‘Race’ and other group discrimination in the genomic era

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Summary. Genetic science has provided new knowledge that has the potential to reduce ‘race’ discrimination. This includes findings that around 95% of human genetic variability is present within any population; and that most human traits are influenced by a complex combination of many genetic and environmental factors. Despite this knowledge, racially discriminatory practices persist internationally, including segregation; unfair sentencing; state surveillance of children; and

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involuntary sterilisation. Moreover, there is an emerging risk that DNA may be used to propel harmful discriminatory practices. For example, new 'DNA-based' groups may emerge in the context of polygenic prediction – aggregating multiple genetic risks into individuals' combined risk indexes. Such DNA-based groups could be viewed as 'new races' - adding yet another category to the already heterogenous definition of 'race'. This paper reviews the genetic advances directly relevant to, and their impact on, 'race' and other group discrimination; and assesses current UK and international discrimination practices and effectiveness of the laws in place prior to and in the genomic era. The paper concludes that current laws provide insufficient protection from 'race' and other group discrimination and still reflect people's beliefs in entrenched differences between 'races'. The paper asserts that the very use of the term 'race' in equality legislation is problematic due to inconsistencies in definition across key legislations; and history of its association with domination. Justice systems must update laws to reflect current genetic knowledge and to address existing and emerging risks of discrimination.

Keywords: Discrimination law; race discrimination; genetics and race; DNA based group discrimination; equality legislation; genetics and race

Genetic science has produced a vast amount of knowledge about human traits. This knowledge has the power to bring both great benefits and harm to people. Numerous discrimination practices have been based on the assumed biological / genetic differences among groups – so called 'races'. This paper argues that the risks

of such discrimination remain high in the genomic era, which has started in 21st century with the completion of the Human Genome Project (Guttmacher and Collins 2003). The paper highlights the problems with the definition of 'race'. The paper outlines the existing UK law on 'race' discrimination, as well as relevant international instruments, and considers their effectiveness in practice. The paper then highlights how genetic science can be used to minimise race and other group discrimination, but that at the same time may introduce new challenges for justice systems, such as discrimination against *DNA-based* groups. Such groups may, for example, include people who have similar polygenic scores linked to particular traits and/or the same genetic markers for particular conditions. Using an interdisciplinary perspective of law and genetics, the paper identifies what is required from justice systems to update laws to alleviate such risks.

Discrimination on perceived biological differences

History of discrimination

Societies have used heredity for centuries as a predictor of an individual's qualities. Relying on lineage, for example, people have selected partners, employees and social circles. People have long known that something *biological* transmits from generation to generation within families. Today we know that what is transmitted is DNA, the genome. However, our understanding of genetic transmission has been limited, leading to incorrect views about genetic differences between groups and to discrimination of groups. Group discrimination is based on many characteristics, including colour, nationality, ethnicity, religion, class, caste, gender and other existing and perceived differences.

Discrimination based on hypothesised biological differences between groups has led to numerous catastrophes, including the fol-

lowing well known genocides: the murder of up to 1.5 million Armenians in 1915; of around 6 million Jews and hundreds of thousands of Roma in the Second World War; and more recently (1992-95), of around 250,000 Bosnians (genocidewatch.com) (Derderian 2005; Paulsson 2011; ushmm.org n.d.). Other horrific group discrimination practices include, the centuries-long segregation of black people; and the persistent discrimination of minority ethnic groups, such as the Roma people.

Another example of group (class) discrimination is that of eugenic practices that used genetics to support its agenda (Lombardo 1985). The eugenic movement, which originated in England, advocated restricting birth within groups considered genetically inferior, targeting immigrants, minorities and poor people (Andrews, Mehlman, and Rothstein 2015; Bouche and Rivard 2014; Daniel J. Kevles 1985; Kevles 1999; UNICEF 2017). It was erroneously believed that undesirable traits (e.g. feeblemindedness, criminality and alcoholism) were passed on in families in a simple way, and therefore it was thought possible to improve the genetic pool of the population by 'breeding out' disease and intellectual weakness. The father of Eugenics, Francis Galton, proposed that '…as a new race can be obtained in animals and plants, … with moderate care in preventing the more faulty members of the flock from breeding, so a race of gifted men might be obtained… .' ((Galton 1869) p 64). Although Galton did not propose sterilisation to improve race, later millions of people were forcefully sterilised. These forced sterilisations were conducted in the name of 'improving race' and alleviating the 'burden' that the poor, disabled and mentally ill 'impose' on society. Reported numbers of forcefully sterilised people, include around 64000 in the US; 60000 in Sweden; and 3.5 million in Germany (Andrews et al. 2015; Daniel J. Kevles 1985; UNICEF 2017).

In the USA, the Eugenics Records Office (ERO) used unreliable data to promote eugenic practices leading to passing of Eugenic laws. In the most damaging case in the history of Eugenics – *Buck*

v Bell 1927 – the US Supreme Court upheld the sterilisation of a poor woman of average intelligence on the ground of 'imbecility', paving the path for millions of sterilisations (Burrus 2016; Georgia State University 1927; Lombardo 1985). For example, 20 states passed eugenic sterilisation statutes in the following 10 years, with the total of 33 US States ennacting sterilisation laws (Andrews et al. 2015; Lombardo 2011; SSHRCC n.d.). The *Buck v. Bell* case has never been overturned.

The eugenic movement spread across the world, and included a number of international organisations and societies which themselves had disagreements on what methods can and should be used to 'improve' a human population (stock) (Macuglia 2014). In the UK, where the first International Eugenics Conference was held in 1912, eugenics was supported by political leaders (Brignell 2010). The UK prime minister, Winston Churchill, for example, is reported to have warned that 'The multiplication of the feeble-minded… is a very terrible danger to the race' (Akomolafe 2016; Larson 2017); and another parliamentarian is reported to have described disabled people as 'human vermin…' (Brignell 2010; Chitty 2009; Sewell 2009).

Using the *inferior race* justification, laws were passed in the USA (e.g. Immigration Act, 1924) to minimise or stop immigrant intakes from a number of nationalities, whose communities were growing large enough to require seats in government (Ager and Hansen 2017; Higham 2002; Ogletree 2000; Stolerman 2017). The set intakes of immigrants were 82% for Northern and Western Europeans; 14% for Southern and Eastern Europeans (e.g. Italians, Slavs and Greeks); and 4% for the rest of the world (Ogletree 2000). This policy/law remained in force throughout the Second World War, at a time when the nationalities allocated small quotas would have had the most need to migrate to the USA.

The use of eugenic laws continued long after the ERO was shut down in 1939 - with the last eugenics laws repealed as late as 1979 in California. Since then, the eugenic laws have been discredited

and eugenic practices have been banned worldwide. For example, the Universal Declaration on the Human Genome (1997) states that 'discrimination based on genetic characteristics that is intended to infringe or has the effect of infringing human rights, fundamental freedoms and human dignity' shall be prohibited. In addition, the Universal Declaration of Human Rights (1958) Article 6 states that 'We *should* all have the same level of legal protection whoever we are...'.

However, there are risks that genetic information will continue to be misused. For example, there have been recent reports of eugenic practices continuing, such as sterilisations of inmates reported to have happened as recently as 2010 - 150 women sterilised between 2006-2010 in the State of California (Johnson 2013). Similarly, sterilisations of Roma women are reported to have continued until 2016, for example in Czech Republic (ERRC 2016). Other race discrimination practices based on genetics persist in other advanced economies. For example, Swedish police were found to keep in a secret register details of over 1000 Roma children, some of whom were as young as 2 years old in the form of family trees (Ghosh 2013; Mansel 2013; Reuters 2013). Other alarming trends include the family cap laws in the US – removing financial support for additional children for parents who were already receiving financial assistance (Berkeley Law 2016; Dinkel 2011; Lombardo 2011). These laws spread (in around 25 States in 2011) following the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) which gave States discretion to pass family cap laws (a number of States have now abolished these laws) (Berkeley Law 2016). Family cap laws have been criticised as *punitive restriction to curtail* poorer people's propensity to have more children, which were falsely promoted as 'as a way of minimising reliance on support' and '*solving the intractable' problems of poverty* (Dinkel 2011; Roberts 1997).

Reasons for persistent discrimination

Discrimination on real and perceived genetic differences is a complex multifactorial phenomenon. One reason for persistent discrimination is that historically eugenic laws and propaganda were used to maintain political control – justifying continued suppression of black people, poor people and minority immigrants (Andrews et al. 2015; UNICEF 2017). Commercial agenda can also exharcebate beliefs in racial differences. For example, the BiDil drug, having undersold for decades as a general drug, was rebranded as a solution for a large select 'racial' group (African Americans) – despite research showing no race/ethnic related effect (Bowser 2004; Brody and Hunt 2006; Hammermeister et al. 2009; Husten 2017; Kahn 2004).

Another major factor is that the propensity to discriminate seems to be an inherent feature of the human mind, tightly linked to the propensity to protect one's own group. This seemingly universal human trait is likely to have evolved and is shared with many species. This propensity can often be paradoxical, such as discrimination on grounds of gender which can result in harming closest family members (e.g. mother, sister, wife). In turn, this universal propensity to discriminate creates a fear that someone or some group will necessarily be discriminated. In other words, people discriminate others in order to avoid occupying the 'discriminated niche'. These and other weaknesses might help explain how extreme discrimination and even genocide can occur amongst people of the same nation, such as that which occurred between Hutu and Tutsi people in Rwanda (Epstein 2017).

Discrimination is further exacerbated by people's tendency to readily accept views that support pre-conceived ideas (Gilead, Sela, and Maril 2018). This means that people can easily accept scientifically weak reports and opinions that support their established belief in the existence of racial differences. This tendency is reinforced by another human weakness - the difficulty in correcting

fake information that was initially accepted as true, even after learning it was fake (De keersmaecker and Roets 2017). In addition, specific to 'race' discrimination, as discussed in the following section, the very use of the term 'race' in law and legal practice may contribute to the problem.

Law and practice

Problems with the term 'race'

The use of the term 'race' in equality legislation is in itself problematic. It is a term that is 'widely recognised as a social and political construct with a long history, originating in economic and expansionist imperatives and directed as legitimising domination' ((Monaghan 2013) p. 187). Various legislations attempt to distance themselves from accepting the existence of 'race' – demonstrating a somewhat confused position: using the term race and at the same time denying the existence of racial differences. For example, the EU indirectly acknowledges that equality law is based on the misunderstanding of the meaning of the term 'race', and includes the following disclaimer in recital 6 of the EU Directive 2000/43/EC (the 'Race Equality Directive): 'The European Union rejects theories which attempt to determine the existence of separate human races. The use of the term 'racial origin' in this Directive does not imply the acceptance of such theories.' Similarly, Belgian law refers to 'alleged race'; and French law to 'real or assumed race' (European Commission 2016).

The term 'race' is also defined in many ways in domestic legislation and other international instruments, with some including ethnicity, colour, religion, nationality, and other features; some considering 'race' to be a distinct feature in its own right; and others using different characteristics (such as ethnic origin and ethnicity) interchangeably with 'race'. For example:

- In the UK, the Equality Act (EA) 2010 (section 9), defines the term ‘race’ as encompassing ‘colour, nationality, ethnic or national origins’. Under EA 2010, section 9(5), the UK government was required to include ‘caste’ in the statutory definition of ‘race’, and in 2014 it was held by a Tribunal that ‘caste’ does fall within the definition of ‘race’ (Pyper 2018; UKEAT 2014).
- Article 1 of the International Convention on the Elimination of All Forms of Racial Discrimination 1969 (ICERD) defines racial discrimination to include discrimination on race, colour, descent, or national or ethnic origin.
- Article 14 of the European Convention on Human Rights 1953 (ECHR) states that the enjoyment of the rights to prohibition from discrimination and other rights under the Convention ‘shall be secured without discrimination on any ground such as sex, race, colour, language, religion, political or other opinion, national or social origin, association with a national minority, property, birth or other status’.
- The European Commission against Racism and Intolerance (ECRI), a human rights monitoring body, defines ‘racial discrimination’ to include discrimination on the grounds of ‘race, colour, language, religion, nationality or national or ethnic origin’ (General Policy Recommendation No. 7).
- The EU’s Race Equality Directive states that ‘the purpose of this Directive is to lay down a framework for combating discrimination on the grounds of racial or ethnic origin’ (Directive 2000/43/EC).
- The Treaty on the Functioning of the EU 2007 (TFEU) states that ‘the Union shall aim to combat discrimination based on … racial or ethnic origin…’ (Article 10).

These definitions partly overlap with the definition of ‘ethnicity’ provided by the European Court of Justice (ECJ), which has recently stated that ‘ethnicity’ has ‘its origins in the idea of societal

groups marked in particular by common nationality, religious faith, language, cultural and traditional origins and background' (CURIA 2015).

In the UK courts have found that discrimination of an English national by a Scottish employer falls under the definition of 'racial discrimination' – stating that in order to determine whether a group is defined by reference to 'national origins', there must be identifiable historical and geographical elements, separate from the individual's origins, which reveal the existence of a nation at some point in the history of the group (EAT 1997).

Some countries have attempted to formulate anti-discrimination laws without mention of the word 'race'. For example, Germany has focused only on specific grounds of discrimination such a xenophobia and anti-Semitism. However, this approach may lead to the neglect of other forms of discrimination (UN CERD 2017).

Such inconsistent use of the term 'race' in equality legislation may partially stem from the fact that the etymology of the word is not clear and that it has been historically used to mean different things, including: 'people of common descent' from the 16th Century French word 'race'; 'race, breed, lineage, family', from the 16th Century Italian word 'razza'; and English uses varying widely, including, 'group of people with common occupation' (c. 1500), 'generation' (1540s), and 'tribe, nation, or people regarded as of common stock' by 1560s (Online Etymology Dictionary n.d.). However, defining race is not simply a matter of understanding etymology, but rather clarifying a complex issue with implications for human rights of all people. As human rights is a universal issue it makes sense for the definition of what can constitute discrimination to be uniform in domestic jurisdictions across the globe. Overall therefore the issue of the use of the term 'race' has not been resolved and more work is needed to achieve a satisfactory solution.

Effectiveness of legal protection against race discrimination

In the 1960s there was a categorical shift in the UK and the US in the protection of people against 'racial' discrimination when laws were introduced which: prohibited discrimination on grounds of race in public places (segregation), in voting, in housing and other civil rights; and invalidated laws prohibiting interracial marriage (Adams, Bell, and Griffin 2007; Brown 2018).

In the UK, legal protection against 'race' discrimination has gradually been extended and strengthened since the enactment of the first piece of equality legislation in 1965. The law is now encapsulated in the Equality Act (EA) 2010 and can be used to bring discrimination claims against individuals, organisations, private companies and public bodies.

However, there are a number of loopholes in the UK law that allow for 'racial' discrimination. For example, Schedule 3 of the Equality Act 2010 permits the immigration authorities to discriminate on (inter alia) grounds of nationality or ethnic/national origin pursuant to a ministerial authorisation. Indeed, it could be said that the whole system of immigration control is racially discriminatory. The Commonwealth Immigrants Acts 1962 and 1968 were essentially designed for the purpose to deprive certain Citizens of the United Kingdom and Colonies, disproportionately Black and Asian people from overseas colonies/territories, of their previous common law right to live in the UK. The 1968 Act in particular was specifically designed to stop East African Asians settling in the UK. The Immigration Act 1971 replicated those injustices in its concept of 'patriality', which discriminated in favour of Citizen of the UK and colonies (CUKCs) who were born in or had ancestral connections to the UK (disproportionately White British people) and against those who did not. That discrimination was then repeated in the British Nationality Act 1981, which abolished CUKC status and gave the new status of 'British citizen' only to those CUKCs who were patrial.

In 2017 the UN Committee on the Elimination of Racial Discrimination highlighted other loopholes. These include the fact that the UK continues to uphold its restrictive interpretation of the provisions of article 4 of ICERD, which deals with hate crime (hate speech, incitement) – thus allowing greater freedom to the media in relation to racial prejudice than the Convention allows. The UN Committee also found an increase in racial prejudice in the media faced by minority ethnic groups, asylum seekers and immigrants, and lack of effectiveness of the Press Complaints Commission (PCC) (which closed in 2014) in dealing with this issue. For example, the UN Committee raised concerns about the UK government allowing the media to use phrases such as 'illegal asylum seekers' – when in fact it is a contradiction in terms. The UN Committee further criticised the UK for the provisions of the Anti-Terrorism Crime and Security Act 2001, which provides for the indefinite detention without charge or trial, pending deportation, of non-nationals of the United Kingdom who are suspected of terrorism-related activities.

The complexity of the legislative equality provisions and the cost of pursuing discrimination claims are additional barriers that render the law ineffective and inaccessible to most people (Selita 2018; The Lord Chief Justice 2015). The UK has also been singled out (alongside Austria and Luxembourg) by the European Commission for the complexity of discrimination laws which may be deterring victims of discrimination (European Commission 2016).

Moreover, the wide discretion afforded to the judiciary may also contribute to discrimination through allowing conscious and unconscious biases to influence decision making. In fact, an analysis of the UK Ministry of Justice identified judges' discretion as a risk of discrimination in sentencing (The Lammy Review 2017). Several studies have found evidence of such discrimination including in the UK and the US. One large study of over 140,000 cases over 13 years found that, within cities (30 cities covered) in the US, a defendant's sentence could vary by up to 63% depending on the

judge (US Sentencing Commission 2019). Statistics show that this discretion contributes to discrimination practices of groups. For example, Black offenders in the US have been found to receive 10% longer sentence than White offenders (Kerby 2012; Nanau et al. In review). Similarly, in the UK Black and Asian defendants have been found to receive considerably longer custodial sentence than White defenders, with Asian defendants receiving the longest sentences (Ministry of Jusice 2017). For example, for all offenders sentenced to immediate custody in 2016, White defendants received an average sentence of around 18 months, and Black and Asian defendants around 24 and 25 months respectively (around 33% higher sentence) (Ministry of Jusice 2017). An investigation conducted by *The Independent* found that between 2009-2017 one in four Black teenage boys convicted of homicide were handed maximum jail sentences (life); and *not one* White teenager was sentenced to more than 10 years (Abu 2018). An independent review found that Black people and other ethnic minorities convicted of a drug offence are around 240% more likely to get a prison sentence than White people (The Lammy Review 2017).

These shortfalls in the law and procedure are among primary reasons for overt / open / institutionalised 'racial' discrimination. There are numerous cases of discrimination that can be described as 'structural racism' (United Nations 2018) and which demonstrate that the legal protection offered by the current laws is insufficient. A striking example is the recent *Windrush Scandal* whereby Black people from former colonies who had arrived in the UK in the 1950s and 60s were, for example, denied health care and other essential services or even deported (Harewood 2018). Some of these people were left without any official record because the government destroyed their disembarkation cards in 2010 (Gentleman 2018).

Other statistics show that group discrimination is also prevalent in areas such as policing and employment. For example, in the UK, use of 'stop and search' powers by the police officers show there is

significant discrimination against people from ethnic minorities, with Black people being more than 8 times more likely than others to be stopped and searched (UK Home Office 2019; UN CERD 2017). Gypsies, Roma and Irish Travellers represent only 0.1% of the wider population, they account for 5% of male prisoners (HM Inspectorate of Prisons 2017; Ministry of Jusice 2017). Similarly, Black people make 3% of the population, but make 12% of prisoners, and Black children make 21% of children in custody (e.g. (The Lammy Review 2017)). Statistics also show that Black people and other ethnic minorities are twice as likely as white English to die after the use of force by police officers and the subsequent lack of access to healthcare (United Nations 2018). In relation to employment, between 2010 and 2015, there was a 49% increase in the number of young people (16 to 24 year olds) from ethnic minority backgrounds who were long-term unemployed, whereas there was a 2% decrease among young white people (Equality and Human Rights Commission 2016).

Internationally, in other developed jurisdictions, racial discrimination is similarly prevalent. In Europe, police violence against people from ethnic minorities is reported to happen regularly (Council of Europe 2012). For example, in *Lingurar v Romania* the European Court of Human Rights concluded that four members of a Roma family who had been badly beaten by Romanian police officers during a police raid were the victims of ‘institutionalised racism’ because ‘the decisions to organise the police raid and to use force against the applicants were made on considerations based on the applicants’ ethnic origin’ (ECtHR 2019). The Court concluded that the authorities automatically connected ethnicity to criminal behaviour. The Court further stated that ‘Roma communities are often confronted with institutionalised racism and are prone to excessive use of force by the law-enforcement authorities’ (para 80).

In the US, 1 in 9 Black men, aged 28 to 34, are imprisoned, compared with the average of 1 in 30 across the whole male popu-

lation. Moreover, 1 in 3 Black men can expect to go to prison in their lifetime (Lyons and Pettit 2011; Office of Justice Programs n.d.; The Sentencing Project n.d.). In New York State, in 2017, Black people made up 58% of those being stopped and searched by the police; Latino people made up 32% and White people 9%. 9 out of 10 of those stopped were innocent (e.g. not carrying a weapon); and in fact more White people (1.4%) than Black people (1%) were found to have breached the law (BBC Reality Check team 2018).

Moreover, it was only recently that disturbing racial discrimination took place in health care/medical research. For example, the US National Institute of Health conducted a 40-year long, Tuskegee Syphilis Study, where 399 poor Black people were tricked into the study and, among other things, it was concealed that they had the syphilis virus and they were deprived of treatment (penicillin) - despite the virus being deadly and transmittable to partners and children. Following a leak from the media, the victims of discrimination merely received in apology from the then President, Bill Clinton (1999) (The White House 1997).

Overall therefore, 'racial' discrimination laws are not sufficiently effective, allowing for misconceptions and stereotypes about group differences to feed into practice. For example, if a particular group is viewed as more prone to criminal behaviour, its members are more likely to be stopped by the police, making them more likely to get arrested, and more likely to get convicted than members of other groups. That statistical reality simply reinforces discriminatory attitudes, creating a vicious cycle.

What genetic findings mean for 'race' discrimination

Many misconceptions and stereotypes about group differences are based on assumed genetic differences. In this section we review

what modern genetic science tells us about validity of these assumptions.

When considering racial discrimination for the purposes of updating protection or views on differences between populations, it is important to distinguish two different claims that are often wrongly merged together. The first claim is that there are behavioural differences between populations (or so called ‘races’) such as, for example, in intelligence. The second is that there are genetic differences between populations - hypothesised to underlie the behavioural differences. Both claims are notoriously difficult to test.

First, establishing the existence of group differences is challenging because it is difficult to achieve representative samples – ensuring that the comparison includes the whole range of each groups’ representatives in the same proportion. Moreover, the assessment methods must be unbiased. For example, comparing the verbal ability of two groups using the same test would be flawed if one group contained a disproportionate number of non-native language speakers.

Second, having established a particular group difference, it is scientifically extremely challenging to determine the reasons for the observed differences. This is because true experiments with natural groups are not possible: participants cannot be randomised to conditions and extraneous variables cannot be properly controlled. Any observed behavioural differences are likely to result from a large number of underlying factors and processes, including group differences in access to resources, cultural practices, societal pressures, as well as average genetic differences.

A striking example of poor practice in group comparisons is research that claimed differences in intelligence between Black and White people; and the claim that these differences resulted from hereditary factors. Much of such research has been shown to be flawed as it did not control for socio-economic conditions, educational opportunity, testing procedure issues and other extraneous variables (Ioannidis, 2005; Zeggini and Ioannidis, 2009). For ex-

ample, any observed differences in such studies could arise partly because Black people have been segregated for centuries, limiting access to educational and other resources (see also (Kaplan 2015)). In 2000, the US Department of Health published a report which showed shocking disparities between Black and White Americans, including the infant death rate being more than twice as high for Black Americans, and the heart disease death rate, over 40% higher. Based on the available evidence, the report concluded that there are no known biological or genetic characteristics for these disparities, but rather they were due to complex gene-environmental processes (US HHS 2000).

When any behavioural differences between any groups are convincingly established, these differences can only be interpreted in the context of two phenomena: (1) variation within the groups; and (2) the size of the group difference. For most human traits, variation within any naturally occurring group is wide. For example, an international comparison of school children's performance in different academic disciplines, including students from many countries (80 in 2015 and 2018) demonstrated that performance within each country was widely varied (OECD n.d.). Within one country, the gap in knowledge and skills between the lowest and highest performing students of the same age was equivalent to almost 6 years of schooling (OECD 2012). The same study demonstrated that the average differences between the countries were relatively small, even between the highest and lowest performing countries. This means that in the top performing countries millions of children were performing worse than millions of children in the lowest performing countries.

This point about wide within-group variability is often forgotten when group differences are discussed. *Average* refers to the statistical mean of a given group – a sum of scores from each individual in a group, divided by the number of individuals in the group. Using such statistics, for example, research has shown that females, on average, show greater performance in some aspects of verbal

ability than males. In contrast, males consistently outperform females on some aspects of spatial ability, such as navigation or mental rotation of objects (Toivainen et al. 2018). However, these group differences are very small, and the variation within the groups is very wide. Despite this, an erroneous common understanding is that, for example, *every* man (or most men) has somewhat better spatial ability than *every* woman. In reality, millions of women outperform millions of men in spatial ability, and millions of men outperform millions of women in verbal ability. The group statistics tell us nothing about an individual's ability.

The same considerations apply to the hypothesised and established genetic differences between groups, including different populations. The starting point of any discussion of genetic differences between populations or any other real or hypothesised groups is the acknowledgement of ten basic facts about human genetics. First, all humans are related to some extent. Second, all humans are extremely similar genetically, sharing more than 99% of the DNA sequence. Third, the differences that do exist among people stem from millions of locations in the DNA – random variation accumulated in our DNA through DNA copying errors and evolutionary processes. Fourth, this variability is present within all populations and new (de novo) mutations continue to emerge and spread in all populations. Fifth, there are generally no *qualitative* differences among populations, in other words, there are no genetic variants (form/allele of the same gene/genetic marker) that exist in one population that do not or cannot exist in another. In rare cases of discovering region-specific variants, they were present in only 1% of the population (Cheng et al. 2015; Rosenberg et al. 2002). This is also consistent with the finding that all individuals are carriers of a large number (more than 8000) of very rare/de-novo variants – not found in other people (Telenti et al. 2016). Sixth, if any genetic differences across populations do occur, they are *quantitative* – meaning that on average, more people in one population have a particular genetic variant than those in another population.

Seventh, many of the average differences in frequency of occurrence of a particular genetic variant across populations have not been linked to any specific human traits, such as intelligence, personality, educational or occupational outcomes or susceptibility to criminal behaviour. It is possible that some genetic differences do not relate to any meaningful behavioural outcomes. Each human trait is governed by hundreds of genes and thousands of DNA markers (polymorphisms), most of which have not yet been discovered (Plomin and Deary 2015). Like any research field, genetic studies designed to find specific links between genetic variants and variation in traits have limitations, including small effects, limited sample sizes, limited genotyping, and liberal interpretation of results (Ioannidis 2005; Zeggini and Ioannidis 2009). All findings from such studies require multiple replications in independent samples before firm conclusions can be reached.

Eighth, when particular genetic variants are linked to particular traits, they explain individual differences within populations, so that, for example, individuals carrying genetic risks for a particular disorder are more likely to develop the disorder than those who carry an alternative variant of the gene. The same variant may also contribute to the differences in the prevalence of the disorder across populations, if more people in one population are carriers of the risk variant.

Ninth, genetic effects are not deterministic, so that, for example, having a particular risk variant does not mean that one would develop an associated problem. Moreover, a particular variant may represent a risk factor for one trait and a protective factor for another trait – a phenomenon called antagonistic pleiotropy. For example, one mutation linked to blindness was found to have a protective effect for heart disease (Cheng et al. 2015).

Tenth, the same genetic variants can express differently in different environments. This means that removing some societal and economic limitations and pressures may negate negative genetic predispositions. Recent behavioural genetic research has demon-

strated that even when people have identical genetic predispositions for certain traits, environmental factors, such as inequality, can enhance or limit these propensities (Selita and Kovas 2018). Most diseases, disorders and other traits result from an interplay of many genetic and environmental factors (Polderman et al. 2015), which we currently do not fully understand (Jing, Su, and Ring 2014; Selita and Kovas 2018). The complex gene-environment processes unravel on physiological, neurological, sociological and psychological levels. Untangling the effects of specific factors is further complicated as they unravel over time and interact with each other. For example, a mother's stress during pregnancy may lead to a cascade of negative genetic expression events for the developing baby, affecting multiple long-term outcomes. Furthermore, environments are responsive to our genetic predispositions. For example, siblings evoke different behaviour from parents and other people, which in turn may affect their development differently.

Findings from population genetics can only be considered in the context of these fundamental facts, as well as in the context of human migration and adaptation. Research has demonstrated average genetic differences between homogenous populations (e.g. (Jiang et al. 2013)) resulting from demographic events, such as migration and relative isolation of populations; genetic processes by which new mutations (genetic variants) occur, recombine, and spread in particular populations; and evolutionary processes, that lead to the spread of most advantageous genetic variants in a particular environment (e.g. dark skin protecting from extreme sun exposure; light skin promoting vitamin D absorption when sunlight is limited). The observed population differences relate to *average* differences in the frequency of occurrence of particular genetic variants/markers or combinations of markers (called haplotypes). These differences have been used for genealogical/ancestry identification, and can be precise, if many markers are examined and very homogeneous groups are considered (Weiss and Long 2009). This is be-

cause smaller and more isolated groups are less diverse genetically, through the processes of evolutionary adaptation and interbreeding – making determination of their origin easier. However, as described above, *average* differences mean that a particular genetic variant or haplotype is more likely to occur in a particular population, *not* that it does occur in a particular individual from that select population or that it does *not* occur in a different population.

Research has shown that average genetic differences between populations are small when compared to genetic differences within any population / 'race'. For example, a landmark study of 52 populations showed that within-population differences account for 93 to 95% of the genetic variation; and across population differences, for only 3 to 5% (Rosenberg et al. 2002). Numerous studies have generated similar results (e.g.(Romualdi et al. 2002; Tishkoff and Kidd 2004). These findings suggest that two randomly selected people within one population (e.g. Roma) can be more different genetically than two randomly selected people in two different populations (e.g. Roma and English). In addition, population genetic differences have been mostly established for specific genetic markers and haplotypes, but have not yet systematically investigated the interactive and cumulative effects of many genes (Jiang et al. 2013). This means that any group information may be uninformative in regards to many traits in individuals.

The small genetic differences found among the world populations are geographically continuous (Xing et al. 2009) reflecting migration of populations from their origin, Africa, where the largest genetic variability is to be found (Campbell and Tishkoff 2008; Tishkoff et al. 2009). There is no clear dividing line of populations across the world regions. Although clustering of individuals is correlated with geographic origin, ancestry and even some traditional concepts of 'race', these correlations are imperfect, because genetic variation is distributed in a continuous overlapping way among populations (Jorde and Wooding 2004). Therefore, 'races'

cannot be biologically precisely defined (Hunt and Megyesi 2008; Weiss and Long 2009).

For reasons outlined above, in relation to an individual's traits, reliance on any ancestry or perceived 'race' or other group information does not provide the necessary precision. Instead, the direct genetic assessment of an individual is necessary – a fact widely recognised in the growing field of personalised medicine. However, where group information can be and continues to be used today is in the identification of *'at risk groups'* – so that they can be provided with more preventative opportunities (e.g., medical tests and checks). This *'at risk'* information can include information on average frequencies of risk genetic variants in different groups. However, this use will become obsolete when every person's risks can be assessed – a likely possibility as the costs of individual genotyping is becoming very low.

Until such individualised approaches become available to all, extreme caution is needed in relying on group information, for example on health risks or response to treatment – when treating individuals (Chen et al. 2018; Sengupta et al. 2018). Some research suggests the existence of some average differences in the prevalence of some traits (e.g. diseases) across populations, and that these differences may be partly explained by genetic differences (Corona et al. 2013; Han et al. 2017; Wyss et al. 2018). A number of studies examined 'racial' differences in the prevalence of different diseases. For example, one study (not using genomic data) examined risk factors in people with ischemic stroke, and reported that Native Hawaiian, and other Pacific Islanders (NHPI) and Asians were more likely to have diabetes, hypertension, dyslipidemia, and obesity than White people (Nakagawa et al. 2013). Another study reported that American Indians had a higher prevalence of some chronic conditions (Amparo, Farr, and Dietz 2011). However, without caution, applications of such information may bring more harm than good to people from ethnic minority groups (Bowser 2004). Whilst it is true that such information can be used

to take preventative measures, it can also be used to discriminate against individuals, for example, through high cost of health insurance.

It has also been claimed that some drugs are more effective in some 'racial' groups than in others. For example, it has been suggested that medications for heart failure are less effective for Black than White people (Campbell and Tishkoff 2008). However, other studies showed that there are 'no clear trial data to show any difference in effect between Black and White patients with heart failure' (Taylor and Ellis 2002). Considering the large genetic diversity within Black people and that these genes would react differently to environments, claims that one drug works better or worse on Black people are misleading. Research has shown that, while there are geographic genetic differences in drug metabolising enzymes, they are of little use because current ethnic labels are insufficient and inaccurate representations of the inferred genetic clusters; and the distribution of drug metabolising enzymes variants differs significantly among these clusters (Wilson et al. 2001).

Taken together, the current scientific understanding of genetics is inconsistent with the concept of 'race'. Therefore, 'racial genetic discrimination' is an oxymoron, a contradiction in terms, because any population is genetically diverse. Paradoxically, the genetic science that has created so much controversy with regard to group discrimination when being highjacked by eugenicists, has generated new knowledge that can be used to combat 'race' discrimination.

However, the same new knowledge has brought new challenges for justice systems. For example, our emerging understanding of which genes are responsible for which human traits, and the advances in genotyping (e.g., whole genome sequencing), enables the creation of *DNA-based groups* – for example composed of people

who have similar polygenic scores[2] for particular traits (e.g. personality or medical conditions). These new *DNA-based groups* can be created based on thresholds for particular risks or probabilities. For example, a group may include all individuals who score above a particular cut-off for the *number* of genetic variants associated with aggressive behaviour (or heart disease, mental health issues, etc.). The problem with this approach is that these groupings may be aetiologically as diverse (and therefore misleading) as the concept of 'race'. This is because the same behavioural outcomes (e.g. diseases, abilities) may result from different combinations of genetic and environmental factors. Therefore, two individuals may have the same number (e.g., 10) of genetic risks for a particular trait (e.g., aggressiveness), but considering hundreds of risks may be involved in this behaviour, these two individuals may share no risks in common. The actual probability of developing a trait for an individual is very difficult to estimate because each individual will also have other risk and resilience factors that are not taken into account.

Another way to create DNA-based groups is to aggregate together people with only identical genetic variants for particular traits. This provides more precise distinctions than the current ones, such as ancestry, geographical attributions, or class. Moreover, DNA provides information specific to the time when it is taken: epigenetic markers (e.g., methylation patterns) that are added to the DNA over the course of a person's life can already be used to de-

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[2] Recent studies across different domains of life show the importance of the genome in prediction and prevention as applicable to an individual. For example, polygenic risk manifested during primary schooling in lower cognitive abilities, lower self-control, academic difficulties, and truancy, was associated with a life-course-persistent pattern of antisocial behaviour that onsets in childhood and persists into adulthood (Wertz et al. 2018). Many studies show genetic links to health, cognition etc. (e.g. (Trampush et al. 2017)). Polygenic scores found for *years in education* explain some variation in criminal behaviour in adults (2 large-scale studies) e-RISK and Dunedin studies (UK and New Zealand) (Odgers et al. 2012; Poulton, Moffitt, and Silva 2015).

termine one's age, smoking status and health-related traits. In the near future, the use of such sequence-based and methylation-based groupings may become widespread because, individual genetic screening may become easier than socio-demographic profiling, and a more effective way of obtaining information on individuals. In fact, it may never be practical, for example, for insurance companies, police force and other institutions to assess each person's genome and to evaluate genetic and epigenetic processes in the context of each person's circumstances. They may therefore opt for the 'easier and cost-effective solutions', such as placing people with certain combinations of genetic markers under surveillance; tracking in education; or gene-based insurance premiums. These new DNA-based groups are not 'visible' geographically or in terms of physiological features. Indeed, members of the same family may fall within different DNA-based groups. Such DNA-based groups could be viewed as 'new races' - adding yet another category to the already heterogenous definition of 'race'. Updated laws are required to prevent the potential discrimination risks of such approaches.

Overall, advancements in genetic science provide new opportunities for the justice system to combat existing discrimination on the basis of 'race'. However, the genomic era requires that legal professionals have sufficient genetic knowledge to apply genetic findings appropriately and to understand new risks of discrimination. Until our knowledge of complex gene-environment interplay becomes more advanced, we need to exercise caution in interpreting genetic findings, when, for example considering genetic factors in sentencing and other contexts. The dangers of not doing so were recently exemplified by research which has suggested that even erroneously believing that one has a genetic risk can have significant negative psychological and physiological consequences that are greater than any possible effects from the actual gene (Turnwald et al. 2019).

Conclusion and recommendations

Statistics on the prevalence of racial discrimination show that it continues to be a wide-spread phenomenon. Group discrimination has a powerful corrosive impact on societies, affecting not only individuals discriminated, but all people, by virtue of the fact that it harms social cohesion (County Health Rankings and Roadmaps 2015). In the genomic era, the risks of racial discrimination may be increased or reduced, depending on how findings are interpreted and on the five steps listed below.

The existing legal protection in the UK and other countries has been found to be ineffective (e.g (European Commission 2016; UN CERD 2017)). The widespread discrimination that exists in the UK and internationally is underscored by historical myths and outdated genetic concepts. Recent advances in our knowledge on genetic differences within and across populations have not yet been assimilated into the law. Beyond the ‘structural racism’ the law and education are also ineffective in combatting subtle and covert discrimination, such as discrimination in the recruitment of employees.

The pace at which justice systems have developed over centuries is inconsistent with advances in other areas. We have evolved from primitive societies to exploring space, replacing organs, and even editing our own text of life, the DNA. Human knowledge has been reported to have doubled every century until 1900; every 25 years by the end of the Second World War (Fuller and Kuromiya 1981); and every 13 months or faster today (Schilling 2013). In contrast, the ‘1000-year evolution’ (Courts and Tribunals Judiciary n.d.) of the UK justice system has been slow. In fact, the UK legal profession and justice system have been criticised by leading UK lawyers / legal researchers for having changed little since mid-17th century (Robertson 2006). This criticism applies equally to UK discrimination legislation and practice, which remain somewhat archaic and ineffective.

We propose the UK justice system can reduce discrimination by taking the following five steps (also generally applicable to other legal systems):

1. The terms ‘race’ and ‘racial’ discrimination should be removed altogether from equality legislation. The concept of ‘race’ is not supported by current biological knowledge, but has been linked for centuries with inferiorities and superiorities. Moreover, the term is ambiguous in legal instruments / legislation – presenting barriers to the effectiveness of laws. Reference to ‘race’ in justice may consciously or unconsciously consolidate this concept in the minds of people, which provides yet another reason for abandoning the term.
2. Instead of using an ambiguous term, legislation should prohibit the discrimination against *identifiable groups*, such as nationality, national origin, skin colour, and possibly a new category – ‘DNA-based groups’, applied to people sharing specific DNA markers or groups of markers.
3. The legislative exceptions which permit discrimination in areas such as immigration and policing should be removed. Provisions aimed at tackling group hate should be strengthened and the media should be subject to effective regulation.
4. Designing effective legal protection requires sufficient knowledge. Relevant genetic knowledge has been found to be low among advocates and judges, and views on use of genetic information in justice and for crime prevention, very divided (Chapman et al. 2018; Selita, Chapman, and Kovas 2019; Selita et al. In review). The level of knowledge can be raised through short training programmes organised by the judiciary, the Bar Council and the Law Society, as continued professional development for lawyers and judges, especially those working on human rights and

discrimination. Genetic knowledge would also enable lawyers to understand and assess the validity of research – which is very important for justice. As has happened in the recent past, unsupported arguments (bad science) can spread, especially when they support particular agendas (e.g. the suggestion that there are differences in intelligence between 'races'); and when they are in line with established views - which is particularly the case with 'racial' matters.

5. Genetic knowledge has also been found to be low among the general population (Chapman et al. 2018). Increased knowledge in the population can help to combat outdated, discredited and ingrained views on 'race' and help to fight discriminaton. Including updated genetic knowledge in the school curricula, as well as training for a wide range of stakeholders (e.g., teachers, psychologists and the police) is an important step forward. Increased knowledge will also protect people from manipulative and misleading science reporting by the media.

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