Study identifies more than a hundred new genes that determine hair color

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A team of scientists, led by academics from King's College London and Erasmus MC University Medical Center Rotterdam, have discovered 124 genes that play a major role in determining human hair colour variation.

The discovery sheds new light on our understanding of the genetic complexity underpinning variations in human pigmentation, and could advance our knowledge of conditions linked to pigmentation, such as skin, testicular, prostate and ovarian cancers. The new findings are also relevant for forensic sciences.

Although previous studies have found that a large percentage of hair colour variation is explained by heritable factors, previous genetic studies only identified a dozen or so hair colour genes. The new study, published today in *Nature Genetics*, largely explains the genetic knowledge gap.

In order to identify the previously unknown hair colour genes, researchers analysed DNA data from almost 300,000 people of European descent, together with their self-reported hair colour information. The data was supplied by UK Biobank, 23andMe Inc., the International Visible Trait Genetics Consortium and their study partners.

By comparing the hair colour of the group with their genetic information, stored at several million locations across the human genome, the team identified 124 genes involved in the development of hair colour, of which more than 100 were not previously known to influence pigmentation.

The scientists also demonstrated that predicting hair colour with this new genetic information is more accurate than with previously known genes.

Joint lead author Professor Tim Spector from King's College London said: "This work will impact several fields of biology and medicine. As the largest ever genetic study on pigmentation, it will improve our understanding of diseases like melanoma, an aggressive form of skin cancer.

The genes that affect hair colour also affect other cancer types, while other pigment genes affect the chances of having Crohn's and other forms of bowel disease.

"Our work helps us to understand what causes human diversity in appearance by showing how genes involved in pigmentation subtly adapted to external environments and even social interactions during our evolution. We found that women have significantly fairer hair than men, which reflects how important cultural practices and sexual preferences are in shaping our genes and biology."

Joint lead author Professor Manfred Kayser from Erasmus MC said: "Besides substantially increasing our understanding of human pigmentation genetics in general, finding these new hair colour genes is also important for further increasing the accuracy of hair colour prediction from DNA traces in future forensic applications, which can help to find unknown perpetrators of crime."

Co-author Dr. David Hinds from 23andMe said: "While the genetics of hair colour is an interesting problem in itself, we hope that better understanding of the biology of melanin pigmentation will be applicable to studies of diseases that interact with pigmentation, such as skin cancer or vitiligo."

More information: Genome-wide association meta-analysis of individuals of European ancestry identifies new loci explaining a substantial fraction of hair color variation and heritability, *Nature Genetics* (2018). nature.com/articles/doi:10.1038/s41588-018-0100-5

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