Review

Rickets in rift valley: A review of manifestation and links with fluoride contents of drinking water supplies and food

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The study is to determine the prevalence of rickets among children under five years and links with fluoride contents in drinking water. Food sources and recommended adequate daily intake for vitamin D. Naivasha hospital Rift Valley Province, confounding correlations between the disease rickets in relation to fluoride contents of water supplies and food. Case study design was used by comparing data from Yemen, Ethiopia, India, Australia and Kenya. Data in Kenya was extracted from Katolo in Kano, a part of the Great Rift Valley, showing bowlegged children and domestic animals from volcanic areas within and outside the Great Rift Valley showing evidence of rickets. Review of reports on incidences and distribution of rickets in East Africa, India, Ethiopia and Australia. Correlations between rickets and fluoride contents of water supplies was reviewed in the report. The incidence of rickets is becoming worrisome in the Rift Valley, it is important to note that through empirical evidence fluoride concentrates can enter public water systems from natural sources. The rise in cases of rickets observed in Rift Valley may be due to three causes ;- Decrease in the calcium content of water and increased concentration of fluoride in water due to global warming, decreased exposure to natural sunlight. They are ever dressed like Eskimos by mothers who leave for work very early in the morning while it is extremely cold in Naivasha and these children are kept indoors most of the time hence their bodies may never manufacture vitamin D from nutrients derived from food and water sources. It is recommended that urgent research is needed on links between drinking water and foods consumed in the Rift Valley basin to determine whether their contents of fluoride comply with the World Health Organisation’s recommendation of 0.5-1.5 ppm.

Keywords : Ricket, rift valley, drinking water, food.

INTRODUCTION

It was reported that there is an increase in cases of rickets in Naivasha Hospital especially among children of parents working in flower farms. Naivasha Town is right in the middle of Rift Valley where high fluoride contents have been reported before, in rivers, bore holes, soil and even dust of the air. (Oginni et al., 2003; Manji 1986). This paper aims to explain what rickets is, and to establish its
prevalence and distribution in Kenya. Rickets is poor deposition of calcium in bones which leads to easy breakages or bow-leggedness. Calcium is normally deposited in bones as Calcium phosphate but high contents of fluoride intake in food or water may hinder its normal deposition in bones (Oginni et al., 2003). Uptake of calcium by bones is hampered by the high fluoride content of most natural water sources in the Rift Valley of Kenya. Naivasha Town is right in the middle of Rift Valley where high fluoride contents have been reported before, in rivers, bore holes, soil and even dust of the air.

The report above mentioned certain constraints in day care centres where services for child care are offered. However, after extensive review of literature, it was concluded that the rise in observed rickets could be due to contamination by fluoride in the water consumed around Lake Naivasha which might have been compounded by lack of adequate exposure to sunshine among the said children. The rise in fluoride concentrations could also be due to the lake drying up due to lack of replenishment from tributaries which have themselves dried due to deforestation in the catchment areas or even, from global warming. The level of fluoride in drinking water and foods consumed around Lake Naivasha are much higher than the 0.5-1.5 ppm recommended by the World Health Organisation.

What exactly is rickets and what are its manifestations? This is an important area that this discussion paper will address. Simply stated, rickets is a disease in which developing bones in infants and children become bent or misshapen has been known since antiquity. Since 1820s cod liver oil was shown to treat rickets. The vital factor which cured rickets was established by E. V. McCollum to be vitamin D (Oginni et al., 2003). The dependence on sunlight for manufacture of vitamin D under the skin was confirmed by Sir Edward Mellanby, between 1919 and 1920. Working with dogs raised exclusively indoors (in absence of sunlight or ultraviolet (UV) light), he devised a diet that allowed him to unequivocally establish that rickets was caused by deficiency of a trace component present in diet, and that the condition was treated by administering fish liver oil (Mellanby 1921).

Vitamin D is a hormone normally manufactured under the skin of mammals exposed to ultra-violet light or sunshine (Health Letter Associates (HLA) 1998). Most foods supply too little vitamin D to meet the needs of growing children-for instance, a five year old child would have to drink 35 pints of milk or eat 0.8 kg of butter or 11 eggs or 0.13 kg of margarine to fulfil the daily recommended intake (Bingham 1977).

Vitamin D is essential for normal mineralization (calcium deposition) in bones. Bone mineralization occurs when calcium and phosphorous crystals are deposited in the soft collagen matrix which forms the foundation of bones (Health Letter Associates (HLA) 1998). However, any factor which interfere with either vitamin D development in the body or calcium deposition in bones causes rickets (Sandstead 1980).

Recommended Adequate Daily Intake for Vitamin D

Since vitamin D can be endogenously produced and is retained for very long periods by the human body, it is very difficult to determine the minimum daily requirements precisely (Teotia and Teotia 2008). This requirement depends on age, sex, degree of sun exposure, season (Harris and Dawson-Hughes 1998).

The current Adequate Intake(AI) of vitamin D, recommended in 1998, by the Food and Nutrition Board of the Institute of Medicine of United States of America is 200 International Units (IU) /day (5 µg/day) for infants, children, and adults <51 (Food and Nutrition Board (FNB) 1998). This report recommends 400 IU/day (10 µg/day) for adults aged 51-70 and 600 IU (15 µg/day) for adults over 70. During pregnancy and lactation the Food and Nutrition Board suggests that 200 IU (5 µg/day) of vitamin D intake is adequate. Animal sources constitute the bulk sources of vitamin D that occur naturally in unfortified foods. Fish and fish liver oils are good sources (Wardlaw 2003). However, the best source is sunlight. Hence, the heavily dressed children of Naivasha (dressed like Inuit, Eskimos of Greenland) may have missed the advantage offered by natural sunlight.(Wardlaw 2003; Manji 1986).

Data Selection

Food and water samples obtained from Rift Valley region and analysed for fluoride contents ranged from 2-21 ppm in drinking water from rivers, milk samples from seven localities ranged from 0.05-0.22 ppm while vegetables ranged from 8.0-60 ppm, soil around Lake Elementaita had over 1000 ppm fluoride content while dust from the area had on average about 2300 ppm (Norman 2001). Lakes Elementaita and Naivasha are right in the middle of Rift Valley and have similar ecological characteristics (Jackson 1962). Similar results were reported for borehole and lake waters sampled around Lakes Nakuru and Baringo by Naslund (Pettifor et al., 1988) hence, confirming the shared ecological similarities for Lake basins in the Rift Valley. Distribution of rickets follows similar patterns, with higher prevalence in high fluoride content areas in Kenya (Teotia et al., 1998) and was reported for Yemen which is also part of the Greater Rift Valley (Williamson 1953).

Vitamin D is manufactured in human bodies exposed to adequate sunshine and ultraviolet light sources for 20 minutes daily for about three weeks. It is also relatively very stable in the human body once it has been manufactured.
Figure 1a. Bow legged children from Katolo in Kano, a part of the Great Rift Valley, showing evidence of rickets (Picture taken in January, 2010 with permission from parents courtesy of New Nyanza General Hospital)

Figure 1b. The Bowed legs of a rickets patient suffering from vitamin D deficiency Source:(15)
Figure 3. Rickets may not be confined to humans. These Domestic animals from Rift Valley may have consumed high concentrations of Fluoride in their water or pastures. (Picture from The Standard, January 18th, 2012, pg. 2).

Figure 4. Geographical areas with high natural fluoride levels. Source: Australian Government, National Health and Medical Research Council, 2007. A systematic review of the efficacy and safety of fluoridation.
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Figure 5. Source; Joy Wanja Muraya, Sunday Nation, March

(itonga and Nair 1982; National Institute of Health (NIH) 2009). This makes it very difficult to predict accurately the amount of vitamin D that should be consumed in foods on daily basis. The requirements for vitamin D also depend on age, sex, degree of exposure to the sun, season and amount of pigmentation (Teotia and Teotia 2008). This finding confirms that of Harris and Dawson Hughes (Harris and Dawson-Hughes 1998). Vitamin D is stored in the human body once it has been manufactured (Norman 2001).

Flouride- Calcium Interactions

Flouride levels in water or foods consumed by children under five have been shown to interfere with calcium uptake by bones in India, South Africa and Nigeria (Oginni et al., 2003; Jackson 1962; Pettifor et al., 1988; Novak 2007). This interaction has also been shown to cause rickets in experimental studies (Mellanby 1921; Norman 2001). Rift Valley area of Kenya consists mainly of volcanic soil with very high flouride concentrations in soil, water and
food sources (Manji 1986; Kahama et al., 1997; Naslund 2005). The World Health Organisation recommends 0.5-1.5 ppm fluoride content of drinking water as safe (Jansen et al., 1987). Levels above that range are considered to be dangerous to human health. The recent volcanic eruptions in Iceland were reported to deposit toxic ashes in pastures which cause long term bone damage that makes teeth fall out and bones break (Pettifor 2008; Pettifor et al., 2008).

**DISCUSSION**

While the incidence of rickets is becoming worrisome in the rift valley, it’s important to note that it has been established through empirical evidence that fluoride concentrates can enter public water systems from natural sources including run off from weathering of fluoride containing rocks and soils and leaching from soil into groundwater. Fluoride pollution from industrial waste can also contaminate drinking water supplies.

In this regard, it would be important through this literature review to establish whether diatomite and fluorspar wastes from industries Kerio Valley and Gilgil, have found way into surrounding domestic water supplies. Hence, policy to regulate fluoride in drinking water to acceptable levels and concentrations are required. Also establishment of guidelines to protect the public from exposure to harmful levels of fluoride is in dire need. This discussion paper will offer a debate that will inform appropriate practices minimising rickets prevalence.

**CONCLUSION**

Fluoride content of Lake Naivasha may have risen recently due to pollution and/or global warming. The residents around Lake Naivasha may have switched from high calcium animal food products to cheaper cereal based complementary foods which are high in pytates, which inhibit uptake of calcium from food sources. The calcium concentration in Lake Naivasha has been reducing, possibly due to global warming. The relationship between fluoride content of Lake Naivasha and it’s relation to recent increase in cases of rickets need to be monitored closely to avoid further suffering by children.

It is recommended that urgent research is needed on links between drinking water and foods consumed in the Rift Valley basin to determine whether their contents of fluoride comply with the World Health Organisation’s recommendation of 0.5-1.5 ppm. Also, it is important to establish the magnitude of rickets deficiency in Rift valley so as to put in place appropriate and relevant strategies. In addition, as follow up to evidence based information, policy frameworks and guidelines are needed on rickets manifestation. In addition, defluoridation systems should be designed and implemented to ensure health for all to meet the target set by the Millennium Development Goals. Rickets is a disease and it should not be allowed to increase.

**REFERENCES**


http://www.fluoridealert.org/health/bone/fluorosis/rickets.html


