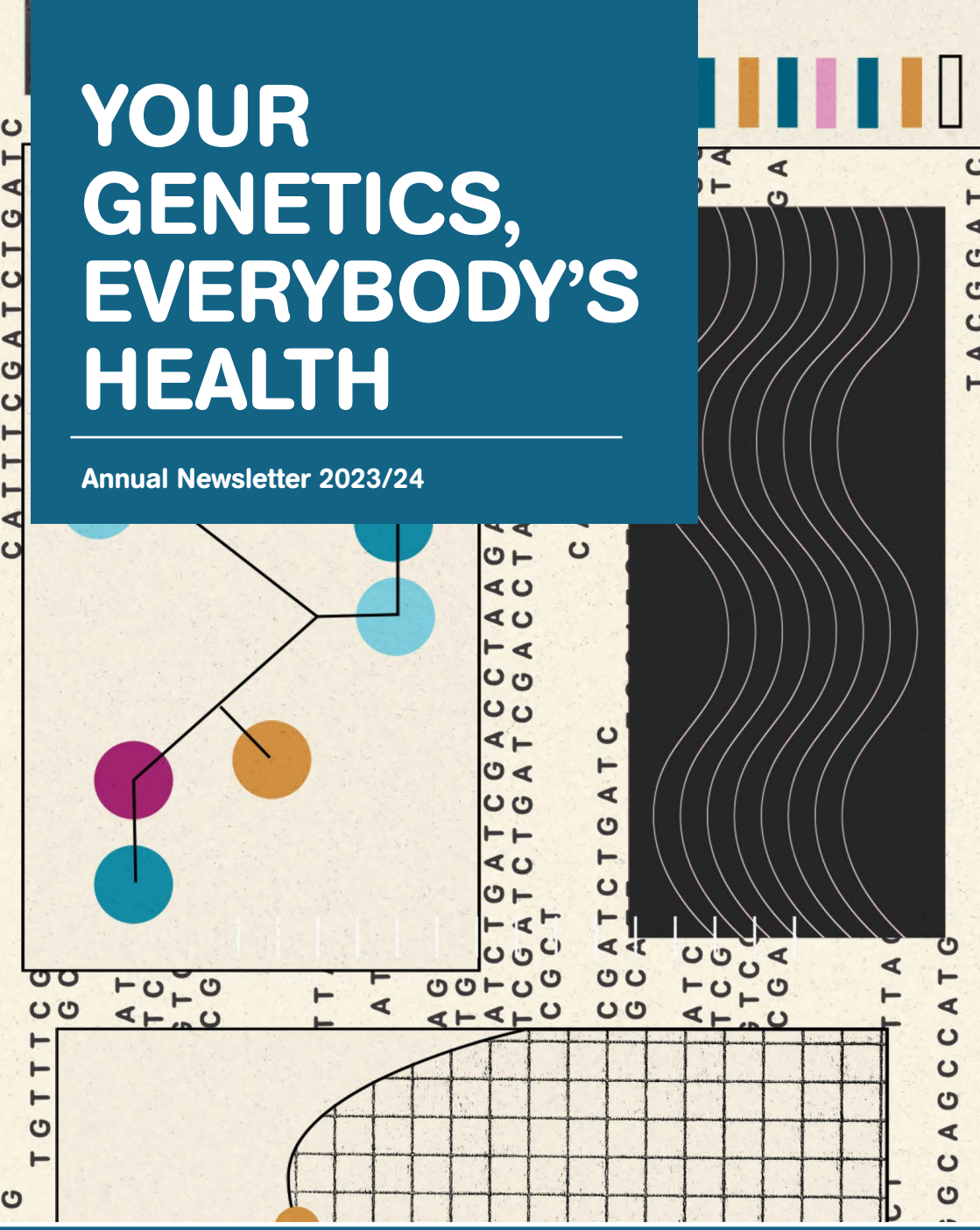
YOUR GENETICS, EVERYBODY'S HEALTH

Annual Newsletter 2023/24



UK biobank

2023 will be seen as a major year in genetics research – and you helped make it possible.

Flick through these pages and see the astonishing achievements your support and time have enabled: from your initial blood samples and physical measures taken at recruitment, to web-based questionnaires and imaging visits.

UK Biobank-approved researchers from universities, charities and companies now have access to information that they could previously only dream about: the entire genetic code for all UK Biobank participants, along with information on the levels of 3,000 proteins from over 54,000 of you.

This means that they can see not only our bodies' blueprints but also key parts of the biological machinery that affect our health. Scientists are also gaining new insights into how the environment and our lifestyles, together with genetics, influence the development of disease.

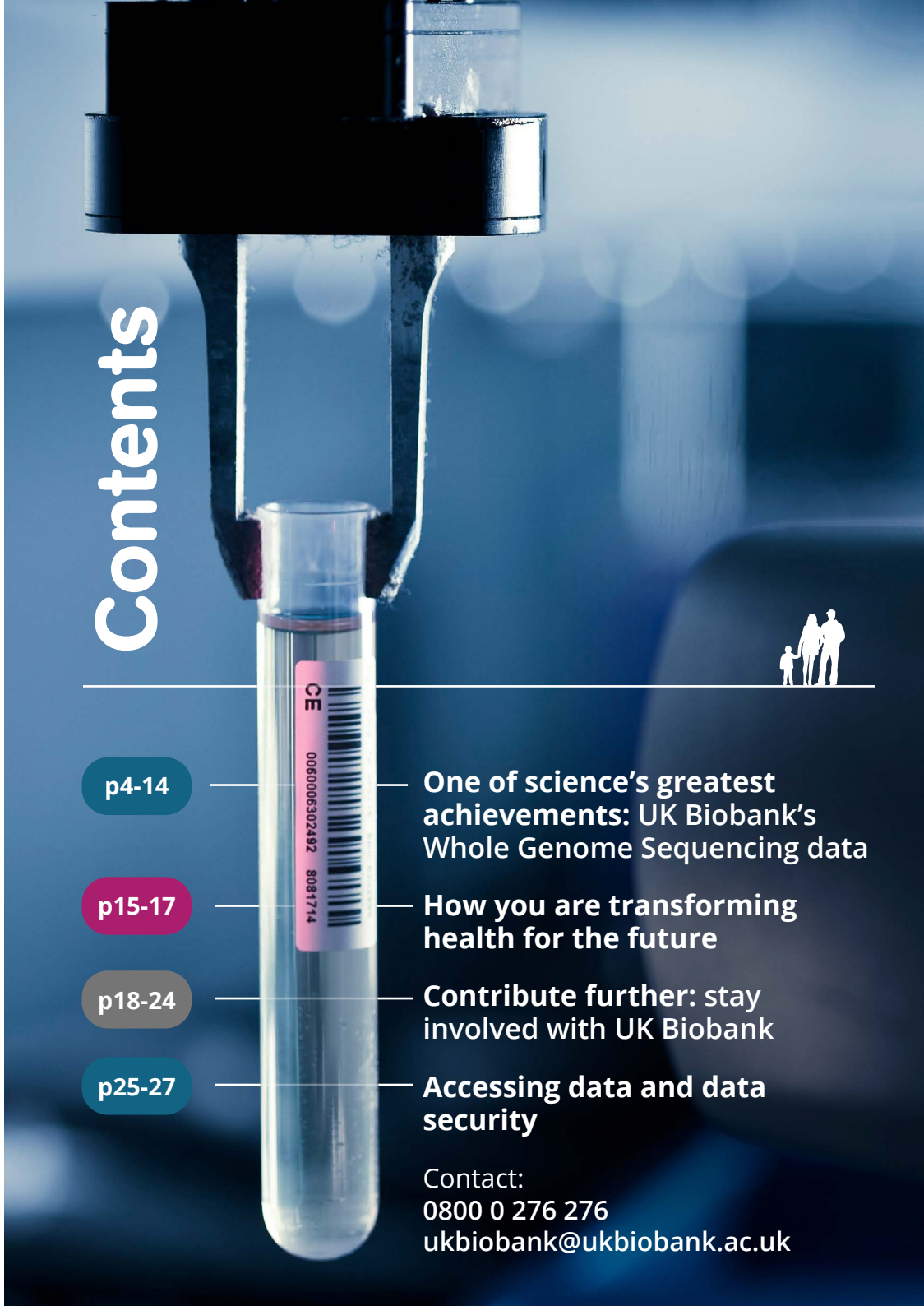
Over 10,000 scientific papers have now been published using data from UK Biobank - and the rate is accelerating!

And that is all thanks to you.

↓ Scan

Communications survey

We would be grateful if you would complete this 5-minute survey to help us improve how we communicate with you. Thank you!
https://eu.surveymonkey.com/r/UKBcomms-email



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Contact:
0800 0 276 276
ukbiobank@ukbiobank.ac.uk

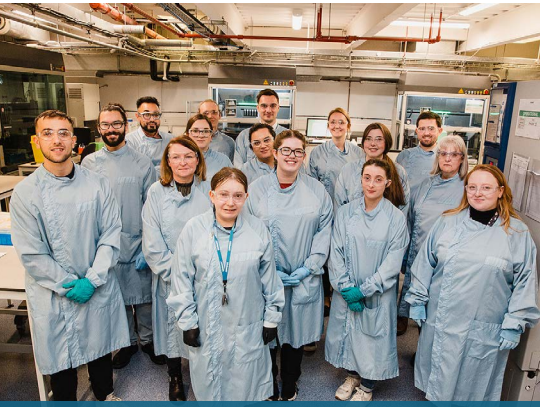
One of science's greatest achievements

Thanks to your help, in November 2023, UK Biobank provided approved researchers around the world with access to the **whole genome sequences** of half a million participants. This is by far the largest amount of genetic data from one study that's been made available to science, and will help scientists to better diagnose, prevent and treat disease.

UK Biobank-approved researchers from around the world will be able to gain fresh insights into a genetic landscape previously unexplored. Scientists will unveil a rich mosaic of rare and hidden genetic mutations implicated in health and disease.

You are changing science as we know it and together we are shaping the future of medical research for generations to come.

UK Biobank is hugely grateful for your ongoing contribution and support.



UK Biobank's lab team

Scan to watch →

How your genetic code was sequenced

The human genome can be thought of as a book... The book of you

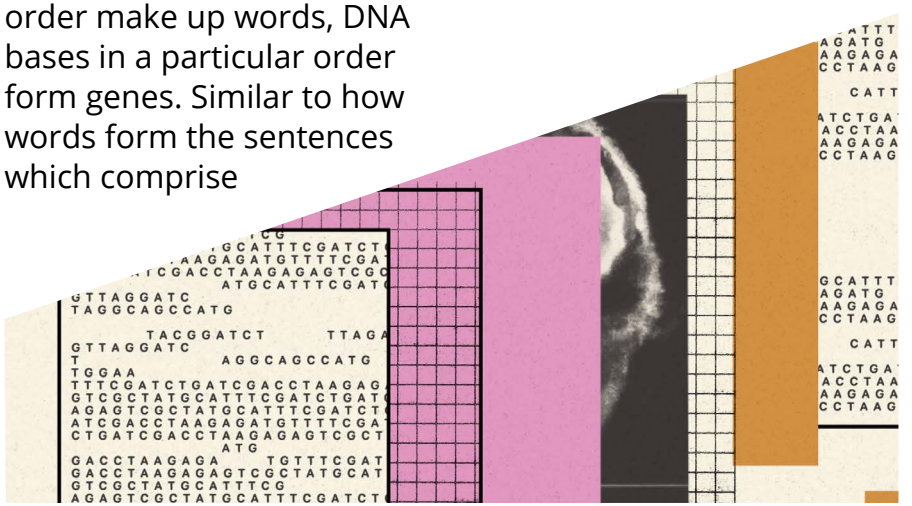
DNA is found in the cells of all living organisms.

A single strand of DNA comprises a string of four main building blocks, also known as 'bases' ('**A**', '**C**', '**G**', and '**T**'). In DNA these bases pair up with other bases (**G**'s with **C**'s, and **A**'s with **T**'s) to form the characteristic double helix. One copy of the human genome is made up of approximately 3 billion pairs of bases!

Your genome can be likened to a book - the book of you. Just as letters in a specific order make up words, DNA bases in a particular order form genes. Similar to how words form the sentences which comprise meaningful stories, genes write the instructions for making proteins. These molecular marvels carry out important functions - such as transporting nutrients or defending the body against pathogens.

Of course, different words create unique stories. The subtle differences in our genes make us unique too.

However, variation in these 'bases' throughout the genome can also contribute to disease development...



Exploring the mosaic of health & disease

Changes to our DNA (for instance, if one base is swapped for another e.g. 'A' to 'T') happen normally in our cells all the time. Sometimes these changes can alter the function of the corresponding gene. This is like when we alter a letter in a word, and it changes the word's meaning (for instance 'boat' to 'beat').

As our genes write the instructions for creating proteins, changes to our DNA can disrupt what our proteins do. This might alter the usual reactions in our cells and lead to disease.

A small number of diseases, for instance, Cystic fibrosis or Huntington's disease, are strongly associated with changes to a single gene which provides the instructions for particular proteins. Both our genes and our environment contribute to the development of many common diseases (e.g. Alzheimer's disease, heart disease, diabetes). The de-identified genetic sequences of all UK Biobank participants will enable scientists to develop an understanding of how different genetics, environments and lifestyles influence whether or not we develop certain diseases.

This comprehensive exploration of the genome – called whole genome sequencing – has staggering potential for health research.

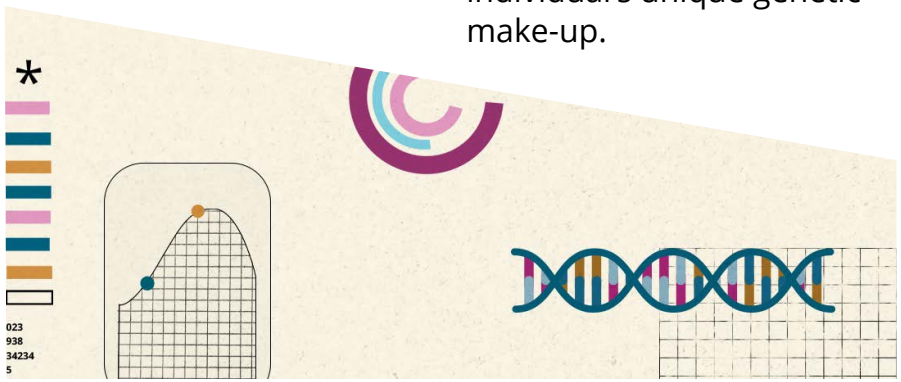
Opening the door to new insights

85% of disease-influencing genetic variations are found in the region of our DNA which makes proteins. Whole genome sequencing will reveal how genetic variation in other parts of the genome (outside the protein-forming region) is associated with health and disease.

Because of you, scientists will be able to more easily identify changes – including rare changes – in our DNA which are linked to disease.

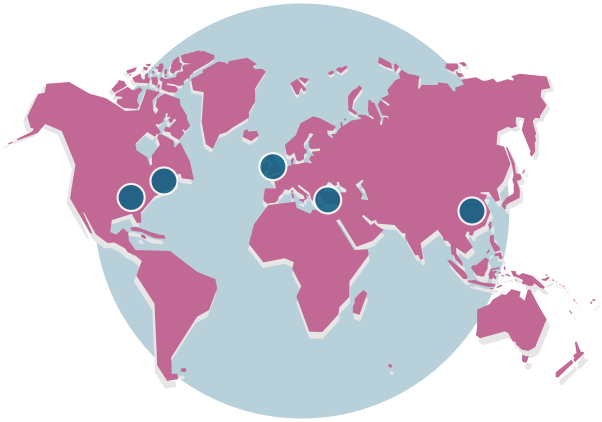
This means classifying individuals at high risk of either common or rare diseases faster - and improving the accuracy of their diagnosis.

Your whole genome sequencing data will also create exciting opportunities for drug discovery. By looking at the genetic information of people with high risk of diseases like Alzheimer's or diabetes, scientists may spot which genes are involved and develop drugs to stop those genes' instructions being followed - this is known as 'precision medicine'. Personalised treatments could be developed which are tailored to an individual's unique genetic make-up.



Your genetics around the world

International research using your de-identified genetic data, along with imaging scans and information about your health, is leading to important discoveries – and here's just a few.



Tailoring measurements of heart health

Institute: University of Leicester (UK)

Findings: This research explored how heart structure and function varies between White European and South Asian participants. For example, the researchers found differences in the mass and wall thickness of people's left heart chambers between the two ethnicities. The findings emphasise that measures of heart health should be tailored to people's sex and ethnicity.

Developing personalised treatment plans

Institute: Izmir Biomedicine and Genome Center (Turkey)

Current research: Scientists are exploring how genetic variation affects the risk of developing life-threatening complications of type 2 diabetes, such as kidney failure or stroke. The aim of the research is to help individualise treatment regimens for those with type 2 diabetes and better manage the risks of its complications.

Understanding the true risk of breast cancer

Institute: University of Exeter (UK)

Findings: Researchers found that females who carry the BRCA2 and BRCA1 gene variants exhibit less than 20% risk of breast cancer. This is much lower than the high risk (60-80%) reported with previous clinical studies. The risk increases to 24% (BRCA2) and 45% (BRAC1) if an individual has a close relative with the disease. The study highlights the importance of performing research in the general population to obtain more accurate risks of future disease.

Exposing the impact of air pollution

Institute: Nanjing Medical University (China)

Findings: This study examined links between long-term air pollution exposure and high blood pressure (hypertension) risk. Exposure to specific particles was associated with a 40% increased risk of hypertension. This association was stronger in individuals at a high genetic risk of hypertension. The study emphasises the need for further policies to improve air quality.

Mimicking protective genes

Biotechnology Company: Regeneron (USA)

Findings: Scientists identified several rare genetic variants which protect against obesity. Individuals with these variants were half as likely to be obese as those without. Mimicking the effects of these protective variants in therapies could help people with obesity to manage their disease.

Views on... genetic data & ethics

Professor Anneke Lucassen, Chair of the UK Biobank Ethics Advisory Committee, discusses some of the ethical issues raised by the use of genetic data in research.

What are the big ethical questions raised by genomic research?

“There are many different ethical issues raised by genomic research. For example, genomic data can reveal sensitive information about a person and their family’s ancestry and health. It is therefore important that we store and provide approved researchers with access to genomic data securely and responsibly.

Another ethical issue relates to equity and fairness - we need to make sure genetic research involves diverse populations so that everyone benefits from the findings, and that we avoid reinforcing existing health disparities.

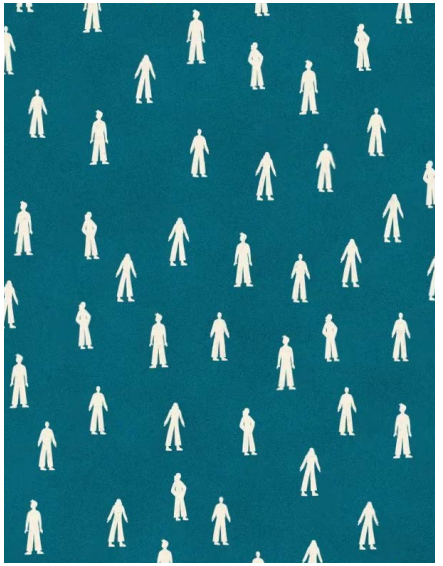
How has UK Biobank considered the ethics of genomic research?

The UK Biobank Ethics and Governance Framework sets out our commitment to respecting our participants’ wishes as well as their confidentiality. The Ethics Advisory Committee works to ensure that this framework remains at the forefront whilst considering the ethical issues arising today. For example, although UK Biobank’s genetic database is currently the largest in the world, including data from people of different ethnicities, we need to continue to involve a diversity of participants in the coming years.

Can UK Biobank participants be identified from their genetic data?

UK Biobank goes to great lengths to protect the information it holds about its participants. Researchers are prohibited from identifying participants using the genetic (or any other) data they access from UK Biobank. This would contravene the legal agreement that researchers sign when they are approved to use UK Biobank data.

However, participants should be aware that if they put information that reveals something about their health and identity on social media or other public websites, this can make it easier for them to be identified. We will be



providing more information to raise awareness about this in 2024.

Sometimes the police look to use DNA databases to identify suspects, but law enforcement agencies (domestic or international) are not allowed to access UK Biobank data for this purpose.

The UK Biobank Ethics Advisory Committee is keen to hear what participants think it should be discussing next. Please contact ***communications@ukbiobank.ac.uk*** *with your suggestions.*

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TG
CTAAGAGAGTCGCTATGCATTTCGATCT

> **From unravelling the mysteries of complex diseases to identifying new targets for life-changing medicines, UK Biobank's whole genome sequencing dataset will be a goldmine for future scientific research into health and disease.**

Dr Keren Carrs,
Director of Genome Analytics, AstraZeneca

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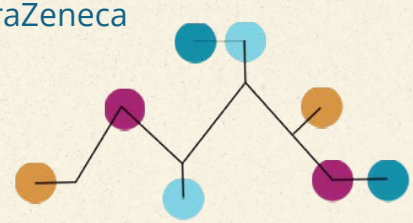
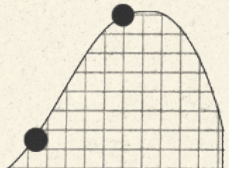


> **A new era of medical discoveries, treatments and cures is on the horizon, researchers say, following the announcement that an unprecedented trove of genetic information is to be made available to scientists.**

The Guardian



> **UK Biobank is the flagship of British biomedical science.**

Professor Sir John Bell
Regius Professor of Medicine, University of Oxford

> **We're like Google Maps for scientists - when they want to know what the pathways are from lifestyle, environment, genetics to disease, they come to UK Biobank.**

Professor Sir Rory Collins,
Principal Investigator, UK Biobank

> **The world's largest trove of human genetic data will power a "new era" for preventing, diagnosing and treating disease, scientists have said, as the DNA sequences of 300,000 Britons go online.**

The Times

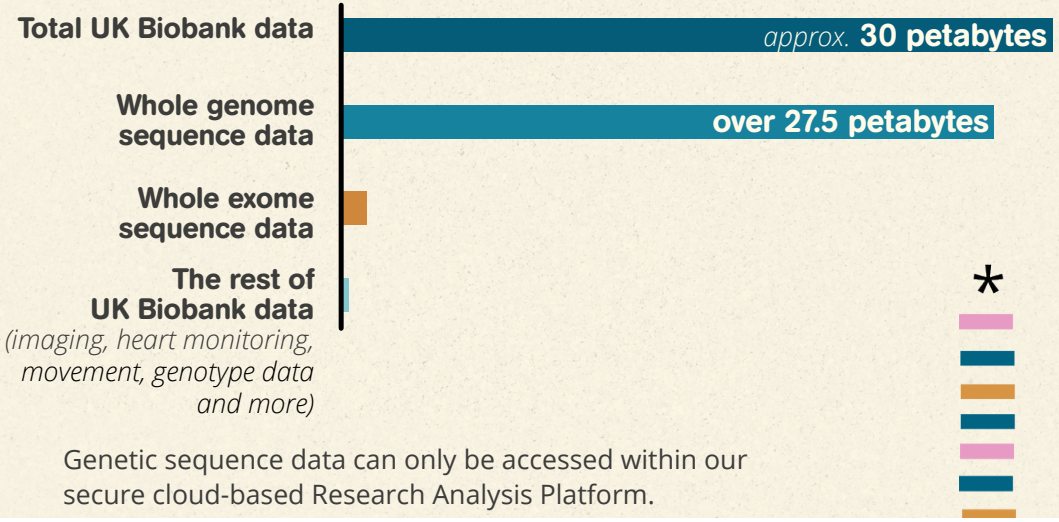
500,000
genomes sequenced

more than **5** years
total project duration

more than **350,000** hours
of sequencing time

more than **£200m**
of investment

The sequencing data dwarfs the existing data we hold in UK Biobank



Genetic sequence data can only be accessed within our secure cloud-based Research Analysis Platform.

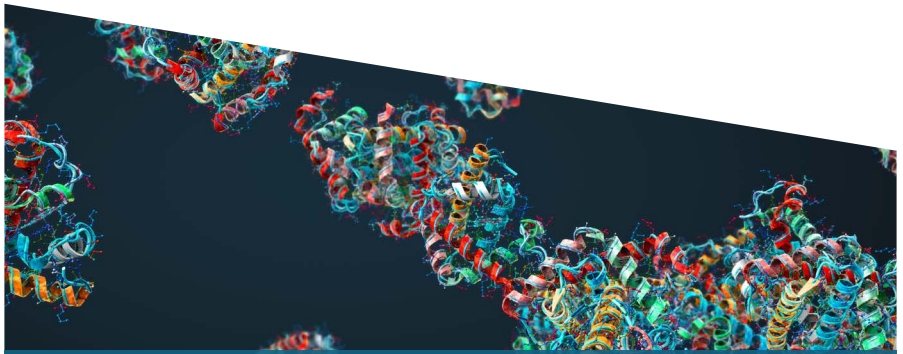
Peering into your proteome

UK Biobank-approved scientists from around the globe now have access to de-identified data on 3,000 proteins from over 54,000 of you.

Proteins are complex molecules that play a role in nearly every process in living organisms and are essential for cells to function. The collection of all your proteins is known as your 'proteome' and it is of increasing interest for scientists, who can now detect some diseases by changes in protein abundance.

If the abundance of a particular protein is different in people with or without a disease, such as Alzheimer's disease, that protein may be used as a signal, a 'biomarker', to alert us.

Scientists can then use these biomarkers to investigate what causes the disease and how it progresses. This can lead to the development of new diseases and earlier diagnoses.



The intricate structures of proteins in our bodies

Global scientific discoveries are being made because of you

Predicting Parkinson's disease ahead of time

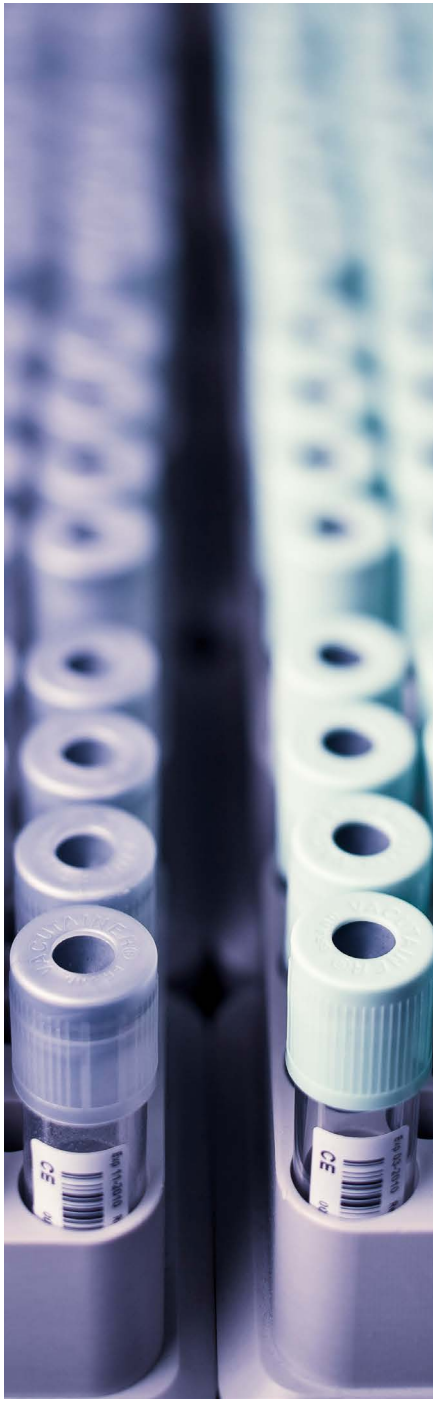
Research that monitored people's daily activity and their speed of movement has found that early signs of Parkinson's disease can be detected several years before diagnosis. Scientists analysed data from UK Biobank participants who wore activity monitors and observed that slower movement is a reliable early predictor of Parkinson's disease. The findings highlight the potential to use wearable technology for early diagnosis and treatment.

Deciphering the links between physical activity, sleep & health

Technology to measure motion has also been used to advance our understanding of the link between physical activity, sleep and health. Researchers at the University of Oxford (funded by the health research charity Wellcome, life sciences company Novo Nordisk and the insurance company Swiss Re) found from UK Biobank data that sleeping for less than 6 hours a night is associated with a higher risk of death. The research also established that increasing physical activity lowered the risk of some cancers and cardiovascular disease.

Personalised prevention based on genes

In a world-first trial, a tool was developed that used UK Biobank genetic data to enhance heart disease risk assessment in GP practices. The study examined how combinations of genetic variants across individuals' genomes influence disease. 24% of participating patients aged 45-64 had their risk of heart disease reclassified: some who had previously been classed as low risk were actually found to be at high risk based on inclusion of their genetic risk score in the study. The findings could help to identify subgroups of the population who may benefit from targeted preventative measures.



Over 82k of you have taken part in the world's largest imaging project

UK Biobank's imaging project is the largest whole body scanning study globally. We have undertaken detailed scans of the brain, heart, body and bones of over 82,000 of you.

In four UK Biobank centres across the UK, Magnetic Resonance Imaging (MRI) scanners are capturing de-identified images many hundreds of times a day. These images illustrate the structure and function of your vital organs to enable scientists to understand how our most common diseases of mid-to-later life develop.

To find out if you are eligible to take part in the imaging study, please email ukbiobank@ukbiobank.ac.uk

↓ Scan to learn more

Learn more about UK Biobank's imaging project

Not once but twice...

In 2023, UK Biobank's imaging project entered an exciting new phase...up to 60,000 of you are being invited back for repeat scans between 2-7 years after your first visit. BBC's Medical Editor Fergus Walsh was the first participant to have his repeat imaging scan in Newcastle upon Tyne last year. The repeat imaging project is funded by the Medical Research Council, the biotechnology company Calico Life Sciences and the Chan Zuckerberg Initiative, a philanthropic organisation.

By comparing two sets of highly detailed imaging data obtained several years apart, remarkable opportunities arise for scientists to observe subtle changes in major organs which could suggest disease development over time.

Your time and effort in attending your whole-body scans is shaping UK Biobank into, as Fergus Walsh described it, a 'treasure trove' of human health.

Thank you.

↓ Scan to watch

Participant event: How our imaging project is boosting research into heart disease

BBC's Fergus Walsh and UK Biobank's Chief Scientist Naomi Allen on BBC Breakfast

Image from BBC

Eye-opening research on retinal diseases

Researchers have used UK Biobank eye imaging and genetic data to investigate rare eye diseases. Findings have identified new genes associated with structural changes of the retina. Such insights will help to improve future diagnoses and therapies.

Stopping the clock for organ ageing

In a world first, UK Biobank imaging data has revealed that a specific organ's 'biological age' can influence the ageing of other organ groups. This research might help to identify individuals at risk of age-related disease earlier than has previously been possible.

Views from our research community

"In over 15 years of research, I think we'd scanned probably about 3,000 people. UK Biobank eclipsed that number within the first year of its imaging project. Its scale and depth were revolutionary and allowed us to look for much smaller details in very large populations.

Giving up the time to volunteer for research is what makes research possible. You, the participants, are changing science as we know it. You should be very proud of your contribution and realise how very grateful scientists are for what you've done.

Professor Louise Thomas, University of Westminster.

Research focus: Abdominal imaging scans.

"The variety and quality of the data in UK Biobank allows us to address a very diverse range of important research questions. Without the altruism of its participants in giving their own time and effort, this depth of data would not exist.

Dr Zahra Raisi-Estabragh, Queen Mary University of London.

Research focus: Heart imaging scans.

The imaging story of you

Bjorn, Cardiff

I live in Cardiff and have been a chiropractor for nearly 40 years. I love to paint and draw - particularly landscapes of where I have lived around the world, portraits, and cartoons! I had my imaging scan at the Bristol Imaging Centre. I found the experience very interesting, the staff professional, welcoming and helpful and the set-up comfortable.

> **You, the participants, are changing science as we know it.**

Simon, UK Biobank participant

Simon, Newcastle

I am a keen historian and archaeologist, a proud grandfather of two and I enjoy keeping busy volunteering and singing in my choir.

Whilst I knew that the personal benefit of joining UK Biobank was small, I felt that I would be making a vital contribution towards the development of knowledge to help other people in the future. I have had two sets of imaging scans at the Newcastle imaging centre and understand that attending both scans enables scientists to gather data from the same people at different points in life, to monitor the ageing process.

In the future, I will contribute as much as I can to this pretty amazing piece of research.

Giving you a say

Our participants are at the heart of everything we do, which is why we give you a say in how we do things. We often ask for your views, for example through feedback surveys and focus groups.

Over the coming year, we will be developing a new strategy for involving and engaging participants in our work. To help us, we have formed a Participant Advisory Group which comprises participants with a range of experiences and backgrounds. We will also be talking to some of our participants' families, friends and carers about the role they might play in the future.

To find out more and get involved, please contact us at **communications@ukbiobank.ac.uk** or call **0800 0 276 276**.

Communications survey

We would be grateful if you would complete this 5-minute survey to help us improve how we communicate with you. Thank you!
https://eu.surveymonkey.com/r/UKBcomms-email

Scan →

Participants at our focus group in August

We want to learn even more about your health and wellbeing

There are many things you can do to help us learn about your health and wellbeing from the comfort of your own home. We regularly contact participants for whom we have email addresses to invite them to complete online health questionnaires.

These questionnaires allow us to collect information on health outcomes that might not be available through health records, such as chronic pain. **We are incredibly grateful that around 1 in 2 participants invited have completed our questionnaires.** The information collected is linked to the existing data we hold for participants and quickly made available in de-identified form to approved researchers.

Due to the cost and environmental impact, we cannot send you questionnaires through the post. However, they are available for you to complete online by logging into the participant website at www.ukbiobank.ac.uk/members.

You can currently take part in questionnaires on visual memory, social interaction, sleep patterns, mental wellbeing, health and wellbeing, and healthy minds.

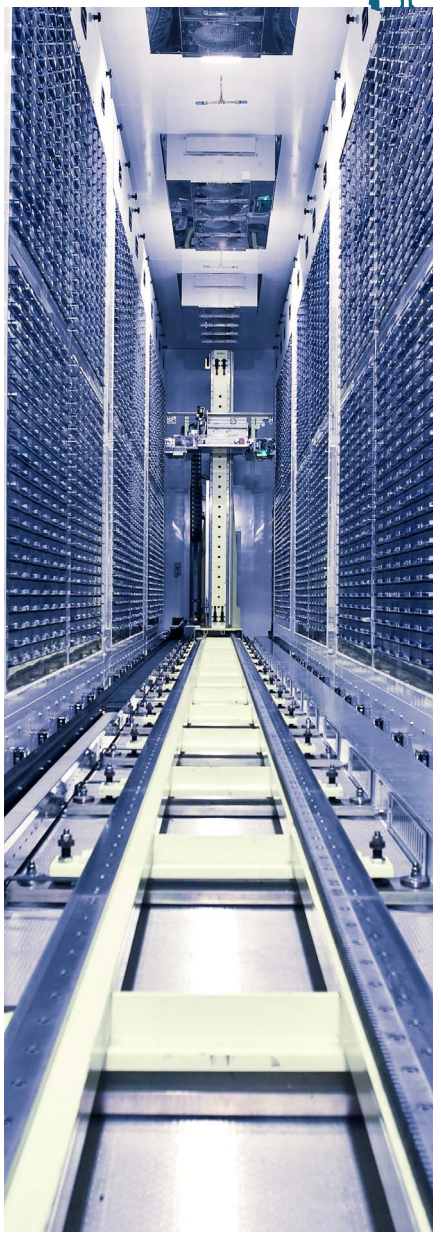
Thank you for supporting this important aspect of UK Biobank's work.

Keeping your data private and secure

We know that information about your health and lifestyle is personal and private to you, and we made a commitment when you joined the study to protect your confidentiality. Information that identifies you – for example, your name, address and NHS number – is never shared with researchers.

We take our commitment to protecting your data very seriously. We continue to invest in the latest technology to keep us ahead of the curve, and we will continue to update you about all the steps we are taking to keep your data private and secure.

If you have specific questions you'd like us to address, please email communications@ukbiobank.ac.uk.



Our research community

Over 30,000 researchers globally have been approved to apply to use UK Biobank data to accelerate health research.

Researchers must undergo a vetting process carried out by our in-house team.

Researchers must work for a credible research organisation. We perform background checks and assess whether their research proposal qualifies as health research in the public interest. This means that the research is likely to benefit the health and wellbeing of society and would not cause harm, such as perpetuate stereotypes about certain groups. If the proposal raises any concerns, it is referred to our expert Access Committee.

When an application is approved, the research organisation must sign a legal agreement before any data can be accessed. This requires the researcher to safeguard the data and put their findings in the public domain. Researchers must provide us with an annual update to ensure their research remains in line with the agreed use.

All researchers go through this process regardless of whether they work for a university, a charity or a company. We charge researchers a fee to cover the costs of processing their application and making the data available. A UK Biobank special fund is available to cover the costs of access for researchers from low- and middle-income countries. Find out more: **www.ukbiobank.ac.uk/enable-your-research/apply-for-access**.

Accessing your GP data

One of the most important aspects of UK Biobank is the collection of health data over time for each participant. To help us do this, you agreed that we could access your health-related records, along with other information about you, and make this available in a de-identified form for health research.

Accessing data from your GP is particularly useful for research, as it will help us to better understand the wide range of diseases that are managed by GPs, such as diabetes, dementia and many mental health conditions. Research using GP data has the potential to improve the lives of millions of people.

However, we have been unable to access health information from the majority of GP practices in England as they are not held centrally by the NHS. We are exploring ways to support GP practices to release the data in a streamline manner, and there are ongoing conversations about this with organisations such as the Royal College of General Practitioners and the British Medical Association.

We understand that your GP record is personal and private, and we will not receive any written notes, free-text or letters from your GP. We will only receive coded data for health conditions and medications. For example, if you visit your GP with bronchitis, the GP will record the code for bronchitis and only this code will be shared with UK Biobank. Any notes from conversations that took place between you and your GP will remain confidential.

over
27.5 petabytes
of whole genome sequencing data
(over 100 years watching time in Ultra High Definition movies)

12,000
images taken per participant in our imaging study

9,000
images of the brain taken per participant in our imaging study

Imaging study
100x
larger than any other

16 million
biological samples stored in the freezer
at -80°C

10,000
scientific papers published using UK Biobank data so far!

KEEP AN EYE OUT FOR INVITATIONS TO TAKE PART IN OUR IMAGING PROJECT

Join us online. Search 'UK Biobank'

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