



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE



# Microbiota, alimentazione e stili di vita

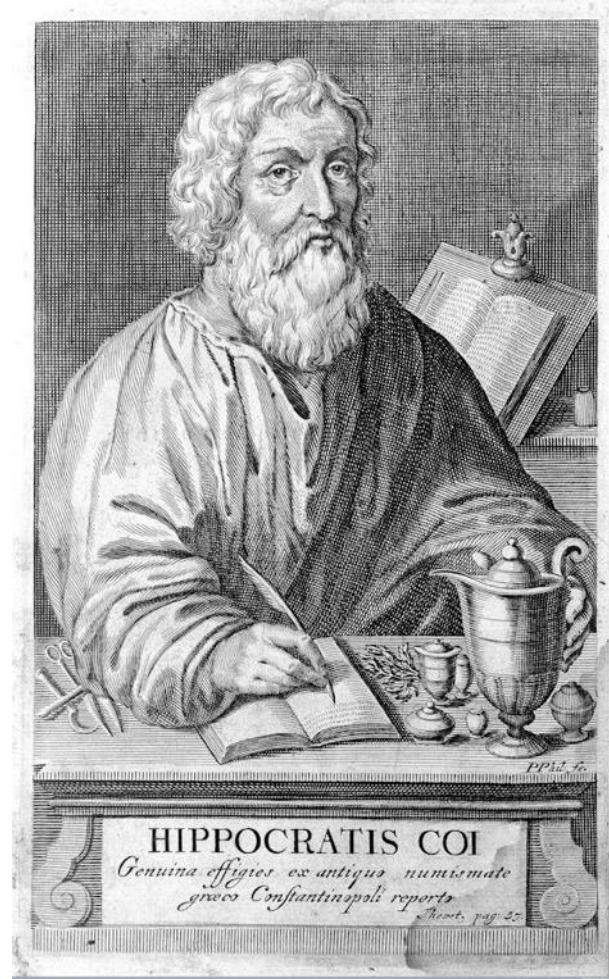
Prof. Francesco SOFI, MD, PhD

Dipartimento di Medicina Sperimentale e Clinica – Università degli Studi di Firenze  
SOD Nutrizione Clinica – AOU Careggi

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*“All disease begins  
in the gut”*

Hippocrates, 460 – 370 BC





## Attività fisica





## Attività fisica

L'attività fisica sembra avere effetti positivi a livello intestinale

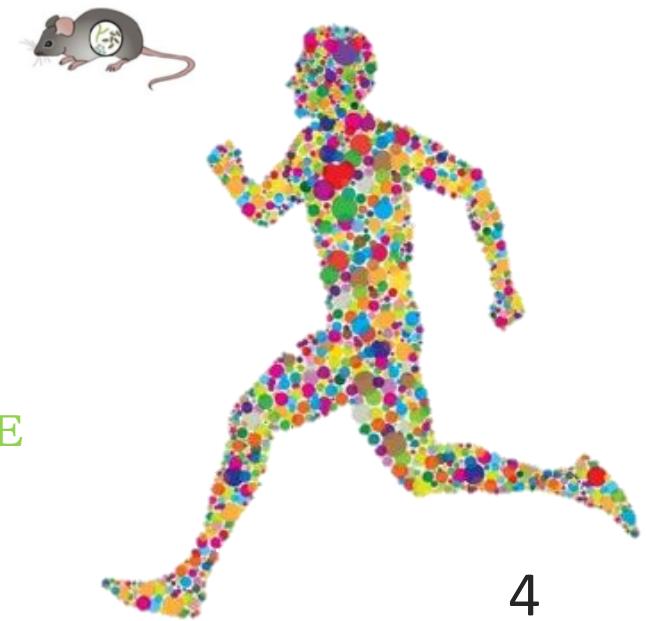
Evidenze da studi su modelli animali dimostrano che:



DIVERSITÀ MICROBICA



EQUILIBRIO TRA SPECIE BENEFICHE  
E SPECIE PATOGENE



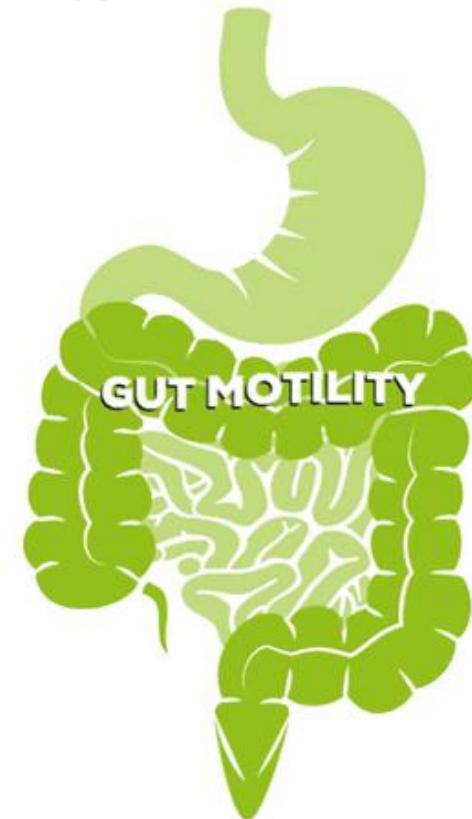


# Attività fisica

**The impact of physical exercise on the gastrointestinal tract**  
Erick Prado de Oliveira<sup>a,b</sup> and Roberto Carlos Burini<sup>a</sup>

Current Opinion in Clinical Nutrition and  
Metabolic Care 2009, 12:533–538

Inoltre, l'esercizio fisico è anche in grado di ridurre il tempo di transito delle feci nel tratto gastrointestinale. Questo riduce il contatto dei patogeni con lo strato di muco gastrointestinale e di conseguenza con il sistema circolatorio, diminuendo l'azione delle popolazioni indesiderate anche quando sono presenti.

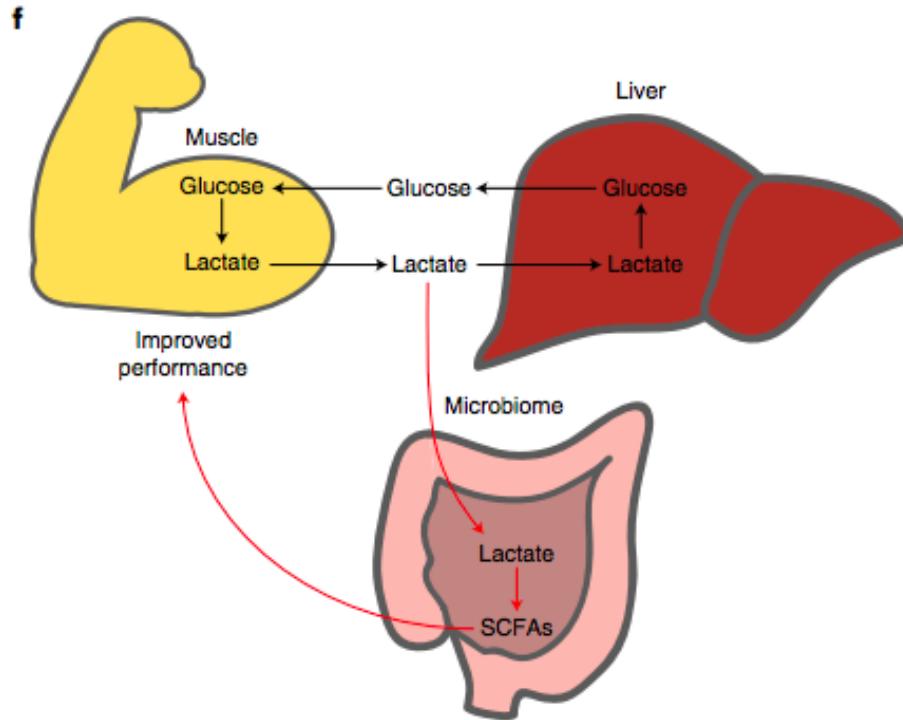




# Attività fisica

nature  
medicine

**Meta-omics analysis of elite athletes identifies a performance-enhancing microbe that functions via lactate metabolism**



Aumento dell'abbondanza relativa di *Veillonella atypica* nei maratoneti post-maratona

L'inoculo di *Veillonella atypica* in modelli murini era in grado di aumentare la loro performance nella corsa, tramite la conversione metabolica del lattato prodotto durante l'attività fisica in propionato

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## Attività fisica

Studi preclinici hanno mostrato che un'attività fisica MODERATA:



- ↑ key antioxidant enzymes (catalase and glutathione peroxidase)
- ↑ anti-inflammatory cytokines (including IL-10)
- ↑ anti-apoptotic proteins (including Bcl-2) in intestinal lymphocytes
- ↓ proinflammatory cytokines (TNF- $\alpha$  and IL-17)
- ↓ proapoptotic proteins (caspase 3 and 7)

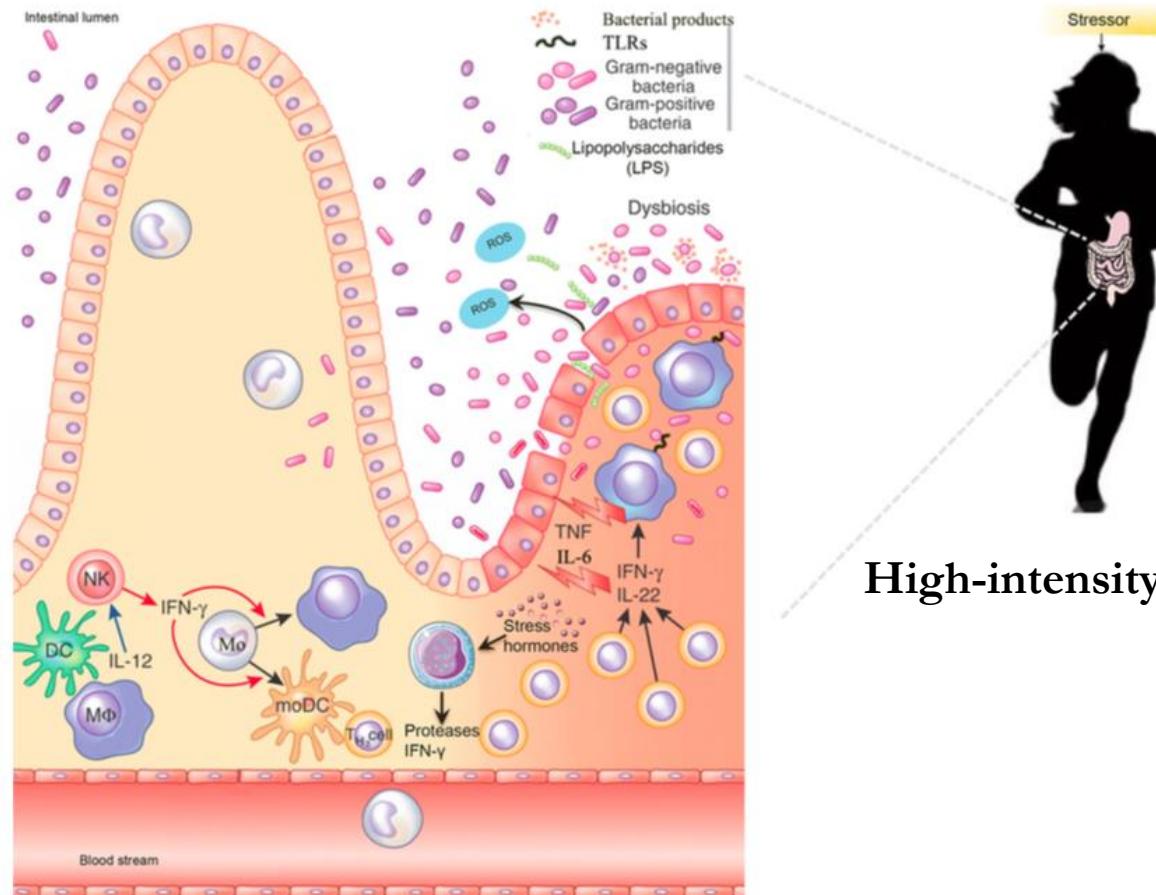


### OVERALL REDUCTION OF GUT INFLAMMATION

Le evidenze sull'uomo sono ancora limitate



# Attività fisica



High-intensity exercise

**Fig. 2** Gastrointestinal disruption during high intensity exercise. Proper intestinal barrier function is crucial for maintaining health and immunity.



# Attività fisica

## Gut Microbiota, Probiotics, and Sport From Clinical Evidence to Agonistic Performance

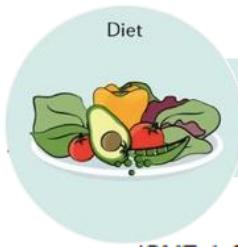
Marco Pane, MS, Angela Amoruso, PhD, Francesca Deidda, MS,  
Teresa Graziano, MS, Serena Allesina, PhD, and Luca Mogna, PhD



- Dal 20% al 60% degli atleti soffre di stress causato da eccessivo allenamento e recupero inadeguato
- Supplementare la dieta con prebiotici o probiotici in grado di migliorare la funzionalità intestinale potrebbe rappresentare una vera e propria terapia per gli atleti
- Un recente studio ha mostrato l'effetto positivo della somministrazione di *Bifidobacterium breve BR03* e *Streptococcus thermophilus FP4* sulla performance, sul recupero, e sull'infiammazione dopo esercizio fisico intenso

*“Selected beneficial bacteria could positively affect athletes undergoing periods of intense training and may assist in the performance recovery”*

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# Alimentazione

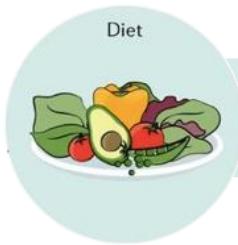
ISME J. 2010 Feb;4(2):232-41. doi: 10.1038/ismej.2009.112. Epub 2009 Oct 29.

**Interactions between gut microbiota, host genetics and diet relevant to development of metabolic syndromes in mice.**

Zhang C<sup>1</sup>, Zhang M, Wang S, Han R, Cao Y, Hua W, Mao Y, Zhang X, Pang X, Wei C, Zhao G, Chen Y, Zhao L.

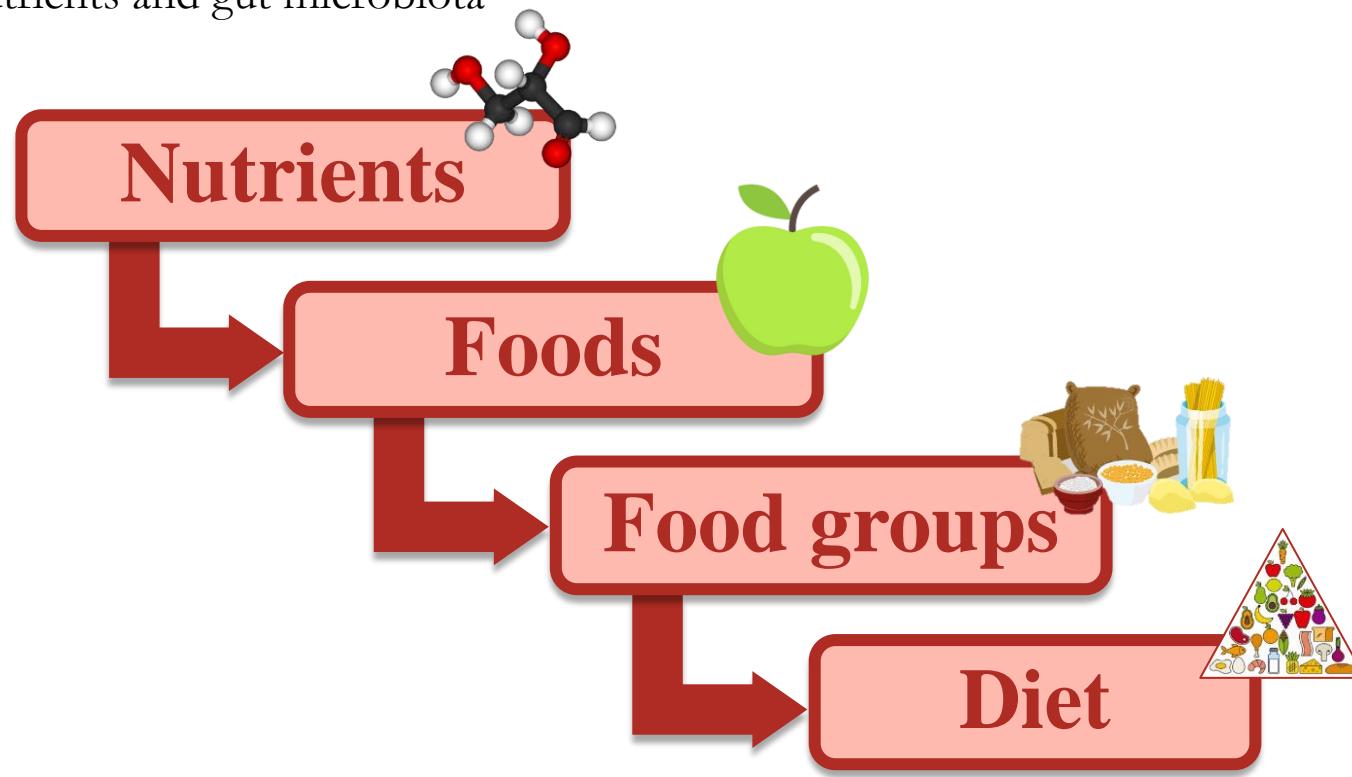
*“It is estimated that dietary alterations are responsible for 57% of the gut microbiota entire variation, whereas genetic background explains only 12%”*





# Alimentazione

Most of the studies have evaluated associations between foods, food groups or nutrients and gut microbiota



Diet



# Alimentazione

## Impact of diet in shaping gut microbiota revealed by a comparative study in children from Europe and rural Africa

Carlotta De Filippo<sup>a</sup>, Duccio Cavalieri<sup>a</sup>, Monica Di Paola<sup>b</sup>, Matteo Ramazzotti<sup>c</sup>, Jean Baptiste Poulet<sup>d</sup>, Sébastien Massart<sup>d</sup>, Silvia Collini<sup>b</sup>, Giuseppe Pieraccini<sup>e</sup>, and Paolo Lionetti<sup>b,1</sup>

<sup>a</sup>Department of Preclinical and Clinical Pharmacology, University of Florence, 50139 Firenze, Italy; <sup>b</sup>Department of Pediatrics, Meyer Children Hospital, University of Florence, 50139 Firenze, Italy; <sup>c</sup>Department of Biochemical Sciences, University of Florence, 50134 Firenze, Italy; <sup>d</sup>DNA Vision Agrifood S.A., B-4000 Liège, Belgium; and <sup>e</sup>Centro Interdipartimentale di Spettrometria di Massa, University of Florence, 50139 Firenze, Italy

August 17, 2010 | vol. 107 | no. 33 | 14515–14596

PNAS

## In This Issue

Proceedings of the National Academy of Sciences of the United States of America

[www.pnas.org](http://www.pnas.org)

### The effect of diet on human gut microbial composition

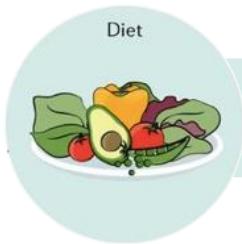
The trillions of microbes that inhabit the human gut are considered an essential “organ” that helps to digest food, protect against pathogens, and limit inflammation, but researchers do not yet fully understand how environment and diet affect the gut’s microbial ecology. Carlotta De Filippo et al. (pp. 14691–14696) used rDNA sequencing and biochemical analysis to compare the fecal microbiota of 15 children, aged 1 to 6 years, from a rural African village with a similar population of children from Florence, Italy. The researchers found that the African children had a lower proportion of microbes associated with obesity in adults, and greater abundance of fatty acids known to protect against inflammation. The African children’s diet, which may resemble human diets shortly after the birth of agriculture, consisted mainly of cereals, legumes, and vegetables, whereas the Italian children ate higher quantities of meat, fat, and sugar. Only children who were still breast-feeding harbored bacterial compositions that resembled children from the other geographical group, indicating that diet may supersede factors such as ethnicity, sanitation, geography, or climate, according to the authors. They suggest that diets common to industrialized nations may reduce microbial richness, potentially contributing to a rise in allergic and inflammatory diseases in the last half-century. — J.M.



Millet and sorghum grain and flour.

Top  
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Most  
Cited

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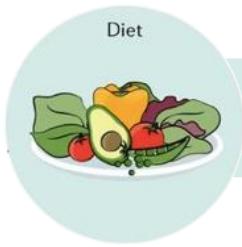
# Alimentazione

## Gut microbiota characterization of children aged 1 to 6 years



Fecal microbiota of 15 European children (EU) living in the urban area of Florence, Italy

Fecal microbiota of 14 African children (BF) living in a rural village of Boulpon, Burkina Faso



# Alimentazione



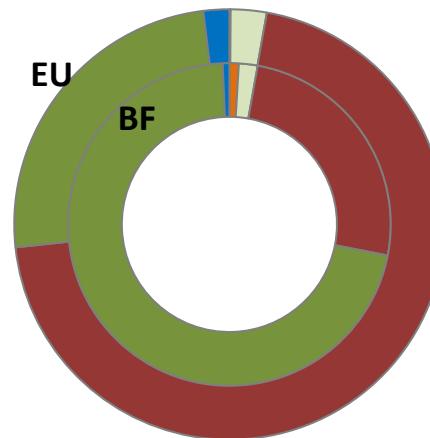
## Impact of diet in shaping gut microbiota revealed by a comparative study in children from Europe and rural Africa

Carlotta De Filippo<sup>a</sup>, Duccio Cavalieri<sup>a</sup>, Monica Di Paola<sup>b</sup>, Matteo Ramazzotti<sup>c</sup>, Jean Baptiste Poulet<sup>d</sup>,  
Sebastien Massart<sup>d</sup>, Silvia Collini<sup>b</sup>, Giuseppe Pieraccini<sup>a</sup>, and Paolo Lionetti<sup>b,1</sup>

<sup>a</sup>Department of Preclinical and Clinical Pharmacology, University of Florence, 50139 Firenze, Italy; <sup>b</sup>Department of Pediatrics, Meyer Children Hospital, University of Florence, 50139 Firenze, Italy; <sup>c</sup>Department of Biochemical Sciences, University of Florence, 50134 Firenze, Italy; <sup>d</sup>DNA Vision Agrifood S.A., B-4000 Liège, Belgium; and <sup>1</sup>Centro Interdipartimentale di Spettrometria di Massa, University of Florence, 50139 Firenze, Italy



*Firmicutes*



*Others*

*Proteobacteria*

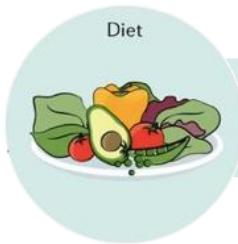
*Firmicutes*

*Bacteroidetes*

*Actinobacteria*



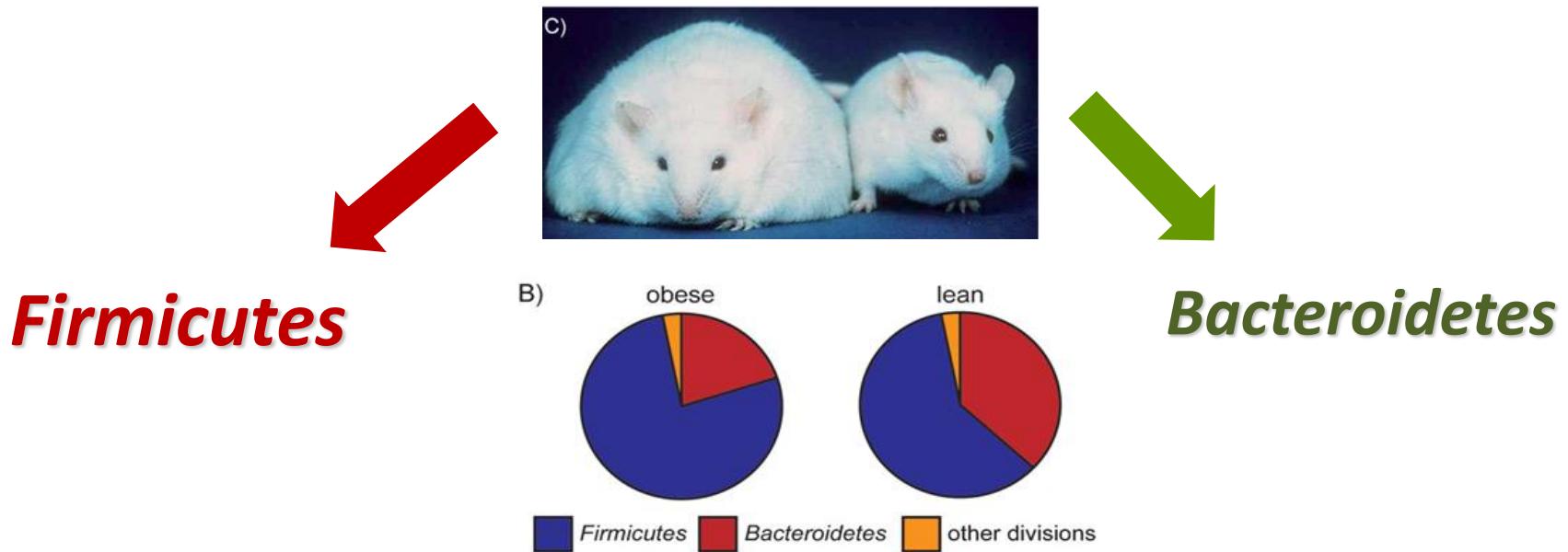
*Bacteroidetes*  
14



# Alimentazione

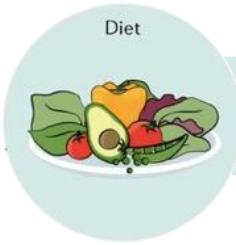
## Obesity alters gut microbial ecology

Ruth E. Ley<sup>†</sup>, Fredrik Bäckhed<sup>†</sup>, Peter Turnbaugh<sup>†</sup>, Catherine A. Lozupone<sup>‡</sup>, Robin D. Knight<sup>§</sup>, and Jeffrey I. Gordon<sup>†¶</sup>



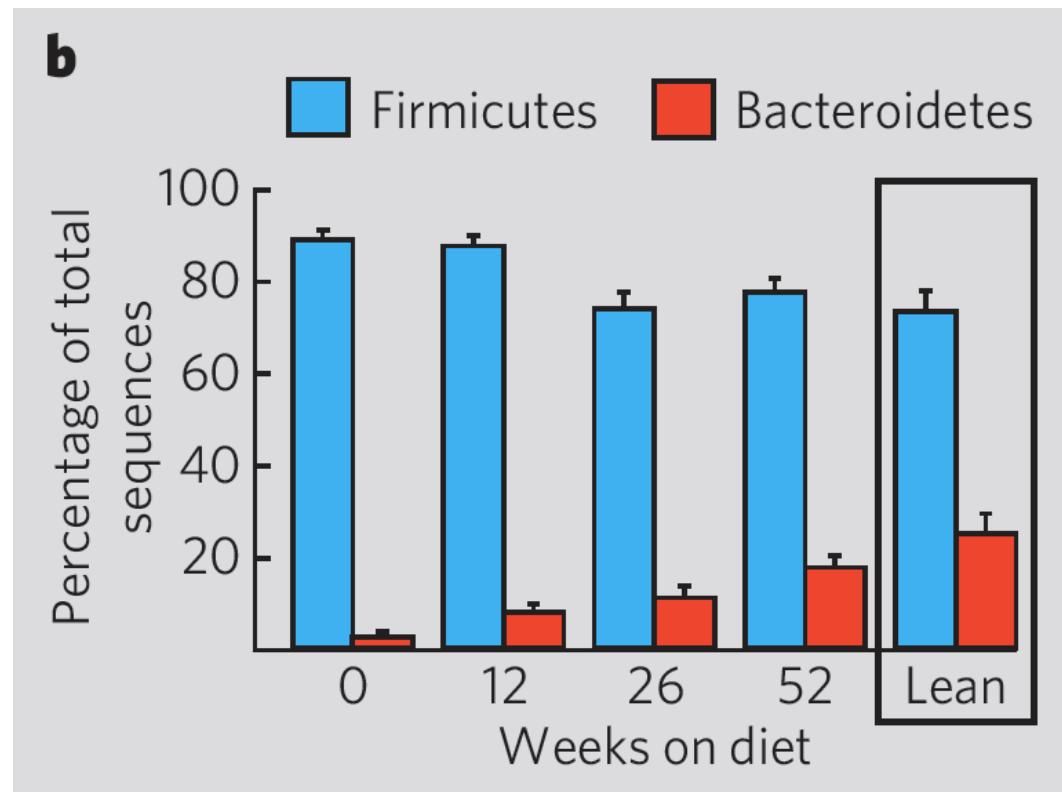
Microbiota of obese mice have a 50% reduction in *Bacteroidetes* relative to lean mice, and a significantly greater proportion of *Firmicutes*

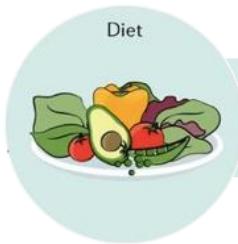
15



## Alimentazione

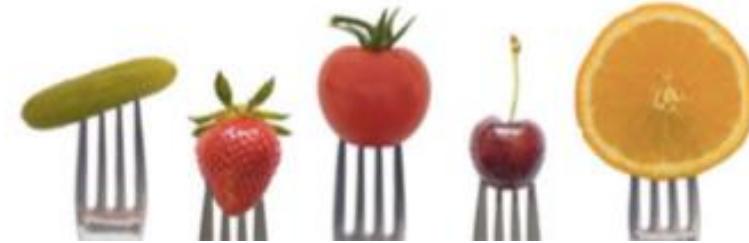
### Human gut microbes associated with obesity





## *Alimentazione*

E' possibile modulare il microbiota intestinale  
attraverso un intervento nutrizionale?





# Mediterranean versus vegetarian diet for cardiovascular disease prevention (the CARDIVEG study): study protocol for a randomized controlled trial

Francesco Sofi<sup>1,2,3\*</sup>, Monica Dinu<sup>1</sup>, Giuditta Pagliai<sup>1</sup>, Francesca Cesari<sup>1,4</sup>, Rossella Marcucci<sup>1,4</sup>  
and Alessandro Casini<sup>1,2</sup>

ORIGINAL RESEARCH ARTICLE

Circulation

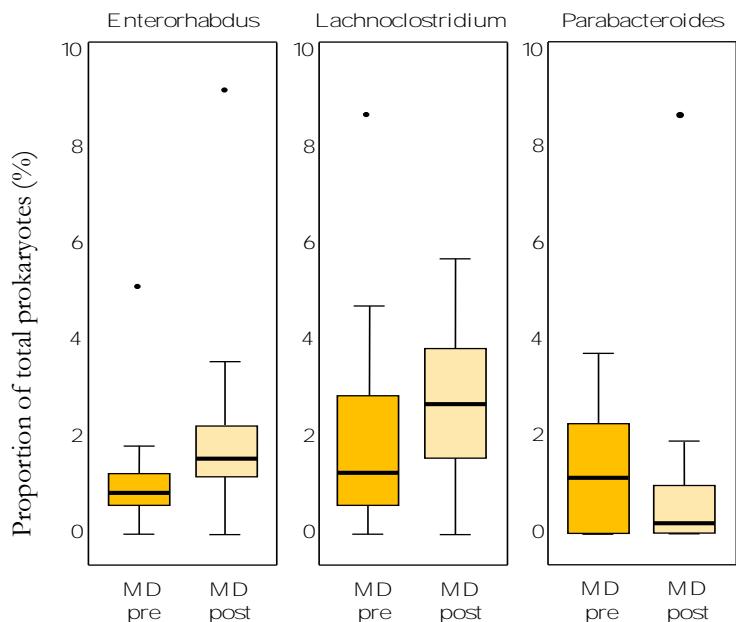
## Low-Calorie Vegetarian Versus Mediterranean Diets for Reducing Body Weight and Improving Cardiovascular Risk Profile CARDIVEG Study

Francesco Sofi, Monica Dinu, Giuditta Pagliai, Francesca Cesari, Anna Maria Gori, Alice Sereni, Matteo Becatti, Claudia Fiorillo, Rossella Marcucci, Alessandro Casini

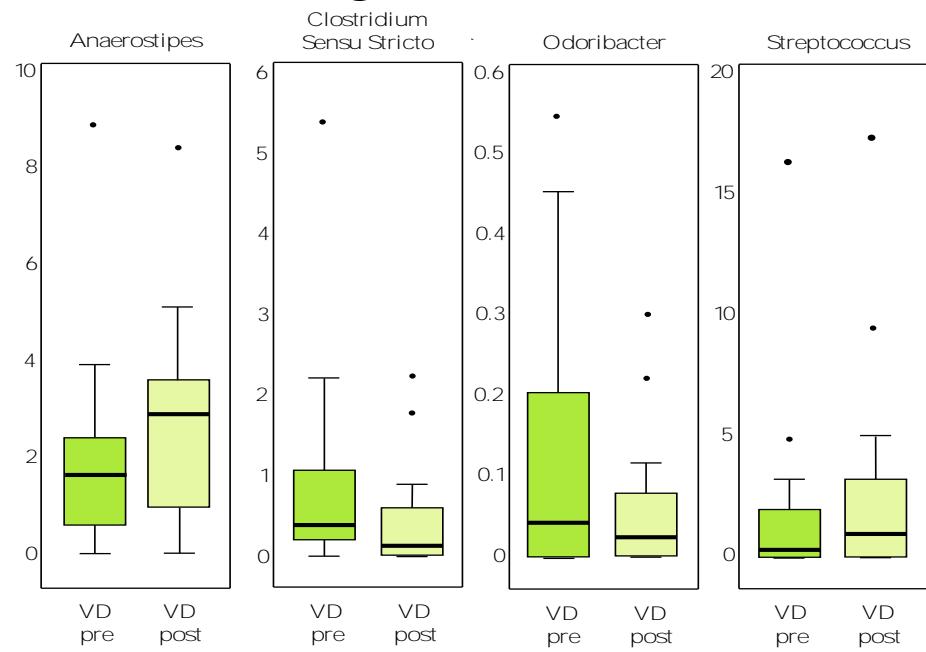
# RESULTS

## *Impact of the diets on gut microbiota composition*

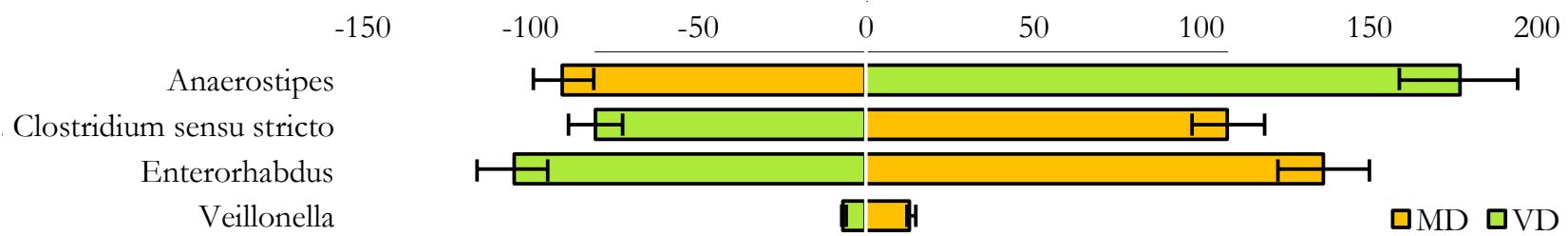
### Mediterranean diet



### Vegetarian diet

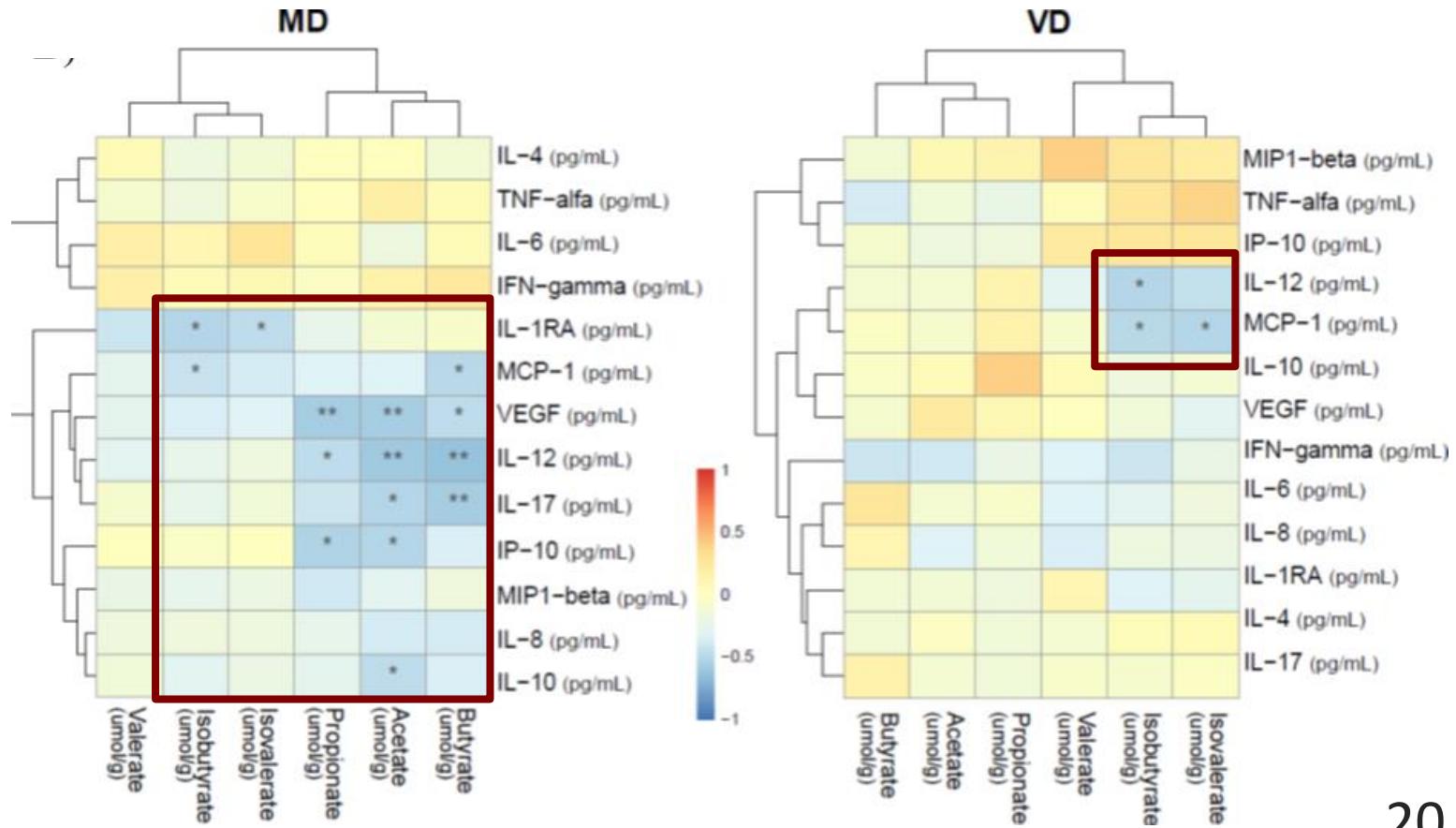


### OTUs



# RESULTS

## *Association between SCFAs and inflammatory profile*



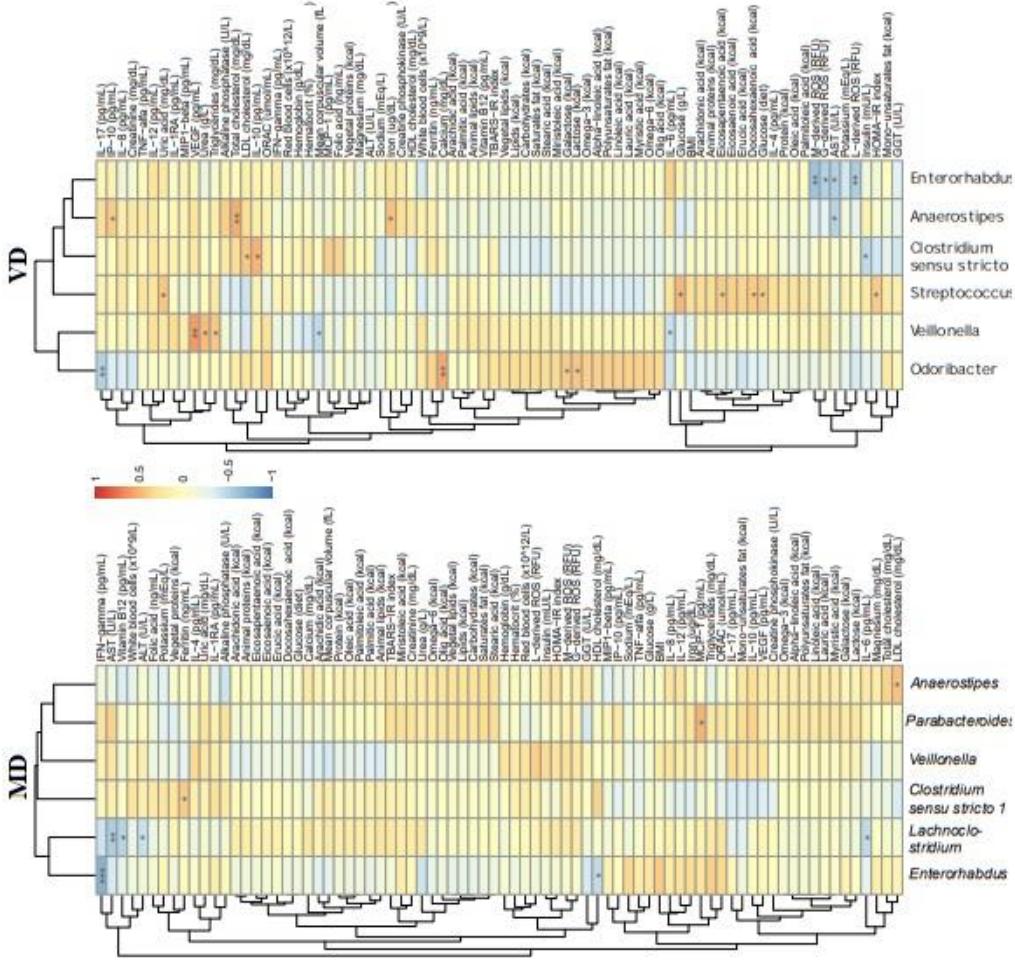
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Spearman's correlation analysis

Pagliai et al. EJON 2019

## RESULTS

## *Quantification of impact of the diets on microbiota, clinical and biochemical variables*



## Vegetarian diet

### Negative correlations:

## Hematocrit

AST

Insulin

IL-6, IL-17

G-, M-derived ROS

### Positive correlations:

## Glucose, HOMA-index

### TG, LDL-c, Total-c

### Urea, uric acid

## Iron, calcium

## Mediterranean diet

### Negative correlations:

AST

Vit. B-12

HDL-e

IFN-gamma, IL-6

### Positive correlations:

## Ferritin

LDL-c

MCP-1

## CONCLUSIONS OF THE STUDY

**A short term MD or VD induces no major changes in the GM composition** confirming that dietary interventions must be protracted over longer periods to scratch the GM's resilience.

**Difference in the abundance were found only at genus level, between and within the two dietary intervention.**

**An opposite variation of SCFAs was reported between the two dietary interventions, in particular for propionic acid.**

**Modifications of SCFAs after MD was negatively associated with a number of inflammatory cytokines, supporting the anti-inflammatory properties of the MD**

**Several associations were found between certain bacterial groups, clinical and biochemical parameters, suggesting that modification of the GM could be responsible for the cardiovascular protection associated with the two diets.**

## Personalized microbiome-based approaches to metabolic syndrome management and prevention.

Shapiro H<sup>1</sup>, Suez J<sup>1</sup>, Elinav E<sup>1</sup>.

