



Lifelong Health and Wellbeing Phase 4

Promoting Physical Activity in Older Age

Additional Information on each award, including a list of the co-investigators and an abstract of the proposal, can be found by clicking the name of the Principle Investigator.

Name	Institution	Award title
Dr Simon Griffin	University of Cambridge	Characterising patterns and changes in physical activity in older people and their determinants and consequences
Dr Jamie McPhee	Manchester Metropolitan University	The consequences of motor unit remodelling for motor control: an important factor in the loss of mobility with old age.
Professor Dawn Skelton	Glasgow Caledonian University	SENIORS USP (Seniors - Understanding Sedentary Patterns)
Professor Jonathan Tobias	University of Bristol	Describing habitual levels of physical activity (PA) in older people in terms of impact loads and how this relates to bone and other systems
Dr Thomas Yates	University of Leicester	Sedentary behaviour in older adults: investigating a new therapeutic paradigm

Lifelong Health and Wellbeing Phase 4 - Promoting Physical Activity in Older Age	
Title of Award	
Characterising patterns and changes in physical activity in older people and their determinants and consequences	
Grant holder	Institutions
Dr Simon Griffin	University of Cambridge
Co-Investigators	
Professor Stephen Sutton	University of Cambridge
Professor Kay-Tee Khaw	University of Cambridge
Dr James Woodcock	University of Cambridge
Dr Esther van Sluijs	MRC Centre Cambridge
Dr David Ogilvie	MRC Centre Cambridge
Professor Nick Wareham	University of Cambridge
Professor Andrew Jones	University of East Anglia
Professor Marc Suhrcke	University of East Anglia
Dr Soren Brage	MRC Centre Cambridge
Abstract	
<p>Non-communicable diseases such as diabetes, heart disease, cancer and mental health problems account for 60% of deaths globally. Poor diet and lack of physical activity play an important role in increasing the chance of developing these diseases. Physical inactivity is estimated to account for around 1 in 10 deaths worldwide, comparable to the impact of smoking. In the face of these statistics it would seem intuitive that everyone should strive to make individual choices to adopt an active lifestyle. However, we do not make such choices in isolation and our activity levels are believed to be driven as much by the broader social, cultural, economic and physical environment in which we live by as our personal knowledge, attitudes and beliefs.</p> <p>One of the main challenges that will face health services, and society, in the foreseeable future is the care of older people with limitations to their independent living. The promotion of physical activity among the middle-aged and elderly may make this challenge more manageable. Unfortunately, the majority of research on levels and patterns of physical activity, why some people are more active than others, and the links between physical activity and health outcomes has been undertaken among individuals less than 60 years of age, and has relied on imprecise questionnaire measures.</p> <p>Our existing collaboration of scientists includes expertise in a range of disciplines from Public Health and Epidemiology, Health Geography and Health Economics to Social and Behavioural Science. We have worked effectively together for several years as part of a national Public Health Centre of Excellence called CEDAR (Centre of Excellence in Diet and Activity Research). CEDAR is a collaboration between Medical Research Council (MRC) Units in Cambridge, the University of Cambridge, the University of East Anglia (UEA) and non-academic partners including the East of England Public Health Observatory (ERPHO). CEDAR researches the determinants of diet and activity at the population level and develops and evaluates potential preventive interventions (see http://www.cedar.iph.cam.ac.uk/).</p> <p>We have expertise in the causes of chronic disease, in physical activity and its measurement and in the development and evaluation of interventions to promote physical activity among individuals with or at high risk of disease. We also have access to a large population-based sample of older people participating in the EPIC-Norfolk study. In this project we will describe the levels and patterns of physical activity and also of sedentary behaviour (such as television viewing). We will study how these behaviours change over time using self-report and objective measures among volunteers in the EPICNorfolk study. We will also improve knowledge about the sorts of activities that might reduce risk of disease and be feasible for older people, the personal and environmental factors that influence physical activity in older people, and to what extent changes in physical activity might reduce disease risk and health service costs. These are important steps in developing interventions and policy to help populations adopt sustainable healthy behaviours.</p> <p>In order to achieve our aims we will use a range of quantitative and qualitative research methods within the context of a large ongoing study. The evidence we gather will help politicians, health</p>	

professionals and society at large make better decisions about how to improve health for the whole population, whether it is through direct public health interventions, or wider ways that influence how we live. It will also help scientists and research funders to focus efforts into areas in which reducing uncertainty through further research would provide the greatest benefit.

Lifelong Health and Wellbeing Phase 4 - Promoting Physical Activity in Older Age	
Title of Award	
The consequences of motor unit remodelling for motor control: an important factor in the loss of mobility with old age.	
Grant holder	Institutions
Dr Jamie McPhee	Manchester Metropolitan University
Co-Investigators	
Dr Emma Frances Hodson-Tole	Manchester Metropolitan University
Professor Ian Loram	Manchester Metropolitan University
Professor David Jones	Manchester Metropolitan University
Professor Frederick Wu	The University of Manchester
Abstract	
<p>The muscles in our arms and legs get smaller and weaker in old age, but what is less well known is that the nerves controlling these muscles also undergo dramatic changes. In this research project we will investigate whether the changes occurring in the nerves are related to the general loss of mobility and poor balance that affects frail as well as healthy older people and impacts on the ability to complete physical tasks thereby reducing quality of life and independence in old age. Each of our muscles has hundreds or thousands of nerves that help us to control movements with each nerve controlling a portion of the muscle, known as motor units which vary in size. For small forces such as used in the majority of daily activities we use the small motor units, giving fine control, while the large units are used only when large forces are needed. Research has shown that more than half of the nerves in a muscle can die by the age of 75 years even during normal, healthy ageing and it tends to be the nerves supplying the large motor units that are affected. However, the nerves that remain, supplying the small motor units, compensate by taking over the portions of the muscle that have lost their connection. This helps to maintain maximal strength but has the disadvantage that when it comes to making the small contractions used for activities such as involving balance, the forces produced may be inappropriate leading to poor motor control, loss of confidence and ultimately a reduction in mobility.</p> <p>There is some hope, however, because it might be possible to preserve the nerves by leading a physically active lifestyle. We will study the nerves and muscles of people who have maintained exceptionally high exercise levels all of their lives to see whether preservation of nerves is a reason why older athletes are able to maintain remarkable physical activity and performance levels similar to that of young adults. It may also be possible to learn new ways of activating the nerves to generate smooth contractions and we will examine people who have continued dancing into old age.</p> <p>A limitation in the available scientific data is that up until now almost all of the information we have on the nerve changes during ageing comes from studies of small muscles controlling hands and feet. We will develop the techniques to estimate motor unit size and number in large leg muscles and study frail, healthy and older athletes to see to what extent changes in nerves affect our muscles and the ability to balance and walk.</p>	

Lifelong Health and Wellbeing Phase 4 - Promoting Physical Activity in Older Age	
Title of Award	
SENIORS USP (Seniors - Understanding Sedentary Patterns)	
Grant holder	Institutions
Professor Dawn Skelton	Glasgow Caledonian University
Co-Investigators	
Dr Michaela Benzeval	MRC Social and Public Health Sciences
Professor Ian Deary	University of Edinburgh
Professor Nanette Mutrie	University of Edinburgh
Professor Malcolm Granat	Glasgow Caledonian University
Professor Sally Wyke	University of Glasgow
Dr Sebastien Chastin	Glasgow Caledonian University
Dr Catharine Gale	University of Edinburgh
Dr Claire Fitzsimons	University of Edinburgh
Dr Philippa Dall	Glasgow Caledonian University
Dr Jason Gill	University of Glasgow
Professor Gillian Mead	University of Edinburgh
Professor Naveed Sattar	University of Glasgow
Professor John Starr	University of Edinburgh
Dr Carolyn Greig	University of Edinburgh
Dr Cindy Gray	University of Glasgow
Abstract	
<p>People who are physically active as they get older are more likely to remain healthy and independent, whatever their circumstances. High levels of sedentary behaviour are associated with poor health, regardless of how physically active a person is at other points in the day. Although older people spend more time sitting than other age groups, surprisingly little research attention has been devoted to either understanding in detail the link between sedentary behaviour and health or finding out what factors determine how active or sedentary older people are. We have assembled a team of researchers with a wide range of knowledge, skills and experience of working in collaboration with older people to try to unpick these important questions. Our team has been working with two large groups (cohorts) of older people living in and around Edinburgh (since 2004) and Glasgow (since 1987). These people have regularly completed questionnaires about various aspects of their lives and many of them have had detailed assessments of their physical fitness (including grip strength and lung function), their health and their cognitive function (including brain scans).</p> <p>In the current study, we will ask 750 members of these cohorts to wear a small device for a week that will give us an accurate (objective) measurement of how active and sedentary they are over that period. We will compare our objective measurements with participants' own self-reported estimates of how active and sedentary they have been over the same period (using past cohort questions and current population survey questions) to identify the most accurate survey tool to use in the future. Using these data and the information about these peoples' daily life, activities and health collected during our cohort studies, we will investigate the relationship between previous individual, social and environmental factors and older people's current sedentary and activity levels. We will also examine the effect of being sedentary and largely inactive on a person's health. This will help us identify those people who are most at risk of becoming more sedentary and less active in later life. For example, there is some evidence from the Glasgow group that working class men may be particularly vulnerable to inactivity when they retire.</p> <p>In addition, we will interview 48 of these cohort members (equal numbers of men and women of different ages and social class who are currently active or inactive) to understand: their views about being sedentary, what they do while they are sitting and how important these activities are to them. We will also ask them about their knowledge about sedentary behaviour and the links between being sedentary and ill health and ways older people might be encouraged to become less sedentary and the barriers that might stop them doing so. We will also understand how receptive different groups of older people (e.g. men vs. women) might be to suggestions about changing their sedentary activities.</p>	

Taken together, these views and understandings of the positive and negative aspects of being sedentary will help to design more effective interventions to encourage older people to become less sedentary and more physically active. We will publish and present our findings at international and national conferences and provide recommendations and workshops for professionals on how to develop and tailor support to encourage people to become more physically activity and less sedentary as they age. We will make use of the internet, social media and YouTube brief videos, produce leaflets and host meetings for a wide range of older people and organisations, giving our results and recommendations the best chance to make a positive impact on future research, policy and practice to improve the quality of life of older people.

Lifelong Health and Wellbeing Phase 4 - Promoting Physical Activity in Older Age	
Title of Award	
Describing habitual levels of physical activity (PA) in older people in terms of impact loads and how this relates to bone and other systems	
Grant holder	Institutions
Professor Jonathan Tobias	University of Bristol
Co-Investigators	
Professor George Davey-Smith	University of Bristol
Professor Joern Rittweger	Manchester Metropolitan University
Dr Jamie McPhee	Manchester Metropolitan University
Professor Cyrus Cooper	MRC Lifecourse Epidemiology Unit
Professor Seif Shaheen	Queen Mary, University of London
Professor Avan Aihie Sayer	University of Southampton
Professor Ken Fox	University of Bristol
Professor Diana Kuh	University College London
Professor Marcus Richards	MRC Unit for Lifelong Health and Ageing
Dr Rebecca Hardy	MRC Unit for Lifelong Health and Ageing
Dr Rachel Cooper	MRC Unit for Lifelong Health and Ageing
Professor Elaine Dennison	MRC Lifecourse Epidemiology Unit
Dr Kate Ward	MRC Centre Cambridge
Dr Soren Brage	MRC Centre Cambridge
Abstract	
<p>Context</p> <p>Accelerometers have been widely used to record physical activity (PA) in studies evaluating effects of exercise on human health. Traditionally, these devices provide a measure related to energy consumption which is ideally suited to studying obesity-related outcomes. More recently, accelerometers have been developed which provide information about exposure to forces of different magnitudes. This may represent a more accurate approach to evaluating PA in the case of physiological systems such as the skeleton, which responds to brief high impacts as opposed to sustained loading.</p> <p>Aims</p> <ol style="list-style-type: none"> 1. To characterise the extent to which older people are exposed to impact loading of varying magnitudes. 2. To determine whether higher levels of impact loads resulting from everyday PA in older people are related to properties of bone, such as its density and size, whereas little relationship is observed with lower levels of impact. 3. To identify lifestyle, social, psychological and health related factors which affect the exposure of older people to impact loads of different magnitudes. 4. To characterise how relationships between PA and other physiological systems differ according to level of impact load. 5. To explore barriers to participation of older people in PA associated with higher levels of impact. <p>Methods</p> <p>Setting: Relationships between PA and bone will be studied in two well characterised population cohorts of older people, namely the MRC National Survey for Health and Development (NSHD; age 68) and the Hertfordshire Cohort Study (HCS; age 74-82) (n=2000 under active follow up in both cohorts). A cohort of 500 elite athletes over 65 will also be recruited.</p> <p>Study design: Participants from the three cohorts will be asked to wear an accelerometer for seven days, and information about exposure to different levels of impact subsequently extracted using methods developed in our previous studies. A questionnaire asking about factors related to PA will be completed at the same time. Bone measures will include bone density at the hip as measured by a widely used low dose radiation method (DXA), and more detailed measurements of bone size and shape derived from cross sectional images of the lower leg using a different low radiation imaging device (pQCT).</p> <p>Analysis: PA data will be analysed in relation to bone parameters (i) currently being measured in a subgroup of HCS, and (ii) due to be measured in a subgroup of NSHD and elite athletes as part of this</p>	

project. We also aim to extrapolate information about exposure to impacts from a previous NSHD data collection involving the whole cohort, relating this to hip bone density obtained at the same time.

NSHD and HCS provide detailed information for other systems (eg muscle, obesity, metabolic, cardiovascular, respiratory, cognitive), which will also be analysed in relation to different impacts.

Potential application

Osteoporosis is a common condition predominantly affecting older people, in which weakening of bone leading to an increased risk of fracture. Since decreased PA is thought to contribute to this process, there is a strong need to develop PA interventions to preserve bone strength and reduce fracture risk in older people, particularly in light of emerging safety concerns over conventional pharmacological approaches. However, if successful PA interventions are to be developed for preserving bone, the relationship between PA and bone strength needs to be clearly understood, particularly if only impacts of a certain magnitude are effective in maintaining bone. Likewise, the types of activities which produce desired levels of impact, and the barriers to carrying out these activities, need to be understood if interventions are to be developed which bring about sustained alterations in behaviour required to prevent bone loss in older people.

Lifelong Health and Wellbeing Phase 4 - Promoting Physical Activity in Older Age	
Title of Award	
Sedentary behaviour in older adults: investigating a new therapeutic paradigm	
Grant holder	Institutions
Dr Thomas Yates	University of Leicester
Co-Investigators	
Dr Charlotte Edwardson	University Hospitals of Leicester NHS
Professor Melanie Davies	University of Leicester
Professor Kamlesh Khunti	University of Leicester
Professor Stuart Biddle	Loughborough University
Dr Jason Gill	University of Glasgow
Dr Danielle Helen Morris	University of Leicester
Professor Naveed Sattar	University of Glasgow
Dr Latha Velayudhan	University of Leicester
Professor Alan James Sinclair	University of Bedfordshire
Dr Dale Esliger	Loughborough University
Abstract	
<p>Older age is associated with an increased risk of many diseases, poor physical function and frailty, cognitive decline and other forms of disability. Also, some groups such as South Asians have higher rate of disease. Research has shown that many of these factors are improved by higher levels of physical activity. However, little is known about the role of sedentary behaviour i.e., sitting time in older adults. Some research has started to show that reducing the time that you spend sitting can reduce the risk of many diseases and improve functional health. This research suggests that improvements in health may be gained by simply helping people to swap time spent sitting with time spent standing or in light-intensity walking. Older adults spend around 70% of their day sitting but little is currently known about whether reducing sitting time promotes health and wellbeing in older adults. This may be particularly relevant to older adults where fear of falls, joint pain, decreased physical function and other contraindications may limit motivation and ability to engage in much purposeful exercise. This grant is therefore going to focus on investigating the impact of sitting in older adults. The results of this research will inform larger studies and public health initiatives aimed at reducing sitting time in the future.</p> <p>Our research plan includes three work packages. In work package one, we will develop a method of estimating time spent sitting and in physical activity which hasn't been done before in older adults. This will be done in a laboratory where participants will complete a set of activities and we will measure the intensity of these activities. Another part of this work package is to use existing data that has been collected as part of the Health Survey for England. We will re-analyse this data to investigate how much sitting and physical activity older adults do, when and how often they do these behaviours (e.g., morning, afternoon, evening, numbers of times in the day and how long for each time), and compare this to other age groups. We will also look at the relationship between sitting and physical activity with health and wellbeing in older adults. This data will be supplemented with data that we have collected within our department in a large population of older multi-ethnic adults. Work package two will develop a novel way of measuring sitting time which allows researchers to capture the location of where older adults spend their time around the home/car environment and more accurately measure sitting time. This will involve a wrist worn device along with very small tags that can be attached to objects (such as chairs, tables, computers etc). We can then combine the information from both devices to measure time spent sitting but also the type of sitting behaviour and the location around the home (e.g., sofa in living room, computer in office, dining table etc). This will help researchers to develop ways to help people to reduce their sitting time. This novel method will be tested in a laboratory and also a small number of people will be asked to test it in their daily lives. Once they have done this we will ask them for feedback on perceptions of sedentary</p>	

behaviour and these novel method of measuring sitting. Work package three will be a laboratory study to investigate the impact of sitting down all day (condition one), reducing sitting by standing every 30 minutes for a few minutes (condition two) and reducing sitting by slowly walking every 30 minutes for a few minutes (condition three). Participants will come into the laboratory and perform each of these conditions over a day (8am-5pm). During these conditions blood sugar, insulin, fats in the blood, mood and cognitive function will be measured. This work package will investigate how harmful sitting is for health and whether health can be improved by reducing sitting time either by standing or light walking or both.