

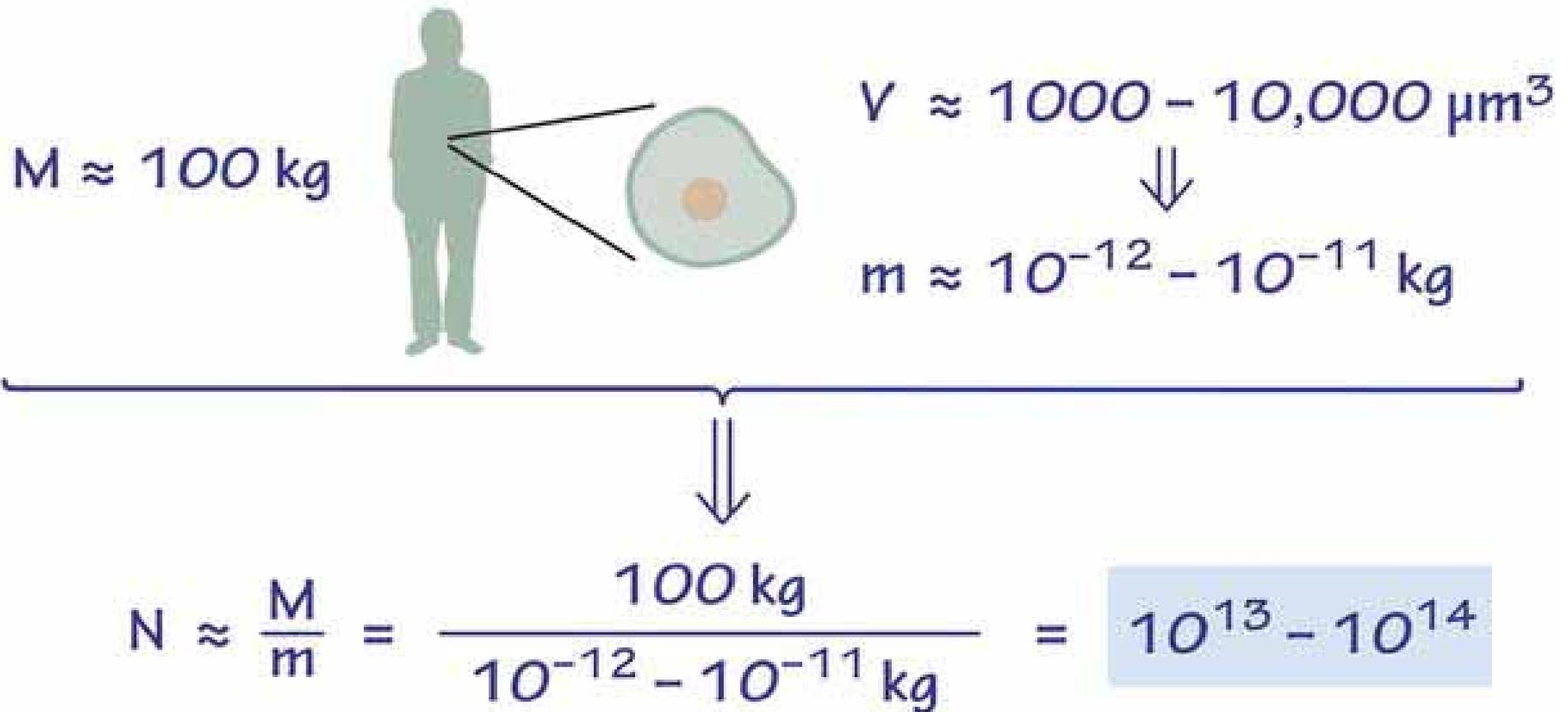
On Behalf of

# Indian Human Microbiome Initiative

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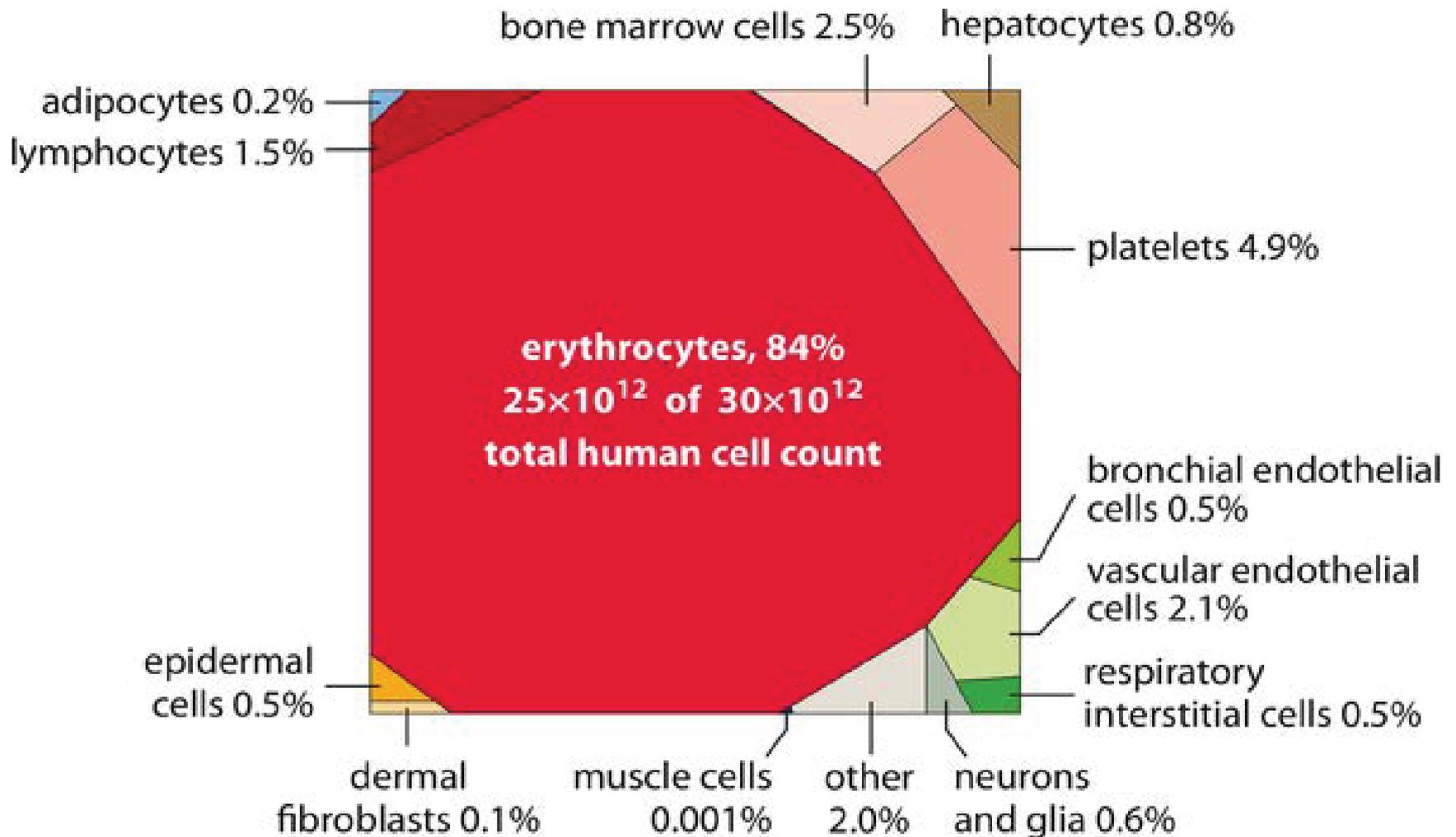
Fig 1. Back of the envelope estimate of the number of cells in an adult human body based on a characteristic volume and mass.



Sender R, Fuchs S, Milo R (2016) Revised Estimates for the Number of Human and Bacteria Cells in the Body. PLoS Biol 14(8): e1002533. doi:10.1371/journal.pbio.1002533

<http://journals.plos.org/plosbiology/article?id=info:doi/10.1371/journal.pbio.1002533>

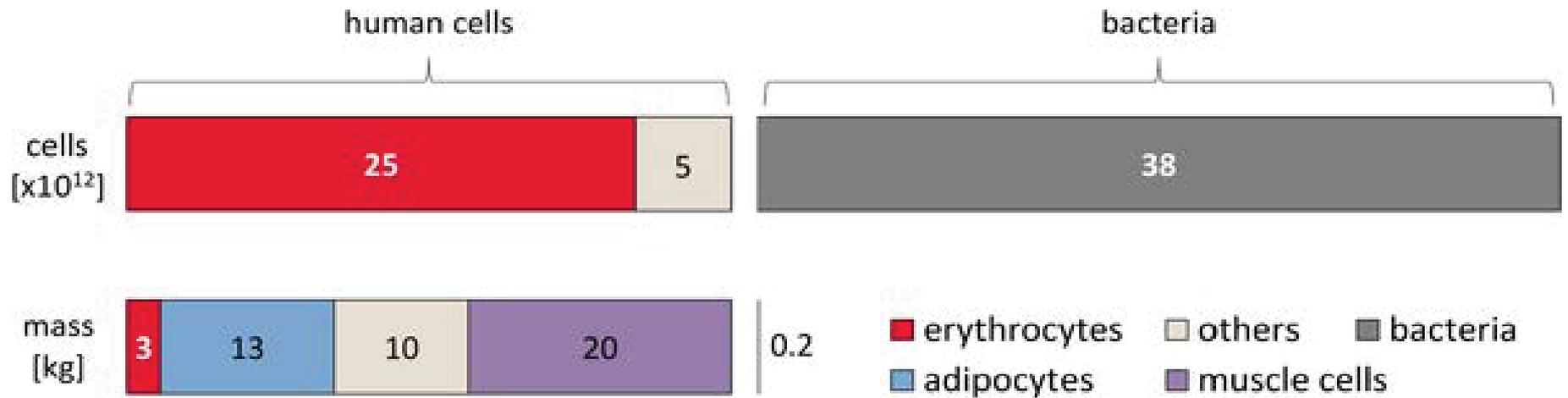
Fig 2. The distribution of the number of human cells by cell type.



Sender R, Fuchs S, Milo R (2016) Revised Estimates for the Number of Human and Bacteria Cells in the Body. PLoS Biol 14(8): e1002533. doi:10.1371/journal.pbio.1002533

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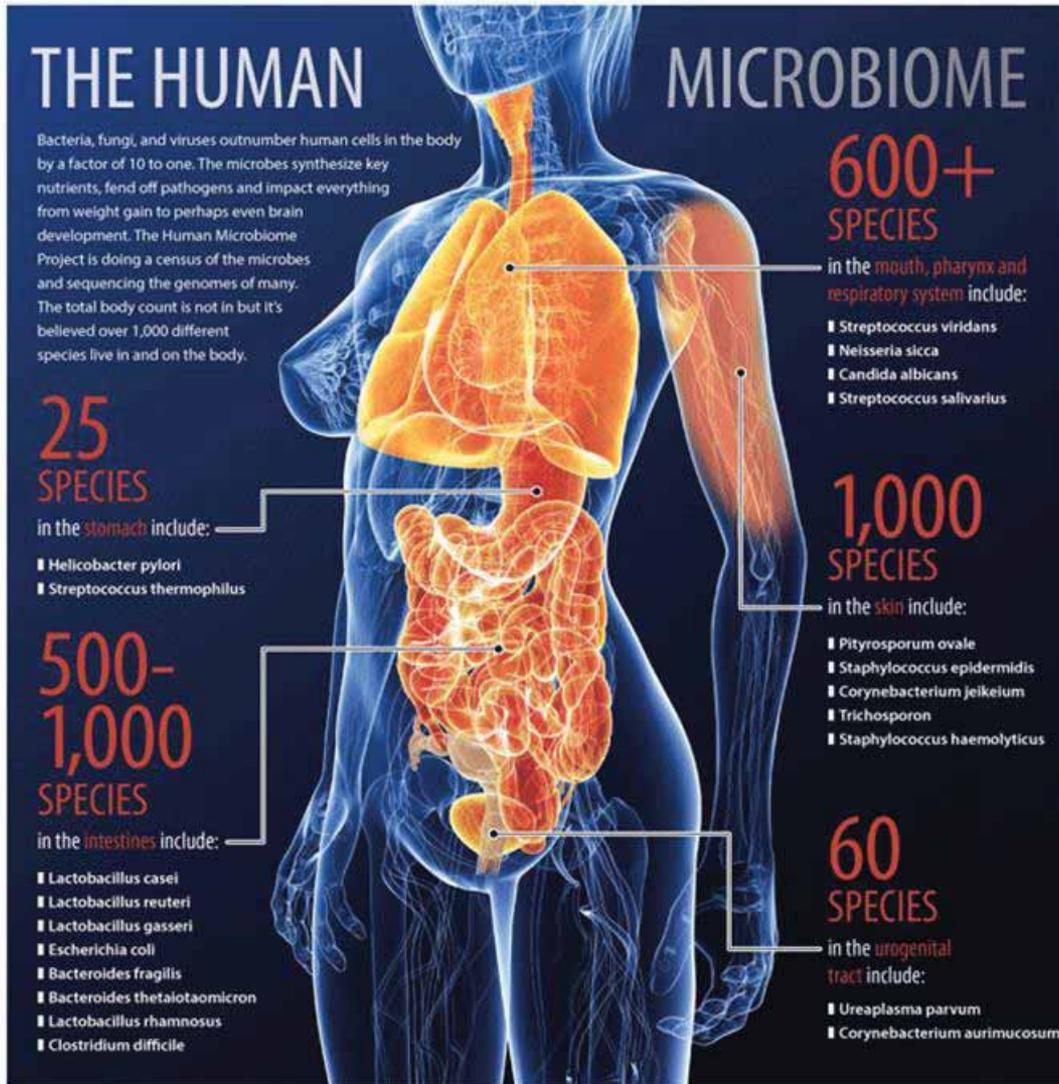
**Fig 3. Distribution of cell number and mass for different cell types in the human body (for a 70 kg adult man).**



Sender R, Fuchs S, Milo R (2016) Revised Estimates for the Number of Human and Bacteria Cells in the Body. PLoS Biol 14(8): e1002533. doi:10.1371/journal.pbio.1002533

<http://journals.plos.org/plosbiology/article?id=info:doi/10.1371/journal.pbio.1002533>

# Bacteria, fungi, and viruses outnumber human cells 10:1



## The human microbiome:

- Consists of 100 trillion cells
- Can be considered an organ
- Has a weight of ~ 3 pounds
- Was discovered in mid 2000s
- Is still poorly understood
- Contributes to metabolism
- Impacts health and disease

# Gut Bacteria help digest food



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## Letter

*Nature* **464**, 908-912 (8 April 2010) | doi:10.1038/nature08937; Received 9 November 2009; Accepted 19 February 2010

### Transfer of carbohydrate-active enzymes from marine bacteria to Japanese gut microbiota

Jan-Hendrik Hehemann<sup>1,2,3</sup>, Gaëlle Correc<sup>1,2</sup>, Tristan Barbeyron<sup>1,2</sup>, William Helbert<sup>1,2</sup>, Mirjam Czjzek<sup>1,2</sup> & Gurvan Michel<sup>1,2</sup>

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Correspondence to: Mirjam Czjzek<sup>1,2</sup> or Gurvan Michel<sup>1,2</sup>. Correspondence and requests for materials should be addressed to M.C. (Email: [czjzek@sb-roscoff.fr](mailto:czjzek@sb-roscoff.fr)) or G.M. (Email: [gurvan@sb-roscoff.fr](mailto:gurvan@sb-roscoff.fr)).

**Gut microbes supply the human body with energy from dietary polysaccharides through carbohydrate active enzymes, or CAZymes<sup>1</sup>, which are absent in the human genome. These enzymes target polysaccharides from terrestrial plants that dominated diet throughout human evolution<sup>2</sup>. The array of CAZymes in gut microbes is highly diverse, exemplified by the human gut symbiont *Bacteroides***

▲ Top

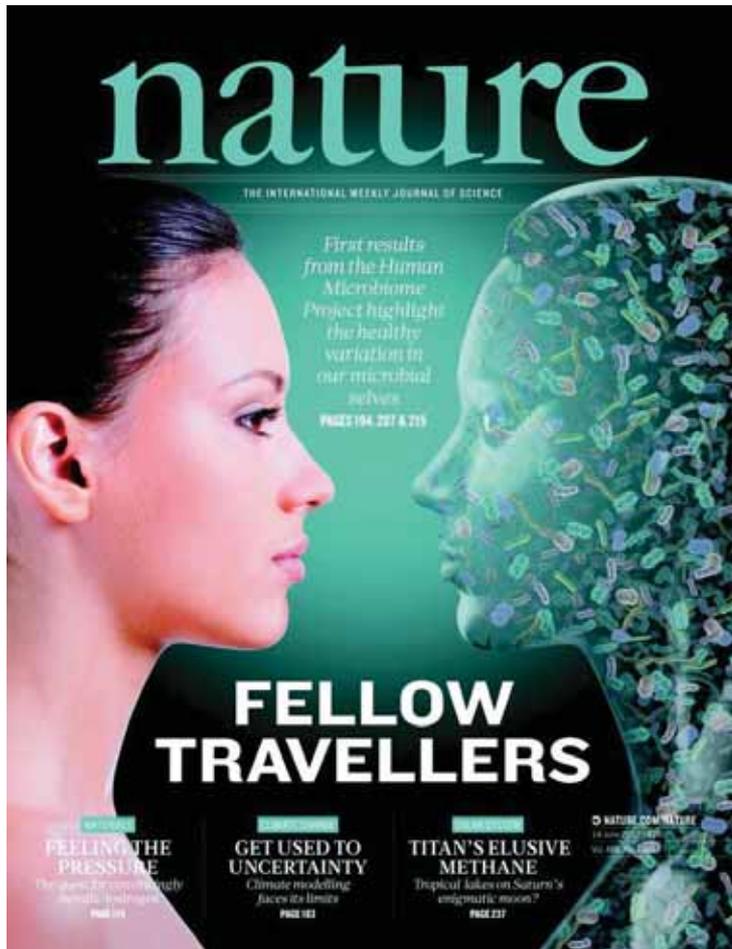
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*Nature* 464, 908-912 (2010)

Picture credit: *Nature* 464, 837-838 (2010)

# Microbiome has been associated with large number of diseases



- Type 2 diabetes
- Cardiovascular disease
- Inflammatory bowel disorder
- NAFLD
- Obesity
- Autoimmune disorders
- Metabolic syndrome
- Cancer
- Autism
- ...

# Potential to Develop New Biomarkers

- Development of new predictive biomarkers so that preventive strategies based on pre- and probiotics can be developed.
- New therapeutic strategies
- Increase our understanding of the etiologies of complex diseases and health





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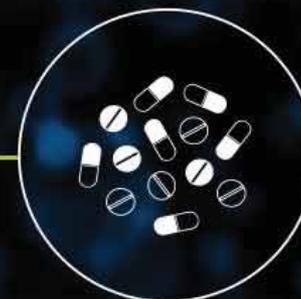
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## MICROBIOME TO MEDICINE™

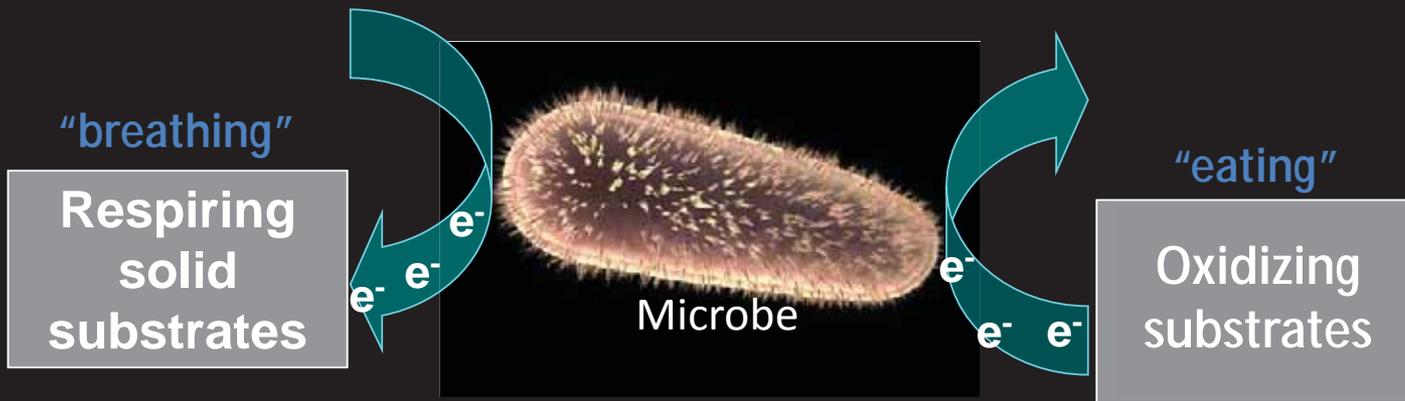


Second Genome is a clinical stage company with a mission to improve human health by unlocking the full potential of the microbiome. We offer the most robust approach to microbiome drug discovery and development through the deepest understanding of how the microbiome works in human health.

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# **Environmental Cleanup and Monitoring**

# Understanding microbial community function for optimizing wastewater treatment



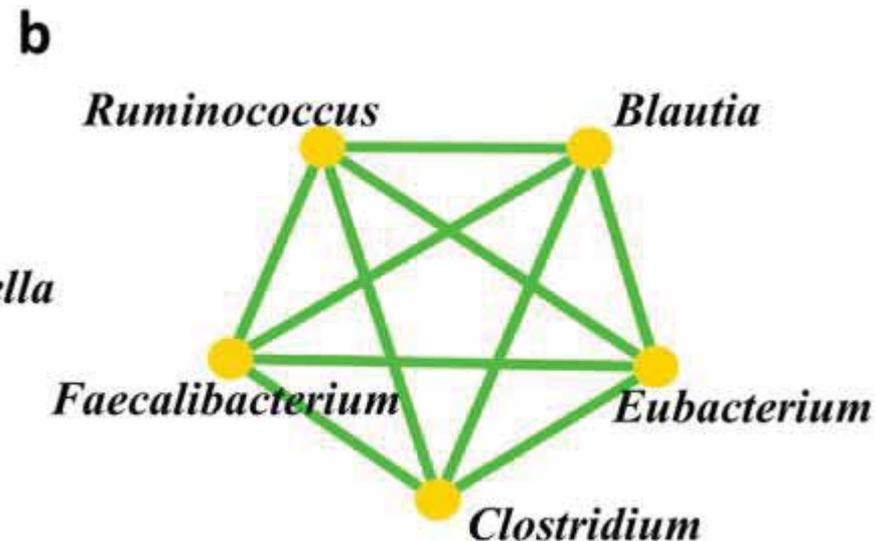
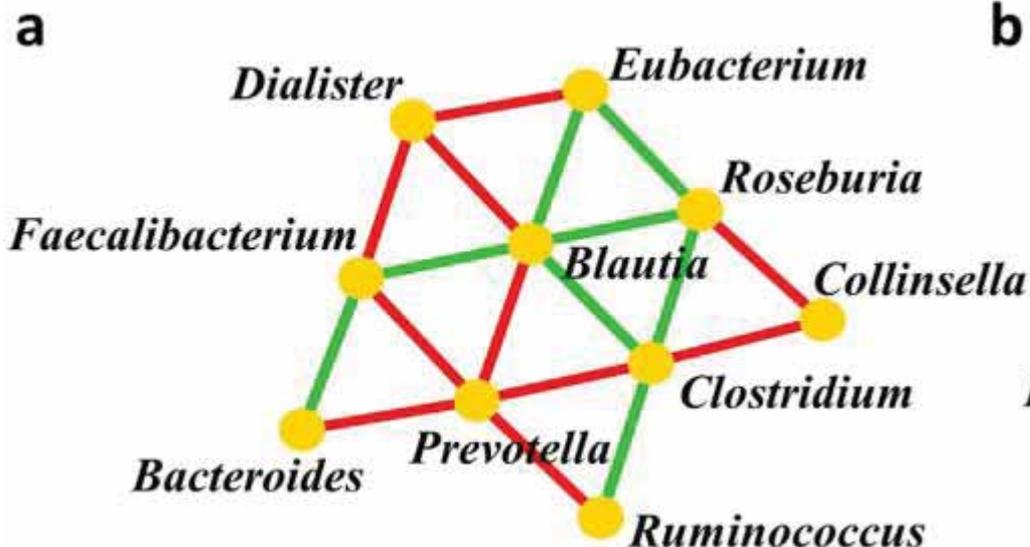
Genomic tools enable the identification of important microbial community members and the genetic components that are associated with accelerated wastewater treatment in MFCs

# Why study Indian population?

- ~6000 communities, ~40,000 endogamous groups (<http://www.ansi.gov.in>)
  - In addition to Ancestral North Indians (ANI) and Ancestral South Indians (ASI), there are two ancestral components in mainland India that are major for the AA-speaking tribals and the TB speakers, AAA (for “Ancestral Austro-Asiatic”) and ATB (for “Ancestral Tibeto-Burman”)- Basu et al., *PNAS* 2016.
  - A measure of population differentiation among Indian endogamous groups is much larger than that of Europeans, indicating that Indian population are structured Reich et al., *Nature* 2009
- Indian population a perfect model to study the ‘Genotype-Microbiome’ association

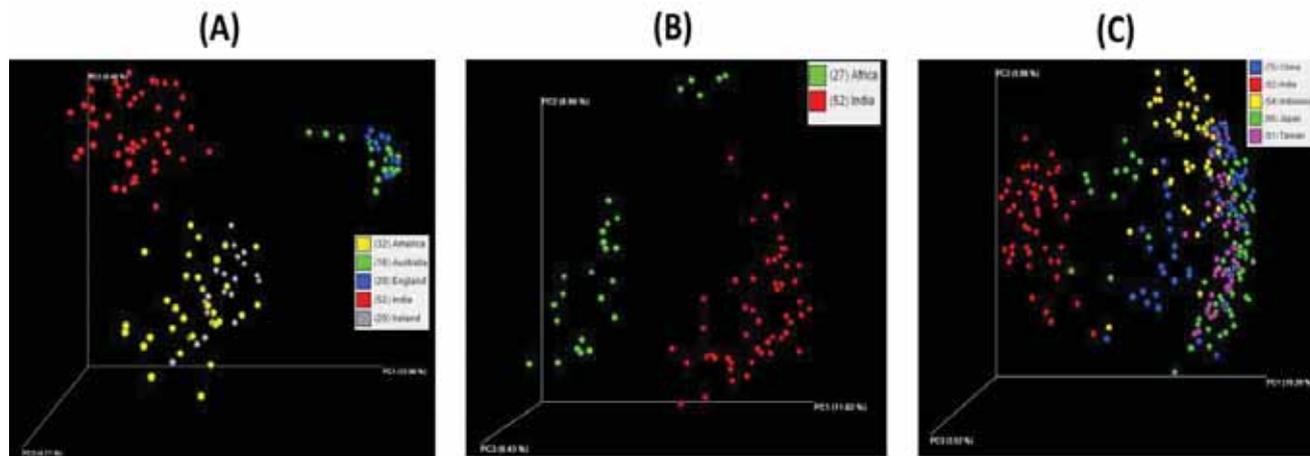
# Why study Indian population?

- Differences in population reflected by dietary habits
- Tribal populations largely unaffected by “modern” diet and life style
- The prevalence of lifestyle related disorders like obesity, Diabetes, IBD etc. known to be significantly lower in tribals compared to the non-tribal (urbanized) populations across the globe.: Jain et al., *Ind J Med Res* 2015



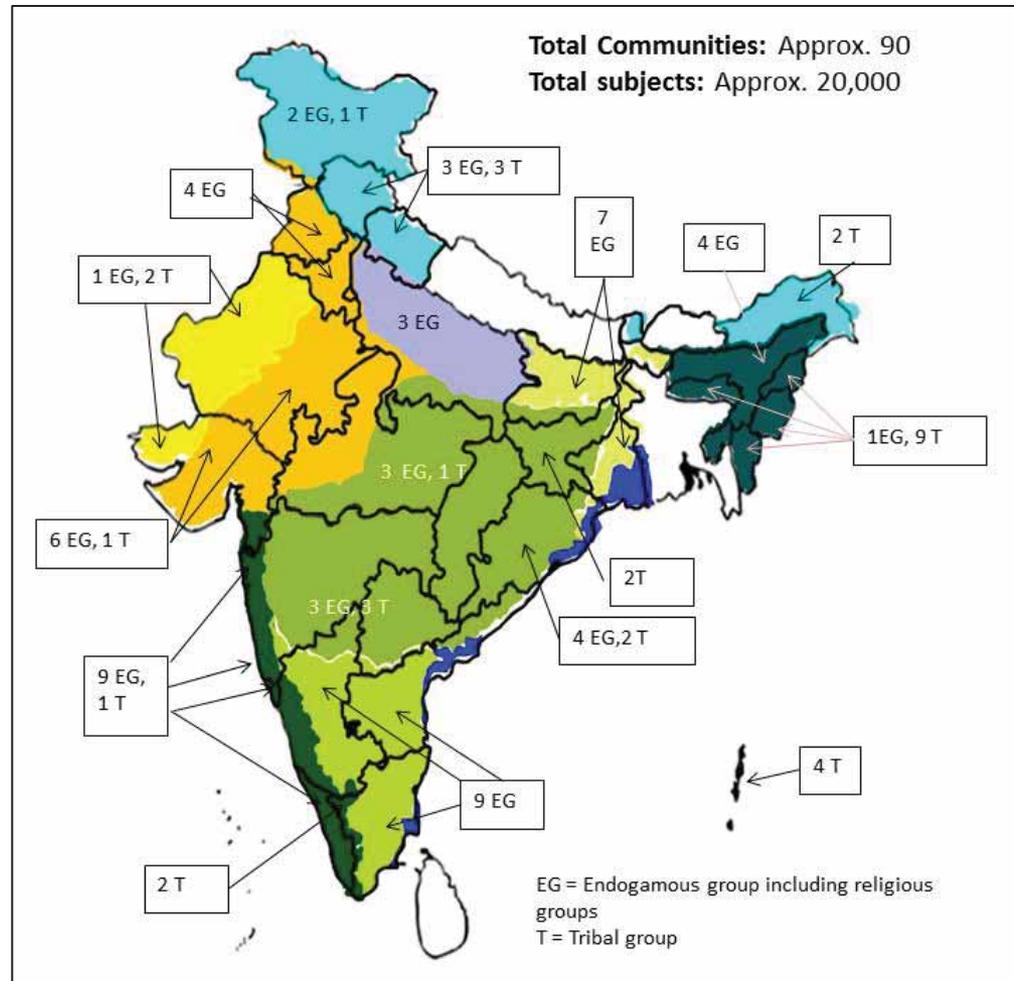
# Why study Indian population?

- Microbiome of Japanese population is significantly distinct from those of other populations, which cannot be simply explained by diet alone. Nishijima et al., *DNA Res* 2016.
- Microbiome, irrespective of lifestyle and age, which is distinct from races and communities from other parts of the world. Leung *et al.*, *Sci Rep.*, 2015, Chong *et al.*, *Sci Rep*, 2015



Shouche et al., unpublished results

# Proposed Study



# Zone-wise recruitment of subjects

<b>Zone (Geographic region of India)</b>	<b>No. of subjects</b>
<b>North</b>	4800
<b>East</b>	3400
<b>North East</b>	3200
<b>South</b>	3600
<b>West</b>	2800
<b>Islands</b>	2200
<b>Total</b>	20,000

# Participating Institutions

.....not limited to...

- National Center for Cell Science (NCCS), Pune.
- All India Institute of Medical Sciences (AIIMS), New Delhi.
- Christian Medical College (CMC), Vellore.
- Institute of Biodiversity and Sustainable Development (IBSD), Imphal.
- Institute for Advances Science and Technology (IASST), Guwahati.
- National Institute for Biomedical Genomics (NIBMG), Kalyani.
- Foundation for Revitalization of Local Health Traditions (FLHRT), Bengaluru.
- Tata Consultancy Services (TCS), Pune.
- Persistent Systems, Pune.

**Thank you!**