

# *An update on nutrition and immune function*

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**Dairy Council NI 2013**



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# Immune function

- The immune system is a complex and integrated network of cells, cell products and tissues that defend against foreign pathogenic antigens and protects against the development of inflammatory disease.
- It consists of the innate immune system and the adaptive immune system.

	<b>INNATE</b>	<b>ADAPTIVE</b>
<b>Characteristics</b>		
<b>Specificity</b>	Structures shared by pathogens	Antigens of pathogens and foreign bodies
<b>Memory</b>	None	Yes
<b>Response time</b>	Rapid – minutes/hours	Slow – days/weeks
<b>Components</b>		
<b>Physical &amp; chemical barriers</b>	Skin, mucosal epithelia, mucous, tears, normal flora	Lymphocytes (T & B cells) and antibodies
<b>Blood proteins</b>	Complement	Antibodies
<b>Cells</b>	Phagocytes (macrophages & neutrophils) & NK Cells	Lymphocytes

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# Nutrition and the immune system

- *Nutrition* influences the immune system response
  - Malnutrition is the most common cause of immunodeficiency in the world
  - Inadequate, deficient and excess intake of nutrients can impair the immune response
  - Sustained malnutrition can lead to chronic inflammatory related disease and organ damage
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# **Examples of how nutrition and the food we eat impacts on the immune response and health.....**

# Examples

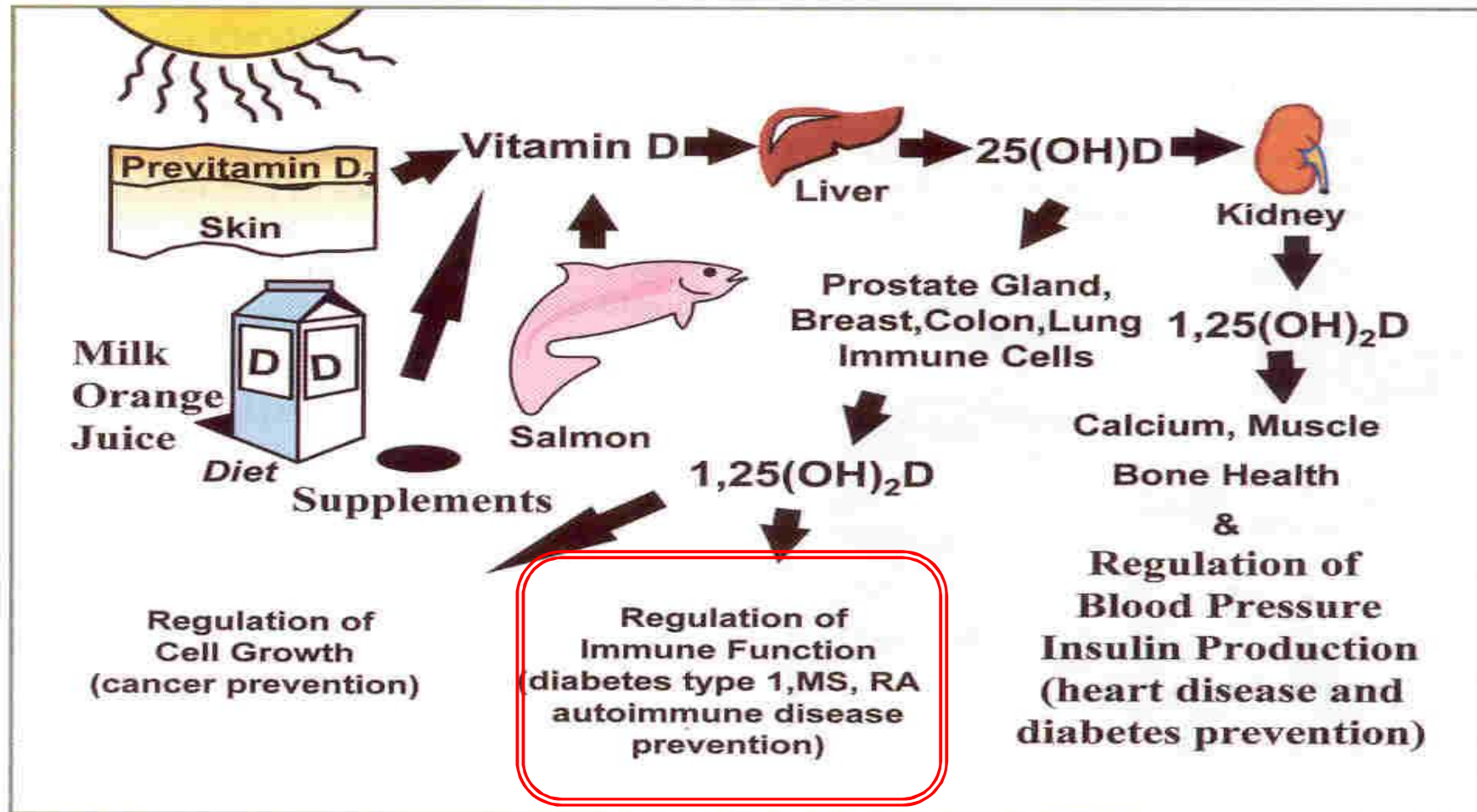
- Vitamin D in normal population
- Vitamin D in clinical condition
- Seaweed as a functional food





# Recent developments.....

## Vitamin D deficiency



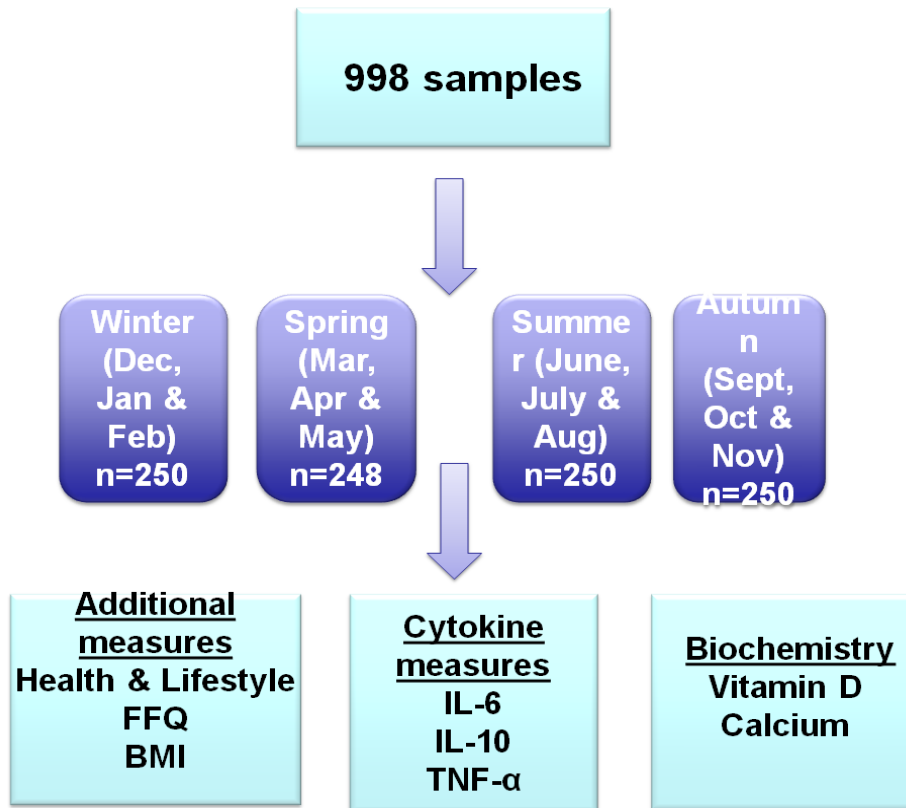


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# Vitamin D – immune system

- Key role in innate and adaptive immunity activation
  - Key role in producing antimicrobial peptides (cathelicidin and defensins) following Toll-like receptor stimulation
  - Key role in T-cell recognition of presented antigens
  - Key role in the production of antibodies by B cells
  - Important in clearance of infections
  - Importance in clinical conditions . autoimmune disease
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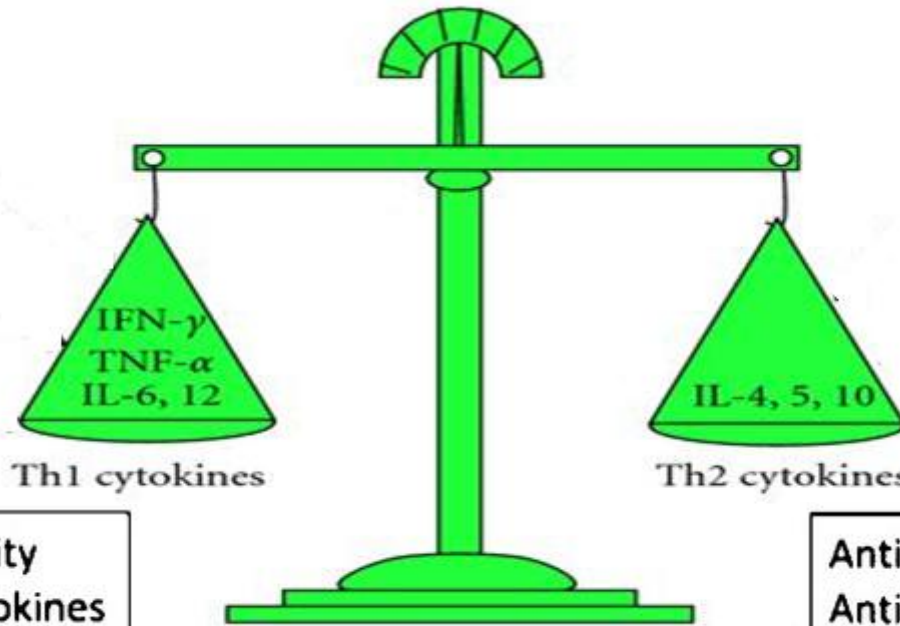
**Figure 1. Study Design:**



Aim ó to investigate the association between vitamin D status, immune markers of inflammation and the ratio of pro: anti-inflammatory cytokines within free living Irish adults (>60yrs) form the Northern Ireland Cohort of the Trinity Ulster Department of Agriculture (TUDA) study.

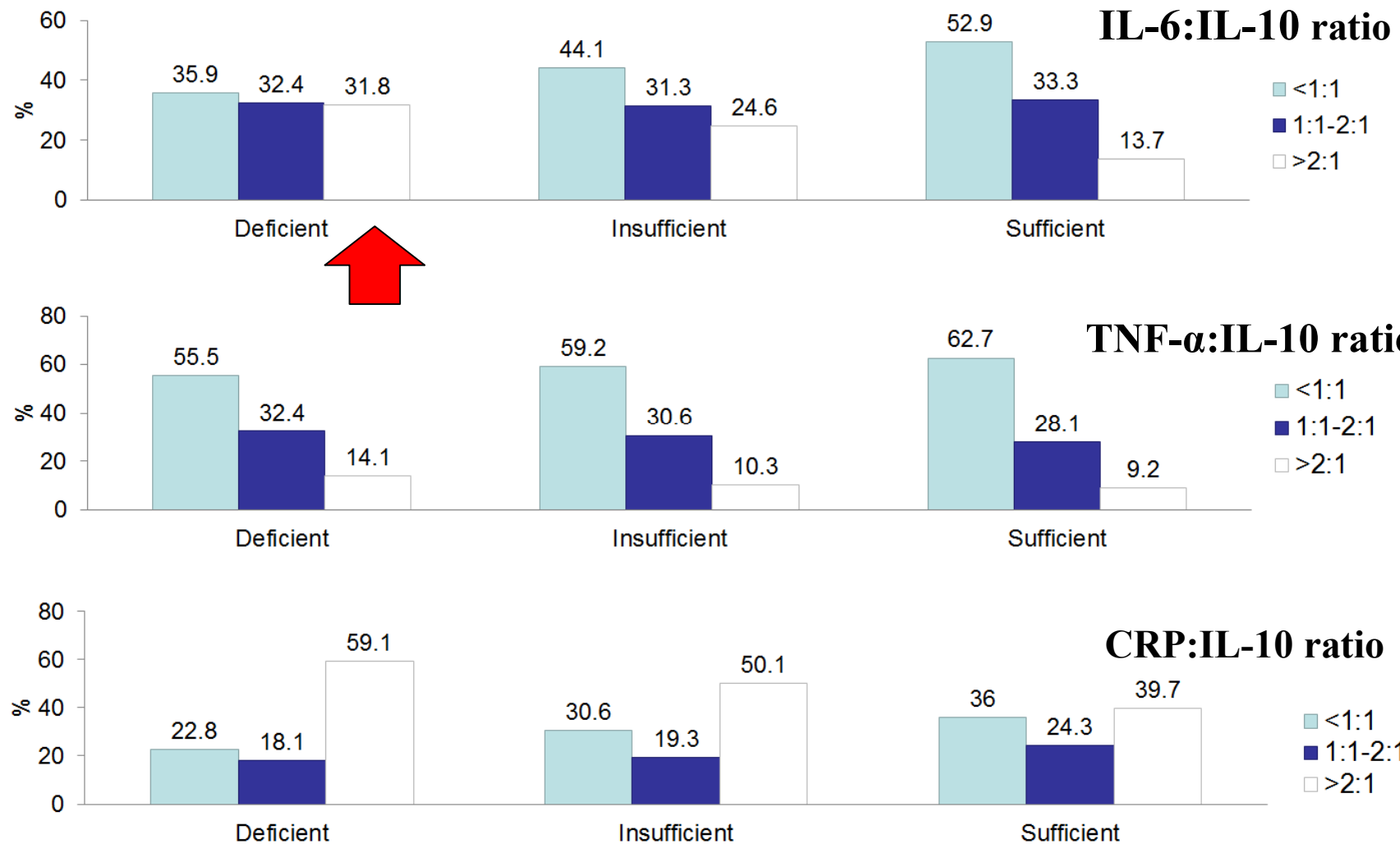
TNF-alpha  
IL6

IL10

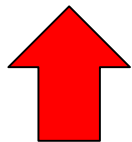
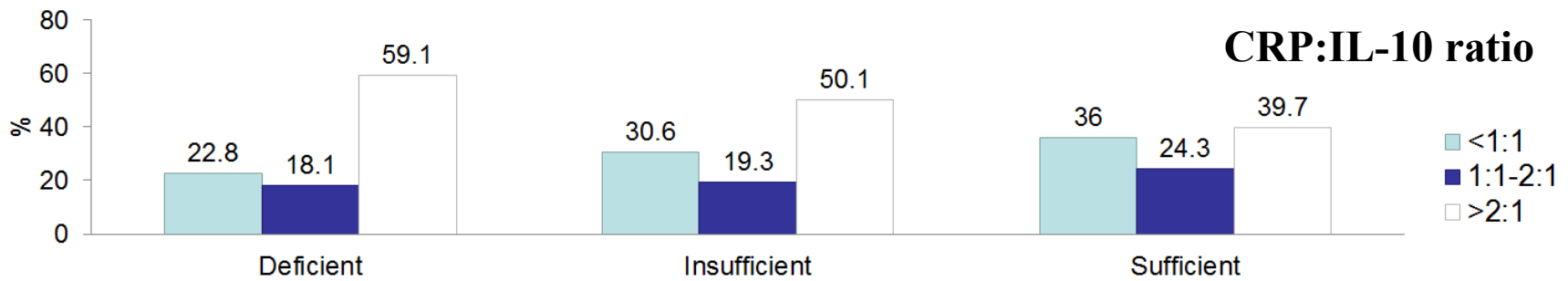
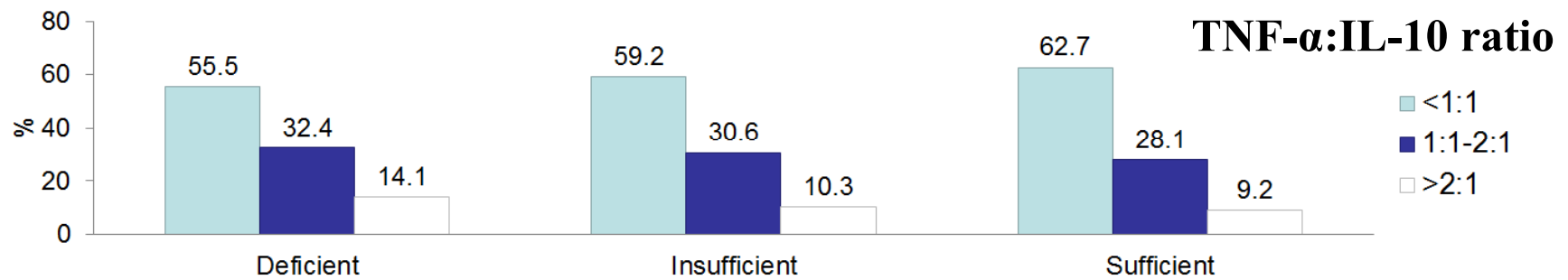
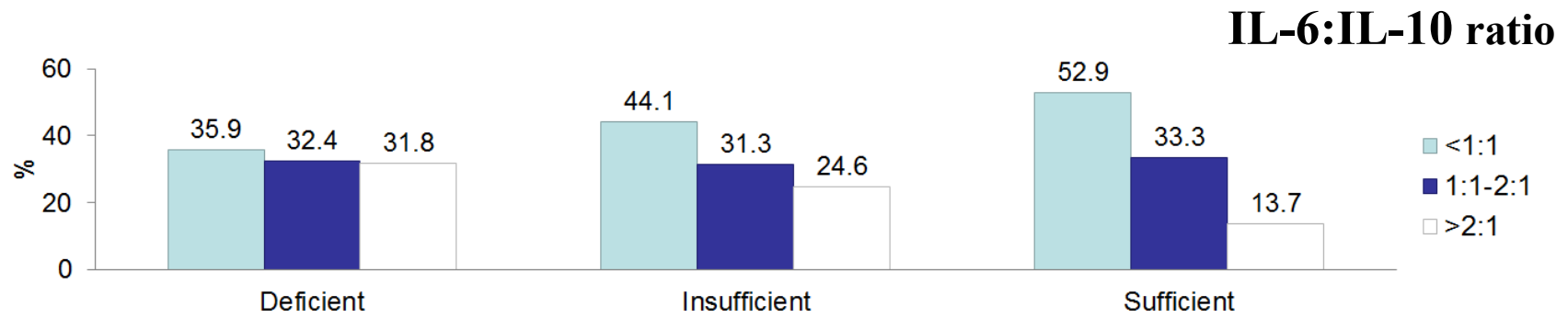


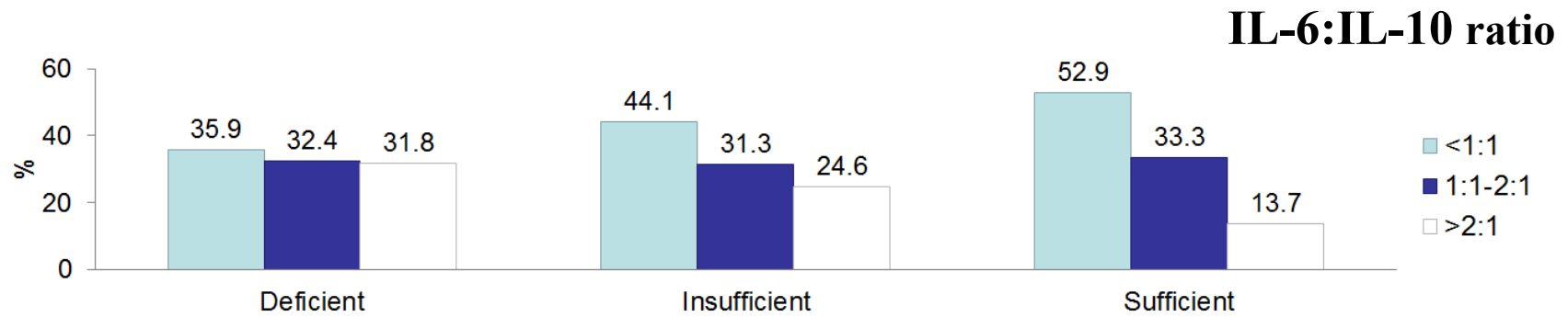
Cell-mediated Immunity  
Pro-inflammatory Cytokines

Antibody-mediated Immunity  
Anti-inflammatory Cytokines

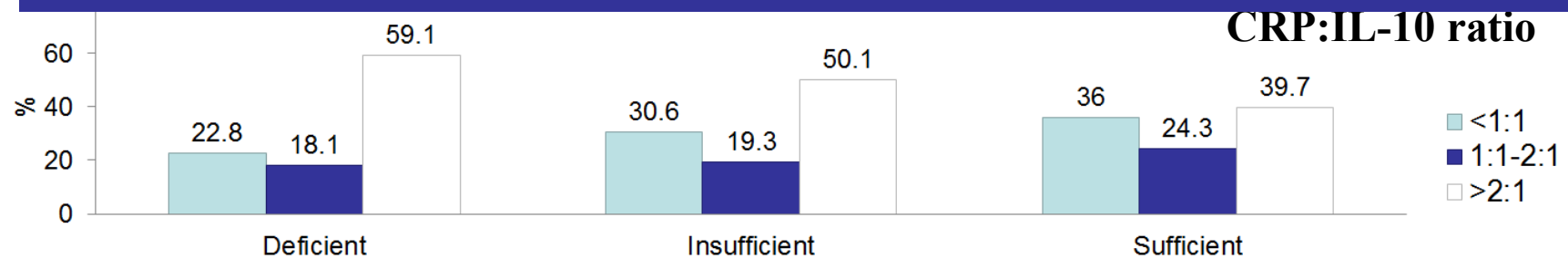


Individuals vitamin D deficient (<25nmol/l) were significantly more likely to have a IL-6:IL-10 ratio >2:1 than those with sufficient status (>75nmol/l) ( $P<0.001$ , OR 2.372, CI 1.09-5.13) adjusted for age, sex, BMI and smoking.





Therefore vitamin D deficiency impairs immune balance in healthy adults

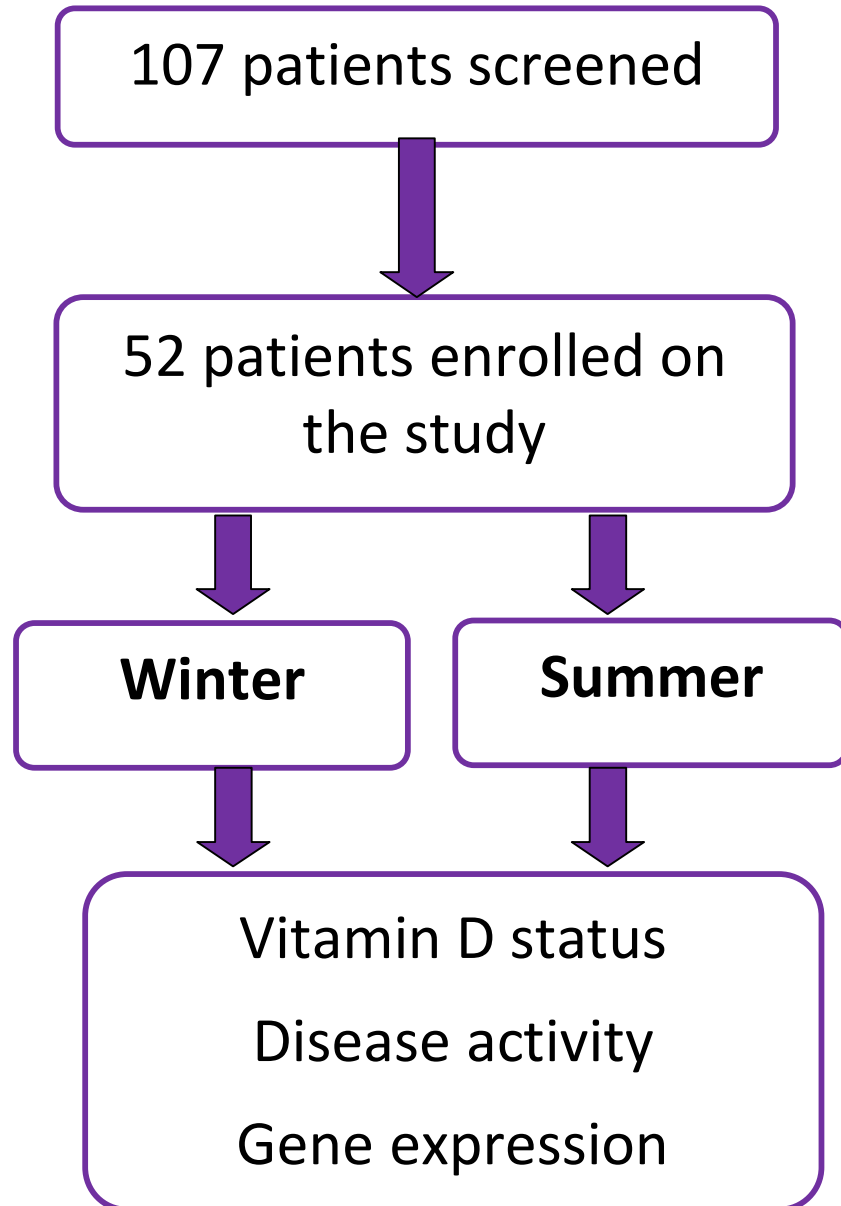


# Systemic lupus erythematosus (SLE)

- Prototypic autoimmune disease
- Genetic susceptibility + exposed to an environmental stimuli
- Vitamin D deficiency common
  - Photosensitivity
  - Sun avoidance
  - Medication use
- Deficiency associated with disease activity



# Vitamin D and SLE



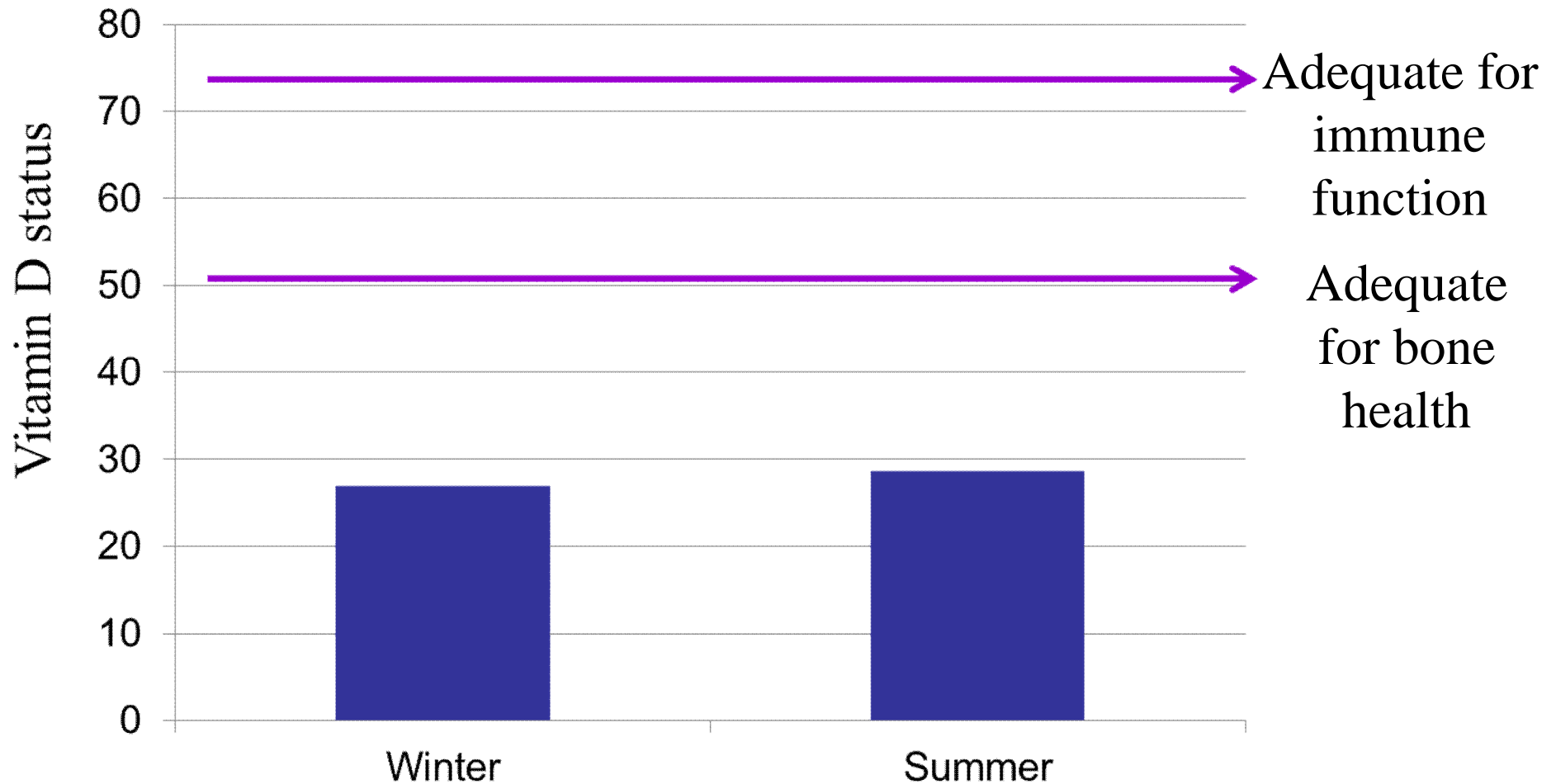
## Aim:

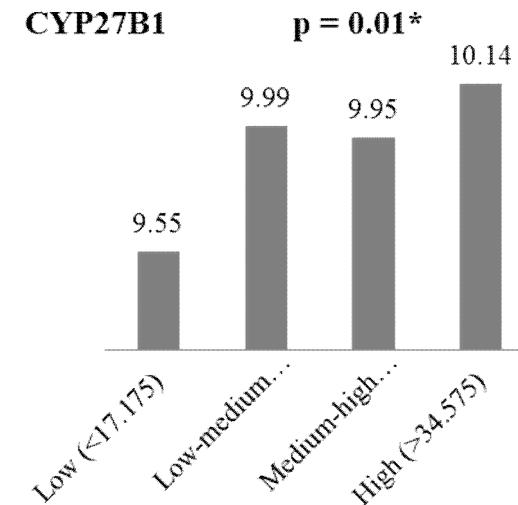
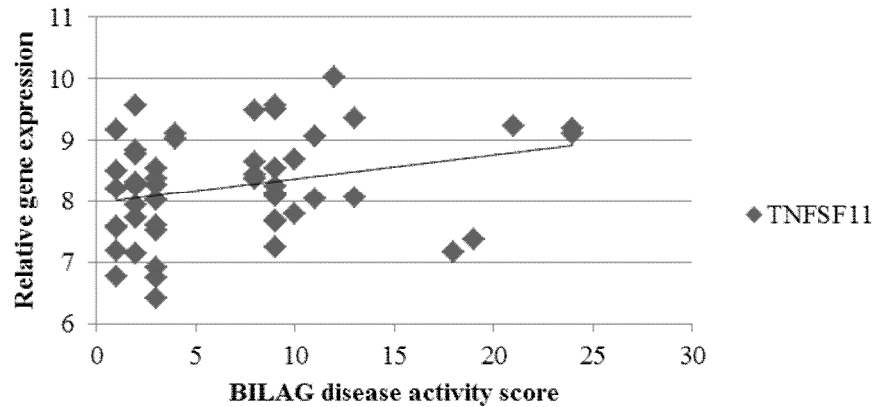
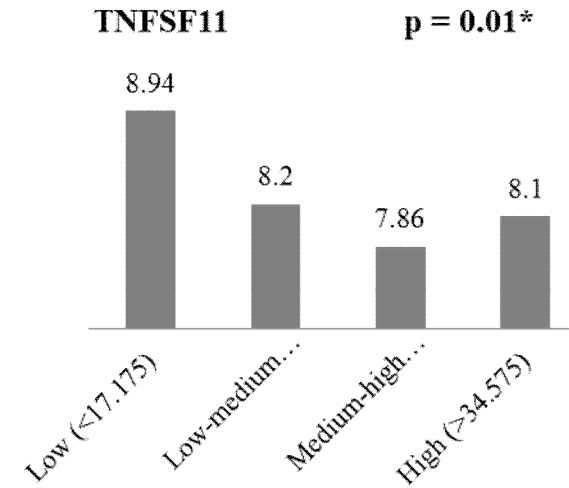
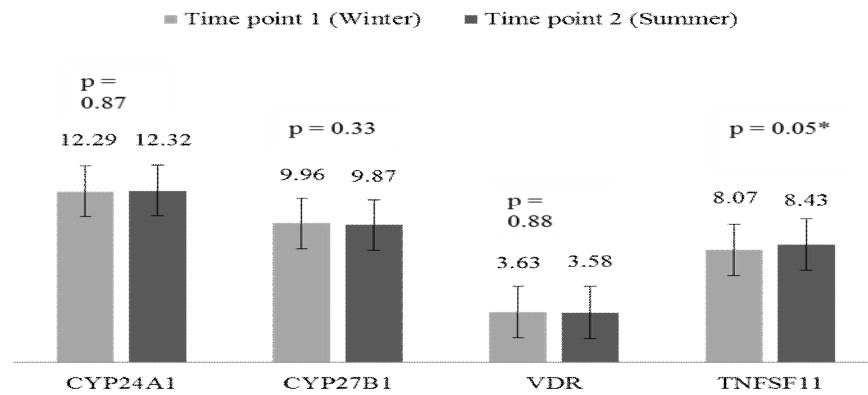
"To test for seasonal variation in vitamin D status

"To investigate the relationship between vitamin D status and disease activity

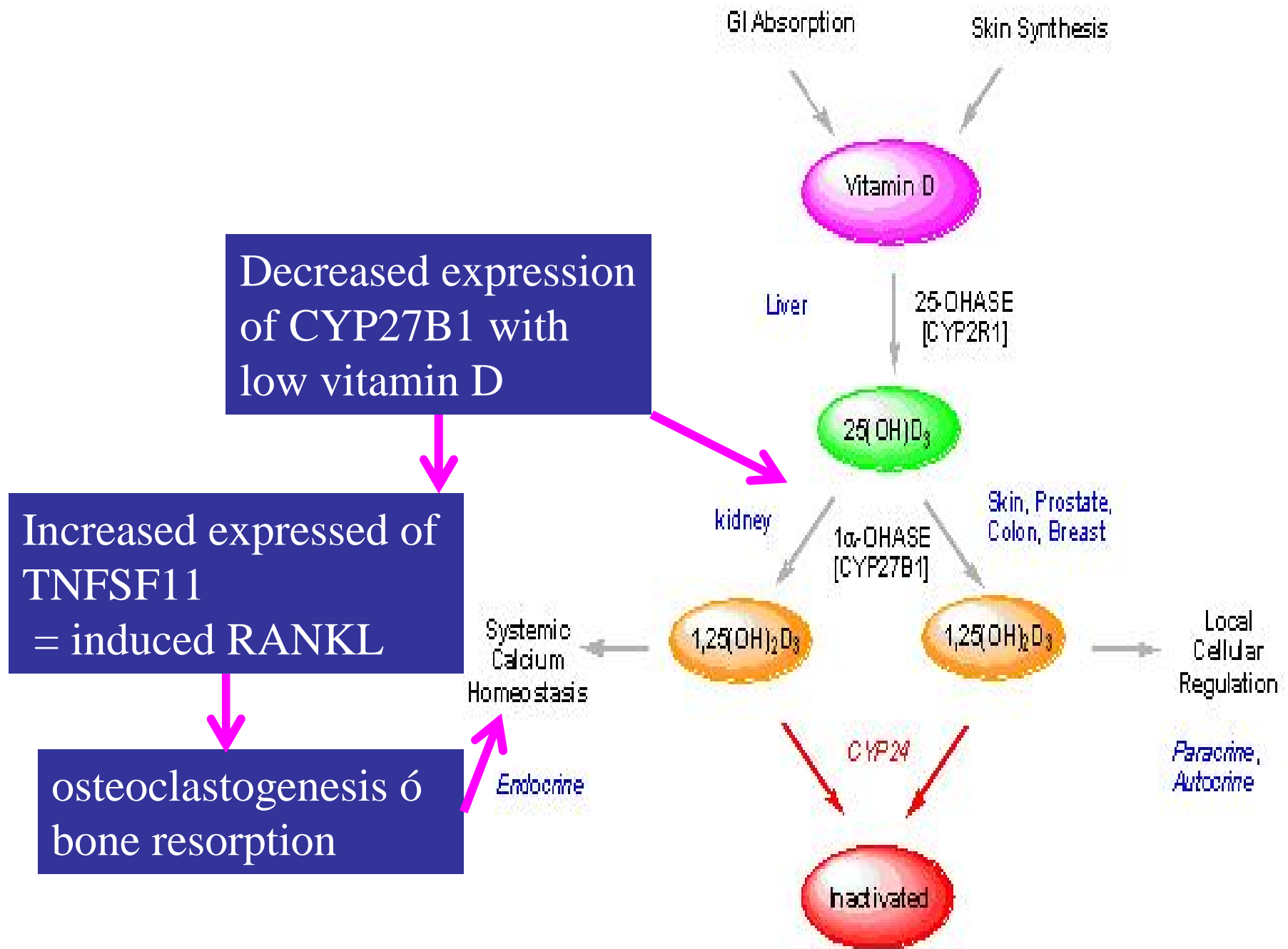
"To investigate vitamin D regulated genes in relation to vitamin D status and disease activity

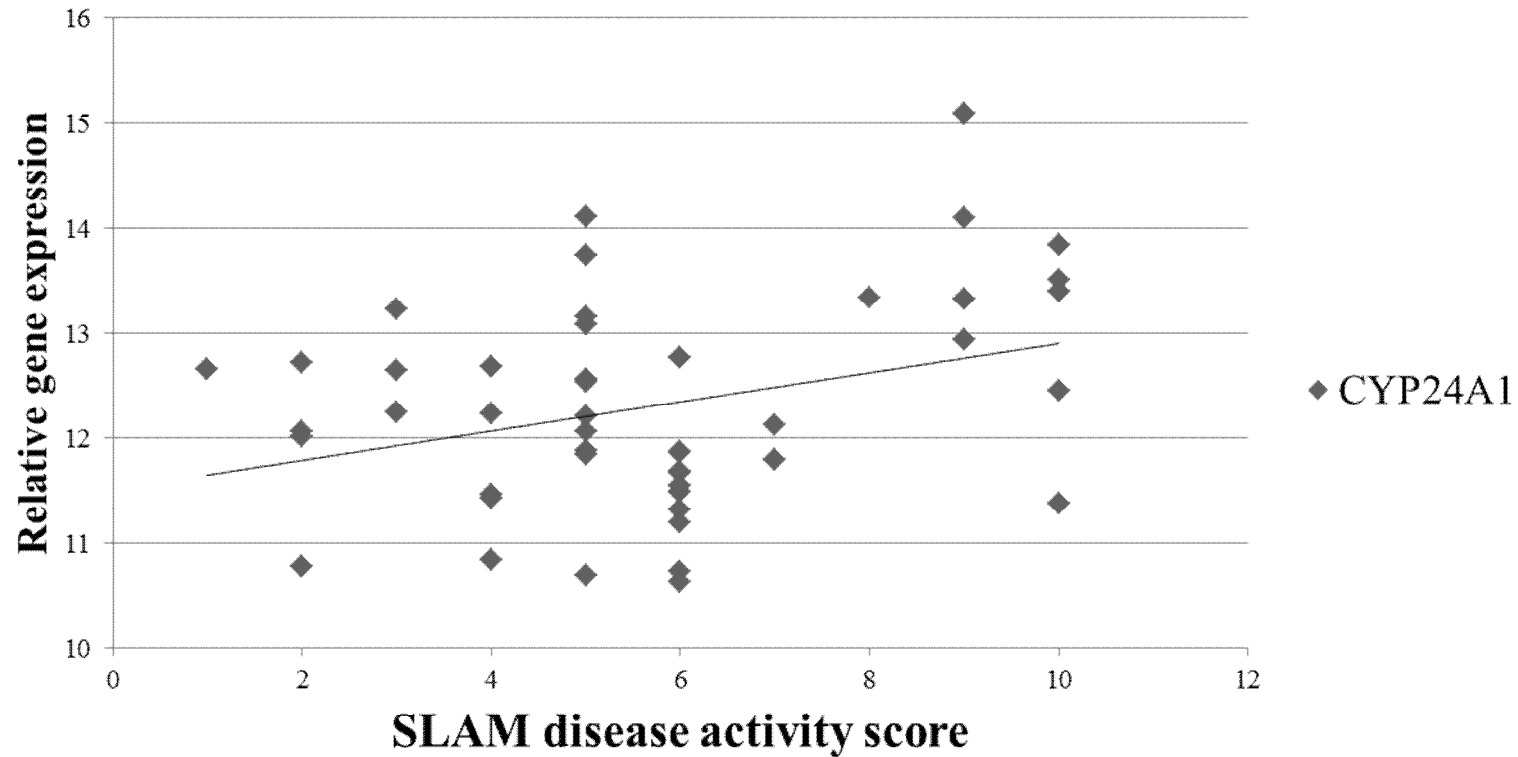
Lower vitamin D status was associated with greater disease activity



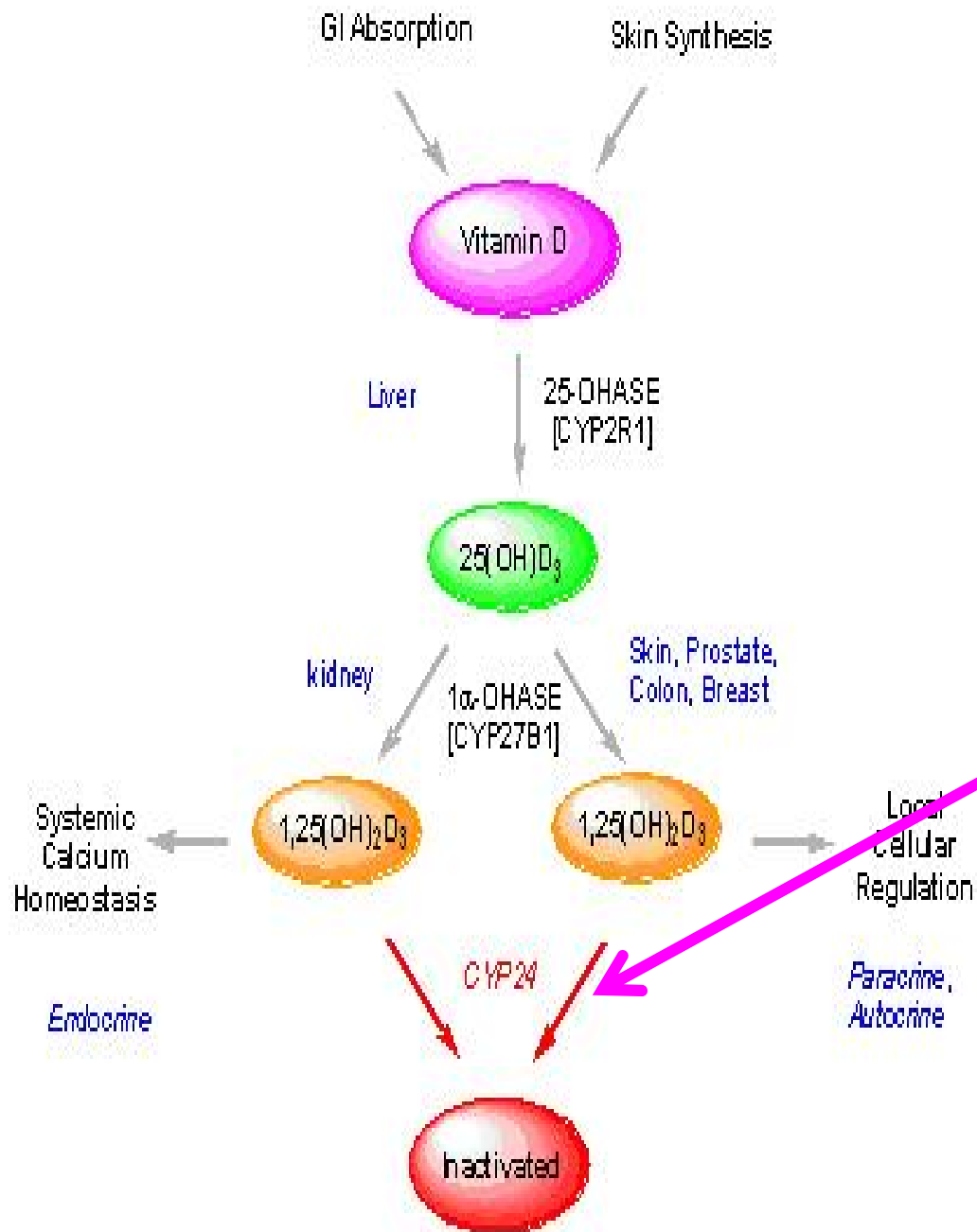


Significantly higher expression of TNFSF11 during summer and significantly higher expression with severe vitamin D deficiency and lower expression of CYP27B1. Negative correlation between TNFSF11 and CYP27B1





Increased expression of CYP24A1 = a reduction in  $1,25(\text{OH})_2\text{D}$



Increased expression with disease activity

Loss of vitamin D immune regulation

## Functional food - seaweed

- NutraMara project . [www.nutramara.com](http://www.nutramara.com)
- An investigation into the effect of consuming bread containing *Palmaria palmata* on markers of inflammatory status in healthy adults+





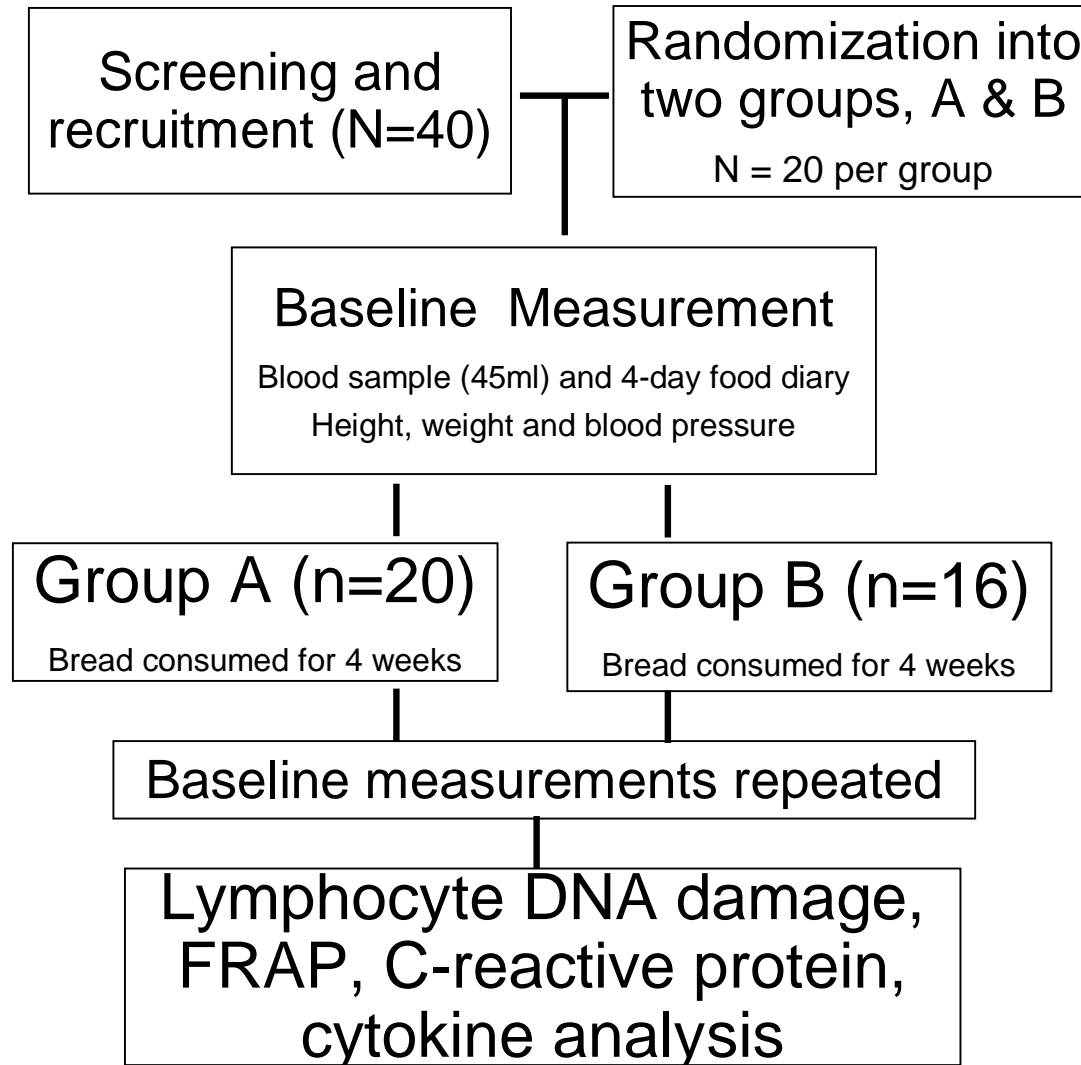
# SeaPalm Study

- *Palmaria palmata* sustainable
- Good anti-oxidant, anti-hypertensive potential, anti-genotoxic activity
- Safe to eat (GRAS) & routinely eaten in Ireland
- Suitable for incorporation directly into a food
- Lower iodine content than other seaweeds



# SeaPalm study

## Double blind, randomized controlled, parallel study



**20 volunteers consume  
bread roll  
(220g/day) – Placebo**

**20 volunteers consume  
dulse bread roll  
(220g/day) – 5g/day  
dulse**

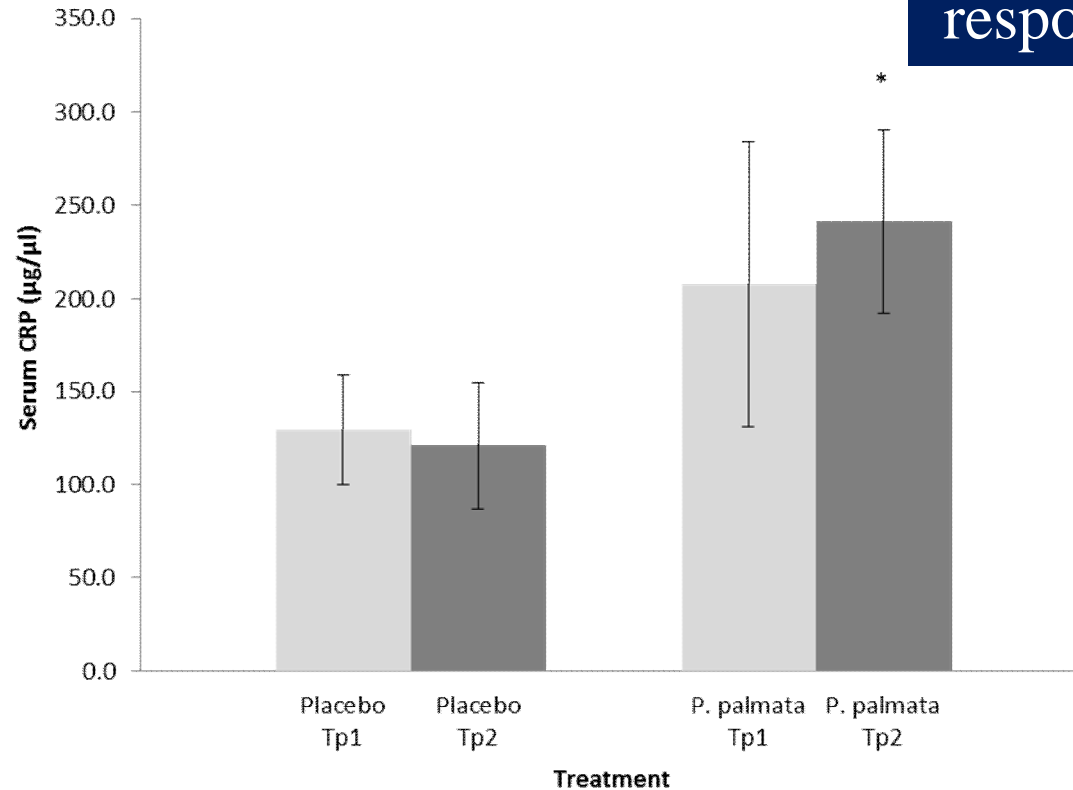


## Bread rolls used for the SeaPalm intervention



# Serum CRP

Appears to enhance immune inflammatory response

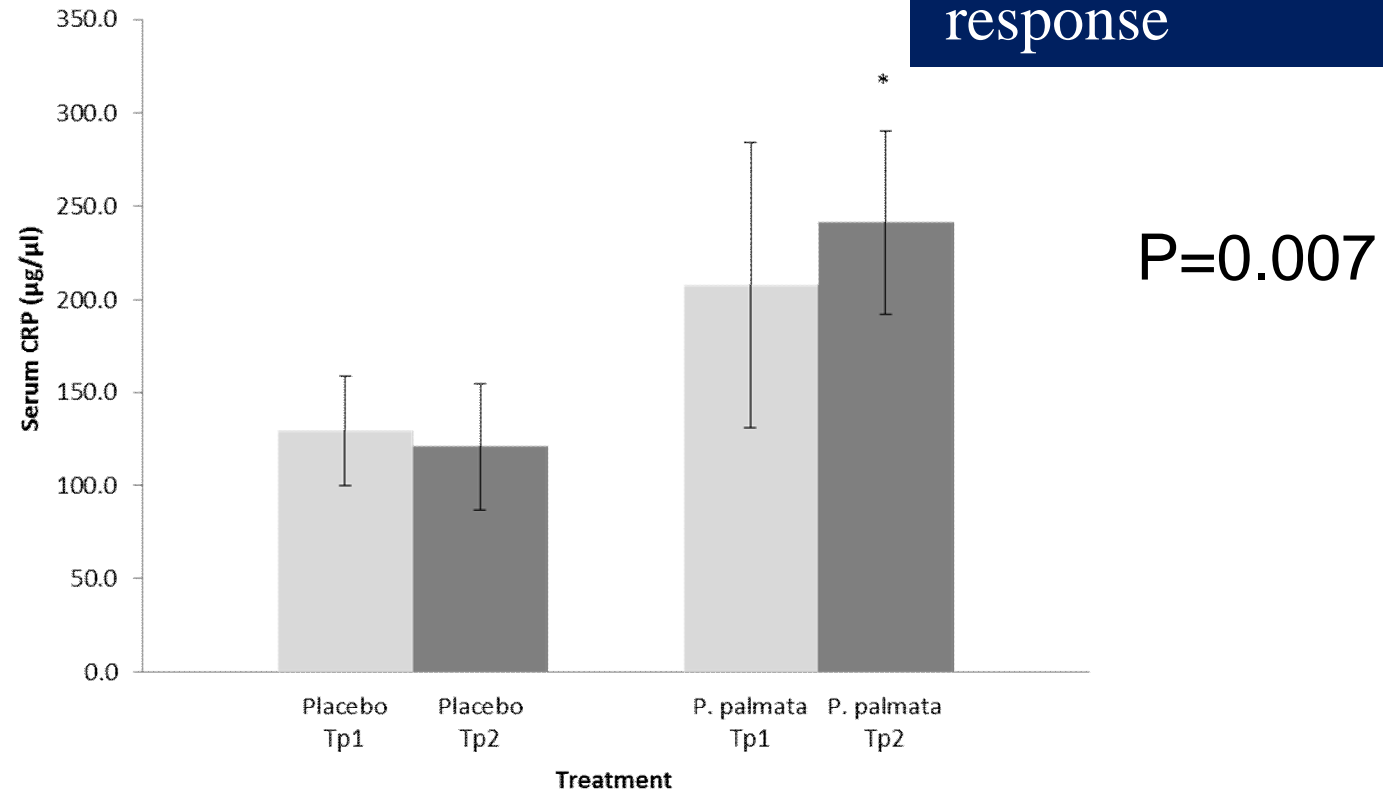


P=0.007

- Supplementation resulted in significantly increased C-reactive protein (CRP) following adjustment for age, sex, BMI and smoking status . ANCOVA analysis

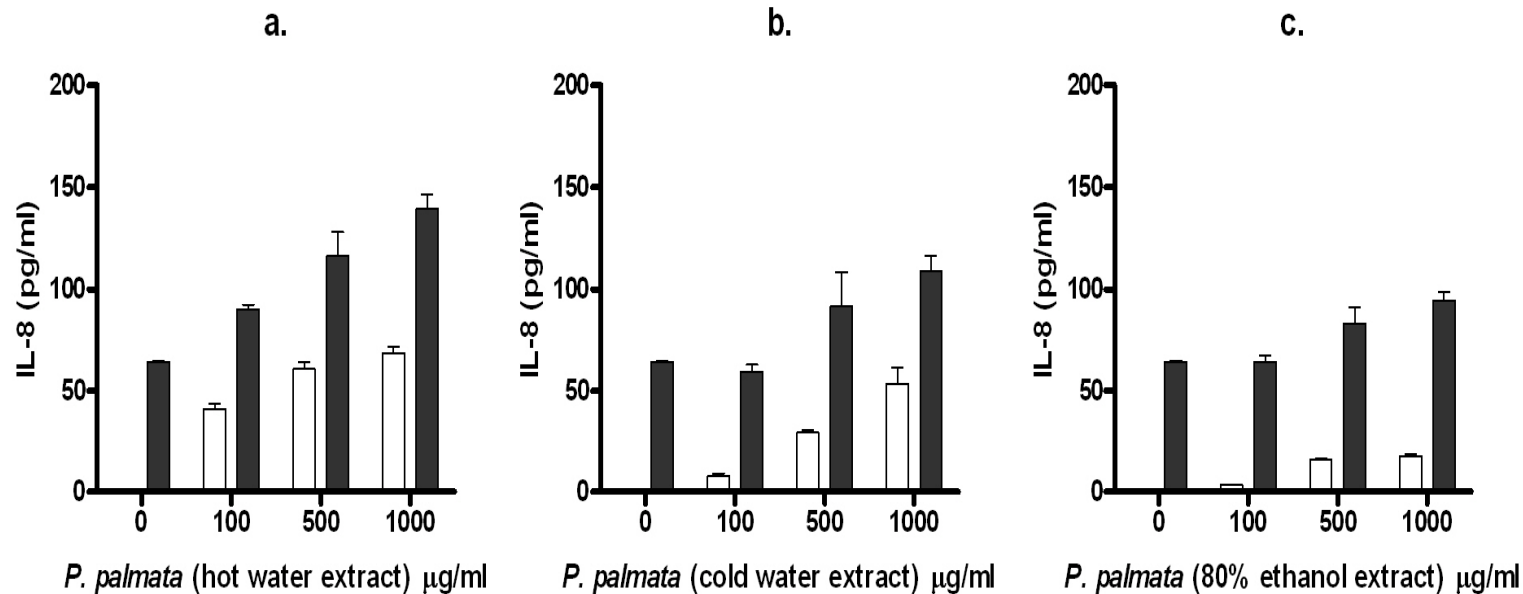
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## *In vitro* - Immune function



Effect of various types of *P. palmata* extract on IL-8 secretion in Caco-2 cells in presence (filled bars) or absence (empty bars) of TNF $\alpha$



## *In vitro* - Immune function

a.

b.

c.

2007

2007

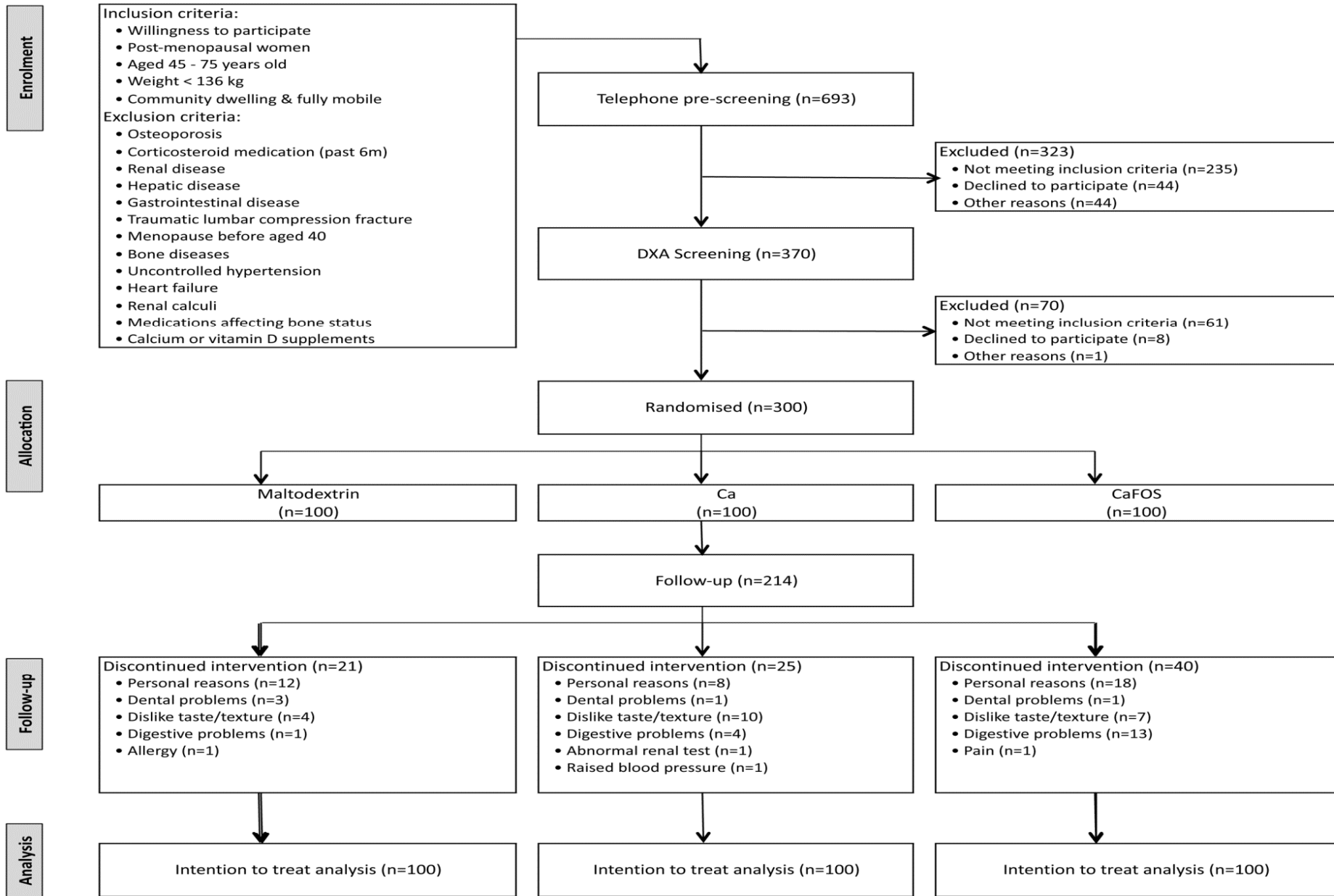
2007

*Palmaria palmata*  
impairs immune balance in healthy  
adults

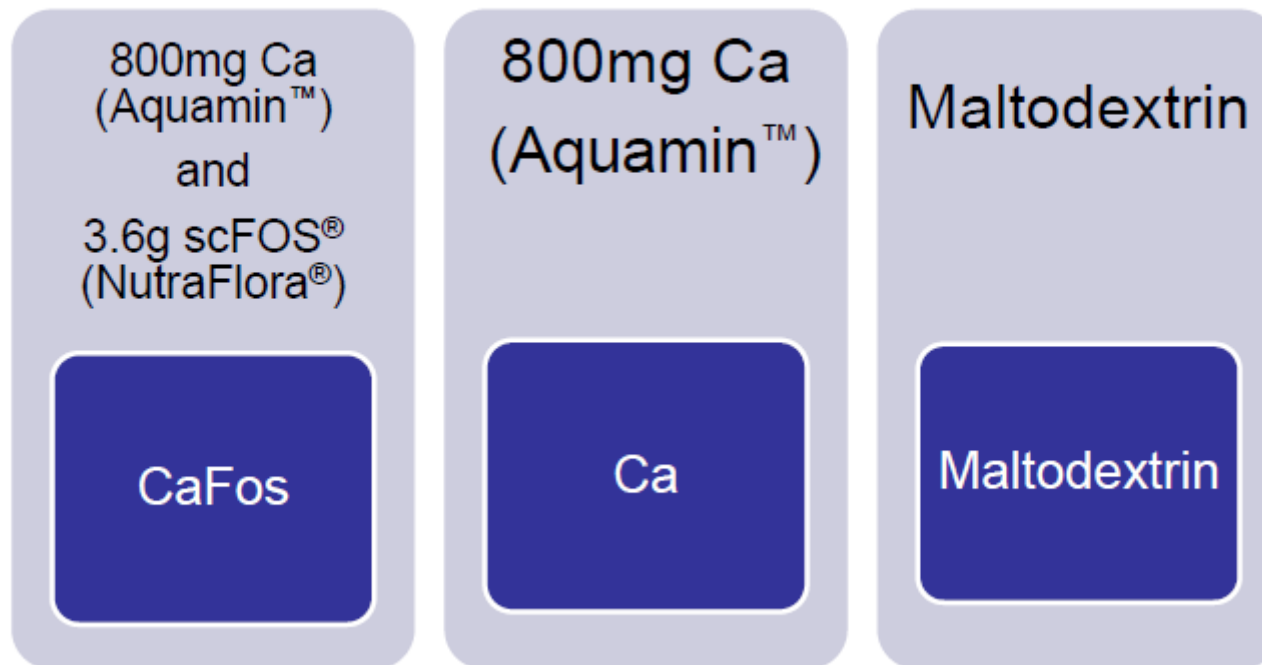
- May be a useful adjuvant
- Traditionally used as cough medicine

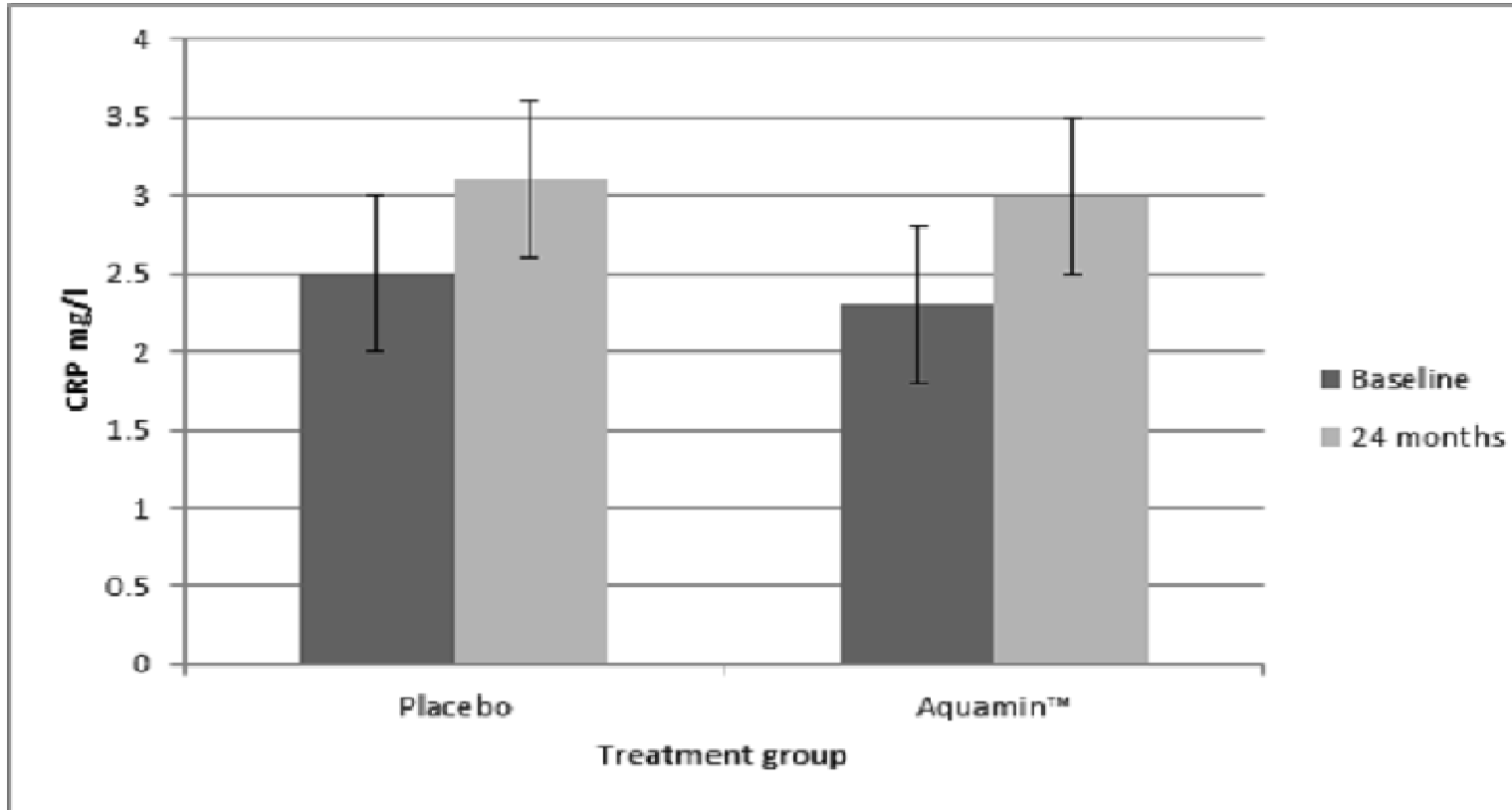


**Effect of 2 year supplementation with a natural marine derived calcium rich supplement in postmenopausal women on a biomarker of heart disease - CRP**



## Treatment groups





No significant difference in change in CRP between treatments after 2 years supplementation.

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## Take home message

- Vitamin D is important in regulation of the immune response in both health free living individuals and in clinical conditions such as SLE
- Seaweed, as a functional food ingredient warrants investigation but care must be given to dose and type of seaweed
- Natural calcium supplements do not appear to increase CRP

# Acknowledgements

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## SLE

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Dr Paul Thompson  
Dr Olaf Sunnotel  
Dr Philip Allsopp  
Mr William Crowe  
Ms Hannah Stewart

## Marigot Bone Study

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Dr Pamela Magee  
Prof Julie Wallace  
Dr Maresa Duffy  
Prof JJ Strain



## Coffee time....



**Proposed to boost your  
immune system.....**