Title

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Figure 1: The graphs (based on mixed models) illustrate the associations between Goutallier Grade and Flexion and Extension Force.

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THE RELATIONSHIP BETWEEN ULTRA-PROCESSED FOOD INTAKE AND KNEE CARTILAGE THICKNESS IN MEN AND WOMEN:DATA FROM OSTEOARTHRITIS INITIATIVE

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Purpose (the aim of the study): Knee osteoarthritis (KOA) continues to be a burdensome disease on our globally aging population with increasing obesity. Compared to men, women with KOA appear to have higher rates of cartilage loss. Lifestyle is an important reason behind this sex discrepancy, for which diet is a modifiable factor. Earlier research has highlighted the importance of healthy diets for healthier joints. The prevalence of ultra-processed foods (UPF), defined as food items that are prepared using industrial-scale chemical processing methods is increasing in food markets. Their longer shelf life and increased palatability have increased their presence in our diets especially in the Western world. However, adverse health outcomes have been reported with increased UPF consumption. To date, the relationship between UPF and structural changes related to KOA has not been investigated. This study examined the relationship between UPF and cartilage thickness in men and women with or at risk for developing KOA.

Methods: Participants from the Osteoarthritis Initiative at enrollment (n= 4330, 1817 [42%] men; mean age= 61.3 ± 9.2; mean BMI = 28.6 ± 4.8 kg/m^2) without rheumatoid arthritis(n=66) or unplausible food frequency questionnaire (FFQ) data(n=400) were included.
Dietary information was assessed based on Block Brief 2000 FFQ. It consists of 102 questions on various foods and beverages and inquiries about the quantity (standard servings) and frequency ("everyday" to "never") of their consumption during the past year. UPF intake was calculated as per NOVA Classification, which groups diet into four classes based on the degree of processing during preparation. NOVA-4 indicates UPF at the highest processing level. The predictor was the percentage of UPF proportion in the daily diet (servings) (NOVA-4/∑(NOVA1-4) x100/365) (**Fig. 1**), the outcome was cartilage thickness (both knees) at enrollment, quantified in 5 regions (medial and lateral tibia [MT-LT]/ femur [MF- LF] and patella) on 3T MRI.

Mixed effects models accounting for two knees/person and 5 regions/knee were used. To assess potential variations in the relationship between UPF and cartilage thickness based on sex and region, a triple interaction model between UPF-region-sex (along with corresponding two-way interactions) was employed. If the interaction was statistically significant ($p < 0.05$) sex- and region-stratified mixed models were employed. All models were adjusted for age, BMI, total daily caloric intake, sex, race, Physical Activity Score of Elderly (PASE), presence of medical insurance and depression. β coefficients represent the change in cartilage thickness (mm) for each 1% increase in UPF proportion (servings) in daily diet.

Results: There was a significant interaction between UPF-cartilage region and sex (p=0.037), suggesting that the association between UPF and cartilage thickness varies by both sex and region. In women, higher UPF was associated with thinner cartilage in MT (β=-0.50, $p < 0.001$), MF (β=-0.51, $p < 0.001$) and LF (β=-0.43, $p < 0.001$). In men, the association between UPF and thickness was not statistically significant in majority of the cartilage regions (β range: 0.10-0.23, $p > 0.05$); the association was significant in the MT (β= 0.40, p=0.016). **Fig. 2** illustrates the associations between UPF and cartilage thickness in men and women for each cartilage regions. **Table 1** outlines sex-stratified relationships between UPF and cartilage thickness in the five knee cartilage regions.

Conclusions: Higher UPF consumption may be associated with KOA in women that is evidenced by thinner cartilage, primary on the medial side of the joint, which may help explain the disproportionately higher disease burden in women. These findings suggest that the contents of our modern diet may be an independent factor affecting cartilage health.

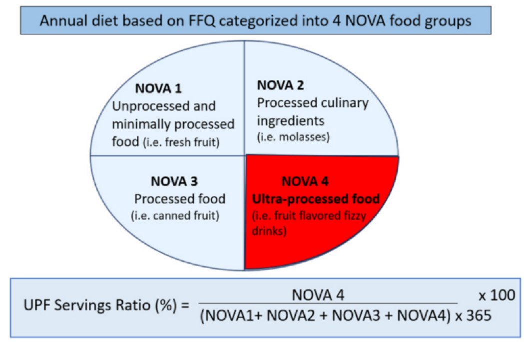

Figure 1. Assessment of the proportion of ultra-processed foods (the predictor) in the overall diet, based on Block Brief 2000 Food Frequency Questionnaire, according to the NOVA Classification of diet.

Figure 1

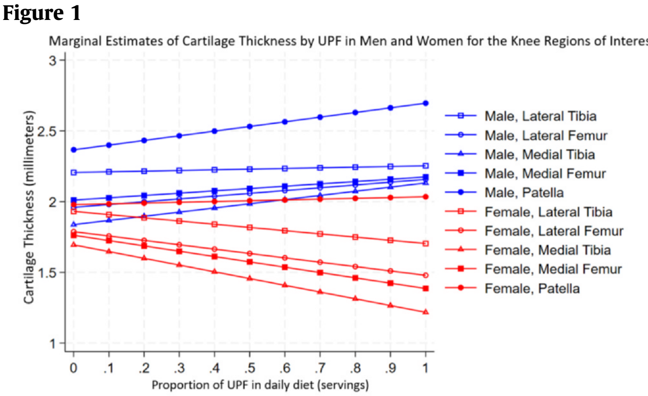

Figure 2: Marginal estimates of cartilage thickness by UPF in men and women for the five knee cartilage regions of interest derived from mixed effects models.

Figure 2

Table 1. Sex-stratified results from mixed effects models with annual UPF servings ratio in diet as predictor and individual cartilage thickness measurements for 5 regions in the knee as outcomes. Beta coefficients represent change in cartilage thickness (in millimeters) for each 1% increase in UPF proportion (servings) in daily diet.

		UPF Proportion (%) in Daily Diet (Predictor)			
		Women		Men	
Cartilage Thickness Outcomes (mm)		β (95%CI)	p-value	β (95%CI)	p-value
Cartilage Regions	Lateral Tibia	-0.22 (-0.51, 0.07)	0.130	0.11 (-0.28, 0.50)	0.528
	Lateral Femur	**-0.43 (-0.66, -0.19)**	**<0.001**	0.23 (-0.10, 0.56)	0.169
	Medial Tibia	**-0.50 (-0.74, -0.26)**	**<0.001**	**0.40 (0.08, 0.72)**	**0.016**
	Medial Femur	**-0.51 (-0.77 -0.25)**	**<0.001**	0.23 (-0.15 0.60)	0.232
	Patella	-0.003 (-0.35, 0.35)	0.988	0.10 (-0.02, 0.21)	0.090

Bold numbers indicate statistically significant results. All models are adjusted for age, race, BMI, PASE, total daily caloric intake, presence or absence of depression and medical insurance.

Table 1