How to Eliminate Race from Human Microbiome Research

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Abstract

Recent human microbiome research has suggested that racial patterns between different groups of people can be understood as variation in how many and which microbes live in and on their bodies. Such racial classifications (from 'Indigenous' to 'Black' or 'Caucasian') are said to be helpful to better grasp microbiome-linked health-disparities (especially in the Global South) and diseases such as obesity and type 2 diabetes. In this paper, we argue that this assumption is illusive. We identify four different scenarios and argumentative patterns in current human microbiome research, which state that race matters for the field. However, we show that race should better be omitted in all these scenarios due to various conceptual and epistemic shortcomings. In addition, we acknowledge that there might still be an—admittedly minor—role for race to play in human microbiome research, namely in particular contexts and groups in which processes of racial self-identification matter for research participants. Based on this analysis, we urge scientists to reconsider the majority of racial classifications used in the field.

Keywords: Race, Microbiome, Health-disparities, Self-identification.

1. Introduction

Postgenomic sciences like epigenetics and microbiome research pose new questions on the debate on the metaphysics and normativity of race (Lorusso and Bacchini 2022; Kaplan and Winther 2014; Meloni 2017; Baedke & Nieves Delgado 2019; Nieves Delgado & Baedke 2021; Chellappoo & Baedke 2023). In these sciences, the concept of biosocial race has been introduced to define the way social and environmental factors, like nutrition or stress, affect 'the biological', potentially creating differences that can be considered as biological racial differences, like patterns of DNA methylation or gut microbial composition. This implies that racial differences would not be located at the genetic level but would be produced by how different human groups experience and act in 'the social'.

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In this paper, we examine four different scenarios in today's microbiome research to explore and highlight the importance of racial classification. These scenarios differ with respect to weighting the relevance of (1) host genetics and (2) microbiome genetics, of (3) cultural practices and (4) racism and racialization potentially causing racial patterns. We argue that we can eliminate the concept of race from human microbiome research in all these cases. More generally, this analysis points to the fact that, contrary to what is commonly argued, acknowledging race in science to identify health disparities or to fight social justice is not a convincing strategy. Instead, in most cases, such agendas can be addressed by talking about racism and racialization process, not race (Hochman 2017). Thus, we suggest that in microbiome research, and across the biosciences, the concept of race should be kept only in the (rather few) cases where it has a positive identity formation role and serves for individuals the purpose of self-ascription and political recognition.

2. Removing Race from Science

We start from a position of race scepticism and argue—in line with biological mainstream—that race has no biological reality despite the various efforts made in the past to prove that race exists on the body (Blumenbach 1865; Kant 1777; Bernier 1863-64) and in the present to frame it as a biological phenomenon (Gooding-Williams 1998; Andreasen 2004; Sesardic 2010; Wade 2014; Spencer 2015, 2019). We back up this claim with the scholarship that proves historically and in the present that there is no stable referent for what racial groupings aim to account for (Teslow 2014; Barkan 1991). In addition, we build on the problematic semantic diversity of race in ordinary and scientific language (Ludwig 2015). Finally, several works on race have shown that racial categories were an invention of a dominant group to exert control over a subaltern group which puts into question the assumed biological reference of this concept.

At the same time, we reject a constructionist view of 'socialrace', as suggested by Hardimon (2013), especially when it comes to microbiome research. As we will discuss in the next section, in microbiome research cultural and social aspects of an individual or a community lifestyle can become biological as they alter their microbial composition. This "biosocial" understanding of race blurs the distinction between biological and social, central to Hardimon's understandings of social race.

In addition, even if the definition of socialrace given by Hardimon (2013) seems to acknowledge the diversity of race relations in different places, we suspect that his notion of socialrace works best in the US context. Thus, the domination of this understanding of race in current academic debates might introduce biases when applied to understand socio-cultural diversity in non-US groups. Other perspectives where race is considered to be a relevant folk category, like racial nominalism (Appiah 2006: 367) or Mallon's (2006) race constructionist approach, might suffer from similar biases.

Despite the huge variety in which race and racial classifications happen in the world, we believe there is something that they share: racism. This means that, in general, the assumption of groups' intrinsic differences led to and justified differential treatment of these groups. In other words, no matter which racial groups are considered to exist, there is usually one powerful group which dominates and discriminates another group under the assumption of racial difference. Thus, if we are interested in identifying globally applicable patterns, it might be more helpful to focus on racism and racialization (Hochman 2017; Malinowska and

Żuradzki 2023). Along these lines, we argue that racism—not race—is key to understand historical or present processes of constant discrimination against human groups that can lead to biomedically-relevant different health outcomes.

Against this background, in what follows, we suggest eliminating race from microbiome research most widely. In recent years, scholars in favour of eliminating race (partially) from science have presented different arguments based on epistemic or ontological grounds. Lorusso and Bacchini (2022), for example, argues that it is possible to discriminate contexts where race can be used from those where it cannot, based on how well race captures relevant differences in health across populations. Other authors have argued that we need to separate those instances where race refers to 'something in the world' from those that do not and eliminate the latter accordingly. In this view, commonly (some) social race categories are kept as they are assumed to have a referent (Kaplan and Winther 2014; Hardimon 2013). Similarly, Wodak (2022) argues that we should not always talk about race, but that it is also a mistake to remove the word race *entirely* from our vocabulary.

By taking these recent debates as general motivation, in this paper, we argue that it is possible to eliminate race from the field of microbiome research most widely, keeping race as a relevant category only in those few instances where it serves the purpose of identifying processes of identity formation and self-identification of groups and individuals. We develop this position by disentangling the different ways race is used in human microbiome research. To set the stage for this analysis, the next section explores the concept of "biosocial race" in human microbiome research, which highlights the idea that social race differences are embedded—through microbes—into the body and thus make race biological again.

3. Human Microbiome Research and Race

Human microbiome research introduces new problems to the debate on race. The human microbiota is the collection of bacteria, archaea, viruses and fungi microorganisms that inhabit different sites of our bodies, from skin to lungs and gut. The collection of all (genomes of) the microbiota is what is known as microbiome. In recent years, the study of the microbiota has attracted a lot of attention because the composition and diversity of microbial taxa living together with human hosts seems to be related to different states of health and disease in the host. The microbiome has been linked to metabolic disorders (see Wang et al. 2017, Al-Assal 2018), autoimmune diseases (Wen et al. 2008), and respiratory diseases (Verhulst et al. 2008). Especially the gut microbiome seems to play an important role in health (Zmora et al. 2019). It seems to influence the host's immune system (Macpherson & Harris 2004), and, through the so-called 'gut-brain axis' (Clarke et al. 2013), could affect even mental health and disorders, like depression (Valles-Colomer et al. 2019). These findings suggest that normal human development strongly depends on the microbiome and that microbiota are susceptible to different environmental, social, and cultural factors, like diets, sport, stress, hygiene regimes, cultural traditions, and lifestyles (Durack and Lynch 2019; Nkera-Gutabara et al. 2022). This implies that health differences between human groups can be linked not only to genetic differences between these groups, but also to differences in cultural practices and inhabited environments that become embodied through the microbiome.

Despite the relevance of environment and culture, human groups are classified in microbiome research following traditional labels from genetics or genomics. Thus, microbiome researchers tend to apply a combination of racial categories (Caucasian, mestizo, white, Black), ethnic names of groups (Yanomami, Hadza, Otomí, Flemish), geographical labels (Latin Americans in the US, Otomí indigenous in Mexico City, Mestizo women in US, Asian), as well as geo-political (Western, non-Western), anthropological (hunter-gatherer) and national categories (US Americans, Dutch, Japanese) in their studies (for an overview and discussion, see Maroney 2017, Benezra 2020, De Wolfe et al. 2021, Nieves Delgado & Baedke 2021, Chellappoo & Baedke 2023). These categories aim to denote that members of these groups share characteristics in their microbiota resulting from similar host genetics, lifestyles, and environments. But, at the same time, these classifications are often mixed in microbiome health debates and are not clearly separated from one another.[1] It is common to find several of these categories used in a single study, when, for example, the "rich" and diverse gut microbiome of indigenous groups like Hadza in Tansania (representing healthy hunter-gatherer populations) is compared to the reduced microbial diversity in Dutch populations or White in the US suffering from Western diseases. Moreover, some studies use racial categories to classify populations also when no host genetics are taken into consideration and the meaning of race is rarely clarified.

In addition, studies in microbiome research tend to evaluate how cultural practices and environments alter the microbiome by selecting certain practices or measurable environmental factors and comparing them across populations. Examples of this are studies measuring how microbial diversity and composition is affected by acculturation levels (e.g., English language acculturation; Hoffman et al. 2018), sexual practices (Ravel et al. 2011), oral hygiene (Rodríguez-Hernández et al. 2017), eating "American" food instead of "Hispanic" food (Kaplan et al. 2019), among others. The effects of these cultural differences become biological by affecting the microbiome. This process leads to the embodiment of racialized environments, cultural and economic differences, pollution exposition, hygiene practices, etc. The re-biologization of environmental and cultural differences is what is called 'biosocial race'. This new version of race is biological, but it is neither clearly separated from the social realm nor immutable (Chellapoo & Baedke 2023: 14). In some way, this new research has let us back to biological race. It introduces a new version of biological race that is allegedly relevant to health.

[1] The tendency to use race, ethnicity and nation interchangeably is not new or specific to microbiome research, but rather it can be considered a general problem in science, for example in human genomics (Wade et al. 2014) and biological anthropology (Tallman, Parr and Winburn 2021). While these concepts are constantly used interchangeably, they refer to different ways of grouping populations. However, this distinction is usually not present in these studies. In this paper, we use the categories used by the papers we analyze and showcase this problematic. We also like to point out that there are multiple definitions of race and ethnicity and these have also changed considerably across time. One main difference between the two is that race has traditionally been linked to biological differences, health states and genealogy. In contrast, ethnicity has been used to refer mainly to cultural and religious differences. In some contexts, like Latin America, nation has come to replace both as nations or states tend to "'make race' by endowing particular axes of variation within a human population with symbolic weight and material consequences" (Loveman 2014: 15). For definitions of race and ethnicity see Cornell and Hartman 1998 and, in the field of genomics, NASEM 2023: 4.

4. Is it Race? Four Scenarios in Microbiome Research

In what follows, we identify and systematize four different scenarios in which current microbiome studies draw on an implicit or explicit concept of biosocial race. We argue that in all these cases, it is illegitimate to use race implicitly or explicitly.

4.1 Scenario 1: Host Genetics as Race

Some studies in microbiome research take into consideration genetic features of hosts (e.g., Bonder et al. 2016). They investigate whether variation in the genotype of the host affects the probability that particular microbial taxa colonize hosts' bodies. This genetic variation is then clustered into, for example, racial, ethnic or national categories, or a combination of these (Gupta et al. 2017, Kolde et al. 2018, Yang et al. 2019, Gacesa et al. 2020, Lopera-Maya et al. 2022).

This research on 'host ancestry' feeds on older understandings of race as genetic ancestry, developed in genetics and genomics by authors since the second half of the 20th century. However, as our knowledge of the intricate nature of the human genome expanded, it became increasingly clear that the genetic variation within putative racial groups far surpasses the variation between these groups (Lewontin 1972, Marks 2010, Winther 2018). Consequently, a growing number of biologists asserted that the concept of race in humans lacks a meaningful biological definition (Cavalli-Sforza et al. 1994: 19, Templeton 2013). This viewpoint reached its zenith with the Human Genome Project, which unveiled the striking genetic similarity among humans below the species level. Especially, given the inconsistency in which genetics and genomics map on what is commonly identified as races, we argue that it is not legitimate to phrase host genotype differences as racial differences. In short, since there is no genetically legitimized concept of biological race, hosts cannot be classified into races in this way.

4.2 Scenario 2: Microbiome Variation as Biological Race

Not all human microbiome studies consider host genetic background. Many of these collect, for example, only data on hosts' microbial diversity and composition (usually the collection of all genetic sequences found in a microbiome). But even in these cases, a genetic race concept is often structuring the interpretation of results. For example, many studies trace microbial differences between different indigenous or indigenous and 'Western' populations. Indigenous communities residing in geographically distinct locations, such as the Matsés in Peru and the Hadza in Tanzania, are found to exhibit commonalities in their microbiomes, such as a greater genetic and taxonomical diversity of microbes (Obregon-Tito et al. 2015). Additionally, individuals from Peru and Malawi demonstrate a notably high abundance of *Prevotella* in their gastrointestinal tracts (Gupta et al. 2017). Other studies investigate how socio-cultural change of host environment affects their microbiome. For example, Hoffman et al. (2018) argue that higher acculturation (e.g., higher English linguistic acculturation scores) in the "at-risk group" of Mexican American women who migrated to the US, is associated with an oral microbial transition from *Prevotella* to *Streptococcus* species. They predict a shift in Mexican woman's metabolism by adapting the US lifestyle, which could make Mexican American women more prone to obesity-related diseases. Finally, another example, are citizen science initiatives like the Microsetta Initiative or nation-wide projects like The South African Microbiome Initiative that aim to measure microbial variation at non-Western

populations. Participants in these studies are asked to complete forms and submit stool samples by mail. Usually, these initiatives do not take host genetics samples but focus solely on the microbiome's genome.

Can such microbial differences be legitimately conceptualized as racial differences? Such a notion of biological race contradicts traditional understandings of race as an unchanging characteristic or set of characteristics inherent to the human body, such as skin color, hair color, anthropometric measurements, IQ, and genes, among others, which are shared by a lineage of genealogically related individuals. This refers to the problem, first, that microbiome-linked traits are fluid and may change over the lifetime of the host. Second, and more fundamental, in humans, microbes do not form a reproductive unit with the host. The so-called holobiont (the integrated unit of the host and its microbiome; see Gilbert et al. 2012, Rosenberg and Zilber-Rosenberg 2016; Baedke et al. 2020) can be characterized as a physiological integrated but not reproductive individual. It has not one lineage, but several trillion. Human holobionts cannot be separated into races, at least not without dropping the traditional ancestry and lineage criterion of race.

Third, another way to legitimize race talk could be to simply understand microbes themselves (without the host) as indicators of human's biological race. However, this is not an option either. Traditionally, from authors like Blumenbach to 20th century population genetic clustering, race was always considered to be informative about groups within a certain taxonomic limit: that of *Homo sapiens*. If biological entities from any level of taxonomy (beyond that of the human species) are considered as indicators of racial differences in humans, the argument that belonging to a human race is somehow informative about belonging to the human species, can no longer be upheld. In essence, the membership of an individual in a specific race no longer offers insights into their inclusion within the human species. Instead, it merely provides information on other non-human taxa. So taking microbial patterns as surrogates for human races leads to a highly counterintuitive and taxonomically problematic view of race—a view in which human races are constituted by other non-human species.[2] Thus, all in all, using microbes to inform a biological view of human race cannot be defended.

4.3 Scenario 3: Cultural Differences as Race

One may argue that we could still treat microbial patterns as biomarkers for *cultural* (rather than biological) differences that can be grasped with a socio-cultural concept of race. In human microbiome studies, researchers often collect information about the social and material environment and the habits of different human groups in order to make sense of their microbial compositions and diversity. In particular, such studies ask for diet and exercise patterns, immediate landscape, hygiene practices, among others. The assumption is that these practices differ between groups due to their local culture. There are two problems in understanding and labelling these socio-cultural differences as racial differences.

First, these studies usually have a quite simplistic understanding of culture. They tend to take a couple of environmental measurable factors to define cultural differences among groups. For example, in the study previously mentioned by Hoffman et al. (2018) on the effects of acculturation on health, the complex process of acculturation is measured using the Bidimensional Acculturation Scale for

[2] We discuss these problems in detail in Nieves Delgado and Baedke 2021.

Hispanics. The authors measure changes in food preparation and consumption and English/Spanish proficiency (i.e., "participants were asked how frequently they spoke, read, watched television programs, and listened to radio programs in English and Spanish", Hoffman et al. 2018: 2). We believe that this study reduces complex cultural practices to a small set of easily measurable parameters, which can contribute to a fragmented view of culture. Moreover, it seemingly presupposes that culture is something static that is acquired or lost instead of something that continually changes in time.

Second, most of the times cultural difference is described in terms of the contrast between Western and non-Western (for example, de la Cuesta-Zuluaga et al. 2018; Soverini et al. 2016). This contrast is established by identifying, for example, a kind of (non-)Western diet, a type of lifestyle or access to antibiotics. This distinction has the effect of lumping together many different populations on one or the other side of the dichotomy. However, in many such cases, these populations, like Hadza in Tanzania and Yanomami in Venezuela, do not share specific cultural traits. Also, these culturally clustered populations cannot be considered to form biological races given the lack of genealogical relationship between them. In sum, in human microbiome research understandings of race as cultural difference between groups often endorse simplistic and fragmented views of culture or adopt a too coarse-grained dichotomous framework that is insensitive to cultural diversity. As a consequence, these approaches cannot establish a consistent view of race.

4.4 Scenario 4: Race as Embodied Racism

One of the main general arguments in favor of keeping the concept of race in science is that it can help acknowledge racism and racialization processes against human groups and fight the accompanying health issues these groups face. Here it is argued that even if biological race doesn't exist, racial thinking has structured different societies and caused important race-based differences in them (Taylor 2004; Mallon 2006). Eliminating race from our vocabulary would lead to not being able to acknowledge those differences (Wodak 2022) or to an inability to promote social movements and policies to equal opportunities (like affirmative action) (Anderson 2010). An example of the consequences of keeping or eliminating race is the current debate on the removal of the word race from the German constitution (Witting 2020). The concerns of people arguing in favor of keeping race in certain socio-political contexts are often related to making injustice visible and provide solutions to it (Jones and Nichols 2020). But, unfortunately, in most national or social settings, keeping race has not fulfilled that role so far.[3] Instead, the ongoing use of race in science may lead to new biological versions of race (Roberts 2008). For those reasons, we suggest referring to racism instead of race.

In microbiome research, most studies discussing race do not address racism or microbiome-mediated health issues related to racism and racial discrimination

[3] Against the background of the long and closely interlinked histories of race and scientific racism, we hold that it is, first and foremost, on the side of those defending the ability of racial classification—instead of, e.g., race-neutral or color blind approaches—in policymaking to provide evidence on whether race effectively and appropriately can identify groups facing injustice, inequalities, or health issues, and help solving these issues without promoting racism. For a discussion of the effectivity of race-neutral, race-conscious, and racism-conscious approaches to health care policymaking, in the U.S., see, e.g., Ford & Airhihenbuwa 2010 and Fashaw-Walters et al. 2023.

(de Wolfe et al. 2021). However, since structural racism is an important factor shaping human life and thus possibly the human microbiome, this shortcoming is unfortunate. In fact, racism (historical and present) can have powerful ways of altering health. A small but growing number of microbiome studies has recently aimed to look at the effects of discrimination based on race and ethnicity (Dong et al. 2022) or at stress as a potential factor in shaping racially different microbiotas (Carson et al. 2018). Focusing on the stressors individuals face due to racism or discrimination can be a novel way to study the effects of racism on health instead of those of race.

Unfortunately, these studies presuppose that people under study already belong to and can be grouped into racial groups. Carson et al. (2018) for example, in their study on how perceived psychological stress in black and white woman might affect gut microbiome related colorectal cancer disparities argue that they "do not assert that these racial differences [in the gut microbiome] were due to race alone, but more likely due to behavioral, environmental and psychosocial factors that are related to race that were unmeasured in this study" (Carson et al. 2018: 10). In other words, race exists independently and in different races different 'behavioral, environmental and psychosocial factors' matter. In the case of Dong et al. (2022), their research found associations related to discrimination in the brain-gut-microbiome system. In black and Hispanic individuals, discrimination resulted in brain network changes, in white people it was related to anxiety, while for Asian individuals the registered patterns suggest somatization of discrimination and behavioural responses. In this study, race and ethnicity are not defined nor distinguished and discrimination is measured using the Everyday Discrimination Scale, a scale not exclusively used for ethnicity or race (Williams et al. 1997). Thus, while it remains unclear what exactly race is in this study (biological, or social race), its causal role and relation to discrimination are clearly depicted by the authors. In Figure 1, we see that 'ethnicity/race' is assumed to precede discrimination. Racial categorizations do not emerge as a result of racial discrimination practices, but race causes and precedes discrimination. We want to argue in favor of a more complex relation between ethnicity/race and discrimination, one that is not unidirectional but historically produced and reciprocal.

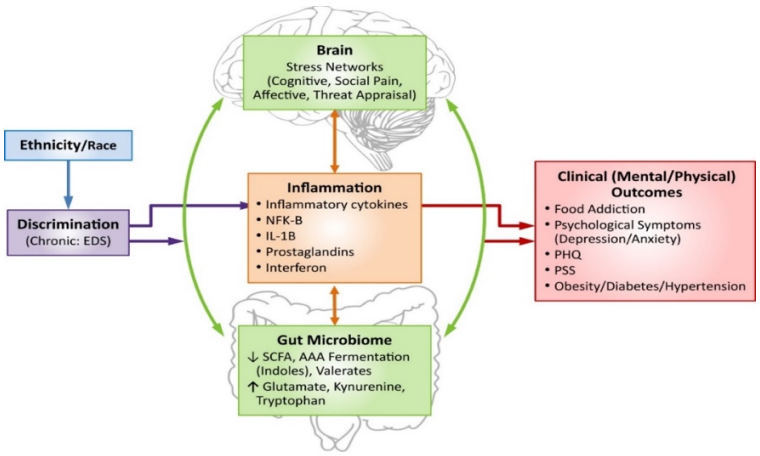

Fig. 1. Conceptual model linking race and discrimination to the brain-gut-mircrobiome system (Reproduced from Dong et al. 2022).

In contrast to these microbiome studies, a more detailed description of inequalities could be a fruitful way to think about the health effects of racism without presupposing racial differences in microbiome research.[4] This could be complemented by defining populations under study through the specific situations of racism or discrimination they face, rather than as racial groups. In such an account, microbiologists could include individuals from such communities in their research design, as they could provide scientists with valuable insider's perspectives into the local workings of structural racism, psycho-physical challenges, and its healthcare consequences. These insights would surely enrich the process of data gathering and the selection of relevant population descriptors (e.g. setting up questionnaires etc.). Such microbiome research could then inform new racism-conscious (rather than race-conscious) approaches that explicitly focus on the influence of racism in decisions related to healthcare policies, the environments in which these policies are crafted, and the resulting effects (see Wallace et al. 1998, Fashaw-Walters et al. 2023). In other words, racism-conscious microbiome research would recognize and address the structural barriers and inequities that create and perpetuate social, political, and economic limitations on marginalized groups and their associated health disparities.

More generally, this means that if we can replace race through a focus on downstream health manifestations of racism in microbiome research, we can also eliminate race from this fourth scenario found in the field.

5. Conclusion

In this paper, we distinguish and examine four different scenarios where racial classifications play a role in today's microbiome research. These scenarios consider race to be defined based on (1) host genetics, (2) microbiome genetics, (3) cultural practices and (4) race as embodied racism. We argue that we should remove the notoriously difficult concept of race from human microbiome research in all these cases, as it is inconsistent and rather makes classification of populations more difficult than clearer. In fact, in order for the field to address health inequalities and the effects of racism on biological processes, researchers do not need to refer to race at all.

Finally, we want to explore yet another, fifth scenario in which conserving race in human microbiome research could be legitimized. This is the case where race and racial identity has a positive meaning to individuals and groups (Haslanger 2005; Jeffers 2013). In this scenario, we can expect people under study to identify themselves as part of a racial group. Jeffers (2013), for example, suggested that Blackness or black identity does not only refer to problems associated with stigmatization, discrimination, marginalization and in general the disadvantages of belonging to such a group. Rather, black identity "[is] partly shaped by the agency, creativity, and traditional cultures of those who came to inhabit it and, as such, it has distinctive cultural meaning and value" (Jeffers 2013: 420). It could be the case that other racial identities besides black identity share similar positive feelings and that this phenomenon exists beyond the US. But this needs to be carefully determined in each case. It is also important to not reduce the value of race as identity described above to a box-ticking exercise. If self-identification

[4] For an example of how such research can be conducted, see Malinowska and Żuradzki (2023)'s discussion of epigenetic research.

is evaluated based on ready-made questionnaires, then researchers are in danger of distorting yet again the (racial) identity of groups. Up to now, we have not found a case like the one described by Jeffers in current microbiome research. Until there are methodologies that explore this path, we urge researchers to drop the concept of race from their studies.[5]

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