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COVID-19 in children aged 0-15 years seen at Amirou Boubacar Diallo National Hospital in Niamey, Niger, 2020-2021

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Abstract:

Background: In 2020, the COVID-19 pandemic affected all age groups. Although COVID-19 is generally benign in children, a diagnostic problem may arise due to clinical similarities with certain pathologies such as malaria, dengue fever and influenza. The objective of this study is to describe the epidemiological profile of COVID 19 in children seen at consultation and to determine the prevalence of influenza, malaria and dengue fever as differential diagnoses.
Methodology: We conducted a prospective cohort analytical study from October 1, 2020 to February 28, 2021 in COVID-19 suspected children aged 0 to 15 years admitted to the pediatrics department at the hospital. We used EPI INFO 7.2.4. software for data entry and analysis. Frequencies and proportions were calculated.
Results: A total of 570 suspected cases of COVID-19 were enrolled. Of the suspected cases, 53.2% were males and 46.9% were females, with a M/F ratio of 1.13. The median age was 2 years (IQR: 1- 3 years), with age range of 0 to 15 years, and 68,8% in the age range 1 to 5 years. Exposure factors were travel (3.7%), contact with a suspected case of COVID-19 (1.0%), while only 2.6 % (15/570) of suspected cases were confirmed positive for COVID-19. The median age of COVID-19 confirmed children was 2.7 years (IQR 0.33-5). There were more male positive cases, with a M/F ratio of 2. Fever (100%) and cough (53.3%) were the predominant symptoms. The prevalence of malaria, Dengue fever and influenza among suspected COVID-19 cases were 16.8%, 0% and 54.7% respectively, while the respective prevalence in COVID-19 confirmed cases were 66.7%, 0% and 33.3%
Conclusion: COVID-19 should be investigated in children presenting with symptoms and signs of malaria, influenza or Dengue fever.

Keywords: COVID-19; malaria; Dengue; flu; children; Niger

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COVID-19 chez les enfants de 0 à 15 ans vus à l'Hôpital National Amirou Boubacar Diallo de Niamey, 2020-2021

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Résumé:

Contexte: en 2020, la pandémie de COVID-19 a touché toutes les tranches d'âge. Bien que le COVID-19 soit généralement bénin chez l'enfant, un problème de diagnostic peut surgir en raison de similitudes cliniques avec certaines pathologies comme le paludisme, la dengue et la grippe. L'objectif de cette étude est de décrire le profil

épidémiologique du COVID 19 chez les enfants vus en consultation et de déterminer la prévalence de la grippe, du paludisme et de la dengue comme diagnostics différentiels.
Méthodologie: Nous avons mené une étude prospective descriptive de cohorte du 1er octobre 2020 au 28 février 2021, chez des enfants suspects de COVID-19 âgés de 0 à 15 ans admis au service de pédiatrie de l'hôpital. Nous avons utilisé EPI INFO 7.2.4. Logiciel de saisie et d'analyse de données. Les fréquences et les proportions ont été calculées.
Résultats: Au total, 570 cas suspects de COVID-19 ont été recrutés. Parmi les cas suspects, 53,2% étaient des hommes et 46,9% des femmes, avec un ratio H/F de 1,13. L'âge médian était de 2 ans (IQR: 1-3 ans), avec une tranche d'âge de 0 à 15 ans, et 68,8% dans la tranche d'âge de 1 à 5 ans. Les facteurs d'exposition étaient les voyages (3,7%), le contact avec un cas suspect de COVID-19 (1,0%), tandis que seulement 2,6% (15/570) des cas suspects ont été confirmés positifs à la COVID-19. L'âge médian des enfants confirmés par le COVID-19 était de 2,7 ans (IQR 0,33-5). Il y a eu davantage de cas positifs chez les hommes, avec un ratio H/F de 2. La fièvre (100%) et la toux (53,3%) étaient les symptômes prédominants. La prévalence du paludisme, de la dengue et de la grippe parmi les cas suspects de COVID-19 était respectivement de 16,8%, 0% et 54,7%, tandis que la prévalence respective des cas confirmés de COVID-19 était de 66,7%, 0% et 33,3%.
Conclusion: Le COVID-19 doit être recherché chez les enfants présentant des symptômes et des signes de paludisme, de grippe ou de Dengue.

Mots-clés: COVID-19; paludisme; Dengue; grippe; enfants; Niger

Introduction:

On January 9, 2020, the discovery of a new coronavirus, severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), that causes coronavirus disease-2019 (COVID-19) was officially announced by the Chinese health authorities and the World Health Organization (1). By mid-November 2022, COVID-19 had caused over 660 million cases and 6.6 million deaths worldwide (2). Current data show that children affected by SARS-CoV-2 generally belong to clustered familial cases (3). Infected children may appear asymptomatic or present with mild symptoms such as cough, fever and nasal congestion. In addition, gastrointestinal symptoms such as diarrhea, nausea, vomiting and abdominal discomfort are more frequent in children than in adults (3,4). Infected children accounted for 2.0% of COVID-19 cases diagnosed in China, 1.2% of cases in Italy and 1.7% of cases in the USA (3). Unlike the majority of respiratory viruses, children appear less susceptible to SARS-CoV-2 and generally develop a mild form, with low mortality (5). The reported mortality rate among severely ill children was 2.0% (6).

Africa was largely spared of COVID-19 compared to China, US and Europe (7), and it accounted for about 4.0% of all cases reported worldwide in 2020 (8). In tropical countries however, there are concerns about the similarities of COVID-19 with other infectious diseases, due to the same chief complaint of fever. The differential diagnosis must be sufficiently broad and always include COVID-19 when a person presents to the emergency department with a chief complaint of fever. COVID-19 is difficult to distinguish from malaria, influenza and dengue fever, as they share similar clinical features in addition to fever, headache, cough, myalgias, and gastrointestinal disturbances such as diarrhea, vomiting, nausea, and abdominal pain (9-11).

In Niger, the first wave of the COVID-19 epidemic began in March 2020, and as of August 9, 2020, the prevalence of confirmed cases in the under-16 age group was 4.7%, with a case-fatality rate of 0.01% (12). Children are a source of contamination that can exacerbate the spread of the disease (13). Niger, like other African countries, was not sufficiently prepared to contain an epidemic of COVID-19, and no paediatric studies exist. The aim of this study is to describe the epidemiology of COVID-19 in children seen at our hospital, Amirou Boubacar Diallo National Hospital, Niamey, and to investigate differential diagnoses in order to contribute to a better understanding of the disease in Niger.

Materials and method:

Study design and period:

This was a prospective cohort analytical study of COVID-19 suspected children aged 0-15 years conducted from October 1, 2020 to February 28, 2021 in the pediatrics department of Amirou Boubacar Diallo National Hospital in Niamey, Niger.

Study participants, inclusion and exclusion criteria:

The study participants were sick children admitted to the hospital pediatric ward during the study period. The inclusion criteria were; (i) all children with fever or any notion of fever and at least one of the following signs; mainly dry cough (then wet cough) and fatigue, angina, nasal congestion and gastrointestinal symptoms including nausea, vomiting, abdominal pain and diarrhea; and (ii) children whose parents have given their free and informed consent to participate in the study. Children who did not meet the case definition and/or whose parents did not give their consent were excluded. The sample size included all suspected cases of COVID-19 during the study period.

Ethical approval:

The study protocol was approved by National Ethics Committee of Niger (N°069/

2020/CNERS). Written informed consent was obtained from the parents/legal guardians of the children for publication. All procedures were compatible with the declaration of Helsinki.

Laboratory analysis of samples:

Two samples were taken for all children included in the study, including nasopharyngeal swab and blood sample of approximately 1 to 2 ml into a dry specimen bottle. SARS-CoV2, influenza and dengue viral RNA were detected in the samples by real-time RT-PCR using specific primers and probes. IgM and IgG serology for SARS-CoV2 was also carried out using a commercial kit from SD Biosensor "Standard Q COVID-19 IgM/IgG Duo" which presents acceptable sensitivity and specificity performances. Malaria parasite was detected in children using thin blood smear and thick film techniques at the Amirou Boubacar Diallo National Hospital laboratory.

Data collection:

Questionnaires were interviewer-administered to collect information from the caregivers of the children at the hospital, which include socio-demographic characteristics of the children (age, sex, origin, nutritional status, mode of admission, sorting, travel history, antecedents), socio-demographic factors of parents (education level, socio-economic status), clinical features of children (signs and symptoms, diagnosis) and biological variables of children (results of COVID-19, influenza and Dengue PCR, malaria blood smear microscopy and C-reactive protein).

Data analysis:

Data were analysed using EPI INFO 7.2.4. Frequencies, proportions, median and inter-quantile range (IQR) of variables were calculated and presented in the form of tables and graphs. Association of dependent variables (COVID-19 status) with independent variables (sociodemographic, clinical and biological) was determined using Pearson Chi square, with calculations of Odds ratio (and 95% confidence interval), and p value < 0.05 was considered to be statistically significant value.

Results:

Socio-demographic and clinical characteristics of COVID-19 children and their parents:

A total of 570 COVID-19 suspected cases were enrolled in the study. Of these cases, 53.2% were males and 46.9% were females, with a M/F ratio of 1.13. The median age was 2 years (IQR: 1-3 years), age range of 0 to 15 years, with 1-5 years age group being the most represented at 68.8%. Most of the children (96.8%) lived in urban areas. Exposure factors were mainly travel by the suspected case (3.7%) and contact with a suspected or probable case of COVID-19 (1.0%). Less than a quarter (18.0%) of the children were malnourished, and 4.2% had a medical history (Table 1).

Children with suspected COVID-19 were admitted directly to the pediatric ward without referral in 87.5% of cases. About 60% of cases were classified as a priority state for systematic triage for all pathologies combined on admission. The average duration between onset of illness and admission was 3.37 ± 2.74 days. The course of the disease was marked by a hospital stay of 1.23 ± 2.90 days, with a case-fatality rate of 0.9% (Table 1). Fever was one of the inclusion criteria and was present in all (100.0%) the recruited children. The most common symptoms and signs aside this, were cough (54.4%), gastrointestinal disorders such as vomiting, diarrhoea and abdominal pain (44.5%), nasal congestion (23.7%) and angina (20.9%) (Table 2).

The age of the parents is marked by the predominance of 25-34 years age group for mothers (49.0%) and 35-44 for fathers (43.5%). The level of education is low among both fathers and mothers, with 30.5% and 29.5% respectively having received no education, compared to 22.0% and 17.2% with a higher education level. Socio-economic status is generally low among families, with 54.2% in low socio-economic group.

Characteristics of the children with confirmed COVID-19:

Of the 570 samples tested, only 2.6 % (n=15) were confirmed positive for COVID-19. The median age of confirmed children was 2.70 years (IQR: 0.33-5), with more males (67.0%, 10/15) than females (33.0%, 5/15), and M/F ratio of 2. However, the prevalence of COVID-19 in the males (3.3%, 10/303) compared to the females (1.9%, 5/267) among the study participants was not significantly different (OR=1.79, 95% CI=0.603-5.30, p= 0.310) (Table 3).

Majority of COVID-19-positive children were in the 1-5 age group (86.7%) and mostly from urban areas (86.7%). In confirmed cases, dry cough was present in 53.3%, nasal congestion, angina and vomiting were reported in 26.7% of cases each, and headache and abdominal pain occurred in 6.7% and 13.3% of cases respectively (Table 2).

Table 1: Socio-demographic and clinical characteristics of children with suspected COVID-19

Characteristics	Number	Percentage
Age group (years)		
< 1	133	23.3
1 - 5	392	68.8
6 - 11	30	5.3
11 - 15	15	2.6
Total	570	100.0
Median age (IQR) in years	2 (1-3)	
Gender		
Male	303	53.0
Female	267	47.0
Total	570	100.0
Residence		
Rural	24	4.2
Urban	546	95.8
Total	570	100.0
Malnutrition		
Yes	102	18.0
No	468	82.0
Total	570	100.0
Admission mode		
Referral	71	12.5
Direct	499	87.5
Total	570	100.0
Medical record		
Yes	155	27.0
No	415	73.0
Total	570	100.0
Triage sorting		
Priority	343	60.0
Ordinary	227	40.0
Total	570	100.0
Travel history (14 days in advance)		
Yes	21	3.7
No	549	96.7
Total	570	100.0
Visit to a healthcare facility		
Yes	82	14.5
No	488	85.5
Total	570	100.0
Participation in a mass event		
Yes	27	5.0
No	543	95.0
Total	560	100.0
Travel history in entourage 14 days prior		
Yes	8	1.5
No	562	98.5
Total	570	100.0
History of contact with a suspect case		
Yes	6	1.0
No	564	99.0
Total	570	100,0
Pathological history		
Yes	3	0.5
No	567	99.5
Total	570	100.0
Outcome of disease		
Survived	565	99.1
Deceased	5	0.9
Total	570	100.0
Time between BD* and admission (days)	3.37 ± 2.74	
Length of hospital stay (days)	1.23 ± 2.90	

*BD= Beginning of disease

Table 2: Clinical signs and symptoms in suspected and confirmed cases of COVID-19

Clinical signs and symptoms	COVID-19 PCR Result		Total (%)
	Negative (%)	Positive (%)	
Fever	555 (100.0)	15 (100.0)	570 (100.0)
Dry cough	278 (50.1)	8 (53.3)	286 (50.2)
Nasal congestion	131 (23.6)	4 (26.7)	135 (23.7)
Angina	115 (20.7)	4 (26.7)	119 (20.9)
Vomiting	112 (20.2)	4 (26.7)	116 (20.4)
Diarrhoea	75 (13.5)	4 (26.7)	79 (13.9)
Abdominal pain	51 (9.2)	2 (13.3)	53 (9.3)
Respiratory distress	25 (4.5)	0	25 (4.4)
Fatty cough	23 (4.1)	1 (6.7)	24 (4.2)
Head ache	21 (3.8)	1 (6.7)	22 (3.9)
Fatigue	11 (2.0)	0	11 (1.9)
Nausea	5 (0.9)	0	5 (0.9)
Arthralgia	4 (0.7)	0	4 (0.7)
Myalgia	2 (0.4)	0	2 (0.4)
Others	255 (45.9)	6 (40.0)	261 (45.8)
Total	**555 (97.4)**	**15 (2.6)**	**570 (100.0)**

Table 3: Bivariate analysis of characteristics of children with suspected and confirmed COVID-19

Characteristics	COVID-19 PCR Test		OR (95% CI)	*p* value
	Negative (%)	Positive (%)		
Gender				
Male (n=303)	293 (96.7)	10 (3.3)	1	
Female (n=267)	262 (98.1)	5 (1.9)	1.79 (0.603-5.30)	0.31
Total (n=570)	555 (97.4)	15 (2.6)		
Outcome of COVID-19				
Survived (n=565)	550 (97.3)	15 (2.7)	1	
Deceased (n=5)	5 (100.0)	0	3.23 (0.17-61.04)	1.000
Total (n=570)	555 (97.4)	15 (2.6)		

OR=Odds ratio; CI=Confidence interval; PCR=Polymerase chain reaction

No positive child was hospitalized or received specific treatment for COVID-19 and all were followed up at home. No death (0%) was reported in confirmed COVID-19 cases. The influenza PCR, dengue PCR and thick film microscopy tests were positive in 16.8% (96/570), 0% and 54.7% (312/570) of suspected COVID-19 cases respectively, whereas in confirmed COVID-19 cases, these tests were positive in 33.3% (5/15), 0% and 66.7% (10/15) cases respectively (Table 4).

Discussion:

In our study, the median age of children with suspected COVID-19 was 2 years (IQR: 1-3 years), with age range of 0 to 15 years. The 1-5 years age group was the most represented at 68.8% and most of the children (96.8%) lived in urban areas. This is comparable to a study in Guinea, where the 0-4 years age group was the most represented (38.6%), with age range of 0-16 years, with a median age of 7.19 years (which is higher than the median age in our study), and majority of the children (70.4%) in the study lived in urban center, Conakry (14). The predominance of children aged 0 to 5 years can be explained by their susceptibility to various infections and the free health care available to this age group in Niger (15).

Table 4: Bivariate analysis of biological characteristics of children with suspected and confirmed COVID-19

Biological characteristics	COVID-19 PCR Result		Total (%)	OR (95% CI)	*p* value
	Negative (%)	Positive (%)			
Influenza PCR test					
Positive	91 (16.4)	5 (33.3)	96 (16.8)	2.549 (0.851; 7.634)	0.084
Negative	464 (83.6)	10 (66.7)	474 (83.2)		
Total	555 (100.0)	15 (100.0)	570 (100.0)		
Thick blood film test for malaria					
Positive	302 (54.4)	10 (66.7)	312 (54.7)	1.675 (0.565; 4.966)	0.347
Negative	253 (45.6)	5 (33.3)	258 (45.3)		
Total	555 (100.0)	15 (100.0)	570 (100.0)		
CRP					
Positive	380 (70.0)	14 (93.3)	394 (70.6)	6.005 (0.789; 46.048)	0.037
Negative	163 (30.0)	1 (6.7)	164 (29.4)		
Total	543 (100.0)	15 (100.0)	558 (100.0)		
Dengue PCR test					
Positive	0	0	0	-	-
Negative	555 (100.0)	15 (100.0)	570 (100.0)		
Total	555 (100.0)	15 (100.0)	570 (100.0)		

OR=Odds ratio; CI=Confidence interval; PCR=Polymerase chain reaction

Exposure factors were travel by the suspected case (3.7%) and contact with a suspected or probable case of COVID-19 (1.0%). We found much higher figures in the literature, where 28.0% of children had a history of travel (16) and 68.0% had been in contact with confirmed infected adults (17). Children are often infected by their families, and at the very start of the epidemic, the notion of travel was a risk factor (3).

The level of education was low among both fathers and mothers, with 30.5% and 29.5% respectively having received no education at all. According to Camara et al., (14) 28.6% of mothers were merchants and 39.7% were contact persons, compared with 37.6% of fathers who were civil servants. In the literature, we found no link between the parents' intellectual and economic level and COVID-19 in children.

Among the suspected children, 2.6% were positive for COVID-19. Our result is similar to those of Farfan et al., (2) where COVID-19 PCR positivity of 3.2% and 2.5% were reported but higher than those of Tagarro et al., (18) who were 1.0% positive. In our study, COVID-19-positive children were mainly found in the 1-5 years age group (86.7%). In other studies, children aged 1-5 years (25.2%) and 6-10 years (33.9%) were the most predominant (19,20). The median age of infected children was 2.70 years (IQR: 0.33-5). Median ages ranging from 3-12 years were reported in some studies (17-20).

There were more males (67.0%, 10/15) than females (33.3%, 5/15) COVID-19 positive cases, with male to female ratio of 2 in our study, and prevalence of 3.3% (10/303) for males and 1.9% (5/267) for females among the study participants, albeit, the prevalence difference was not statistically significant (OR=1.79, 95% CI=0.603-5.3, p=0.31). Nevertheless, male predominance has been reported in the literature (17,19,21-24). In Niger, girls, unlike boys, tend to be kept at home, which exposes the boys more to the disease.

In the COVID-19 positive cases, all (100.0%) the children selected had fever, and dry cough was found in 53.3% of cases, which were the most predominant symptoms. Our results are in line with the findings of other studies (22,25-28). Thick blood film test for malaria in COVID-19 confirmed cases were positive in 66.7% (10/15). Malaria and COVID-19 are strikingly similar in their symptoms (29). People living in malaria-endemic areas who are infected with SARS-CoV-2 may be at increased risk of severe COVID-19 or adverse disease outcomes if they are unaware of their malaria status (30). Results from literatures show malaria seroprevalence ranging from 3.1% to 40% (2,24,30,31).

SARS-CoV-2 and alpha influenza virus are RNA viruses that cause COVID-19 and influenza respectively. Both viruses present similar symptoms and use surface proteins to infect the host (32). We found influenza in

33.3% (5/15) of confirmed COVID-19 cases in our study compared to influenza in 5.0% of COVID-19 confirmed children in the study by Tagarro et al., (18). Overlapping clinical and pathological similarities can lead to missing cases, which in turn can be fatal (33). In our study, we found no co-infection between COVID-19 and Dengue fever. However, co-infection of Dengue and COVID-19 has been reported in some studies and is associated with significant morbidity and mortality (34,35).

Treatment is marked by the absence of specific anti-COVID-19 therapy, but in our study, no COVID-19 positive children were hospitalized and no deaths were reported in the COVID-19 confirmed cases. Other studies (18,24) agree with the findings of our study.

Conclusion:

Our study highlights the need to strengthen the capacity of African health centers, particularly those in Niger, to manage moderate to severe paediatric cases of COVID-19. We noted that many cases of COVID-19 escape surveillance because the similarity of their symptoms and signs to malaria, influenza and Dengue fever can lead to confusion in endemic areas. Health care providers need to redouble their efforts to diagnose and manage co-infected individuals rapidly, in order to prevent serious consequences.

Conflicts of interest:

Authors declare no conflict of interest

Contributions of authors:

HIA developed the study protocol and was involved in data collection, processing and analysis, manuscript preparation, and proofreading; SA was involved in data collection; AO and MMY were involved in data processing, analysis and manuscript revision; OBT, SM and MG were involved in manuscript revision; and BD was involved in manuscript proofreading. All authors reviewed and approved the final version of the manuscript.

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