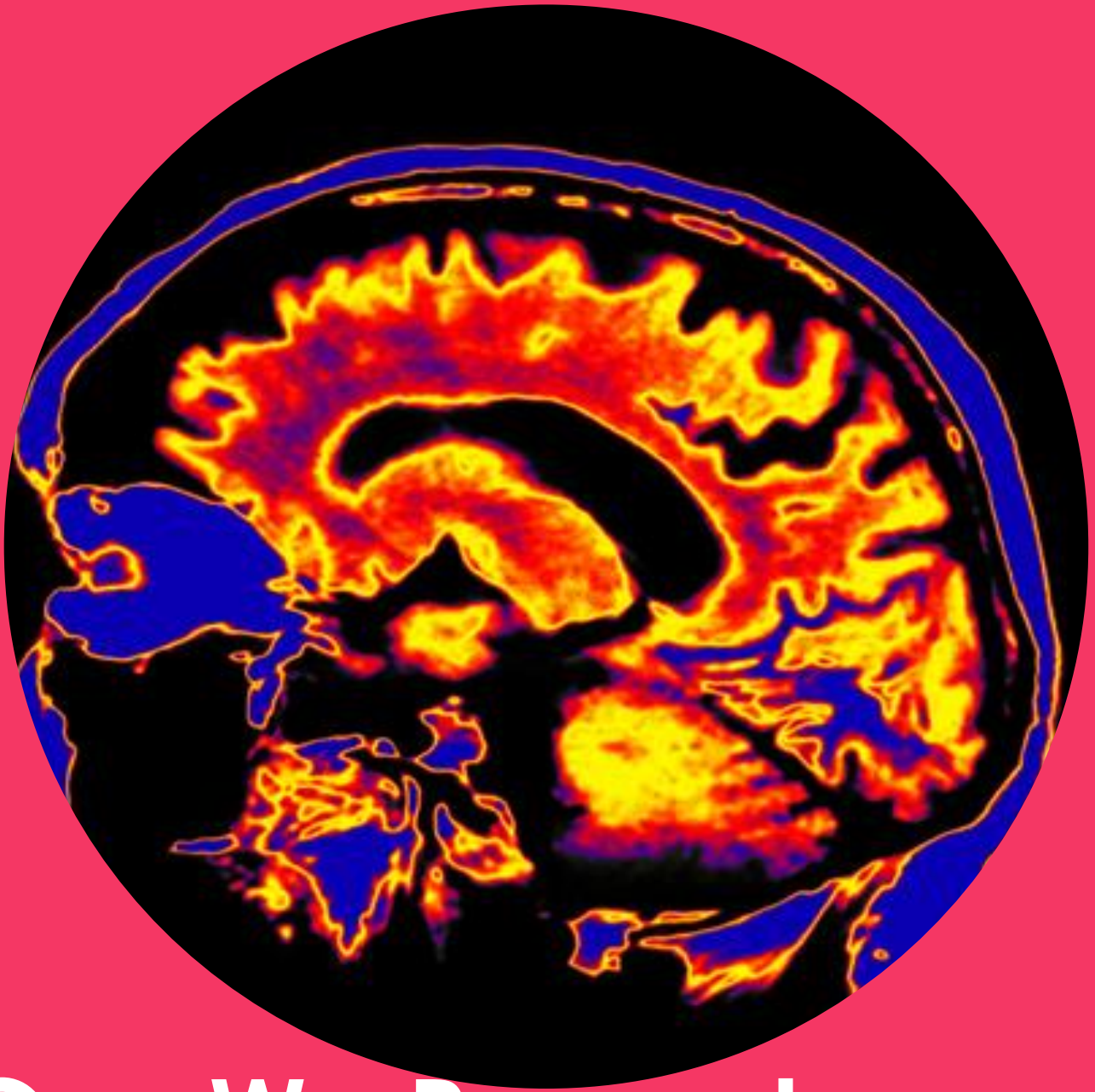


The
Scholars
Programme



Can We Prevent Dementia?

Key Stage 5 Programme

Pupil Name

Tutorial
Group

Coursebook
Designed by

Hannah Taylor



Course Rationale

According to the Office for National Statistics, in 2018 **Dementia was the leading cause of death** in the UK. **Cardiovascular disease** and **diabetes** are **risk factors** for dementia, with individuals with diabetes having a staggering **60% increased risk of developing cognitive decline and dementia**. Diabetes is one of the most common chronic diseases in the UK, with more than 4.9 million people diagnosed, and a further 13.6 million at risk of developing type 2 diabetes.

Why do people with diabetes and cardiovascular disease have such an increased risk of dementia?

Is this something that can be targeted to prevent the progression to dementia?

This course will study the links between these diseases, and explore the importance of considering how common diseases relate to one another. The course will also consider how common **lifestyle** and **environmental factors** can change risk for different diseases, and how to modify disease risks.

Over the next few weeks, we will look at three diseases of interest; **dementia, diabetes and cardiovascular disease**. Once comfortable with these diseases, their risk factors, and important molecular mechanisms involved, we will look into common mechanisms that we covered in the previous tutorials and how this may **link the diseases**. You will be encouraged to think creatively about how the **molecular mechanisms** we learn about for each disease may increase an individual's risk of developing other diseases. You will work towards a final assignment that includes bringing together scientific evidence, as well as your own thoughts and opinions into an evidence-backed argument. This course will encourage creative thinking in a scientific context, and highlight the importance of being open minded in science.

Cover image from the British Heart Foundation website, article titled 'Less than half of those eligible in England take NHS test to prevent dementia' 2018. (<https://www.bhf.org.uk/what-we-do/news-from-the-bhf/news-archive/2018/december/less-than-half-take-nhs-test-to-prevent-dementia>)

The Brilliant Club is a registered charity in England and Wales (no. 1147771) and Scotland (no. SC048774).

The Brilliant Club is a registered company limited by guarantee in England and Wales (no. 7986971).

The Brilliant Club, 17th Floor, Millbank Tower, 21-24 Millbank, SW1P 4QP

Sample Tutorial Activity

Reading a scientific article: Vascular Cognitive Impairment and Dementia

Below is a segment from the review 'Vascular Cognitive Impairment and Dementia' by Iadecola et al (Iadecola et al., 2019).

In groups, see if you can spend 20 minutes reading through, dissecting and discussing this scientific article. In science, it is really important to be able to summarise, and communicate science in a clear and concise way. In your groups, see if you can answer the questions.

After 20 minutes we will go around the groups and discuss.

Vascular Cognitive Impairment and Dementia:

JACC Scientific Expert Panel

Costantino Iadecola, MD^a, Marco Duering, MD^b, Vladimir Hachinski MD^c, Anne Joutel, MD, PHD^d, Sarah T. Pendlebury, PHD^e, Julie A. Schneider, MD^f, Martin Dichgans, MD^{b,g,h}

Iadecola et al.

Page 2

Dementia is characterized by a progressive and unrelenting deterioration of mental capacity that inevitably compromises independent living. Advancing age is the main risk factor, and due to the aging of the world population and lack of effective treatments, the number of affected individuals, estimated at 50 million worldwide in 2018, is anticipated to triple by 2050 at a cost approaching \$4 trillion (1). The anticipated "dementia epidemic" has spurred world leaders to develop national plans to deal with its devastating socioeconomic impact (2) and increase research funding to accelerate therapeutic development (3).

Alterations in cerebral blood vessels have long been implicated in age-related cognitive impairment. Alois Alzheimer, best known for identifying the condition now called Alzheimer's disease (AD), was a strong proponent of the concept that the dementia of the elderly was due to cerebrovascular insufficiency (4). The idea was that hardening of the arteries impaired the ability of cerebral blood vessels to relax and to adjust the delivery of blood to the metabolic needs of the brain, causing hypoperfusion, neuronal death, and dementia. This view prevailed well into the 1970s, when measurement of cerebral blood flow (CBF) demonstrated that cerebral blood vessels were able to increase CBF in cognitively impaired individuals (5), casting doubt on the dominant hypothesis of global vasoparalysis and vascular insufficiency. Around the same time, the concept of multi-infarct dementia was introduced, which proposed that cerebrovascular disease causes dementia through multiple brain infarcts (6) and proved to be another argument against the global ischemia concept. Multi-infarct dementia implied that if strokes are preventable, so should be cognitive impairment due to cerebral infarcts, suggesting that some dementias could be treated or prevented. Subsequently, the term vascular dementia (VaD) was felt to be too restrictive, failing to capture the entire spectrum of cognitive alterations caused by vascular factors, and the term vascular cognitive impairment (VCI) was proposed (7) and eventually widely adopted (8). The most severe form of VCI is VaD.

With advances in the understanding of the molecular pathology of AD in the 1990s (9), the term *dementia* became synonymous with AD, and the cognitive impact of vascular pathology was over-looked compared with neurodegenerative pathology (e.g., amyloid plaques and neurofibrillary tangles). More recently, a wealth of epidemiological, clinical-pathological, and basic science observations has led to a reappraisal of the role of vascular factors in cognitive impairment (10), and have identified vascular dysfunction and damage as critical components of the pathophysiology of late-life dementia including AD (11).

Brain infarct – a brain infarct occurs due to a disruption in blood flow to the brain, as a result of problems with the blood vessels. This prevents oxygen and glucose reaching the brain, and can cause death of brain tissue.

Cerebral blood flow – the blood supply to the brain in a given period of time

Cerebrovascular insufficiency – when not enough blood is flowing to the brain, due to something not working correctly e.g. arteries in the brain

Cognitive – in relation to the functioning of the brain

Global ischemia – when blood flow to the brain is stopped or reduced

Vasoparalysis – when the blood vessels are paralysed or are abnormally relaxed and/or weak

Hypoperfusion – reduced blood flow, can be used to describe when ischemia develops as a result of low blood flow

Neurodegenerative – when cells in the central nervous system (including the brain) stop working or die

Question	First guess	Correct answer
What characterises dementia?		
What did Alois Alzheimer first think the cause of dementia was?		
What is different between the multi-infarct dementia theory and the cerebrovascular insufficiency theory?		
What is the difference between vascular cognitive impairment and vascular dementia?		

Types of cognitive decline

Spend 5-10 minutes matching the descriptions with the conditions and diseases below.

A disease where abnormal build-up of proteins is found in and around the brain, including amyloid beta and tau

Vascular cognitive impairment (VCI)

Cognitive decline as a result of not enough blood flowing to the brain

Dementia

Dementia caused by reduced blood flow to the brain

Alzheimer's disease

Impaired cognitive function to an extent that effects daily life, including the ability to remember, think and make decisions

Mild cognitive impairment (MCI)

A condition in which an individual has minor problems with cognition, including memory and thinking

Vascular dementia