

# Ethics of exploring the microbiome of native peoples

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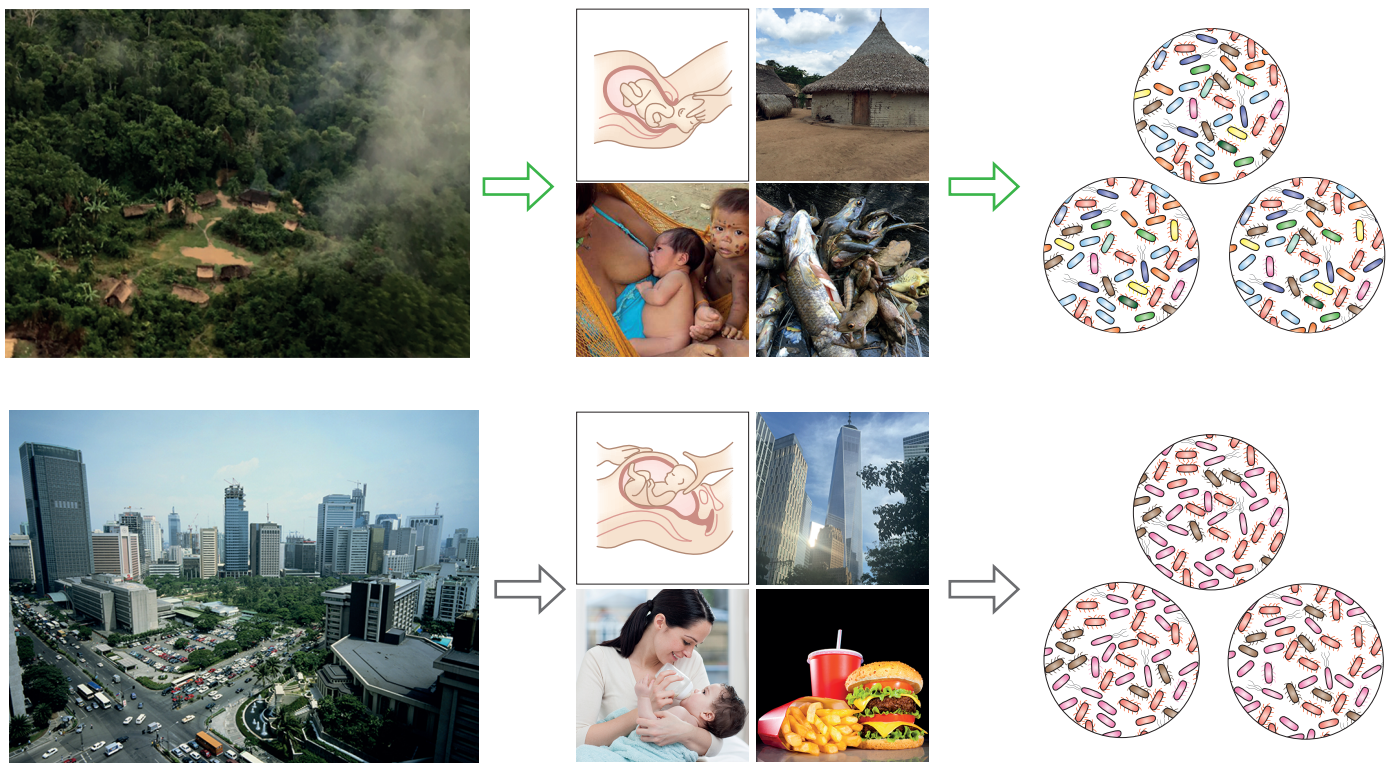
Microbiomes of native peoples could provide constituents to improve our health. Research must be conducted ethically and native peoples appropriately rewarded. However, sharing our medical practice risks spoiling these microbial oases and could lead to the same disease risks that we are trying to prevent.

The field of microbiome research is providing important insights into the roles of our microbial genomes, contained in human-evolved microorganisms — our ‘microbiome’. We have learned that our microbiome affects immune and hormonal modulation, resistance to infections, and metabolism<sup>1</sup>. As we mine the human microbiome for knowledge, issues related to therapeutic or preventive use of microorganisms (as

probiotics) will be increasingly relevant to science and society.

People living in Western industrialized countries have reduced gut microbiome diversity compared with people living traditional lifestyles (Fig. 1)<sup>2</sup>. Uncontacted Amerindians, for example, not only have substantially higher faecal bacterial diversity than US peoples, but also than semi-transcultured Amerindians<sup>3</sup>. The evidence is becoming clear that we are

missing microorganisms that are common in these native peoples<sup>4</sup>. Lifestyle factors that adversely affect human gut microbiome diversity are not fully identified, but surely include use of antibiotics and C-section birthing as factors that perturb early microbiome assembly<sup>5</sup>. Concomitantly, these two factors have been associated with maladies related to immune and metabolic malfunctions that are reaching epidemic proportions in industrialized societies,



**Figure 1** | Gut microbiomes from native versus Western lifestyles. Lifestyle factors (such as environment, delivery mode, infant feeding, diet and housing) shape the human gut microbiome. This results in high diversity, but low individuality, in native peoples (top) and low diversity with high individuality in Westernized populations (bottom). Photo credits: Monica Contreras (breast feeding); Image Source/Getty Images (bottle feeding); PhotoDisc/Getty Images (large cityscape); iStockphoto/Thinkstock/Getty Images (fast food).

including obesity<sup>6</sup>, asthma<sup>7,8</sup>, allergies<sup>9</sup>, coeliac disease<sup>10</sup> and type 1 diabetes<sup>11</sup>. If urban-related factors impact the human microbiome in ways that cause or perpetuate disease states, leading to the extinction of microorganisms in industrialized societies<sup>12</sup>, then solutions might depend crucially on the microorganisms of people untouched by Western lifestyles. Their microbiota might provide the reservoir to help us replace the microorganisms we have lost, but restoration will require far more research about the best strains, best practices, cultivation and, importantly, safety.

Yet the very same peoples whose microbiomes may hold crucial clues to tomorrow's medical advances continue to pay the enormous toll of historic deadly infectious diseases, now cured or preventable with Western medicine and vaccines. Rather than coming to our cities, where their sociocultural integration into the institutional spheres of national states often fails to meet their needs, the desire of many tribes is to remain on their lands and preserve their traditions, but with the benefits of medicine, electricity, and communications. Native peoples need the power of our resources to improve their health as much as, reciprocally, we may need them to improve ours.

The notion of preserving their lifestyle and culture with technology transfer from us is not without challenges, because our medicine may end up killing 'the goose that lays the golden egg'. Medical practices may bring them to where we are now — a gain

of control of infectious diseases on one hand, but a loss of their 'microbial oasis' and exposure to new modern diseases on the other. The only way out is to improve our understanding of human adaptations to ancestral lifestyles and our urban-maladaptations over the past two centuries. Such knowledge can both help us and spare native peoples the damage; we need to optimize technological applications to achieve health and sustainability.

As the microbiome field and its potential applications unfold, scientists must ensure that the remarkable promise be accompanied by ethical correctness. If we are to mine the microbiome of native peoples for translational knowledge, they should be rewarded in ways that are commensurate with the benefits that their microbiome provides to us. Any possible commercialization should be done with the highest ethical standards, respect for native cultures, and involving a mediator of their choice, familiarized with financial systems and terms, who can defend their interests. For our part, scientists should acknowledge in publications the origins of microbiome data and/or microorganisms derived from native peoples, as potential beneficiaries from future technological developments. Native peoples must decide their own destinies, but it is our responsibility to provide recognition and safe technologies towards materializing their freedom to choose to remain in their lands, to live their traditional way, and to continue being the guardians of their unspoiled micro- and

macro-habitats. If they do, it will be for the benefit of humanity. □

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