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Epidemiology of Meningitis in Infants and Children in the Pediatric Hospitals, Kenitra (Morocco), 2018–2021

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ABSTRACT

Background: Meningitis is a public health medical emergency. It is a health problem in Morocco. **Aim:** This study was to determine the epidemiological, cytochemical, and bacteriological profile of this disease and the lethality by type of meningitis in patient children in the Northwest region of Morocco. **Methods:** The present investigation is a cross-epidemiological, cytochemical, and bacteriological study of meningitis. The target population was cases of all forms of meningitis recorded in children under the age of 15 hospitalized in the pediatric department of Al Idrissi Hospital during the period (2018–2021). Data were collected from meningitis declaration forms. **Results:** About 100 cases were included in the study, with an average cumulative incidence of all forms of meningitis during the study period of 24.34 per 100,000 children living in the province of Kenitra. There was a male predominance in all types of meningitis, with 68% males in total. In addition, (22%) infants aged <1 year. Fevers, neck stiffness, purpura, and photophobia were significantly associated with meningitis in infants (1 to 15 years) (p<0.05). The febrile meningeal syndrome was observed in 57% of cerebrospinal fluid (CSF) and was cloudy in 50.5% of cases. The median leukocyte count was 280 mm3. Mean glycorachia was 0.47 g/l (±0.23 g/l) and mean proteinorachia was 1.23 g/l (±1.35 g/l). Bacterial meningitis was the most common type of meningitis observed, followed by the occurrence of lymphocytic meningitis and confirmed meningococcal disease. Overall, an 11% mortality rate was found. **Conclusion:** Meningitis is a real health problem in the area of Kenitra, particularly in children, requiring the effective involvement of all health personnel and the community in control actions, the allocation of necessary resources, and regular monitoring of the measures taken.

Keywords: Cerebrospinal Fluid; Epidemiology; Lethality and Morocco; Meningitis

INTRODUCTION

Meningitis is an inflammation of the cerebral envelopes leading to cerebrospinal fluid (CSF) abnormalities (Sthal, 2013). Indeed, meningitis is a terrible disease. It comes on suddenly, strikes all ages, especially infants, children, and young people, and can kill within hours. In addition, a significant number of survivors of this disease have significant permanent sequelae such as deafness, epilepsy, cerebral palsy, or mental retardation. It is most often caused by a bacterial, viral, or fungal infection (WHO, 2021; Barichello *et al.*, 2023). Indeed, meningitis is a terrible disease. It suddenly strikes all ages, especially infants, children, and young people, and can kill within hours. It is crucial to give particular focus to conducting laboratory analyses for the identification of viral pathogens and serotyping. This is essential for accurately assessing the actual infection rates in various geographical areas and for implementing the necessary public health interventions (Yerdessov *et al.*, 2023). In addition, many survivors of this disease retain permanent sequelae such as deafness, epilepsy, cerebral palsy, or mental retardation. A bacterial, viral, or fungal infection (WHO, 2021) most often causes it. Bacterial meningitis is severe because it progresses rapidly and is associated with a high mortality risk. Their etiology varies with age and geography. Infrequent bowel movements and difficulty

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passing stool, along with neurological issues and common waterborne infections like diarrhoea, polio, and meningitis, are associated with the waterborne pathogen H. alvei, with the gastrointestinal tract being the main portal of entry for bacteremia and subsequent meningitis (Nayak *et al.*, 2018; Hossain, Ali, & Islam, 2021). The fatality rate depends on age and the bacterium in question, typically ranging from 3% to 19% in developed countries (Ministry of Health, Morocco, 2010). In Morocco, meningitis, especially meningococcal, is a severe public health problem. They usually occur in an endemic-sporadic mode, with the emergence of epidemic foci of meningitis in meningococcal disease and viral meningitis. Morocco in 2020 records that the number of recorded cases of all forms of meningitis (MTFC) was 433 cases, representing the third of the annual average of 1217. The distribution of cases by age group shows that 57% of patients were less than 15 years old, i.e., almost the exact distribution in the last ten years. This lethality is exceptionally high among the most vulnerable groups, including children less than five years of age, in whom acute meningitis was responsible for 11.79% in the Tangier Tetouan Al-Hoceima region between 2006 and 2015 and 19.2% of children admitted to the children's hospital in Rabat between 2009 and 2013 (Merabet, Aouragh & Idrissi, 2018). It is useful to carry out this work to describe the epidemiological, cytochemical, and bacteriological profile of this disease and the lethality by type of meningitis in patient children in the North-West region of Morocco.

METHODOLOGY

Participants

A cross-sectional study was conducted in the pediatric department of El Idrissi Hospital, Morocco, during the period 2018–2021, among children under 15 years.

Study Location: The selected pediatric department of El Idrissi hospital with the coordination of the Monitoring, Health Security, and Environmental Health Unit at the delegation of health and social protection of the area of Kenitra as the place of study, which is responsible for providing continuous epidemiological surveillance of diseases of the population of the province.

Study population Patient charts from the age of one month to 15 years admitted in the pediatric department of El Idrissi Hospital during the period 2018–2021 due to meningitis were used to collect the data.

In the presence of signs of meningeal syndrome (headaches, stiff neck, nausea, etc.), the nurse must adopt very specific behavior to prevent any vital risk and help the doctor carry out the examinations. One of the complementary examinations is the lumbar puncture.

Inclusion Criteria: All records of children under the age of 15 who reside in the province of Kenitra and were hospitalized for meningitis in the pediatric department of El Idrissi Hospital.

Exclusion Criteria: Excluded from this study are all children not residing in the province of Kenitra and any child over the age of 15 years. Neonatal meningitis, tuberculous meningitis, post-operative and post-traumatic meningitis, meningitis complicating an anomaly of closure of the neural tube, and nosocomial meningitis were excluded from the study.

Data Collection

For each patient, a sheet grouping socio-demographic data was established (age, sex, month of admission), clinical parameters (fever, state of consciousness), paraclinical (CSF cytology and chemistry), and evolutionary (duration before hospitalization, complications) collected from investigation sheets.

Data Analysis

The completed questionnaires were checked exhaustively and were numbered and classified. The questionnaires have been codified. Their counting, coding, entry, and clearance were carried out on a computer using SPSS software (version 20).

Ethical Consideration

The study was approved by the Delegate of Health and Social Protection in the province of Kenitra with Ref No. 99/Health delegation/SRES/2017 on 25th December 2017.

RESULTS

One hundred cases were included in the study, with an average cumulative incidence of all forms of

meningitis during the study period of 24.34 per 100,000 children living in the province of Kenitra. The average cumulative incidence of meningitis of all forms combined in the area of Kenitra during the study period was 24.34 (100,000 children). The incidence has increased from 41.27 (100,000 children) in 2018 to 8.44 (100,000 children) in 2021. On the other hand, the average cumulative incidence of meningococcal meningitis is 15.32 (100,000 children) and fell from 27.51 in 2018 to 6.57 in 2021 (Fig. 1).

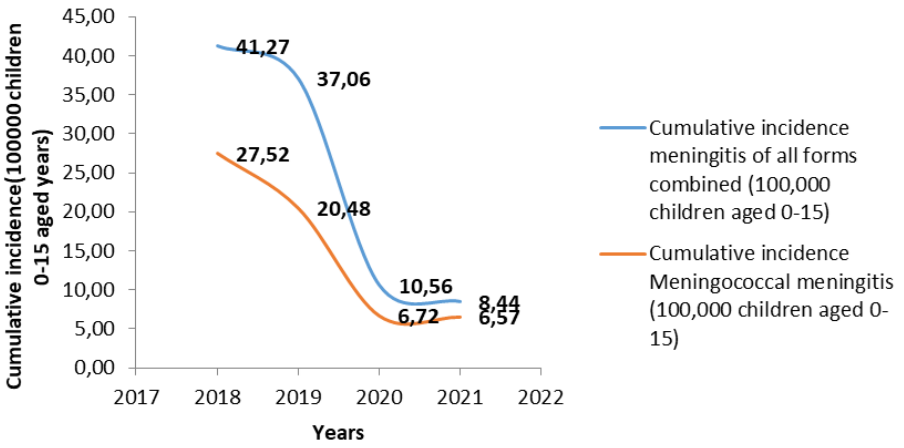

Figure 1: Evolution of the Incidence of Meningitis in Children Aged 0-15 Years in the Pediatric Department of El Idrisi Hospital Between 2018 and 2021 (per 100,000 Children)

The children were divided into two groups for analysis, as follows: < 1 year, 1 to 15 years. The majority of cases were in the age group of 1 month to 15 years, with 78/100 (78%). Of the total, 32 (32%) were female. The median age of the patients was 6.5 years, with extremes of 18 days and 15 years; the male sex (68%) was predominant compared to the female sex (n=100 cases), with a sex ratio of H/F = F=2.12. Approximately 58% (n=100) of cases were of urban origin. The seasonal distribution of cases of meningitis was characterized by a high frequency during the winter (29%) and summer (27%) (Table 1).

Table 1: Risk factors for Meningitis Patients Admitted to the Pediatric Department of El Idrissi Hospital During the Period 2018-2021(n=100)

Variables		**Frequency**	**Percent**
Age Group	1month -1year 1-15years	22 78	22% 78%
Gender	- Male -Female	68 32	68% 32%
Residence	-Urban -Rural	58 42	58% 42%
Season	-Autumn - Winter - Spring - Summer	25 29 19 27	25% 29% 19% 27%

According to age, the fontanel bulging was present only in 77.3% (n=22) of infants under one year of age, whereas headaches and the syndrome meningitis were observed only in children aged one year and over.

Clinical features also vary according to the age of the patient. Vomiting, neck stiffness, purpura, and photophobia were significantly associated with meningitis in children (1–15 years old) (p<0.05) (Table 2).

Table 2: Analysis of Symptoms among Two Age Groups

Variables	< 1 Year	1 to 15 Years	*P* value
Fever (n=100)	100%	98.7%	0.593
Vomiting (n=100)	68.2%	85.9%	0.056
Neck Stiffness(n=100)	31.8%	87.2%	0.000
Purpura (n=100)	13.6%	6 07.7%	0.389
Photophobia (n=100)	4.5%	42.3%	0.000
Headache (n=78)	-	91%	-
Typical Febrile Meningeal Syndrome(n=78)	-	57%	0.000
Bulging of the Fontanel (n=22)	77.3%	-	-
Convulsions (n=100)	22.7%	9.0%	0.079
Alteration of Conscience (n=100)	13.6%	15.4%	0.839
Coma(n=100)	0%	2.6%	0.448

A lumbar puncture was performed for 97%. The macroscopic observation of the CSF revealed a predominance of the cloudy appearance in 50.5% of the cases, followed by the clear and hematic appearance in 40.2% and 9.3% of the cases. The median CSF leukocyte count was 280. Mean glycorachia was 0.47 g/l (±0.23 g/l), and mean proteinorachia was 1.23 g/l (±1.35 g/l) (table 3).

Table 3: Biochemical Parameters in Different Types of Meningitis

Biochemical Parameters	Range Min-Max	Mean	Standard Deviation
WBC (cells/ mm3)	(2.00-16000.00)	1371.51	±2836.82
Neutrophils (%)	(00-100)	55.68	±35.12
Lymphocytes (%)	(00-100)	44.32	±35.12
Glycorachiag/l	(0.10-1.14)	0.47	±0.23
Proteinorachia g/l	(0.10-5.00)	1.23	±1.10

The incidence of various types of meningitis detected in the study is summarized in Table 4. Bacterial meningitis was the most common type of meningitis observed, followed by the occurrence of lymphocytic meningitis. Fewer cases of meningococcal disease and other types of meningitis were observed (Table 4).

Table 4: Categorization of Meningitis in All Patients

	Lymphocytic Meningitis Number %	Bacterial Meningitis Number %	Confirmed Meningococcal Disease Number %	Meningococcal Meningitis Number %	Pneumococcal Meningitis Number %
Number of Patients	33(33.0%)	43(43.0%)	13(13.0%)	7(7.0%)	4(4.0%)

The mean time between the onset of illness and admission was 3.77±3.62 days. Management is done upon suspicion of a case of meningitis at the level of the pediatric service. The average fatality rate during the study

period was 11%; in fact, this rate fell from 14.29% in 2018 to 11.11% in 2020. (fig 2)

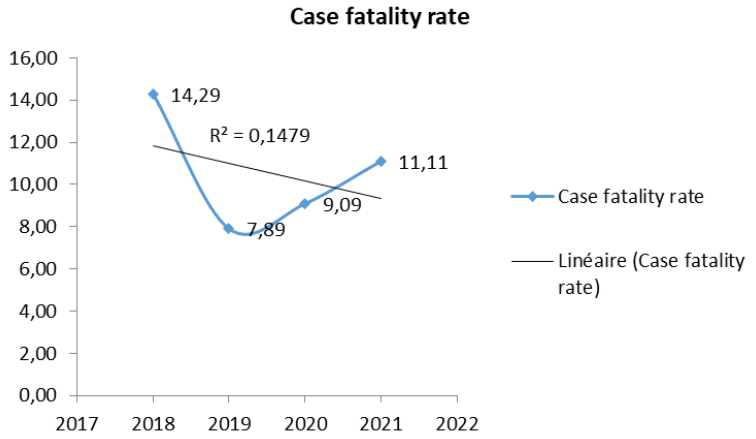

Figure 2: Evolution of the Meningitis Case Fatality Rate in the Province of Kenitra Between 2018 and 2021.

Table 5: Lethality by Type of Meningitis Between 2018 and 2021

Outcome	Number	%	Type of Meningitis					Khi-2	*P*
			LYM Number %	MBP Number %	MMC Number%	MMP Number %	PM Number %		
Death	11	11.0	00 (00.0%)	06 (13.9%)	01 (08.4%)	03 (42.8%)	01 (25%)		
Cure	89	89.0	33 (100%)	37(86.1%)	12 (92.6%)	04 (57.2%)	03 (75%)	12.664	**0.013**

On the other hand, the highest lethality rate is recorded for probable meningococcal meningitis (42.8%), followed by pneumococcal meningitis (25%), while for lymphocytic meningitis, 0% (0 deaths) were recorded (Table 5). $P< 0.05$ significantly level; LYM, lymphocytic meningitis; MBP, probable bacterial meningitis; MMC, confirmed meningococcal disease; MMP, meningococcal meningitis; PM, pneumococcal meningitis; BM, bacterial meningitis; VM, viral meningitis.

DISCUSSION

Between 2018 and 2021, one hundred cases of meningitis in children aged 1 month–15 years were declared by the pediatric department of El Idrissi Hospital under the area of Kenitra; these meningitis were dominated by bacterial origin (43%); although most meningitis is due to viruses, according to the literature, indeed viral meningitis, most often benign and bacterial, is more dangerous and must be treated urgently (Mijovic & Sadarangani, 2019).

In this study, meningitis was common between 1 month and 15 years of age. This was 78% and was higher in males (68%) than females. The comparison of the incidence of meningitis in children aged 1–15 years in the area of Kenitra remains very difficult given the absence of other similar studies in Morocco. Besides, it was found that meningitis is seen all year round, with a predominance in summer and winter. But this seasonal variation depended on the germs in question (virus, bacteria). This may be due to the fact that most patients (29%) were admitted in the winter season. A similar study conducted in Khartoum, Sudan by Abdelrahim, Fadl-Elmula & Ali (2019) indicated that most meningitis patients were admitted in the spring season.

In the study, the incidence of meningitis decreased during the study period 2018–2021, and it went from 41.27 per 100,000 children in 2018 to 08.44 per 100,000 children. This sudden decrease can only be explained by the impact of the COVID epidemic on the behavior of Moroccans. Indeed, the preventive measures to reduce the risk of contamination (confinement, distance learning) have also reduced the incidence of meningitis.

In the study, there was a prevalence of male subjects (68 %, in the study. On the contrary, Águeda, Campos & Maia (2013) reported that the majority of their study subjects were females, 60.3% . This discrepancy might be owing to the different regions in which these studies were conducted, as Águeda, Campos & Maia (2013) performed their study in Portugal. The incidence of lymphocytic and bacterial meningitis is 33% and 43%, respectively. The study revealed a low coverage of children by the anti-meningococcal vaccine, which did not exceed 1%. This is explained by the fact that the said vaccine is not part of the national immunization program; this is consistent with the work by Merabet, Aouragh & Idrissi (2018) in children under 5 in the Tangier-Tetouan-Al Hoceima region (Morocco) from 2006–2015, which was 5.75% Merabet, Aouragh & Idrissi (2018). For 33% of cases, antibiotic therapy in the ten days preceding hospitalization was reported; this is consistent with several studies, including that of Amrani & Barkia (2016), which was 24.26%. Fevers, neck stiffness, purpura, and photophobia were significantly associated with meningitis in infants (1–15 years) ($p < 0.05$). The febrile meningeal syndrome was observed in 57% of cerebrospinal fluid (CSF) and was cloudy in 50.5% of cases. The median leukocyte count was 280 mm3. Mean glycorachia was 0.47 g/l (±0.23 g/l) and mean proteinorachia was 1.23 g/l (±1.35 g/l). Fever was the dominant clinical sign in the children of the study, which has always been reported in several studies, notably those of El Azher, Bourrous & Bouskraoui, 2014; Kane *et al*. (2020).

In the study, bacterial meningitis was the most common type of meningitis observed, followed by the occurrence of lymphocytic meningitis and confirmed meningococcal disease.

For children under one year, the meningitis confirmation rate was low (22%). This weakness observed in the study was the consequence of the non-systematic practice of confirmation examinations (culture, soluble antigens, blood culture), but above all of a dominant negativity of the results, which raises questions about the quality of these examinations and the conditions in which they were carried out. The confirmation problem has a negative impact on the quality of care, makes it difficult and sometimes unreliable to classify cases, and poses many problems for the response. In comparison with the studies conducted at the national level, the confirmation rate in the study was much higher than the series of the province of Larache (9.2%), almost similar to that of the area of Ouezzane (18.2%), and lower, respectively, to the areas of Al Hoceima, Tetouan, Chefchaouen (29.9%), Tangier Assilah, Fahs-Anjra (31.2%), and M'diqFnideq (68.8%) (Merabet, Aouragh & Idrissi , 2018) . The mortality rate remains variable from one year to another, according to the age group and according to the pathogen, with an average of 11% during the period of the study, and remains difficult to compare with other studies, among other things, due to differences in the populations under study (age groups studied in particular) or the focus on a particular germ. However, this rate remains almost similar to the study by Merabet, Aouragh, & Idrissi (2018), which was 11.79% and lower than that of Amrani & Barkia (2016), which was 19.2% in children under 5 years. On the other hand, the study showed a significance between the mortality rate and the type of meningitis; indeed, the percentage of the mortality of the MMP remains the highest, at 42.8%. This agrees with the results of Loutfi *et al.* (2020), which was 31% for the same type of meningitis. Most of the deaths in the study occurred within the first days of hospitalization, reflecting the critical condition of the patients at admission.

CONCLUSION

Meningitis remains a public health problem in the context. Although viral meningitis is at the forefront, The frequency of bacterial meningitis remains twice as high in the pediatric department of El Idrissi Hospital. Better training of practitioners in the diagnosis of meningitis would make it possible to avoid inappropriate antibiotic therapies. Bacterial meningitis, in particular, MMPs remain a high lethality factor; a wider distribution of the meningococcal vaccine is desirable, as is rigorous epidemiological surveillance for evaluating vaccine strategies. Educating families to recognize the first signs of meningitis would improve the prognosis, allowing treatment in the first hours of the disease.

Conflict of Interest

The authors declare that they have no conflict of interests.

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Professional secrecy, anonymity, confidentiality relating to the identity of the participants, and the regulatory provisions in force have been respected. The administrative authorization relating to the collection and access to information was obtained from the Delegate of Health and Social Protection in the province of Kenitra.

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