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Research Article

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Factors Associated with the Occurrence of the Measles Epidemic in the Garoua Health District

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Abstract

This study aimed to seek the factors associated with the occurrence of the epidemic of measles in the Garoua health district 1. A mixed retrospective study on 163 households with children aged between 9 and 23 months reside in the health area from Bangli for at least 6 months. The data has been collected by survey by structured questionnaires. These factors were evaluated and analyzed by SPSS software which made it possible to establish the relationships between the various factors. A total of 163 households interviewed on the socio-demographic characteristic, general knowledge about measles, of the vaccination calendar of their children and the 32 children having contracted measles during the period of the epidemic. Of the 163 responding households, the geographical distribution shows that the participants come mainly from the villages of Ouro Ardo (40.1 %) and Nakong (33.5 %), while Bangli (25.7 %) and Garoua (0.6 %). On a professional level, 43.7 % of the participants are cultivating, which corresponds to the majority rural profile of the studied population (99.4 % lies in rural areas). The group of housewives also represents a significant part (49.9 %), while breeders (6 %) and civil servants (0.6 %) are under-represented. In terms of education level, the vast majority of participants (88 %) have only a primary level with a low proportion with a secondary level (5.4 %) or without formal education (6.6 %). There is a strong correlation between the level of education and the knowledge of measles.

- *90.9% without level of study,*
- *99.3% had the primary level*

The difference is statistically significant (Chi-Squared = 19.092, p Value <0.0001), highlighting the importance of education in the awareness of measles.

Of the 32 children contaminated by measles during the epidemic peak, children come from various localities, with a higher distribution in Laïdé Djoumo and Nakong (25.0% each). Other localities such as Guidjol Campment (18.8%) and Djabawa Peul (12.5%) also have significant cases. The concentration of cases in certain areas may suggest that geographic or community factors influence the propagation of measles. In addition, most children belong to the Bororo ethnic group (43.8%), followed by Fulani ethnic groups (15.6%) and Laka (15.6%). The data shows a predominance of children from Bororo communities, which could indicate cultural specificities or mobility influencing exposure to measles. Most children (65.6%) do not attend school. This fact may have implications for access to information on health and vaccination, as well as on the spread of measles within communities which are not regularly in contact with school structures.

In view of these results, the socio-environmental factors contributed to the host population exhibition by the ethnic group Bororo which are households and vectors of propagation of measles. If all the children in the host community were completely vaccinated, we will observe an inter -family contagion therefore within households only Bororo and Peul (shepherds). Their nomadic characteristic is a factor associated with the re -emergence of the measles epidemic in a stable community.

Introduction

Measles is a highly contagious and serious viral disease that is transmitted through the air and is caused by a virus that can lead to serious complications or even death [1]. It is caused by the measles virus, which belongs to the Morbillivirus genus, of the Paramyxovirus family. The virus is transmitted by direct contact and through the air, infecting the mucous membranes and then spreading throughout the body. Measles is a strictly human disease, with no animal reservoir. Although generally benign, measles can cause serious complications, such as encephalitis and pneumonia and can in rare cases be fatal, much more so in intertropical Africa [2].

Despite the availability of a vaccine, measles remains a public health problem in several countries. In April 2024, WHO reported that measles vaccination had prevented 57 million deaths between 2000 and 2022 [3]. Despite the availability of a safe and cost-effective vaccine, an estimated 136,000 measles deaths were expected worldwide in 2022, with most deaths occurring in children under 5 years of age who were unvaccinated or under-vaccinated against measles.

According to the European Centre for Disease Prevention and Control, the epidemiology of measles was most dramatic between 2018 and 2019, with exponential increases observed in Africa (835%), the Western Pacific (122%), the Americas (30%) and Europe (18%) [4]. Three countries were particularly affected during this period: The Democratic Republic of the Congo with 311,471 cases and 6,045 deaths, Madagascar with 125,725 cases and 818 deaths and Ukraine with 57,282 cases and 20 deaths. Africa continues to bear the heavy burden of measles, despite the fact that the overall coverage of the combined first dose of Measles-Rubella vaccination has plateaued at about 80% [5].

In Cameroon, measles is one of these diseases with significant repercussions on the population and continues to resurface in all regions of the country. In 2023, the Cameroon epidemiological bulletin reported that 69 Health Districts entered a measles epidemic [6]. At the 52nd epidemiological week, 6775 suspected cases of measles were reported throughout the territory (6); 6084 (89.80%) cases are confirmed, i.e. 499 by the laboratory (IgM+), 5531 by epidemiological link and 54 are clinically compatible cases. In view of the pattern presented by the spread of this disease, it would be likely that its re-emergence is associated with a coincidence of several factors which concomitantly contribute to the realization of this event.

Methodology

The study was conducted in the Garoua 1 Health District, specifically in the Bangli Health Area. It is a Health Area that covers four health facilities, namely the Bangli CSI, the Nakong CSI, the Ouro-Ardo CSI, and the Tcharatché CSI. The study population was that of the Bangli Health Area and the target is children aged 9 to 23 months, children who contracted measles during the epidemic period and their parents. The study was mixed and we used SPSS software to analyze the quantitative data. The qualitative data were transcribed on paper for interpretation. We had obtained ethical clearance before conducting this study and it took place from July to September 2024.

Results

The quantitative survey was conducted in households, the respondents were the parents of children aged 9 to 23 months.

A-Demographic and Social Characteristics of the Respondents

The analysis of the demographic and socio-economic characteristics of the sample reveals several important observations. The gender distribution shows a slight female predominance with 51.5% of participants being female, while 48.5% are male, indicating some parity in the sample composition. Regarding age groups, the majority of participants (71.2%) are between 18 and 39 years old, with a relatively equal distribution between 18-29-year olds (35.3%) and 30-39-year olds (35.9%), suggesting a predominantly young population. Only 3% of participants are over 50 years old, reflecting a low representation of older people. The geographical distribution shows that participants come mainly from the villages of Ouro Ardo (40.1%) and Nakong (33.5%), while Bangli (25.7%) and Garoua (0.6%) are less represented. This geographical distribution could influence the results depending on the local specificities of each village.

In terms of occupation, 43.7% of the participants are farmers, which corresponds to the majority rural profile of the population studied (99.4% live in rural areas). The group of housewives also represents a significant share (49.9%), while livestock farmers (6%) and civil servants (0.6%) are underrepresented. In terms of education level, the vast majority of participants (88%) have only a niveau primaire, avec une faible proportion ayant un niveau secondaire (5.4 %) ou sans éducation formelle (6.6 %).

Concernant le statut matrimonial, une vaste majorité des participants (95.8 %) sont mariés, ce qui indique une population stable sur le plan familial. Sur le plan religieux, les musulmans constituent le groupe majoritaire (48.5 %), suivis des catholiques (29.3 %) and Protestants (22.2%), reflecting significant religious diversity.

In terms of ethnicity, the Peuls form the dominant group with 43.7% of participants, followed by the Laka (26.3%), Moundan (15%), and Daba (10.2%), while the Toupouri are poorly represented (4.8%).

The majority of participants (89.8%) have lived in their area for more than 5 years, suggesting a strong rooting in their rural environment. Regarding the number of children under 9 years old in the household, 41.9% of households have three children, and 23.4% have four, indicating a prevalence of large families, typical of rural areas.

Table 1: Socio-Demographic Characteristics of Respondents (n=167)

Characteristics	Frequency (n)
Sex	
Female	86

Male	81
Total	167
Age groups	
Under 18	19
Between 18 and 29	59
Between 30-39	60
Between 40-49	24
Over 50	5
Total	167
Village	
Bangli	43
Garoua	1
Nakong	56
Ouro ardo	67
Total	167
Occupation	
Farmer	73
Breeder	10
Civil Servant	1
Housewife	83
Total	167
Level of education	
No level of education	11
Primary	147
Secondary	9
Total	167
Marital status	
Single	6
Cohabiting	1
Married	160
Total	167
Religion	
Catholic	49
Muslim	81
Protestant	37
Total	167
Ethnicity	
Daba	17
Laka	44
Moundan	25
Peul	73
Toupouri	8
Total	167
Number of years spent in the environment	
1-2 years	6
3-4 years	11
Over 5 years	150
Total	167
Environment of current residence	

Rural	166
Urban	1
Total	167
Number of children under 9 in the household	
0	1
1	12
2	44
3	70
4	39
13	1
Total	167

B-Knowledge and Habit on Vaccination in General

The analysis of the results concerning knowledge and habits on vaccination in general shows a majority of parents well informed about vaccination practices. Among the respondents, 80.2% say they know their child's vaccination status, while 19.8% do not know. An even higher proportion (92.8%) is aware of the recommended vaccines for children, demonstrating a high awareness on this subject.

Concerning the place of vaccination, all participants (100%) vaccinate their children in the Integrated Health Centers (CSI), a sign of trust in these establishments. In addition, 86.8% of participants know the vaccination schedule for children under 5 years old, mainly thanks to the Multipurpose Community Health Workers (ASCp) who are the source of information for 77.8% of respondents. Mothers are the main responsible for accompanying children to vaccination (89.2%), followed by siblings (6.6%), while fathers represent only 4.2%.

In terms of practice, 85.6% of parents report having personally taken their child to vaccination, and 67.1% are aware of the recommended vaccines for children aged 12 to 23 months. However, 32.9% are not aware of these vaccines, suggesting a need for increased awareness among this group. Regarding the completion of recommended vaccinations, 76.6% of participants confirm having had their child vaccinated, while 21% do not remember, and 2.4% have not had these vaccinations. The main reason given for vaccination is disease prevention (86.2%), followed by advice from health professionals (12.6%). Only 0.6% of respondents report having been influenced by the media or their entourage.

These results illustrate good knowledge and widespread practice of vaccination among parents, although some groups may benefit from additional educational campaigns to améliorer la compréhension du statut vaccinal et des vaccins recommandés.

Table 2: Knowledge and Habit About Vaccination in General

Questions	Frequency (n)	Percentage (%)
Do you know your child's vaccination status?		
No	33	19.8
Yes	134	80.2
Total	167	100.0
Do you know the recommended vaccinations for children		
No	12	7.2
Yes	155	92.8
Total	167	100.0
Where do you vaccinate your children?		
CSI	167	100.0
Have you learned about the vaccination schedule for children under 5 years of age?		
No	22	13.2
Yes	145	86.8
Total	167	100.0
How did you learn about the vaccination schedule		
Carnet le bon chemin	37	22.2
By an ASCp	130	77.8

Total	167	100.0
Who often takes the child to the vaccination?		
The mother	149	89.2
The father	7	4.2
His sister or brother	11	6.6
Total	167	100.0
Have you ever taken the child to the vaccination?		
No	24	14.4
Yes	143	85.6
Total	167	100.0
Do you know the recommended vaccines for your child aged 12 to 23 months?		
No	55	32.9
Yes	112	67.1
Total	167	100.0
Have you had the recommended vaccinations?		
I don't remember	35	21.0
No	4	2.4
Yes	128	76.6
Total	167	100.0
For what reason		
Advice from my entourage and from a ASCp	1	.6
Because I heard in the newspaper that it is necessary to do it	1	.6
To avoid illness	144	86.2
On the advice of a health professional	21	12.6
Total	167	100.0

Do you Know your Child's Vaccination Status?

Among the respondents, 134 (80%) say they know their child's vaccination status, while 33 (20%) do not know as illustrated in the graph below.

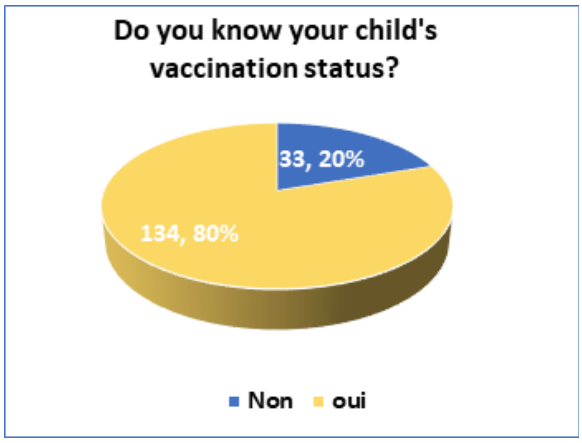

Figure 1: Knowledge and Habit About Measles

C-Relationship Between Demographic Factors and Measles Knowledge

A total of 7 questions were asked to the respondents to assess their knowledge about measles. The mean knowledge score was 5.28 ± 0.82. A total of 163 (97.6%) of the respondents had good knowledge about measles.

- A total of 163 (97.6%) of the respondents had good knowledge about measles.

There is a strong correlation between education level and knowledge about measles.

- 90.9% had no education,
- 99.3% had primary education

The difference is statistically significant (Chi-squared = 19.092, P value < 0.0001), highlighting the importance of education in raising awareness about measles.

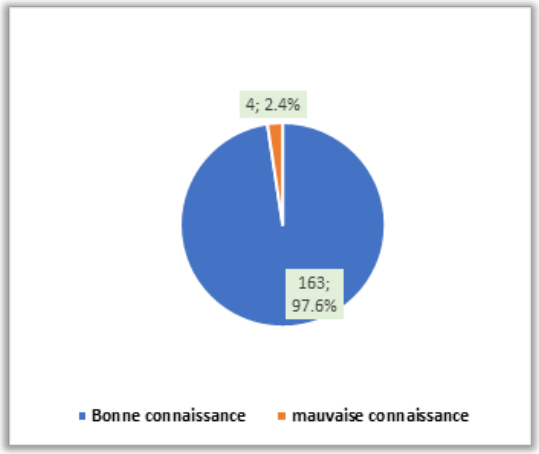

Figure 2: General knowledge about measles

Results of the Survey on Confirmed Measles Cases Recorded During the Outbreak

This table presents the socio-demographic characteristics of sick children among the 32 respondents. The data provide information on gender, place of residence, ethnicity, religion, living conditions, and other aspects related to the health of the children. The gender distribution is perfectly balanced between girls (50%) and boys (50%), suggesting that measles affects children of both sexes equally. The children come from various localities, with a higher distribution in Laidé Djoumo and Nakong (25.0% each). Other localities such as Guidjol Campement (18.8%) and Djabawa Peul (12.5%) also have significant cases. The concentration of cases in certain areas may suggest that geographic or community factors influence the spread of measles. These localities may require special attention in awareness and vaccination efforts. Furthermore, the majority of children belong to the Bororo group (43.8%), followed by the Peul (15.6%) and Laka (15.6%) ethnic groups. The data show a predominance of children from the Bororo communities, which could indicate cultural or mobility specificities influencing measles exposure. In addition, the majority of children are Muslim, which probably reflects the religious composition of the region. However, Christian children are also significantly affected. Regarding the Person with whom the child lives, most sick children live with both parents (75.0%), suggesting that traditional family structures are present. However, a quarter of children live only with their mother, an element to be taken into account for social or health interventions. Also, more than half of the children live in households with 1 to 5 children, while 43.8% live in large families (6 or more children), which could influence measles transmission and family dynamics. Regarding the location of first case reporting, half of the first measles cases were reported at the Integrated Health Center (IHC), while the other half were reported in the community. This shows a mix between formal and informal management of measles cases. A majority of children (65.6%) do not attend school. This may have implications for access to health and vaccination information, as well as the spread of measles within communities that are not regularly in contact with school structures.

Table 3: Sociodemographic Characteristics of the Sick Child

Characteristics	Frequency (n)	Percentage (%)
Sex		
Female	16	50.0
Male	16	50.0
Total	32	100.0
Residence		
Tcharatché Fulani Camp	2	6.3
Djabawa Fulani	4	12.5
Guidjol Camp	6	18.8
Kotogou	3	9.4
Laidé djoumo	8	25.0

Nakong	8	25.0
Ouro Ardo	1	3.1
Total	32	100.0
Ethnicity		
Bororo	14	43.8
GIME	1	3.1
Guidar	1	3.1
Laka	5	15.6
Marba	1	3.1
Massa	2	6.3
Mboum	1	3.1
Mofou	1	3.1
Moundan	1	3.1
Peul	5	15.6
Total	32	100.0
Religion		
Christian	13	40.6
Muslim	19	59.4
Total	32	100.0
Who does the child live with?		
Mother	8	25.0
Both parents	24	75.0
Total	32	100.0
Number of children in the household		
1 – 5	18	56.3
6+	14	43.8
Total	32	100.0
Where was the first case reported?	32	100.0
CSI	16	50.0
In the community	16	50.0
Total	32	100.0
How many children have contracted measles before him in the household?		
0	13	40.6
1	14	43.8
2	4	12.5
3	1	3.1
Total	32	100.0
The child attends school		
NA	2	6.3
No	21	65.6
Yes	9	28.1
Oui	9	28.1

1,164 / 5,000

Reason for Child Non-Vaccination

The reasons why some children were not vaccinated are summarized below. Among the 32 valid responses collected, several factors were identified, ranging from information access constraints to logistical issues.

Lack of information (43.8%) is the main reason for non-vaccination. This finding highlights a critical need to improve awareness and communication about the importance of vaccination. Dropout and distant CSI each account for 15.6% of cases. Both factors point to structural and logistical barriers. Child vaccinated RR2 (9.4%) suggests that some children were already protected,

reducing the magnitude of the non-vaccination problem for this group. Forgetfulness and lack of time (6.3% each) indicate that improvements in time management and appointment tracking could further reduce non-vaccination. Not eligible (3.1%) shows that a small fraction of children were simply not eligible to receive the vaccine at the time of the survey, which could include age or health-related factors.

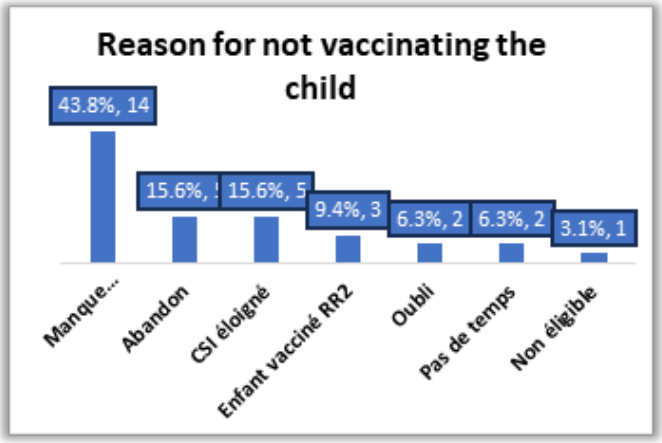

Figure 3: Reason for non-vaccination of the child

Analysis of Number of Incompletely Vaccinated Children

A large number of children are not fully vaccinated, with a majority of households having up to 3 incompletely vaccinated children. The majority of households have between 1 and 3 children who have not received a complete vaccination. 37.5% of families have 3 children who are incompletely vaccinated, which is the largest proportion. Similarly, 12.5% of families report having no incompletely vaccinated children, which is a positive indicator, but this percentage remains relatively low. For 12.5% of respondents, the vaccination status of children is not known, which could be related to a lack of information or low awareness on the importance of vaccination.

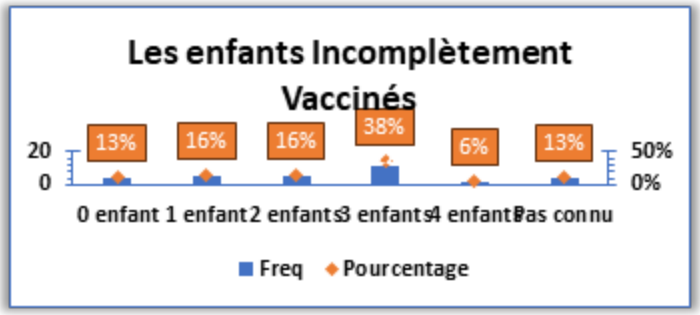

Figure 4: Analysis on the Number of Incompletely Vaccinated Children

Discussions

Demographic and Social Characteristics of Respondents

This analysis shows that the geographical distribution shows that the participants come mainly from the villages of Ouro Ardo (40.1%) and Nakong (33.5%), while Bangli (25.7%) and Garoua (0.6%) are less represented. This geographical distribution could influence the results depending on the local specificities of each village. These localities are exactly the places where measles cases were recorded during the epidemic.

In terms of education level, the vast majority of participants (88%) have only a primary level, with a small proportion having a secondary level (5.4%) or no formal education (6.6%). The level of education is a very important determinant for having better health. For a literate population, it is better equipped to adopt healthy behaviors and work to maintain good health. Given this result, it is understandable that these parents will not be able to read the numbers of antigens already received by their children and the appointment for the next vaccine set by the vaccinator.

The low level of education is an important element that affects the complete vaccination coverage of children (abandonment or loss of sight at the next sessions). Bakolon Andre Justin, et al conducted a study on the factors associated with the re-emergence of measles epidemics in the New Bell and Deido Health Districts, they found that most mothers, 57.1%, are between 20 and 29 years old. The Single Parent Profile specifies the fam-

ily type of approximately 57.7% of mothers residing mainly (52.6%) in rural areas[7].

Adding to this the level of education of this population alone contributed 40% of the occurrence of the epidemic. This shows that there is a relationship between demographic factors and knowledge of measles. For our study, the level of education factor is related to demographic factors, the results show that there is a strong correlation between the level of education and knowledge of measles. People with no level of education have a knowledge rate of 90.9%, while those with a primary level reach 99.3%. The difference is statistically significant (Chi-squared = 19.092, P value < 0.0001), highlighting the importance of education in raising awareness of measles.

Gille Pison (1998) made the same observation when he was interested in child mortality due to measles in the locality of Bandafassi in Senegal. According to Gille Pison, this area was essentially rural and with a population in disadvantaged conditions and settled in a small ethnic group. The same result is obtained by Maty Diagne "The majority of measles cases were found in children whose parents had no education" or 72% of parents [8]. This illiteracy would be at the origin of the major problems posed by measles in the Garoua Health District 1. The barriers relating to women's access to education constitute a fundamental fact that must be considered by any health policy. Arising from this aspect, Farho, joins us in saying that illiteracy comes first in the difficulties in accessing care. He states: "in my opinion illiteracy will always cause health improvement efforts to fail and will keep populations in desperate conditions". This assertion by Farho finds its validity in this population studied. The conclusions of a survey conducted as part of a health development project in Benin in 1995 corroborate this point of view. Indeed, this study highlights the correlation between the level of education of women and the non-use of health care: the lower the level of education, the lower the attendance of health services [9].

Knowledge and Habit on Vaccination in General

The result from our survey shows a majority of parents well informed about vaccination practices. Among the respondents, 80.2% say they know their child's vaccination status, while 19.8% do not do not know. An even higher proportion (92.8%) is aware of the recommended vaccines for children, demonstrating a high level of awareness on this subject. These results show that the information is understood by parents in terms of the vaccines available against the target diseases. However, in terms of the number of doses for complete immunization of the child, this remains a reality that needs to be explored with parents. The dropout rate is generally observed according to the WHO which estimates that RR2 coverage is 74% worldwide, a performance that is still mixed, and is 37.1% in Cameroon, which calls into question this knowledge and habit of vaccination. Thus, among the respondents, 134 (80%) say they know their child's vaccination status, while 33 (20%) do not know, but by digging deeper, we can find qualitative knowledge of different antigens that the child is supposed to receive [10, 11].

Socio-environmental Factors.

This section deals with questions on various aspects of the respondents' lives. The aspects addressed are mainly the walking time to reach the health center, the source of drinking water, type of housing, lifestyle and the movement of people in mass or in camps in their locality. These elements are very determining in maintaining the state of health in general. But the result on the time required to reach a health center shows that the participants (78.4%) spend about 15-30 minutes to reach a health center. This is quite acceptable because the WHO sets this time at 1 hour of walking to reach a health facility.

As for access to drinking water, the result shows that 80% of respondents use public drilling. However, we do not know the ratio of drilling per inhabitant, which leads us to believe that access to water would be difficult and the water point will be filled with children or mothers of children. This may be a factor in exposure to measles. In terms of housing type, almost all participants (98.2%) live in earthen dwellings. This reflects precarious housing conditions that can have repercussions on the health and general well-being of the household's inhabitants, mainly children. This beaten house for most respondents proves a certain stability in the environment, and this effectively corroborates with the results on lifestyle. Overall, we have a sedentary population, i.e. 96% of respondents. However, this population observes the arrival in their entourage of groups of people, although it is true that they are at 21%, but this remains a fact to be taken into consideration. Indeed, during the COVID-19 crisis, the movement of people was suspended throughout the world as a measure of international health response. The virus of this pandemic has the same mode of transmission as measles, which means that just as the movement of people promotes the spread of Covid-19, it is also favorable for measles. According to WHO, the risk of an outbreak of the epidemic is high in a context of mass movement or displacement of individuals. This is why refugee camps are systematically vaccinated in order to anticipate the occurrence of epidemics.

Laboratory-confirmed and Epidemiologically Linked Measles Cases

The second target of our study is children who contracted the disease during the epidemic. Through the ASCp, we found 32 children in the community. All the parents of these children agreed to participate in the study. The analysis of the results shows that the sick children come from various localities with a higher distribution in Laidé Djoumo and Nakong (25.0% each). Other localities such as Guidjol Campement (18.8%) and Djabawa Peul (12.5%) also have significant cases. We note the concentration of cases in certain localities, this suggests that geographic or community factors influence the spread of measles. Furthermore, the majority of children belong to parents who are Bororo (43.8%), followed by the Peul (15.6%) and Laka (15.6%) ethnic groups and most had an average age of 1-5 years. The data show a predominance of children from Muslim communities, which could indicate cultural or mobility specificities influencing exposure to measles.

Indeed, the Bororos are typically nomadic ethnic groups. They move in groups and set up camps around the villages. They have a duration of 3 to 12 months on site and move to look for pastures because they are breeders [12]. These sick children are not educated in the majority of cases (65.6%) and their parents (40.6%) have attended Koranic school and (34.4%) primary school. In this context of nomadism, it is difficult to have children fully vaccinated, hence the vulnerability of this category

of group of individuals and the exposure of the host population. This same result was found by Issatou Bella Camara in 2018, children suffering from measles in the Dubreka Health District were aged 0-5 years and 95% had not received all doses of measles vaccine [13].

The main reason for non-vaccination of children is the lack of information. These parents do not have information on the merits of vaccination and the availability of EPI services for any child. Some children are also not fully vaccinated because the parents consider the vaccination site to be far away and they forgot to continue vaccinating their children. In the New Bell and Deido Health Districts, Bakon Justin et al found the same factor of non-vaccination of children but the underlying causes are very different: for our study, the group identified is nomadic and it is difficult to follow them, on the other hand for Bakon Justin et al the population is sedentary, rural and without level of education [14].

The promiscuity factor is to be noted in our result, because we identified two types of contagion: contagion between children of the same family (43.6%) and contagion between children of different families. Despite good vaccination coverage in many countries, hesitation to vaccinate getting vaccinated has hampered vaccination coverage and put some groups at risk of outbreaks. Somali immigrant groups are known to have low measles vaccination coverage, leading to outbreaks in their communities. Research indicates that a general lack of trust in the health system, reliance on alternative sources of information, and inadequate health education may be contributing factors [15]. This is the same phenomenon in Garoua Health District 1, especially with its proximity to the border with Nigeria. Sherin Marie Jenness et al found that children born to Somali immigrant parents in Norway had suboptimal measles vaccination coverage at age 2; for children born in 2016, coverage was 85%. Coverage declined between 2000 and 2016, and at a higher rate for boys than for girls [15]. Children born to mothers who had been living in Norway for 6 years or more had lower vaccination coverage than those whose mothers had been living in Norway for less than 2 years before their birth. Children born in the capital and surrounding counties had significantly lower vaccination coverage than children born elsewhere in Norway.

Children, through direct contact or through the area, can approach the community and the contamination process begins. We have children in the community whose parents have settled in a camp some time ago but which has not been the subject of an assessment of vaccination status (no assessment report either to the District or to the local CSI). These are potential foci and vectors of measles. The study conducted by Maty Diagne reached the same conclusion insofar as she says "indeed, Serer women during the dry season go to the big cities where they do housework [16]. Quite frequently. They brought their children with them. The latter are generally measles-free and unvaccinated subjects who find themselves relatively quickly in an environment where the virus is endemic." This Bororo community lives with measles, but does not have enough information to take preventive measures. Their integration into a community exposes the entire locality to the outbreak of the epidemic. The Garoua 1 Health District is crossed by the Benue River, the banks of this river constitute a preferred grazing area. Bororo shepherds circulate between the Cameroon-Nigeria borders but are not monitored in their movements.

A global consultation on measles held in May 1996 concluded that measles could eventually be eradicated if a measles elimination strategy were properly implemented. However, given that the world is already engaged in a polio eradication initiative, it should be emphasized that the immediate priority in global vaccination efforts must be polio eradication [17]. The success of this latter initiative will be essential to gaining the political and donor support needed to coordinate measles elimination efforts. In an increasing number of countries that have already eradicated polio, a measles elimination strategy is in place. The overall strategy aims to rapidly reduce the number of susceptible individuals in a population through a mass vaccination campaign and then to maintain the number of susceptible individuals below the “epidemic threshold” by ensuring high coverage with routine childhood immunization. This strategy has been widely used to interrupt measles transmission in the WHO Region of the Americas, as well as in some countries in the European, South-East Asia and Western Pacific Regions, with great success [18]. Key elements of this strategy include strengthening routine immunization services and implementing supplementary immunization activities, as well as strengthening measles surveillance and laboratory confirmation of cases.

Conclusion

In view of these results, socio-environmental factors have contributed to the exposure of the host population by the Bororo ethnic group who are foci and vectors of measles spread. If all children in the host community were fully vaccinated, inter-family contagion would be observed, therefore within Bororo and Peul (Herders) households only. Their nomadic characteristic is a factor associated with the re-emergence of the measles epidemic in a stable community.

Suggestions

Close monitoring of vaccination coverage in children by geographic area (district) and population subgroup is necessary to determine areas where coverage is well below the target. In addition, the age and vaccination status of measles cases should be carefully examined to determine whether they correspond to the reported vaccination coverage. Pockets of low coverage may expose the general population.

Areas or populations identified as having low coverage should be investigated to determine the reasons, and appropriate measures introduced to address the issues. These measures may include:

- Improving coordination and collaboration between different government and non-government sectors to support border vaccination activities;
- Reducing marked vaccination opportunities through training and supervision of community health workers on the Nigerian side;
- Strengthening health education and disseminating social mobilization messages to the nomadic community through all available means;
- Ensuring compliance with the vaccination schedule for all children to ensure better protection. Conduct a baseline assessment or a CAP survey upon arrival of nomads

- Carry out targeted vaccination upon arrival of nomads in the locality
- Track down all children lost to follow-up at the second RR2 dose
- Implementation in the CSIs of a computerized system that reminds children of vaccination appointments
- Synchronized the vaccination of nomads' children with the neighboring country (Nigeria)

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