



## Niger's Experience in Neurotoxicology

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### Abstract

**Introduction:** On the studies of toxic pathologies in Niger, several studies have been found, the effects of fluoride on the developing bone will be presented.

**Objective:** Describe Niger's experience in toxicology. Patients and methods: we consulted studies already carried out in the country.

**Results:** Thus in the first study, clinical and radiological abnormalities were observed in children exposed to water intoxication with fluoride in the commune of Tibiri. The clinic was made up of osteodental fluorosis, bone manifestations mainly of the limbs, rarely head and teeth. This disease has occurred in children aged 2 to 3 years in the majority of cases, sparing adults and elderly people. The bone development disorder was linked to the high concentration of water from the borehole (3.24 to 4.77 mg/l). Conclusion: Fluoride intoxication of water origin was responsible for the bone malformations observed in children.

**Keywords:** Niger; Fluoride

### Introduction

Niger is a country in West Africa, completely landlocked, with an area of 1,267,000 km<sup>2</sup>. The latitude is between 11°37' and 23°33' North, its longitude between 0°06' and 16° East of the prime meridian. Its geographical location makes it a crossroads for trade between North Africa and Africa south of the Sahara. The closest border to the sea is more than 600 km from the Gulf of Guinea. 3/4 of the country is made up of hot desert and is located in the

northern area of the country. Niger is an immense plateau with an average altitude of 500 m with little contrasting relief; high plateaus of the northeast, the Air massif (up to 2,000 m), low plateaus of the west, center and south and the plains. Cultivable land represents 16.5 million hectares, of which only 4.5 million were used for agriculture in 2002. This potential is very unevenly distributed between the regions of the country. Studies have been found on toxicology in Niger which are as follows:

- Spatial distribution of metallic trace elements in the gold-bearing soils of Komadogou in Niger, published in 2019 in International of Biological and Chemical Sciences which found concentrations of trace elements (As, Cd, Co, Cr, Cu, Ni, Pb and Zn). In soils were determined by inductively coupled plasma mass spectrometry.
- Impacts of climatic and anthropogenic factors on the resources and water quality of the Tabalak pond published in June 2015 in *int.j.Biol,chem Sc*,9(3):1665 which found a source of diffuse pollution of the water of this pond by iron, zinc, nickel, pb, maganese and Chromium.
- Seidou Guidah., *et al.* Radiology department, histoembryology department, orthopedic surgery service, HNL, Effects of fluoride on developing bone: About 104 cases observed in the rural commune of Niger, *J Afr Imag Méd* 2012;(4),2:66-73 Niger.

However, is one of the leading uranium producing countries, exploited since 1968, and no epidemiological study has been carried out to provide scientific evidence. Gold extraction could expose populations to lead, several areas for example the Samira area??

An epidemiological, clinical, biological and radiological investigation as well as physicochemical analyzes of the water were carried out. Thus abnormalities have been identified as resulting from osteodental fluorosis. Bone manifestations mainly concerned the limbs, more rarely the head and teeth. The disorder of bone development in children in this town was linked to the high concentration of fluoride in borehole water (3.24 to 4.77 mg/l). This disease appears around the age of 2-3 years in the majority of cases, sparing adults and the elderly.

Disturbances in the development of bone tissue in children can lead to disabling skeletal deformities. The causes of these disturbances can be acquired or constitutional.

Acquired causes can result from disorders of phosphocalcic metabolism, vitamin D deficiency, sequelae of previous acute poliomyelitis, heavy metal and metalloid poisoning (lead, arsenic, aluminum, fluorine, etc.) [1].

The constitutional causes are numerous and their manifestation is not always congenital, sometimes posing a problem of differential diagnosis with an acquired cause.

Examples include genotypic chondrodystrophies, mucopolysaccharidoses, hereditary deviations in osteogenesis, etc.

### Problematic

In the commune of Tibiri (Niger), many school and preschool children presented with multiple osteoarticular anomalies whose etiology could not be identified. The hypothesis of rickets was initially posed. But due to the limited response to vitamin D treatment, this hypothesis was rejected. A national investigation was launched to determine the cause(s) and propose solutions to remedy them.

### Results

This was a descriptive study involving 104 children presenting skeletal deformities presumed to be related to water fluoride poisoning following the installation of a borehole in a rural commune in Niger.

We found 104 cases including 67 boys (64.42%) and 37 girls (35.58%), i.e. a sex ratio of 1.8. The cases were frequent between 2 and 3 years (50% against 36.53%) between 3 and 6 years, 13.47% between 0 and 2 years). Isolated cases among siblings represented 63.34%).

The notion of marriage Consanguineousness was only noted in 25.97%. The mode of breastfeeding was maternal in all cases. From a clinical point of view, the signs were dominated by: bone pain (58 cases), impotence of the lower limbs (41 cases), fever (37 cases), diarrhea (20 cases).

The physical and radiological abnormalities observed are summarized in tables 1 and 2.

Physical signs	Number
Genu valgum	53
Genu varum	42
Saber leg and bow leg	53
Dental discoloration (brownish or yellowish teeth)	30
Ankylosis of the hip, spine and neck	19
Epyphyseal pads of the wrist	25
Forearm in varus	22

**Table 1**

Radiological signs	Localisations	Number
Bone hypertrophy	Skull, femurs, ribs	5
Osteocondensation	Crane, humerus	7
Lamellar periosteal reaction	Humerus, femurs	2
Osteophytes	Tibias	3
Diaphyseal fissures	Tibias	2

**Table 2**

**Discussion**

Fluorine exists naturally mainly in the earth's crust. At low doses its beneficial effects are known, particularly in the prevention of dental caries. But excessive intake in the human body causes disturbances with acute or late manifestations [2-4].

At low doses its beneficial effects are known, particularly in the prevention of dental caries. But excessive intake into the human body causes disturbances with acute or late manifestations.

The appearance of bone deformities leading to functional impotence in children in the rural commune of Tibiri reveals an epidemic nature due to its recent appearance in relation to the incriminated cause and the high number of affected children. No cases were observed in this municipality before the installation of the water tower in 1985.

The first cases dated back to 1987 and were aged 14 years in 1999. Faced with these clinical pictures, several hypotheses were put forward.

The first hypothesis was rickets, but seemed increasingly ruled out due to the following arguments: the recent appearance of the problem while the climatic (good sunshine) and nutritional conditions have not changed.

Only the children of Tibiri were affected while the children of the villages in the immediate surroundings of this commune with the same socio-cultural and economic habits were not affected.

This pathology was observed both in high-income families and in those with an average or low standard of living. Yellow or brownish discoloration of the teeth, ankylosis of the neck, hip and spine are unusual in rickets. Water intoxication from drinking water was confirmed.

The fluoride content of the water was 3.24 to 4.77 mg/l, a normal level (less than 1.5 mg/l) according to WHO. This condition causes signs of gastroenteritis, bone pain, convulsions and impotence. function of the lower limbs in a sometimes febrile context [3,5,6]. In our series we found 37 cases of fever out of 104 compared to two cases out of 34 for Roholom in 1937 in acute fluoride poisoning [1].

Bone pain was observed in 58 cases as the mode of onset of clinical manifestations, i.e. 55.77%. Dia found a frequency of 16.30% in 1993 in Senegal. For the notion of individual susceptibility, note that two cases of twins were observed in our sample where only one presented bone deformities. The literature mentions this possibility of individual susceptibility.

The first cases of fluorosis were observed just two years after the acquisition of a new source of drinking water in Tibiri. This observation differs from that of Short who estimated that it would take 30 to 40 years of residence in an endemic area for a well-defined picture of fluorosis to appear [1].

But according to the same source it is similar to that of SIDIQUI who reported the appearance of symptoms of fluoride poisoning 1 to 4 years after their arrival of immigrants who had settled in the village of Kamaguda.

**Conclusion**

Several studies were found on neurotoxicology but it is the study carried out on fluoride poisoning in the Tibiri region which

was detailed. Bone deformities reflect a developmental disorder in childhood orthopedics. The causes are constitutional or acquired. In Tibiri there was fluoride poisoning of water origin at the base of the bone deformations observed in children and linked to the presence in the water of an excessive quantity of fluoride of the order of 3.24 mg/l at the borehole level and 4.77 mg/l on the supply network.

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