



HOUSE OF LORDS

Science and Technology Select Committee

Corrected oral evidence: Ageing: Science, Technology and Healthy Living

Tuesday 5 November 2019

11.25 am

[Watch the meeting](#)

Members present: Lord Patel (The Chair); Lord Borwick; Lord Browne of Ladyton; Baroness Hilton of Eggardon; Lord Hollick; Lord Kakkar; Lord Mair; Baroness Manningham-Buller; Baroness Penn; Baroness Rock; Baroness Sheehan; Lord Winston; Baroness Young of Old Scone.

Evidence Session No. 8

Heard in Public

Questions 58 - 64

Witnesses

Professor Paul Greenhaff, Professor of Muscle Metabolism, University of Nottingham; Professor Alun Hughes, Professor of Cardiovascular Physiology and Pharmacology, UCL; Dr Samuel Nyman, Interim Deputy Head for Research, Department of Medical Science and Public Health, Bournemouth University.

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Professor Paul Greenhaff, Professor Alun Hughes and Dr Samuel Nyman.

Q58 **The Chair:** Good morning, gentlemen. Thank you for coming to assist us with our inquiry today. We are on live broadcast, so anything you say or talk about between yourselves will be picked up and broadcast to the millions who are listening—and there are millions who are listening. If you do not mind, I would like to start with the person sitting to my left. Please introduce yourselves so that we get you on the record, and if you want to make an opening statement, please feel free to do so.

Professor Paul Greenhaff: Good morning. I work at the University of Nottingham. I am deputy director of the MRC-Versus Arthritis Centre for Musculoskeletal Ageing Research. I was also chair of the expert panel for the Physiological Society's recent report on ageing.

The Chair: Apropos that, we have read the report from cover to cover, Professor Greenhaff.

Dr Samuel Nyman: I am interim deputy head for research in the Department of Medical Science and Public Health at Bournemouth University. I specialise in research into promoting physical activity and preventing falls among older people and, more recently, people with dementia. My background is in psychology, primarily health psychology, but my research falls into preventive medicine and the psychology of ageing.

Professor Alun Hughes: I am professor of cardiovascular physiology and pharmacology at UCL, and I am associate director of the MRC Unit for Lifelong Health and Ageing at UCL. Most of my research focuses on cardiometabolic disease and cardiovascular health throughout the life course, from teenagers through to older people.

Q59 **The Chair:** Thank you very much. I shall start by trying to understand from you the scientific basis for the link between physical activity and healthy ageing. What is the scientific link, and what amount of physical activity might we be talking about if there is a link?

Dr Samuel Nyman: There is lots of evidence linking physical activity to health benefits, however you measure it. It was estimated a few years ago that 9% of worldwide premature mortality is caused by a lack of physical activity. Leisure-time physical activity is associated with a reduction in the risk of 13 types of cancer, regardless of body size or smoking history, and we know that it is beneficial to mental well-being across the ages—across the lifespan it is highly beneficial. It was deemed a miracle cure by the Academy of Medical Royal Colleges a few years ago. It is almost a panacea. However we measure it, it is beneficial to health.

Professor Paul Greenhaff: I think there is a gap. It would be correct to say that physical activity can reduce the progression of disease. If you look at, say, pulmonary rehabilitation for patients with COPD, it is clear that exercise is a very powerful and positive intervention.

However, the real data on ageing is not there. Most of our human understanding comes from epidemiological studies. That is useful, but it does not provide mechanistic insight. A problem is that physical activity affects mainly the skeletal muscular and nervous systems, but the measurements being made of these systems are usually not hard end-point measurements. The mechanistic studies being conducted usually involve rodent models of ageing, but there is a clear difference between rodent and human physiology, and response to inactivity and diet.

So while the rodent based ageing research brings mechanistic insight, whether that translates to the human condition is questionable. Several papers have shown that rodents, for example, have poor metabolic stability. That means that when stressed, their metabolism changes more markedly than humans. That is important, because humans are very metabolically stable. Finally, I would argue that the insight that we have into disease is good and increasing, but ageing itself is falling between the gaps because it is not a disease.

The Chair: If I hear you correctly, you are saying that you do not think it would be appropriate to tell people, "If you want to remain healthy in older age, exercise is an important component".

Professor Paul Greenhaff: No, exercise is an important component, but we cannot give the most optimal advice until we understand the mechanisms that are operative. For example, we do not know the dose response to exercise; we do not know the frequency; we do not know how quickly the effects of exercise disappear in terms of muscle metabolic health, for example; and, more importantly, we do not know the effects of inactivity, which seems a crazy thing to say but it is true. Most people do not perceive being inactive as a physiological stressor.

The Chair: So what would you say is the fundamental thing underlying influences in healthy ageing?

Professor Paul Greenhaff: I think that it is physical activity levels or, more importantly, inactivity levels, as well as the positive energy balance that accompanies this. If you are inactive, your energy requirements decline.

Professor Alun Hughes: Can I contribute? I probably fall somewhere between the two statements.

The Chair: Yes, particularly if you disagree.

Professor Alun Hughes: The real problem is that the really strong evidence is epidemiological. There is very persuasive evidence that people who undertake high levels of physical activity have better health outcomes in later life. The problem is that that does not necessarily mean that there is a causal relationship. Obviously, undertaking physical activity is bound up with lots of other health behaviours, so it is very difficult in observational studies to disentangle those confounders, as we call them.

In contrast, there is limited evidence from what would be regarded as gold-standard interventional clinical trial data, and that often partly conflicts with some of the observational data. That could be because the trials are not done properly on the right people, for the right length of time or for the right ages, or it could be that there is a real discrepancy between the observational and the experimental data. We need to be aware that the evidence base from observational data is really strong, and that is what guidelines are based on.

The evidence from intervention is less strong, and evidence on scalability to populations is almost non-existent, I think. So one of the challenges here is getting across those different levels of evidence before we are confident about policy.

The Chair: So is there any evidence to suggest a link between levels of physical activity, or physical activity per se, and cognitive function or mental health?

Professor Alun Hughes: Observationally, there is a clear association. People who undertake higher levels of physical activity tend to have better cognitive function. So far, the studies, which are generally quite small and short-term, where people have undertaken exercise interventions, have not really shown convincing evidence of improvement in cognitive function.

Again, it might be that they are the wrong experiments but, of the ones that have been done, a recent, quite large study—the DAPA study—showed a marginal decline in cognitive function with an exercise intervention in people with mild to moderate dementia. These are really difficult questions. We definitely need more evidence, but at the same time we have to make guidelines and provide advice on the basis of what we have.

The Chair: How difficult is it to do international randomised studies of physical activity and health?

Professor Alun Hughes: Hugely.

The Chair: So in the absence of that, we should take note of observational studies.

Professor Alun Hughes: I think you are right. We are where we are. That is not an argument for not doing interventional studies, but we need to recognise that they are difficult and hugely expensive; you are talking of perhaps a couple of thousand pounds per participant for a clinical trial, so undertaking that in 1,000 people is extraordinarily expensive. But ultimately we need that sort of evidence if we are to progress this field.

Professor Paul Greenhaff: With the development of technologies that are now available, such as whole-body or even tissue-level MRI, you can do very detailed studies in people in a longitudinal setting. Using stable isotope tracers, you can now do experiments that previously were not

feasible without bringing people into a laboratory environment, so you can measure, say, muscle protein synthesis in free living people.

It is possible to do these studies but, as we heard from Alun, they are not cheap experiments to do. We should look at this positively. If we look at cross-sectional studies, we know, for example, that there is a relationship between brain grey-matter volume and cardiorespiratory fitness, or fitness levels, and we know that there is a relationship between cortical density and physical activity levels, but these are single-time-point cross-sectional studies.

Lord Winston: Can we just come back to the rodent for a second, because of course the model has been used there? I was thinking of the paper by Voss and another one by Kerlick, which is some time ago now. None the less, they showed that animals that were not deprived of exercise showed changes in their ability to understand where a platform was under water. But, more importantly, seven days after exercise they showed increased numbers of neurons in the hippocampus and elsewhere in the brain.

I know that Kerlick then said that it was not clear what was happening in humans. You cannot easily brain biopsy humans, but I wonder whether any further work has been done in that area, because it seems quite relevant to the issue that the chairman has been asking about.

Professor Paul Greenhaff: The studies that I am aware of are single point, cross-sectional studies in humans of varying levels of fitness and age. They have looked at relationships between cortical density and physiological function.

I guess what I am saying is that technologies are becoming available to allow mechanistic longitudinal studies to be done in humans. I am not at all trying to put down rodent research—I have done it myself—but in this case the rodent is not a good model of human ageing. That is the only point I am making.

Lord Winston: We know that exercise increases endorphin release in the brain, do we not?

Professor Paul Greenhaff: Yes.

Dr Samuel Nyman: There is trial evidence for exercise-based interventions to prevent falls among the general healthy older adult population. We have enough trials now to know exercise is effective with this population, so we do not need to do any more. We know that it reduces the risk of falls by about 20% to 30%. Falls have been identified since the 1970s as one of giants of geriatric medicine.

Whether exercise specifically addresses the progression aspects of ageing, one of the four key issues of ageing is trying to prevent people from having a hip fracture. Recovery from that is quite poor, so there is really good evidence for preventing that from happening.

Q60 Baroness Rock: This leads us very neatly on to my question about age and activity levels. The NHS produces specific guidelines on activity for adults from 19 to 64. Is the same advice applicable to older people or does it vary based on other factors like environment and genetics? How does advice on recommended activity levels differ for older people and younger people? Perhaps you could touch on whether personalised advice on exercise is feasible, and, if you believe it is, how you believe it could be delivered.

Professor Alun Hughes: Perhaps the most obvious example of that is cardiac rehabilitation, for which there is a well-established evidence base from trials. As it stands, exercise interventions are tailored to people, particularly to older people who may have infirmities that impact on their ability to undertake exercise. You also need to discuss with people what form of exercise they are likely to take on, because the crucial thing about exercise is that you have to do it. A lot of tailoring goes on already. No doubt there could be more.

There are issues about what approaches are culturally appropriate. There is probably a lack of research into what interventions are the most appropriate in minority ethnic groups, for example, and whether the approach in men and women should be the same.

There is lots to be done on the question of stratification. We are not in a position at the moment to judge whether genetic background is likely to be of influence. I think there are some animal studies that suggest that genetic background influences response to exercise, but whether that applies to humans we do not know.

Professor Paul Greenhaff: If you look at the effects of exercise interventions, they tell us that invariably there is a positive response. Going back to pulmonary rehabilitation, most if not all patients respond positively, particularly if they are given supervised exercise intervention. Exercise is a good thing. The question of whether it is different in an older person versus a younger person is impossible to answer at the moment, because no one controls for habitual physical activity level in experimental designs.

To exemplify that, studies out of Copenhagen, where generally the population is pretty active, show that if you put an elderly person in bed and take a similar elderly population in the US and you put them in bed, they experience different responses to the bed rest. That is probably related to their habitual physical activity levels.

The whole question of ageing becomes more complicated because we have to ask whether this is really ageing or whether it is environmental stress from habitual physical activity and dietary differences.

These studies are difficult to control for. The good thing is that if it is less of a genetic driver and more an environmental driver, exercise will be an excellent intervention. We need to know more about the mechanisms by which sedentary behaviour alters metabolism and physiology, its rate of onset and the dose of exercise that can be bet used to intervene—the minimal intensity to have the biggest effect.

Things like this we just do not know. We do know that, if we put someone in bed, they become insulin-resistant within 24 hours of not moving, which is incredible. That tells you that being inactive is in itself a physiological stress.

Dr Samuel Nyman: That is often the result if you are in hospital and you have broken your arm and you are sat in a bed for a week or whatever, or if you are in a care home where you are constantly told to sit down.

The challenge, when we talk about older people, is partly about where that starts. It could be people in their 60s or, according to some studies, in their 50s, and then up to people living past 100. We have a wide variation of people, from those who are very fit and active to someone with multiple chronic illnesses who has difficulty walking unaided, and all the variation in between.

There is a need to tailor approaches accordingly, and you might be alluding to the opportunity that we have to tailor exercise to people's interests and what is appropriate. Work has been done in that area; a study in the Netherlands, for example, recommended advising people of opportunities in their local area. That seems to have been quite effective—advising them of walking or cycling routes and other things in their immediate vicinity, depending on what they are interested in doing.

Q61 Baroness Hilton of Eggardon: We are bombarded with public messages about how much exercise we should be taking; so many hours a week, at a certain impact, intensive training or whatever. But from what you are saying, there is no very clear evidence about how much exercise we should be taking or at what age older people should start or continue to take exercise. Do you have any evidence behind these public messages?

Dr Samuel Nyman: On your last point about when to start, that should be from when people are toddlers and able to walk. There is evidence to suggest that older people are much more likely to be active if they have been active earlier in their lives. It is then perhaps more part of their usual routine or something they have more confidence in doing.

Thinking long-term, we need the entire population to be active. Some studies suggest trying to catch people in the retirement window. That is an opportunity when people's routines can change dramatically, and is one area that we can look at.

On the flip side, it is never too late. Even if you are in a care home and in your 90s, that does not mean that you cannot do any exercise. It might need to be closely supervised, or to be more about cognitively challenging activities while seated. Things like that might be more appropriate—or something like Tai Chi, which consists of gentle, fluid movements rather than muscle-building exercise.

Professor Paul Greenhaff: The Government's physical activity guidelines are offered in a positive way. No one is arguing that physical activity is not a good thing. The evidence, as we heard earlier, is gathered mainly from associations. We also know that most people are

not meeting the Government's physical activity guidelines, but that is not to say that we should not be drilling down into the mechanisms.

If you compare an 85 or 90 year-old frail person who maybe takes 300 steps per day to a 50 year-old person who is perhaps taking 6,000 steps per day, the guidance will be very different. But that guidance needs to be based upon mechanistic insights into what is causing the physiological dysregulation in that age group.

You may argue that the frail old person has neuromuscular events happening that make exercise less effective, so you may suggest a different modality. You may argue, for example, that the energy intake of a young person is in excess of their requirements, which may be a better strategy to address. It very much depends on the individual groups that you are looking at.

Baroness Hilton of Eggardon: So you would be in favour of individually tailored exercise regimes rather than the general messages that we get.

Professor Paul Greenhaff: I would, yes. The typical person in a care home—a female weighing between 30 and 40 kilos who is severely sarcopenic—compared to someone in their 50s or even their 60s, is so different, so the stressors are very different between the two.

Professor Alun Hughes: I would like to make a point, which I heard in the previous session. It is important that we do not fracture over lifestyle considerations; guidance on lifestyle needs to be integrated across all the risk factors and not focus on just one.

We can produce guidelines for particular groups, but, to be successful, public health policy needs to be integrated across the whole spectrum of activities. That is crucial. History suggests that the most effective public health policies are those that apply to the whole population. We need to remember that, because it is unlikely to change in the future.

The Chair: But we might apply it to groups of the population.

Professor Alun Hughes: I am not saying that we should not tailor; I absolutely agree. With something like exercise, you cannot suddenly go to running a marathon from sitting around watching TV all day. There is clearly a need for tailored programmes, but we also need to integrate that with policy-level activities that enhance the likelihood of undertaking exercise in the first place, and we need to align that with other health-positive behaviours. There is a big onus on policy and social measures to reinforce all these beneficial activities

Lord Borwick: With the increased sales of Fitbits and Apple Watches, there are millions of gadgets on people's wrists worldwide, which must be producing an enormous amount of information on what they are actually doing rather than what they say they are doing. Is there any research on how that extra information could be used?

Dr Samuel Nyman: Yes, the use of those kinds of activity monitors, trackers and so on can be described as a behaviour-change technique

called self-monitoring. There is good evidence that those kinds of devices are motivational; people can track their progress and get a sense of achievement from that. So these devices are very helpful from both a motivational and a data point of view.

There is a difference between what people say they do in a self-report questionnaire and the output on a device. The exercise levels are always much lower on the device; people overestimate. It is just that they are trying to remember over the previous week—"How much exercise did I do?" It is difficult to quantify that level of detail.

Professor Paul Greenhaff: You can gather awfully valuable information with these new technologies, but it needs to be used in the context that the measurements you are making are informative.

By way of example, if someone is sitting for three hours working at a computer, does that have a greater negative effect on muscle protein synthesis than if they got up every hour and walked for five minutes? We do not know the answer, but we could definitely use movement tracking information to get at such questions.

Lord Borwick: It would be a lot easier to collect that information than carry out some other study, would it not?

Professor Paul Greenhaff: Yes, but you would need to use that information in a context where you are also making gold-standard physiological end-point measurements.

Professor Alun Hughes: One other point I would like to make is that, whenever you imprecisely measure an exposure, such as exercising, you underestimate its effects on an outcome. Having said something about the limitations of observational studies, it is almost certainly true that the observational studies based on self-report underestimate the strength of association between actual physical activity—as opposed to self-reported physical activity—and outcomes. The consequence of this is that some of the evidence on the strength of associations may be an underestimate.

So, I think you are right: every cohort that I am involved in is using these sorts of technologies to assess what activity people actually do, rather than what they say they do.

Lord Browne of Ladyton: So should we be encouraging general practitioners to ask people what their phone says they are actually doing, rather than what they say they are doing?

Professor Paul Greenhaff: From my perspective, as a muscle physiologist looking at the studies that have been performed, yes, you can measure physical activity levels quite accurately, but you are then relating those to measurements such as blood glucose and insulin, which are so divorced from the target tissue that is causing the physiological decline.

More definitive, end-point measurements are needed, married to these precise measures of physical activity. You could even at the same time

validate these movement monitors by doing, for example, oxygen-18 measurements to measure metabolic rate in free-living people. It is possible to do these things.

Baroness Sheehan: I am not sure that I am getting the right message. Maybe you can tell me if I am. What I am hearing is that sedentary behaviour is bad, and we have little evidence of whether exercise, and what level of exercise, will improve healthspan. However, exercises that improve bone density and/or balance to reduce fractures are obviously good for improving healthspan. Is that right, and is it right that the number of steps that we take in the day does not correlate to anything that you can quantify?

Professor Alun Hughes: That is not the message that I would wish you to hear. The evidence on correlations is very strong, so the number of steps that you take per day correlates with a whole range of beneficial health outcomes.

The point is that we are uncertain about how much benefit we get from intervention, as opposed to the relationship. It is the difference between what you can expect from an intervention and the association that you might see. That is really just reiterating that causation and correlation are not the same thing.

The Chair: But that is a nuanced scientific comment.

Professor Alun Hughes: It is, but from the perspective of the health of the public it is important that we do not overpromise. If we overpromise on interventions and they do not deliver, we lose trust.

Baroness Young of Old Scone: I have just done a four-month diet and exercise programme online. My cohort staggered me—they will kill me for this if this ever comes into the public domain—because the amount of activity they took, even on that programme, was remarkably small.

Is it not the reality that the vast majority of people, other than a small proportion of the middle-class chatterati, are regularly taking very low levels of physical activity and that anything we can do to get people to take more will be worth while, even if we do not have the scientific proof of how much more? We are starting from a very low base.

Professor Paul Greenhaff: Absolutely.

Professor Alun Hughes: Absolutely. All the evidence on the dose response is that the more you do, the better. We do not know exactly how much or how many minutes a week you should do to get a particular benefit, but we do know that the more you do, the better.

Q62 **Lord Mair:** In our earlier session, we heard a lot about the importance of diet and nutrition for healthy ageing. In that context, what links are there between diet and physical activity? Does one augment the other? Are they thought about separately? Do they interact? What is known about that?

Professor Paul Greenhaff: One of the major features of ageing is a concept known as anabolic resistance, which is when the ability of dietary protein to stimulate muscle protein synthesis is diminished. If the anabolic stimulus of protein is diminished, muscle growth will also be diminished.

At the moment, we do not really know what causes anabolic resistance in ageing. However, we do know that consuming more protein cannot overcome it, but the combination of exercise and increased dietary protein intake may act more positively than diet alone. The longitudinal studies are missing, but in short-term studies it appears that exercise plus dietary protein supplementation can diminish anabolic resistance of ageing.

The other issue is that, if physical activity levels go down but energy intake stays the same, you will be in positive energy balance. Therefore, excess energy will be stored, particularly in skeletal muscle and liver.

Dr Samuel Nyman: There is a trial which shows that if you want to lose weight, the best way is a combination of diet and exercise.

Professor Alun Hughes: There is substantial intervention-based evidence that a combination of exercise and diet is the most effective way of achieving weight loss. It is also a more effective way of lowering blood pressure through lifestyle. This reinforces what I was trying to say earlier: that to address the issues of lifestyle and health you need to have a multifactorial approach.

Lord Mair: Is it just a feeling, a hunch, that you all have that it makes sense to have physical activity as well as good nutrition, or have there been scientific trials?

Professor Alun Hughes: There have been trials, albeit small and not of long duration, showing that combining physical activity with weight-loss measures is more effective than either alone.

Professor Paul Greenhaff: The combination of exercise and increased protein intake increases muscle protein synthesis more than either alone. It is an additive thing.

The Chair: We have now heard evidence that suggests that, as you age, the one body system affected is primarily the skeletomuscular system, and that to guard against that deterioration you need a higher intake of protein. At the same time, with age and a reduction in the amount of food that you eat, you restrict protein, so the cycle gets worse. However, we have not explored at any stage the role of malnutrition and what we mean by that.

Professor Paul Greenhaff: I am not informed on studies that have looked at malnutrition in the context of physical activity, so I cannot comment on that.

Professor Alun Hughes: I think it is fair to say that the quality of diet in older people, particularly disadvantaged ones, is often poor, and that is

clearly a contributory factor to their poor health. That is a very important issue; despite a societal trend to more calories coming in, many older people eat poorly.

The Chair: What is the physiological effect of malnutrition?

Professor Alun Hughes: There is muscle loss. Clearly, if you are not taking in an adequate calorie burden, you will mobilise energy from your own stores. Muscle is a major store that is lost in response to nutritional deprivation at any age.

Professor Paul Greenhaff: Do you mean malnutrition or undernutrition? Undernutrition will cause clear loss of fat mass and muscle mass, and mitochondrial decline. However, I consider malnutrition to be when finite components of the diet are missing. Undernutrition will have a much more profound effect on age-related losses than malnutrition.

Q63 **Baroness Penn:** It sounds as though we do not understand well enough the mechanisms by which activity can promote healthy ageing, but the association is strong enough that we think public health messaging to increase activity is important. Do we have evidence showing what messaging or public health interventions are effective or ineffective in promoting activity in older people?

Dr Samuel Nyman: On promoting physical activity, we talked earlier about activity trackers and those kinds of things. They are good for activity that can be easily tracked in that way, for example walking and those kinds of activities. However, if you are interested in something like swimming or Tai Chi, which do not involve constant stepping, clearly they will not work.

There is a body of evidence that suggests that—there are a few things to mention—if you talk to older people about physical activity, there can be a misperception that you are talking about exercising hard in the gym. That is what they conjure up in their heads. For a lot of people, that is not something they want to be a part of. Also—my work focuses on falls—there is a stigma around falls. People do not want to accept the label of being at risk of falls, so they distance themselves from falls prevention interventions, be that exercise or whatever.

However, on the other side, there is a theory about the psychology of ageing which suggests that, as we get older, we tend to prioritise activities that we enjoy, and that include opportunities for socialising with other people. They seem to be more motivational for people. I have had that experience in my Tai Chi classes for people with dementia and their carers. They enjoy doing the activity and they enjoy the socialising. That is much more powerful in bringing them along every week than knowing that there will be a health benefit way down the line. It seems to be more about the immediate benefits that people will get from it.

It would be helpful to move the public messaging away from purely, “It’s going to help your body or health”, or, “It might help prevent something happening in 10 years’ time”, and shift to messaging about this being

part of having quality of life, living and ageing well, enjoying life, getting out, being part of society, participating, meeting up with friends and using active transport. Exercise is not just about the gym; it could be walking and getting the bus and using a free bus pass to make it easier to do that.

We need to make it as easy as possible to be physically active. That is the nudge theory: if you make it as convenient and as easy as possible, it is much easier for people to do it and there is a more even playing field. Otherwise, if you are interested in using a leisure centre but it is miles away and you cannot drive any more, it is not accessible.

I guess what I am saying is that, as much as behaviour change and motivation are important, there is the wider question about what opportunities there are and how appropriate they are. How can we make it easier for people to do this? It needs to be the default choice.

Professor Paul Greenhaff: Of course, the public health message to exercise is positive, but it can be even more positive if efforts are made to make the public aware that being inactive is a stressor in itself. When you are inactive, muscle protein synthesis falls and insulin resistance in muscle develops. Understanding that being inactive is not a good thing and getting people to try to move will be a positive thing.

Dr Samuel Nyman: I partly agree with that, but on the whole, fear appeals tend to be ineffective. They need to be coupled with establishing people's confidence to do things. If you just tell people, "If you don't do this, you're going to die", that does not motivate them. If you say, "There's a really easy solution", you build people's confidence to be able to do it. As you said, for a lot of people, 150 minutes of moderate to vigorous physical activity a week is way out of reach and the idea is just demotivating. But if you start small, with light exercise, people can do that.

Baroness Penn: So can there be a tension between public health messaging about the optimum thing to do and messaging that actually encourages behaviour change for people?

Dr Samuel Nyman: As we know, most people are sedentary and do not do much activity, so rather than setting the bar really high for everyone, we could encourage even just light activity, including things that people might not consider to be physical activity, such as active transport. Some exercise is better than none, and light exercise is better than none, if you cannot manage moderate to vigorous activity. Getting people started and getting them moving will be a great thing. Giving people the confidence to do what you are asking them to do is a big thing.

Professor Alun Hughes: When studies have looked at why older people in particular do not exercise, some of the key issues that have come out are that they feel they have no social support to do so and they feel they would be doing it alone. Sometimes they feel that it would be age-inappropriate for them to do exercise. This perhaps affects women particularly.

Lord Winston: You mentioned mitochondria. A paper has just come out in the *Journal of Physiology* which you may not yet have seen. It is from Memme in Canada and shows that exercise directly improves mitochondrial health. Could you comment on that? Clearly that would be relevant to ageing.

Professor Paul Greenhaff: Absolutely. It is relevant to not just ageing but age-related disease too. For example, it is known that there is a loss of mitochondrial mass and function in diabetics, but if they exercise, this is restored. As you know, mitochondria play a central role in metabolism and tissue homeostasis. Inactivity is a major driver of mitochondrial loss. If you are not moving and muscle energy requirements decline, mitochondrial mass and protein synthesis will also decline. I agree that mitochondrial proliferation and growth are key to exercise benefits.

Lord Winston: The advantage is simply that this is a very good journal to cite.

Professor Paul Greenhaff: I know. I am a member of the editorial board.

Lord Winston: My point exactly.

Lord Hollick: One area of great interest for public messaging and scientific research is alcohol consumption—I am sorry to raise this. A tippie a day is supposed to be helpful in reducing the risk of stroke. Richard Peto, along with others, recently published a very significant report in which he concluded that there is no safe level of alcohol consumption and that the suggestion that it could reduce the risk of strokes was an old wives' tale. What is the scientific community telling us about our tippie?

Professor Alun Hughes: Again, the difficulty with assessing the evidence on alcohol is that it is based largely on observational data. Having said that, it is well known that alcohol intake is associated with higher blood pressure, so my bet is that Professor Peto is right on that. There are some studies using genetic techniques where to some extent one can overcome the problems of observational data to derive causal conclusions. Those also suggest that there is probably no safe level of alcohol, disappointing as it might be for all of us.

Lord Hollick: Is that the agreed view of the panel?

Dr Samuel Nyman: I have specialised more in physical activity and fall prevention, so I have not researched alcohol consumption specifically.

Professor Paul Greenhaff: It will probably depend on how you define a "tippie". I agree with the first point that it is mainly observational anecdote. I am not aware of any longitudinal data in relation to ageing, physical activity and alcohol.

Lord Hollick: A theme that has come through in this whole session and

previous sessions is an absence of study and scientific evidence. Public policy is being promulgated, but there seems to be a lack of a scientific foundation for much of it.

Dr Samuel Nyman: You have to work with what you have. My assumption would be that be that if someone is a heavy alcohol consumer, that will cause problems.

Baroness Penn: I want to come back to a question that we touched on earlier about public health messaging and what is effective in getting people to become more active. In terms of changing behaviour, is it more effective to establish more physical activity at a younger age, so we carry that on, or is it possible to change our levels of activity at a later age in a sustained way?

I am thinking about public health interventions. Is it more important to try to establish some lifestyle patterns early on because they are more likely to be sustained—not that it is ever too late to do so? Do we know how effective some of those interventions can be, and are they sustained if they are taken on later compared to earlier habits and routines?

Dr Samuel Nyman: I would say that it is both. As a population, we need to be more active. We hear of rising levels of childhood obesity. If someone has lived a lifetime of obesity with no physical activity, it will be even harder to try to persuade that person that they should consider a different lifestyle. We are very habitual beings, so it is about trying to make physical activity part of our everyday, weekly routines, to make it an automatic, taken-for-granted thing, so that it becomes the norm. That seems to be much more effective.

What you said about “sustained” is important. For example, a falls clinic can run an exercise class for 12 weeks, which may have some nice short-term benefits, but the benefits wear off, so people need to continue. There needs to be much more transitioning of people from NHS programmes to community programmes, to make it a lifelong activity. We are in the education sector, so we talk a lot about lifelong learning, but it is the same with physical activity and healthy lifestyles. It needs to be a lifelong pursuit.

Professor Paul Greenhaff: The message is that exercise works. In the 1990s, Bill Evans, an eminent physiologist in the US, was doing very high-intensity exercise studies in people in their 90s in the care home setting. They had enormous benefits from exercise. That required almost one-to-one supervision and very motivated individuals, but it worked. As people decline into frailty, it becomes more difficult for them to be motivated to work hard, but exercise will work.

Dr Samuel Nyman: You would not necessarily have to work hard. Exercise like Tai Chi is a very gentle form.

Professor Paul Greenhaff: To reverse muscle wasting in frailty, you will have to work hard.

Lord Winston: In a sense, what we are talking about is not exercise when you are already old and decrepit. We are really talking about leading up to ageing. That is the issue. That is really where we need to get data.

Professor Paul Greenhaff: We also need to get data about the frail. They are a population whom we know very little about. An MRI scan of a frail person looks very different from a scan of a healthy, non-frail person. We need more information on the frail and what interventions would work. We probably need complex interventions and not just exercise per se.

When it comes to the public health effect, then yes, intervening in middle age is key, and we need to gather more information about what changes occur over time. We talk about exercise, and I know that I said it earlier but we know very little about what being inactive does. We just employ exercise to address it. Until we know more about the mechanistic effects of being inactive, we cannot really address the question head-on.

Q64 **Baroness Young of Old Scone:** The Government have their healthy ageing grand challenge, but that is focused on the mechanisms of the industrial strategy and prompting businesses, technologies and services to be developed as opposed to any of the other interventions that we have just been talking about. Do you think that the Government are wasting their money, and should they spend it on getting better research on the impact of exercise and helping promote healthier lifestyles?

Professor Alun Hughes: Technology is likely to be a two-edged sword here. Historically—I think this addresses a point that you are making¹—we have seen that technology has been labour saving, so physical activity has reduced. It is not altogether obvious that that will change over the next few decades. Devices may well reduce physical activity. One issue is to try to promote using technology to increase physical activity and increase health behaviours across the whole spectrum. It is a wise decision to support that sort of engagement.

Dr Samuel Nyman: I agree. There are technological advances and things like exergaming: that is, video games that are so enjoyable that people end up doing exercise and forget that they are doing it. There are trackers and smartphones. But there are also other low-tech solutions. There have been some papers on the advent of the free bus pass. The evidence is correlational, but people are increasing their number of steps and social isolation is reduced because of it. Of course, it addresses the issue of inequality as well, because it is across the board and regardless of disposable income. There are therefore some obvious low-tech solutions.

From a motivational point of view, it is about making physical activity in all its guises available to people depending on what they enjoy. If it is walking by themselves and having lots of green and blue space, we know the restorative benefits of that. If it is going to classes, it is about making

¹ In reference to an earlier question from Baroness Penn

sure that appropriate classes are available and affordable. We know that affordability is a factor in sustainability and people drop out due to cost.

Baroness Young of Old Scone: Can we explore the point you made about green and blue spaces? The evidence is starting to accumulate that walking in green and blue spaces improves mental health. There is not necessarily a link to dementia, but certainly it improves overall mental health, reduces depression and helps with dealing with more serious conditions. Is that a motivator of the sort that you were describing? Would people be more interested in activity if they felt that it would impact on their mental health, since mental health is now such a growing issue?

Dr Samuel Nyman: Potentially. There is probably a lack of awareness of the cognitive and psychological benefits of physical activity. If someone feels they are becoming depressed, the first thing they think of is antidepressants. They do not ask, "Should I be exercising more to help with that?"

Baroness Young of Old Scone: Or going to a wood and hugging a tree. I should declare the interest that I am the chair of the Woodland Trust.

Dr Samuel Nyman: Again, by doing Tai Chi or going to such places, you can immediately feel the physical benefits. It is relaxing. Such things are incredibly rewarding, and people are motivated to continue doing them. So it then becomes how can we make those spaces available to everyone. They should not just be in the affluent areas but be easily accessible to everyone.

Professor Alun Hughes: One reason why older people report not engaging in walking as an exercise is the safety of the streets. There is a clear opportunity there in relation to public policy and accessibility to green spaces and so on to achieve improvement, which is societally beneficial.

The Chair: Thank you very much indeed for coming today to help us with our inquiry. We appreciate it very much. If you suddenly have a brainwave about something that you missed saying, please send it in.