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RESEARCH ARTICLE

RICKETS IS A COMMON CONDITION CHARACTERIZED BY GROWTH SLOWNESS AND BONE AGE RETARDATION DUE TO MINERAL DEFICIENCY

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Nutritional Rickets & its Clinical Features Among Children in Mosul –Iraq

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ABSTRACT

Background: Rickets is a common condition characterized by growth slowness and bone age retardation due to mineral deficiency that occurs at the growth plate. Nutritional rickets in children is mainly due to vitamin D deficiency or due to dietary calcium deficiency which is very rare. Rickets has been known since Roman times, it derived its name from an old English word, WRECKTEN, meaning *to twist, the original account of the disease was by Glisson &Whistler in 1650, but not until the late 1880 was its recognized as a dietary deficiency disease and it was first successfully treated with cod liver oil in 1807 and by ultraviolet irradiation in 1919. *Rickets is unlike most nutritional disorders in that it is more determined by cultural factors than social& economics*. **Objective:** To find out the cause of nutritional rickets and to detect the main presenting symptoms and the distribution of rachitic signs. I also tried our best to reach the best recommendations that may decrease the incidence of nutritional rickets. **Methods:** This study was carried out on 100 patients with diagnosed rickets who were either seen at the outpatient dept or admitted in Bin –Sina teaching hospital in Mosul city (iraq) from September 2018 –Jun 2019.The criteria for diagnosis were physical findings, radiological studies and biological investigations full detailed history was taken from each case focusing on age group, type of feeding, economic state type of housing, season of birth and sun exposure strategy. The presenting symptoms at time of diagnosis were organized also. Results: (62%)of cases borne during winter, almost half of them were exclusively breast fed, the vast majority(89%) came from urban areas, all of them had history of a good sun exposure, the commonest presenting feature was a respiratory problem(42%), (97%) were proved to have wide wrist,(91%) had an excessive sweating, (62%) had a persistent open anterior fontanel and (81%) of them showed their first tooth between the age of 5_9 months. Conclusion: Nutritional rickets is still an increasing medical problem in Iraq specially in Mosul after a 3 years of a very horrible war which caused a significant nutritional deficiency among pregnant and lactating women and among the children themselves. Still I noticed the ignorance mothers about the importance of sun exposure.

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INTRODUCTION

The natural form of vitamin D is cholecalciferol (vit D3)which is a sterol found in an animal fats and oily secretions.It is formed by ultraviolet irradiation from 7 dehydrocholesterol.After absorption, the vitamin undergoes successive hydroxylation reactions catalyzed by hydroxylaze enzymes of the liver and kidney to form 25(OH)D and 1.25 (OH) 2 D metabolites respectively.Each of these hydroxylation steps confers increased antirachitic potential so that 1.25 (OH) 2 D compound is thought to represent the active form of the vitamin 25 (OH) D which is the main circulating form.

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Dark skin pigmentation decreases the amount of vitamin formed after exposure to sunlight.Unlike vitamin D3, D2 is not formed in the skin but is obtained only from dietary sources. Vitamin D2 is formed by the conversion of a plant sterol and ergosterol to the vitamin. Adequate exposure to sunlight diminishes the need for dietary or supplemental vitamin D, and to maintain serum 25 (OH) D above the lower limit of normal, we need to expose the baby to sunlight 30 min per week wearing only diaper or 2 hours per week fully clothed (no hat). The major organs affected by 1,25 dihydrxyvitamin D are the intestine and bone.In the intestine, its chief effect is to increase the active transport of calcium, it dose this predominantly in the proximal part of the small intestine, although good evidence is now available that other parts of the intestine and colon also respond to physiologic amounts of the vitamin.other effect of this vitamin is PO4 transport enhancement. In the bone 1,25 dihydroxyvitamin D has two distinct actions.

The first effect involves the mobilization of calcium and is dependent, at least in part, on the presence of parathyroid hormone.the second and more widely known effect of 1,25 dihydroxyvitamin D is to facilitate the mineralization of the bone. Vitamin D & its metabolites have other actions like :On the kidney :has variable effects on reabsorption of calcium and promote phosphaturea in hyperphosphataemia. On parathyroid glands : It inhibits PTH secretion. On muscles: It maintains normal functions. The vitamin D content of human milk appears to be low, ranging from 4_90 IU per liter similar to value found in cow s milk. Vitamin D content may vary with the fat content of the milk, the vitamin D content in colustrum may be higher than that of mature milk.An increased content of bioactive vitamin D apparently may occur in the breast milk of mother receiving cow s milk fortified with vitamin D. Recently, it appears that even with 90 seconds of total body ultraviolet exposure to lactating women or with oral vitamin D (2000 IU / day),the vitamin D content in the serum & breast milk can be increased tenfold.

Exposure to sun is crucial, this may be inadequate in northern cities with their cold climate and smoke interfering with irradiation or it may equally well arise in tropics and subtropics where infants are swaddled from head to feet or kept in door with their mothers. Inadequate intake, impaired absorption, defective metabolism of vitamin D and perturbation in the availability or retention of bone mineral substances, may all result in nutritional rickets. In the normal infant there is a zone of cartilage between the diaphysis and epiphysis (epiphyseal plate). At the epiphyseal end, this cartilage is actively growing, whereas at the diaphyseal end mature cartilage cells are arranged. Osteoblasts lay down calcium and phosphate to form new bone. In rickets, defective growth of bone results from retardation or suppression of normal growth of epiphyseal cartilage and of normal calcification. Cartilage cells fail to complete their normal cycle of proliferation and degeneration and subsequent failure of capillary penetration occurs in patchy manner.the result is frayed irregular epiphyseal line at the at the end of the shaft. Failure of osseous and cartilaginous matrix to mineralize in the zone of preparatory calcification, followed by deposition of newly formed uncalcified osteoid, result in wide, irregular frayed zone of non rigid tissue (the rachitic metaphysis) and this zone is responsible for many of the skeletal deformities and becomes compressed and bulges laterally producing flaring of the ends of the bones and the rachitic rosary. Lack of mineralization in subperiosteal bone and if this process continues, the shaft loses its rigidity and the resultant softened and rarefied cortical bone is readily distorted by stress, deformities and fractures result.

The earliest sign of rickets is craniotabes specially among low birth weight infants, rachitic rosary and thickening of the wrist and ankles are other early signs in addition to increased sweating.the osseous abnormalities of infantile rickets are bossing of the forehead, exaggerated Harrison s sulci, pigeon chest, kyphoscoliosis, abnormality in shape of the pelvis coxa vara and bowing of the legs. The anterior fontanel is larger than normal and its closure may be delayed. The head may be larger than normal and may remain so throughout life. Eruption of teeth may be delayed and the permanent teeth that are calcifying may also be affected deformities of the spine, pelvis &legs result in reduced stature (rachitic dwarfism).relaxation of ligaments, helps to produce deformities and partly accounts for knock knee the muscles are poorly developed and lack tone, as a result.children with moderate –sever rickets are late in standing and walking. Vitamin D or calcium deficiency, may be an important predisposing factors for pneumonia among children under 5 years in developing countries. Biochemical tests :S calcium level may be normal or low, S phosphorus level is below 4 mg/dl, S alkaline phosphates is elevated, urinary cyclic AMP level is elevated & S 25-hydroxycholcalciferol level is decreased. Roentgen graphic changes vary with the disease and the age of the patient.thy include poor mineralization of both flat & long bones, delayed development of the epiphysis and marked changes in the metaphysis at the growing ends of the long bones in which concave irregular margins are found together with a greater than normal diameter (cupping, fraying and splaying).In young children and infants, similar changes may be observed at the costochondral junction.

Aim of the study: My prospective study is a simple trail to find out the cause of Nutritional Rickets in a 100 diagnosed case & to detect the main presenting symptoms and the distribution of rachitic signs, I also tried my best, to reach the best recommendations that may decrease the incidence of nutritional rickets in Mosul –Iraq.

METHODS

This study was carried out on 100 patients with rickets who were either seen at the outpatient dept or admitted in the ward (bin sina teaching hospital)or checked in my private clinic in Mosul – Iraq from sep 2018 –Jull 2019.criteria for diagnosis depend on physical findings, lab work and X-ray studies. full history was taken and the 100 patients were organized according to age, type of feeding, daily income, type of housing, residency region, season of birth sun exposure history (ie less than 30 min /week with only a diaper, 2hr /week with cloth but no hat, exposure with natural clothing or exposure without clothing),the presenting symptoms at time of diagnosis (such as delayed walking, abnormal gait,, respiratory problems, convulsion malnutrition, symptoms suggesting celiac or other disease like UTI …ect) and also a detailed history was taking about the teeth eruption or nature of sweating, if presents, and if the mother herself have rickets. Every case was examined thoroughly for weight, height and OFC. Results 59% of patients were male, 4% were in their first six months of life while 56% were between 7 &12 months old and the rest 40% were older than one year(table 1).62% borne at winter, 11% in spring,16% in summer & 11% ai autumn s months (Figure A).Because of 3 years of wars in Mosul (2014-2017), I faced a great difficulties to classify the families socioeconomically, but were categorized according to their income and the distribution shows that 54 % have daily income less than 10000 ID 32% gain between 10000_25000 ID and only 14% could get more than 25000 ID.39%were exclusively breast fed at time of diagnosis, 25% were on breast &diet, 23% on diet alone, 3% was the same percentage for those who were on bottle milk, on breast & cow milk and on breast & bottle while 2% was the percentage for both who were on bottle & diet and those who were on diet, bottle & breast.89% of patients came from urban areas and only 19% are living in open houses. History of frequent sun exposure with clothes, but no hat, was found in 91% of them while only 9% have history of frequent sun exposure with only diaper.42% were presented because of respiratory problems, 32%with delayed walking.81% showed their first tooth between the age of 5 -10 month Age & Sex Distribution of Rickets in 100 Iraqi Patients.

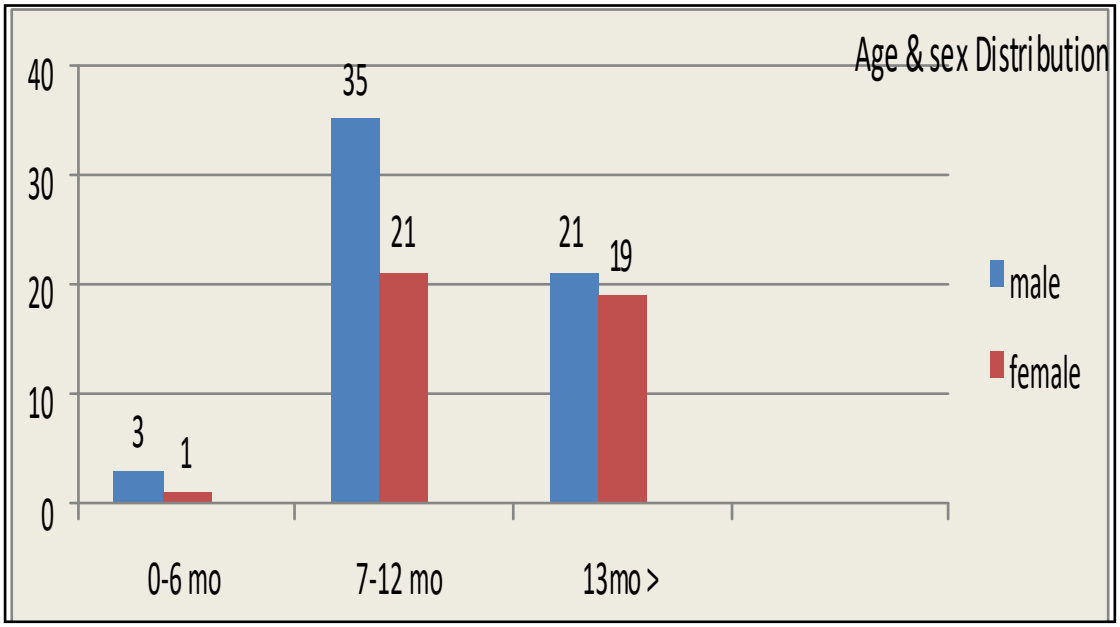
ersistent or wide open anterior fontanel	62%
ypotonia	41%
rontal bossing	29%
achitic rosary	21%
raniotabes	13%
ow leg	6%
arrison grooves	3%
igeon chest	3%
coliosis	1%

hest infection or pneumonia	42%
elayed walking ,abnormal gait or referred case	32%
Malnutrition	8%
onvulsion	3%
uspected celiac	3%
ther like GE ,UTI ……etc .	12%

GE	MALE	EMALE	OTAL
6 mo	(3%)	(1%)	(4%)
12 mo	5 (35%)	1 (21%)	6 (56%)
mo	1 (21%)	9 (19%)	0 (40%)
otal	9	1	00

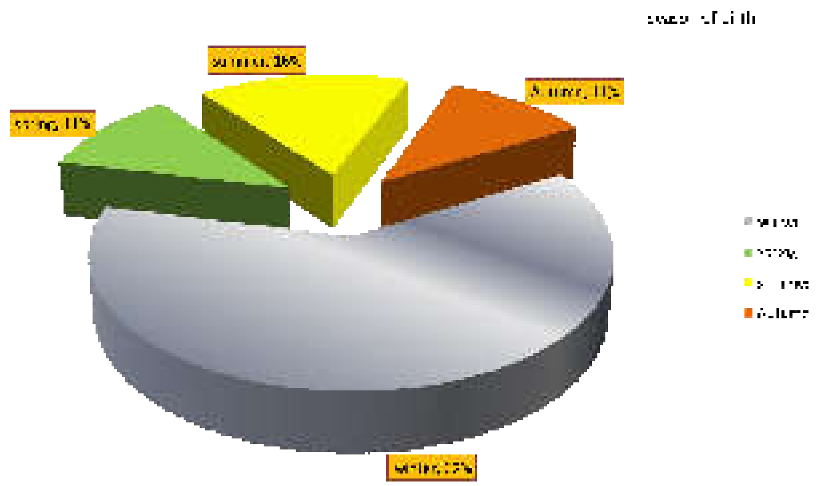
xclusive Breast	39%
reast & Diet	25%
iet	23%
ottle milk	3%
reast & Bottle	3%
reast & Cow milk (or even yogurt)	3%
reast ,bottle & diet	2%
ottle & Diet	2%

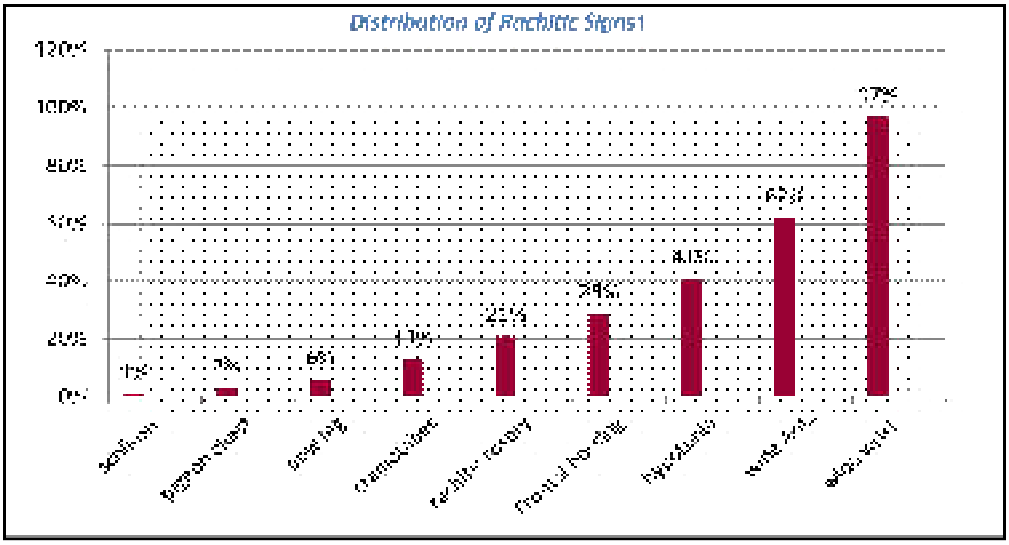
gns & Symptoms	NO %
Wide wrist	97%
xcessive sweating	91%

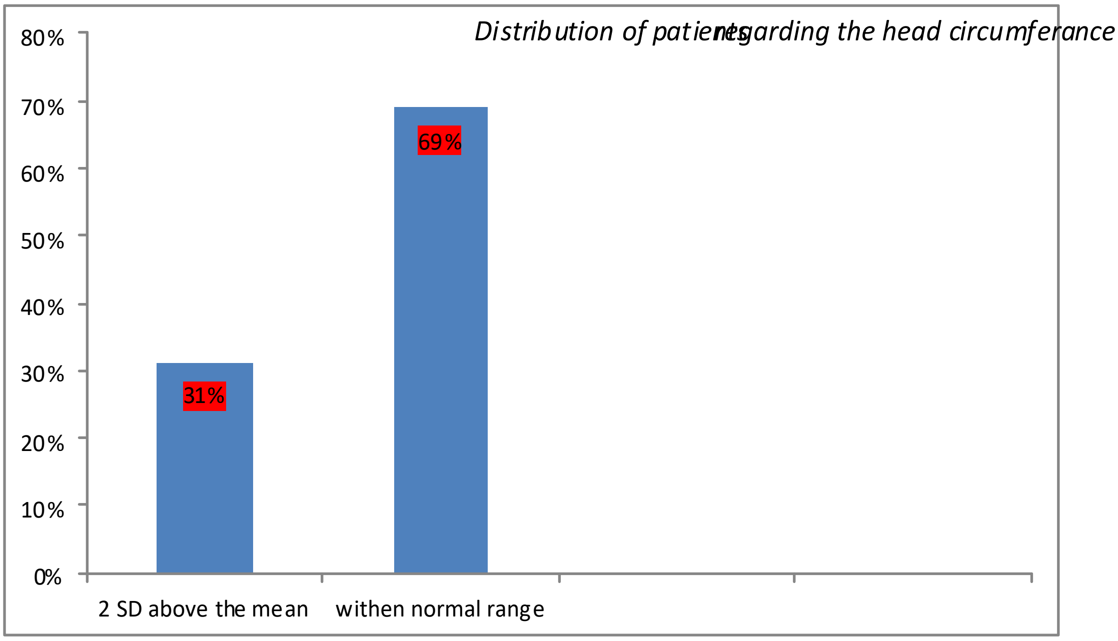


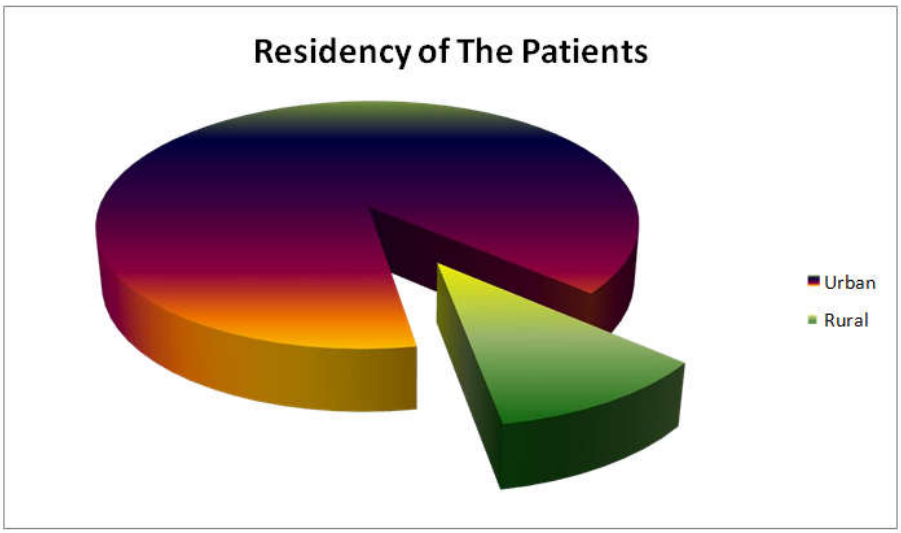
DISCUSSION

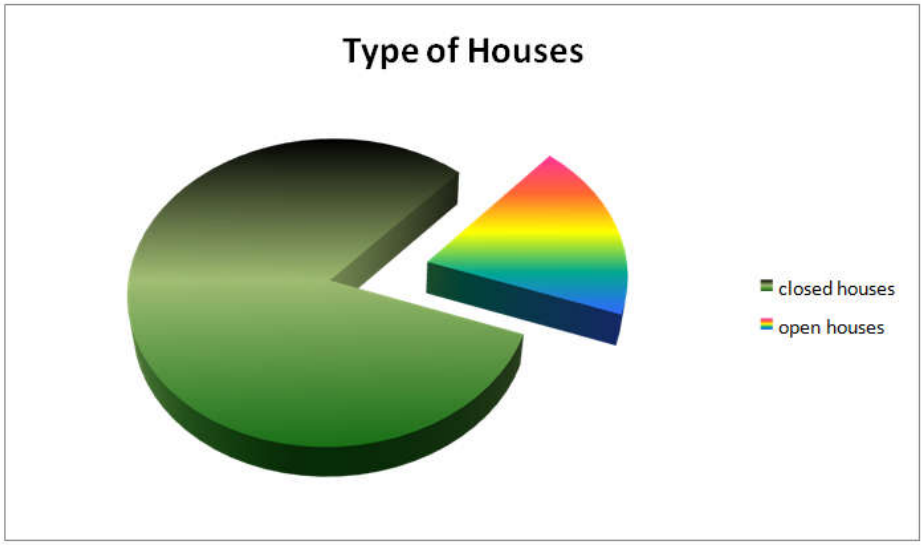
Nutritional rickets is a systemic disorder characterized by growth failure, bony deformity, hypotonia, listlessness & delayed motor development. It was not proven by any study, that sex has an effect on the incidence of rickets.56% of my patients were between 6 & 12 month old so this age group was more prominent, probably because of exclusive breast feeding, swaddling habit and low sun exposure during the early months of life.62% of my patients born during winter, the possible explanation is that usually those babies who borne in during winter in Mosul city, they were swaddled from head to feet and they were kept in door for many months away from sunshine.54% of the families included in my study have a daily income of less than 10000 ID (8$) and this, possibly, led to inadequate dietary intake in both mothers and children. The results of my study supported the fact that nutritional rickets is more prominent among the breast fed infants. A high percentage (89%) of my patients were from urban areas where




Distribution of Rachitic Signs1
120%
100%
0%


Distribution of patients regarding the head circumferance
80%
70%
60%
50%
40%
30%
20%
10%
0%
31%
69%
2 SD above the mean
withen normal range





sun exposure is absolutely less than that in rural areas, specially that, 81% of cases are still living in closed houses. In other fact, probably, that the dietary intake of vitamin D (regarding milk, eggs, cheese …) in the rural areas is much higher than in urban locations.68% of patient presented with features did not suggest the diagnosis of rickets and their parents were not aware of this additional illness, so, it is of value, not to forget rickets mainly among those with chronic illness, malnutrition or those who were exclusively fed (specially between 2014 &2018 when Mosul passed through a great disaster).

The commonest sign was widening of the wrist but only 13% of my cases were discovered to have craniotabes, this is probably due to the fact that a high percentage of them are around their first birthday and this sign (craniotabes) may disappear between the age of 8-12 months. Craniotabes should not be confused with the virtually physiological suture softening in preterm infants.31% of my cases showed head circumference 2 SD above the mean, so still rickets remain one of the causes of large head but again we should not neglect the familial large head.

Conclusion and Recommendation

Nutritional rickets is still an increasing medical problem in Mosul –Iraq, especially during the last 2 years and after what was happen between 2014 & 2017 (invasion & war of liberation) which caused a significant nutritional deficiency among pregnant & lactating women and in the children themselves. Many mothers restricted their infants to their breast s milk exclusively because of the high prices of the fortified milk. Still I noticed the ignorance of many mothers about the importance of sun exposure to their infants. As a trial to decrease the incidence of nutritional rickets among infants I advise to;

- Start an expanded program of medical education about rickets, its causes and how to prevent. We have to educate the families about the importance of taking eggs, milk, cheese, fish & liver specially during pregnancy and lactation.
- Give the pregnant women vitamin D preparation in a dose of 1000 IU / day starting on the last trimester.
- Give a massive dose of vitamin D 40000 IU /day for 10 days to all lactating women.
- Start to give all infants from day 4 old till completion of one year, vitamin D supplement of 400 IU /Day.
- Encourage adequate sun shine exposure for both mothers & children.

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