Polyunsaturated fatty acids and their relationship with bone mineral density and markers of bone turnover in post-menopausal women

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Introduction

- Age-related bone loss leads to a significant decline in bone formation and an increase in bone resorption resulting in a marked negative effect on bone mineral density (BMD).

- This bone turnover cycle can be further disrupted by estrogen deficiency during menopause which can lead to a great net loss of bone in post-menopausal women.[1,2]

- Evidence suggests that n-3 polyunsaturated fatty acids (PUFA) may have a beneficial effect on the inflammatory regulation of bone remodeling and thus reducing bone loss. [3,4]

Aims/Objectives

This study investigated the relationship between PUFA status, total body BMD and bone turnover markers (BTM) in a cohort of post-menopausal women in Northern Ireland.

Methods

SCREENING (Sep 2008-Jun 2009) (n=372)

Dual-energy x-ray absorptiometry (DXA) scan
excluding osteoporotic women

PARTICIPANTS

Post-menopausal women 45 – 75y (*n*=300)

MEASUREMENTS

DXA: Body composition; BMD; T-score
BTM: serum osteocalcin, alkaline phosphatase, C-terminal telopeptides of type 1 collagen (CTX)
BTM: urinary deoxypyridinoline (DPD)
Diet & lifestyle: 4 day food diary & questionnaire

PUFA ANALYSIS (Dec 2018)

Serum concentrations (mg/ml) quantified using GC-MS
Total n6 PUFA (LA+AA)
Total n3 PUFA (ALA+EPA+DPA+DHA)
Total n6:n3 ratio was calculated

STATISTICAL ANALYSIS

Correlation & regression
SPSS v25 (SPSS Inc, Chicago, IL, USA)

Results

Table 1: Descriptives of cohort

Variable	Median (interquartile range)
	n 300
Age (years)	61.0 (10)
Height (cm)	160.1 (9.0)
Weight (kg)	67.8 (18.6)
Body mass index (kg/m^2)	27.0 (6.0)
Total body T score (SD)	0.05 (1.4)
Total body mineral density (BMD) (g/cm^2)	1.13 (0.11)
Bone mineral content (kg)	2.4 (0.4)
Age of menopause (years)	50 (6)
	n 299
LA:ALA ratio	33.472 (14.817)
Total n3 (mg/mL)	0.231 (0.128)
Total n6 (mg/mL)	1.248 (0.477)
n6:n3 ratio	5.82 (2.63)
LA (mg/mL)	0.954 (0.383)
AA (mg/mL)	0.301 (0.124)
ALA (mg/mL)	0.265 (0.017)
EPA (mg/mL)	0.055 (0.046)
DPA (mg/mL)	0.035 (0.014)
DHA (mg/mL)	0.096 (0.061)
Serum CTX (ng/mL)	0.6 (0.3)
Serum Osteocalcin (ng/mL)	18.2 (10.1)
Alkaline Phosphatase (u/L)	74.0 (22.0)
Urinary CTX/creatinine (ug/mmol/L Cr)	281.7 (189.1)
DPD/Creatinine (nmol DPD/mmol Cr)	7.8 (3.0)
	n 291
Total calcium intake from food diary (mg/day)	702.0 (364.0)
Total vitamin D intake from food diary (ug/day)	2.2 (2.3)

Table 2: Correlation analysis between BTM and PUFA

Variables	Serum CTX		Serum osteocalcin		Alkaline phosphatase		Urinary CTX/creatinine		Urinary DPD/creatinine	
	r-value	*P-value*	*r-value*	*P-value*	*r-value*	*P-value*	*r-value*	*P-value*	*r-value*	*P-value*
total n3	0.004	0.944	-0.011	0.850	-0.033	0.565	-0.035	0.547	**-0.137**	**0.018***
total n-6	-0.026	0.656	-0.061	0.292	-0.026	0.65	-0.094	0.106	0.004	0.944
AA	-0.049	0.396	-0.061	0.295	-0.029	0.622	**-0.121**	**0.036***	0.014	0.805
LA	-0.015	0.792	-0.058	0.317	-0.021	0.718	-0.078	0.176	-0.009	0.876
ALA	-0.06	0.301	-0.087	0.133	0.023	0.688	**-0.123**	**0.033***	-0.100	0.085
EPA	0.020	0.725	-0.007	0.901	0.002	0.977	-0.017	0.771	**-0.150**	**0.009***
DPA	-0.017	0.774	0.018	0.762	-0.078	0.18	0.014	0.813	**-0.118**	**0.042***
DHA	-0.005	0.937	0.017	0.769	-0.07	0.227	-0.015	0.802	-0.102	0.079
n6:n3	-0.028	0.629	-0.009	0.872	0.030	0.608	-0.017	0.776	0.112	0.054

- There were no significant correlations between markers of total n3, n6, n6:n3 ratio and total body T-score, BMD or bone mineral content.
- A significant negative correlation was observed between urinary CTx and both AA and ALA and also between urinary DPD and total n3 PUFA and both EPA and DPA.

Conclusion

n3 PUFA were associated with less bone resorption therefore it is plausible that PUFA have a positive anti-inflammatory effect on bone resorption, which warrants further investigation.

References
1. Shen *et al.* 2017; 2. Orchard *et al.* 2012; 3. Kajarabille *et al.* 2013; 4. Sharif *et al.* 2010

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