

# Bone Biochemistry In Children With Fractures Presenting With Suspected Non-Accidental Injury

## Background

- Fractures are reported in a 1/3 of children who have been abused<sup>1</sup>
- Royal College of Paediatrics and Child Health (RCPCH) recommends that assessment of fractures, where there is suspicion of physical abuse, should include bone biochemistry: calcium (Ca), phosphate (Ph), alkaline phosphatase (ALP), parathyroid hormone (PTH) and Vitamin D (Vit D)
- The British Paediatric and Adolescent Bone Group's statement on vitamin D deficiency, states that low vitamin D is not implicated in unexplained fractures when conventional radiography and biochemistry provide evidence of rickets<sup>2</sup>

## Objectives

- To examine adherence with RCPCH guidance on completion of bone biochemistry investigations described above
- To describe the pattern of bone biochemistry in children with fractures when non accidental injury (NAI) is confirmed

## Methods

Retrospective review of case notes, electronic results database and radiology records over a five year period (2012-2016)

Children included who were under two years of age and had undergone a skeletal survey as part of a child protection investigation and were found to have one or more fractures

A criteria to classify NAI was used to confirm whether fractures were as a result of physical abuse

Bone biochemical markers were classified as normal or abnormal using local reference ranges

Vitamin D deficiency was classified as Vitamin D <25nmol/L and insufficiency as 25 – 50 nmol/L

## Results

Case No	Age (W)	Vit D (nmol/L)	Ca (mmol/L)	Ph (mmol/L)	PTH (pmol/L)	ALP (IU/L)
1	4	24	2.4	2.22	11	255
2	36	30	2.26	1.59	9.2	221
3	3	42	2.51	1.97	1.6	287
4	9	45	2.53	1.75	8.5	344
5	12	46	2.54	1.83	2.5	385
6	7	46	2.47	2.04	4.8	288
7	24	46	2.54	1.83	2.5	385
8	4	46	2.67	2.25	4.8	404
9	56	47	2.25	1.07	7.8	205

Table 1: Bone biochemistry results for confirmed NAI cases where vitamin D is in deficient or insufficient range

•Biochemistry Reference Ranges  
 Calcium (mmol/L) (<4weeks – 2.0 – 2.7, 4 weeks – 15 years – 2.2 – 2.7)  
 Phosphate (mmol/L) (<4 weeks – 1.3 – 2.6, 4wk - < 1yr – 1.3 – 2.4, 1yr – 15yr – 0.9 – 1.8)  
 ALP (IU/L) (<4wk – 70-380, 4wk – 15yr – 60-425)  
 Parathyroid Hormone (pmol/L) (<1yr – 0.7 – 9.4, 1 - <9 yr – 1.7 – 6.7)

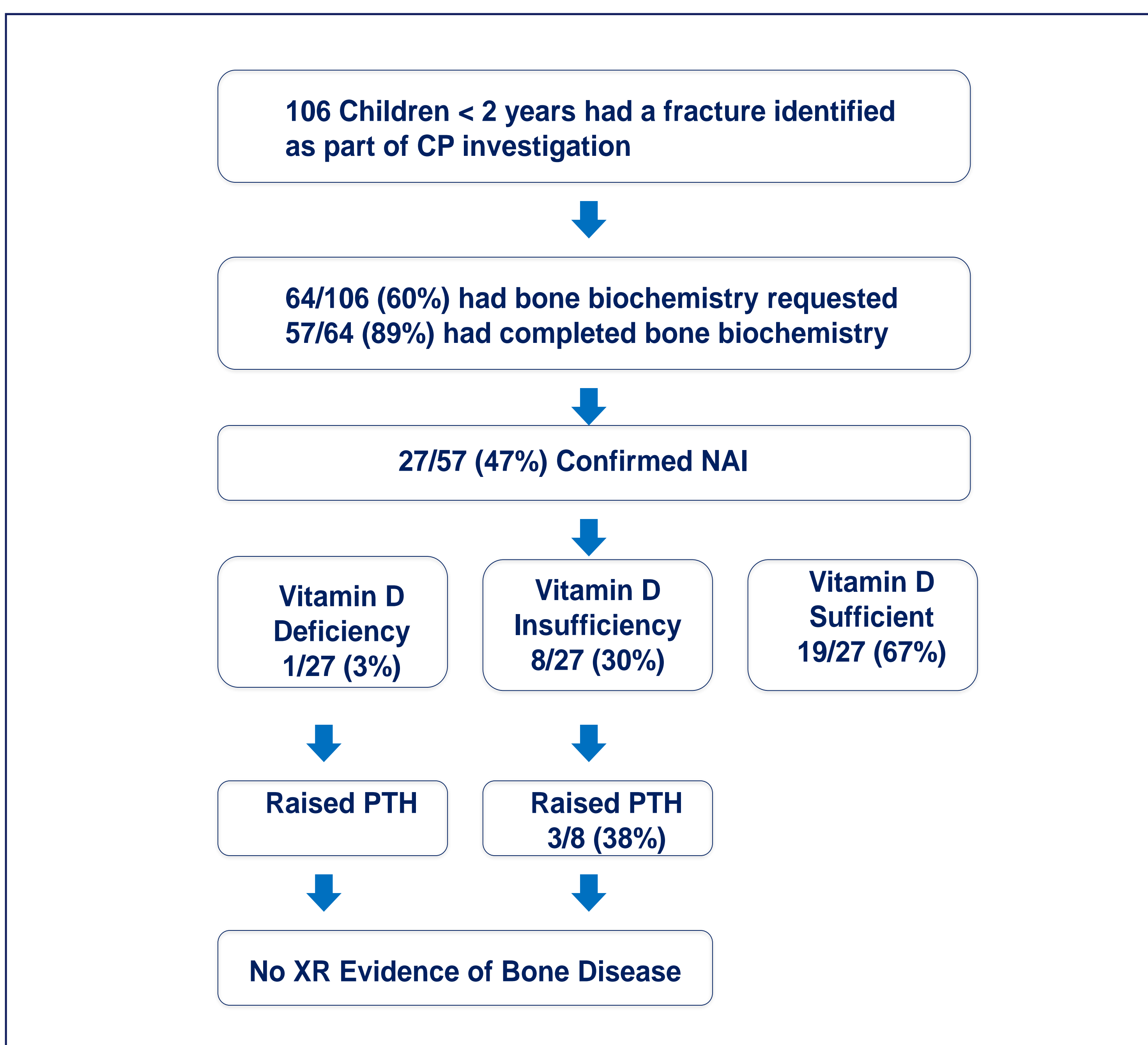


Figure 1: Summary of results

Non accidental injury (NAI) Definition	Confirmed non accidental injury either at case conference, by criminal conviction or perpetrator confession
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## Discussion

- When decision was made to investigate fractures biochemically, adherence to RCPCH guidance was good
- In NAI population 1/3 had vitamin D in deficient or insufficient range – demonstrating that vitamin D is frequently low in this population
- 4/27 (15%) had an elevated PTH
- The one child with vitamin D deficiency also had an elevated PTH
- There is a need for further research in this area and the British Paediatric and Adolescent Bone Group statement should reflect the fact that other biochemical markers are occasionally outside the reference range in the presence of low vitamin D

## References

- Royal College of Paediatrics and Child Health. Child Protection Companion 2013. Recognition of physical abuse. RCPCH, 2013
- British Paediatric and Adolescent Bone Group. 'British Paediatric and Adolescent Bone Group's position statement on vitamin D deficiency'. British medical journal; 2012;345:e8182