacterial species found are *Streptococcus pneumoniae* (83.3%) and *Klebsiella pneumoniae* (1674%). The same bacteria were found in the literature but in different proportions. Indeed Mwaniki [33] in 2011 in Kenya found Streptococcus *pneumoniae* in 18.6% and *Klebsiella pneumoniae* in 3.5%.

### *Septicemia*

In this work, sepsis accounts for 4.3% of the etiology of fever in infants up to 3 months of age. The most common bacteria found are Staphylococcus aureus (57.1%) and Klebsiella pneumoniae (28.6%). A multicenter study based on 63 studies conducted in several developing countries from 1980 to 2007 noted that the bacteria associated with sepsis in infants aged 29 to 90 days were *Streptococcus pneumoniae* (26.95%), *Staphylococcus aureus* (12.77%), *Streptococcus pyogenes* (11.35%) and *Escherichia coli* (9.22%) [34].

## Conclusion

Fever is common in children aged 0 to 3 months in Bouaké. It most often affects a newborn whose mother is poorly educated and has an unfavorable socioeconomic status. The confirmed cause of this fever is a bacterial or parasitic infection in all cases. In the newborn, the maternal-fetal infection is mostly due to the usual germs (*Streptococcus B and Escherichia Coli*) which are still sensitive to the usual antibiotics. Whereas the post-natal infection is mainly due to the nococomial multi-resistant bacteria *Staphylococcus aureus, Klebsiella sp* and *Streptococcus pneumoniae.* For infants aged 1-3 months, fever is mainly due to acute

low respiratory infection and *Plasmodium falciparum malaria*. The confirmed bacterial infectious agents of acute low respiratory infections remain the three main bacteria namely *Staphylococcus aureus, Streptococcus pneumoniae,* and *Haemophilus influenzae* usually isolated with good sensitivity to common antibiotics. Pregnancy monitoring, hygiene education of parents, use of the long-lasting insecticide-treated mosquito net, strengthening the capacity of the service for diagnosis, adherence to asepsis and hospital hygiene by health personnel are priority measures to be undertaken to improve the diagnosis and prognosis of febrile infants.

## References


**[1]** **Asse KV**. The essentials in tropical pediatrics. Abidjan : EDUCI; 2016 : 492p. ISBN : 978-2-355656-043-7

**[2]** **Hui C, Neto G, Tsertsvadze A, Yazdi F, Tricco AC, Tsouros S**. Diagnosis and Management of Febrile Infants (0–3 Months). Evid Rep Technol Assess 2012 ; 1 :1-297

**[3]** **Milcent K** Diagnostic tools for the recognition of severe bacterial infections in febrile infants less than three months of age visiting pediatric emergency departments. Public health and epidemiology. Paris-Saclay University, 2015. French. ffNNT : 2015SACLS224ff

**[4]** **Baysal B, Calkavur S, Atlihan F, Baysal B**. Etiology of Fever in Neonates: Is It Just Due to Infection? J Pediatr Infect Dis 2018 ; 13 : 224–8

**[5]** **Bertille N, Pons G, Khoshnood B, Fournier-Charrière E, Chalumeau M**. Symptomatic Management of Fever in Children : A National Survey of Healthcare Professionals' Practices in France. PLoS One 2015 ; 10 : e0143230

**[6]** **Janakiraman D, Muthumani K, Thirumalaikumaraswamy S**. Clinical profile of fever in newborn and predictors of outcome. Int J Contemp Pediatr 2017; 4 :1709-16

**[7]** **Elhassanien AF, Alghaiaty HA, Alrefaee F**. Fever without source in infants and young children: dilemma in diagnosis and management. Risk Manag Healthc Policy 2013 ; 6 : 7-12

**[8]** **Oulaï MS, Tiécoura WV, Plo KJ**. Newborn Fever in Tropical Environments: Etiological Aspects. Med Afr Noire 1997 ; 44 :133-8

**[9]** **Asse KV, Plo KJ, Yao KC, Konaté I, Yenan JP**Epidemiological, diagnostic, therapeutic and evolutionary profile of the patients referred to the pediatric emergencies of Bouaké University Hospital (Côte d'Ivoire). RAMUR 2012 ; 17 : 81-7

**[10]** **Asse KV, Plo KJ, Yenan JP, Yeboua YK, Aka KA, Yao KC**. Malaria in infants aged 1 to 6 months: retrospective study of 50 cases collected in 2013 in Bouaké (Côte d'Ivoire). J Pediatr Pueric 2015 ; 28 : 1–6

**[11]** **Gras-Le Guen C, Hubert G, Feildel C, Danjou L, Dupont M, Launay E**. Decision trees commented by pediatric societies. Fever before 3 months. Available on : URL : https://pap-pediatrie.fr/immuno-infectio-parasito/fievre-avant-3-mois. Accessed on 10/27/2019

**[12]** **Novignon J, Nonvignon J**. Socioeconomic status and the prevalence of fever in children under age five : evidence from four sub-Saharan African countries. MC Res Notes 2012 ; 5 : 380

**[13]** **UNICEF**. Basic education and gender equality. Girls' education. Available at URL: https://www.unicef.org/french/education/ bege_61718.html. Accessed on 20/03/2020

**[14]** **Vauloup-Fellous C**. Viral infections in newborns. Revue Francophone des Laboratoires 2018 ; 500 : 48-54

**[15]** **Aujard Y**. Neonatal Viral Infections. EMC-Pédiatrie 2013 ; 8(1) :1-9 [Article 4-002-R-91]. Doi : 10.1016/S1637-5017(12)55760-1

**[16]** **Simonsen KA, Anderson-Berry AL, Delair SF, Davies HD**. Early-onset neonatal sepsis. Clin Microbiol Rev 2014 ; 27 : 21-47

**[17]** **Stoll BJ, Hansen NI, Sanchez PJ, Faix RG, Poindexter BB, Van Meurs KP et. al**. Early onset neonatal sepsis: the burden of group B streptococcal and E. coli disease continues. Pediatrics 2011 ; 127 : 817-26

**[18]** **Couto RC, Carvalho EAA, Pedrosa TMG, Pedroso ER, Neto MC, Biscione FM**. A 10-year prospective surveillance of nosocomial infections in neonatal intensive care units. Am J Infect Control 2007 ; 35 :183-9

**[19] Talbert AW, Mwaniki M, Mwarumba S, Newton CR, Berkley JA**. Invasive bacterial infections in neonates and young infants born outside hospital admitted to a rural hospital in Kenya. Pediatr Infect Dis J 2010;29 : 945-9

**[20] Bentlin MR, Rugolo LM, Ferrari LS.** Practices related to late-onset sepsis in very low-birth weight preterm infants. J Pediatr 2015; 91: 168–74

**[21] Sinha S, Miall L, Jardine L.** Essential neonatal Medecine. 6e edition. Middlesbrough, UK: John Wiley & Sons Inc; 2018

**[22] OMS**. Malaria. Report 2018. Available at : URL: https://www.who.int/fr/news-room/fact-sheets/detail/malaria. Accessed on 11/04/2020

**[23] Assé KV, Yao KC, Avi C, Aka KA, Yenan JP, Yeboua KR et. *al***. Congenital malaria in Bouaké (Côte d'Ivoire): results of a prospective study on 28 cases. J Afr Pediatr Genet Med 2017 ; 1 : 19-24

**[24] Bilal JA, Malik EE, Al-Nafeesah A, Adam I.** Global prevalence of congenital malaria: a systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol* 2020;252: 534-42

**[25] Kurtis JD, Raj DK, Michelow IC, Park S, Nixon CE, McDonald EA et. *al***. Maternally derived antibodies to Schizont Egress Antigen-1 and protection of infants from severe malaria. Clin Infect Dis 2019;68:1718-24

**[26] Moormann AM**. How might infant and paediatric immune responses influence malaria vaccine efficacy? Mal J 2009; 31 : 547-59

**[27] Milstone AM, Voskertchian A, Koontz DW, Khamash DF, Ross T, Aucott SW et. *al***. Effect of Treating Parents Colonized With Staphylococcus aureus on Transmission to Neonates in the Intensive Care Unit: A Randomized Clinical Trial. JAMA 2020;323:319-28

**[28] Zachariah P, Saiman L**. Decreasing Staphylococcus aureus in the Neonatal Intensive Care Unit by Decolonizing Parents. JAMA 2020 ; 323:313-4

**[29] Sharon E**. Diagnosis and management of pneumonia in infants and children. Continuing Medical Education Publishing. Disponible sur : URL: https://www.reliasmedia.com/articles/51510-diagnosis-and-management-of-pneumonia-in-infants-and-children. Consulté le 12/04/2020

**[30] Mbonye MK, Burnett SM, Naikoba S, Colebunders R, Wouters K, Weaver MR et. *al***. Malaria Care in Infants Aged under Six Months in Uganda : An Area of Unmet Needs! PLoS One 2015 ; 10 : e0123283

**[31] Elliott EJ**. Acute gastroenteritis in children. BMJ 2007 ; 334 : 35–40

**[32] DCPEVCI**. Activity report of the Expanded Program on Immunization 2017 coordination directorate. EN03-M01; 1: 53

**[33] Mwaniki MK, Talbert AW, Njuguna P, English M, Were E, Lowe BS et. *al***. Clinical indicators of bacterial meningitis among neonates and young infants in rural Kenya. BMC Infectious Diseases 2011; 11:301

**[34] Zaidi AKM, Thaver D, Ali SA, Khan TA**. Pathogens Associated with Sepsis in Newborns and Young Infants in Developing Countries. Pediatr Infect Dis J 2009 ; 28 : S10–S18

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