Sunlight robbery: Vitamin D and public health – Is current UK public health policy on vitamin D fit for purpose?

Annual Caroline Walker Lecture

delivered by Oliver Gillie

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The Caroline Walker Trust

The Trust was set up in memory of the nutritionist and campaigner Caroline Walker, who died in 1988. The Trust's mission is the improvement of public health by means of good food – a cause which Caroline made important to everybody in this country. The Trust, which relies on charitable donations, exists to further her work through research and publications.

For my two boys Calder and Sholto

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Preface

Dark forces

"*… science should not be discussed just in technical monotone. Nutrition and food policy is everybody's business, and I believe, as did the founders of the Royal Society, that the most vital scientific issues need dynamic expression and vigorous debate in plain language. Everybody concerned with the sustenance of the whole living world now and in the future, is in a battle against dark forces.*"
Geoffrey Cannon – *The Fate of Nations* – Caroline Walker Trust Lecture 2003

In this lecture I attempt to go beyond the scientific monotone referred to by Geoffrey Cannon and, indeed, to tackle dark forces of a kind. To avoid the technical monotone I have brought in celebrities such as Gwyneth Paltrow and Jacqueline du Pré whose illnesses illustrate the consequences of vitamin D deficiency. Critics may say I have wasted time on this when I should have been delving further into significant differences and meta-analysis but I make no apology. The data on vitamin D and disease is now very extensive, yet it remains little known. So I have attempted to stimulate interest and arouse curiosity in the hope that you will search for more evidence and apply your own critical judgement.

Dark forces lie behind the pandemic of illness caused by insufficient vitamin D. Not, perhaps, the forces Geoffrey Cannon had in mind, but nevertheless powerful changes that affect the way we live, movements which individuals cannot easily control. As cities grew, smoke from domestic fires and industry polluted the atmosphere, blocking out the sun which is our major source of vitamin D. Rickets, the tragic disease that distorts the growth of children, emerged in epidemic form in 19th century Europe. It was the surface reflection of much more sickness and of pitifully brief lives, recorded by Dickens in his literary records of life in our city slums.

Air pollution is the first of the dark forces that block out the sun. In the UK the Clean Air Acts of the 1950s did much to remove the most obvious smog and bring

sunshine into our cities. Only now are we beginning to understand the depths of sickness and deprivation caused in the past by air pollution and insufficient sunshine. Scientific evidence now links insufficient vitamin D with some of our most common diseases: cancer, heart disease, diabetes, arthritis, and multiple sclerosis are among them.

Other secular changes limit the amount of sun we get. Most important are the desk jobs that keep us indoors all day and the TV programmes and computer activities that keep us inside at the weekend. Instead of warming ourselves in the sun outside our cottages as of old we stay indoors because our work keeps us there and our houses are more comfortable and better heated than they have ever been. Fashion is another secular force with dark effects: schoolboys no longer wear short trousers and girls wear leggings in the summer. Overuse of suncreams and everyday use of cosmetic foundation blocks the UV that makes vitamin D in skin. And there is another force which I hesitate to call *dark*: people have been wrongly told to avoid the sun when simple exposure to sunshine is beneficial if burning is avoided.

These secular forces are dark not only because they block out the sun but because their full effects on health have been unrecognised, hidden. Now, as a result of many years of scientific investigation, we can comprehend their effect in shading us from the sun which is our natural source of vitamin D. Understanding mechanisms of disease has led to great hygienic reforms in the past. In the 19th century modern sewers were built when the spread of cholera in infected water became understood for the first time. In the 20th century major changes in our habits have come from demonstration of the ill effects of smoking. In this century, understanding the importance of sunshine and vitamin D may be expected to bring further benefits.

We know sufficient now about vitamin D to forge new policies that will save many lives. We need vigorous debate. A scientific monotone is not enough. We must engage the public and policy makers if we are to contend effectively with the forces of darkness.

Oliver Gillie,
Health Research Forum,
London, October 2010

Sunlight robbery: Vitamin D and public health – Is current UK public health policy on vitamin D fit for purpose?

It is almost 100 years since the English scientists, Edward and May Mellanby, experimented with puppies raised in the dark and discovered a "calcifying vitamine"[2]. Shortly afterwards Dr Harriette Chick, the distinguished English nutritionist, showed that both cod liver oil and sunlight could cure rickets in children in post-war Vienna. After a century of scientific research we now know much, much more about the importance of the calcifying vitamine, vitamin D, but we are still failing to prevent rickets[3,4], and failing to use this powerful and cheap chemical to prevent a multitude of ills[1].

Government and others in the UK have failed to develop a coherent public health policy which addresses the problem of widespread vitamin D insufficiency. I can answer the question in my title straightaway and say that our policy in the UK is not fit for purpose – in fact it is a disgrace and has been for some years[5]. But I am going to start by taking you back some millions of years to when the human story began.

Human beings evolved in Africa[6]. We now know this for certain. Modern DNA studies have proved the "out of Africa hypothesis"[6]. In Africa the sun is strong enough for vitamin D to be synthesised in the skin all year round. From Africa it was a long journey to northern Europe where the sun is too weak to provide any substantive vitamin D except during the short summer months.

Few of us realise it, but Europe is actually an extreme environment for human beings so far as sunshine is concerned[7]. For three to five months of winter, depending on latitude, the sun is not strong enough to synthesise vitamin D in skin. Britain is much further north than most people realise. We are on the same latitude as Labrador in north America and the Alaskan panhandle. So the summer season is short. Even in summer we have to wear clothes to keep warm and these shade us from the sun.

The first modern human beings came to Europe some 20,000 years ago, and they almost certainly had brown skin like their African ancestors[7]. The land teamed with game, as shown in cave paintings, providing plenty of food for these pioneering people, but there was relatively little sun compared with their distant African homeland. Dark skin takes five times longer to make vitamin D than white skin[8-10]. Over thousands of years the first brown-skinned migrants either evolved

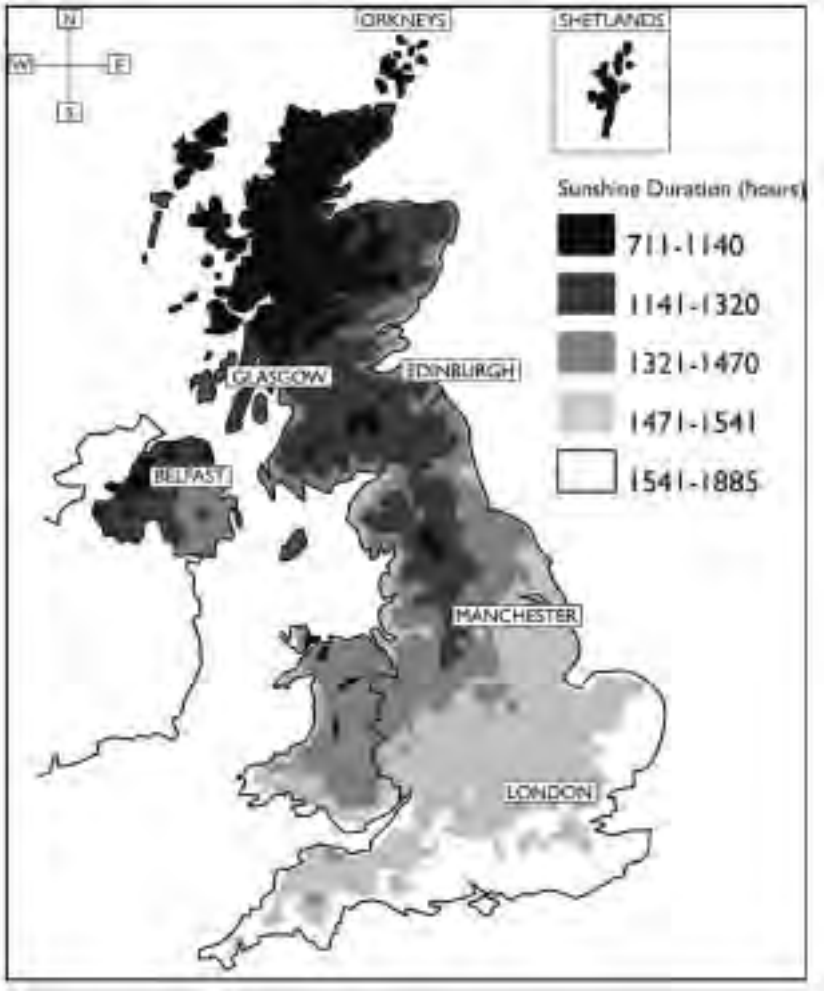

Figure 1. Annual hours of sunshine in the UK: Scotland gets less sun than England because it is so much further north and because it is more exposed to humid westerly and north-westerly airstreams which bring cloudy weather and rain. England, on the other hand, is relatively sheltered from the west by Ireland and by the Cumbrian mountains. The sunniest places are on south-facing coasts and flat coastal plains. Some sites along the south coast of England from the Isle of Wight eastwards and the Channel Islands record more than 40% of the maximum amount of sunshine possible in a year (1,800 hours out of 4,000). The Shetland Islands only achieve about 24% of the maximum possible sunshine.
Map redrawn from Meteorological Office data.

lighter skin or were replaced by white migrants from the continent[11]. The fittest survived. This in itself tells us how important vitamin D is for health.

The British Isles as a whole receives less sunshine than most other industrial countries, not just because we are far north, but because we have very cloudy weather[12,13]. And Scotland has much cloudier weather than England making it possibly the most extreme environment in Europe so far as sunshine is concerned[12].

Our weather is cloudy because the prevailing westerly wind brings in dense cloud from the Atlantic. South-eastern England gets some protection to the west from the Irish landmass and the mountains of Wales and Cumbria which draw down much precipitation before it is able to cross the country. This can be seen clearly in a sunshine map of the UK (see figure 1, left). But there is little to stop this wet westerly wind from blowing across the lowland corridor linking Glasgow and Edinburgh where most Scots live. As a result Scotland has more cloud and Scots get less sunshine than most English people, as well as having a very short summer season lasting barely four months[14].

Scots of all social classes die younger than English people of equivalent social class. This excess mortality, known as the "Scottish effect"[15], is only partly explained by differences in smoking, alcohol consumption and poverty. Certain causes of death appear to be more frequent in Scotland compared with England. These include: heart and blood vessel disease, certain common cancers e.g. bowel and breast, fractures and heart disease in children, autoimmune diseases including: multiple sclerosis, diabetes type 1, and Crohn's disease[14]. These are all diseases for which there is evidence that vitamin D insufficiency is a risk factor. So it seems that vitamin D insufficiency could account in part for the excess mortality of Scots, as I have argued in detail elsewhere[14].

The English language has 32 words for rain and another 12 for cloud or fog (Box 1, overleaf), not counting technical words such as cumulo-nimbus, 44 words in all. Rain for the British is like snow for the Eskimo (Inuit). Indeed our rain and cloud is so pervasive that Scots get little more annual UVB, the part of the spectrum that makes vitamin D in skin, than Eskimos living inside the Arctic Circle[12,16]. But we lack the marine diet, rich in vitamin D, which keeps Eskimos relatively healthy. Inuit people living traditionally are arguably better off than Glaswegians because their diet consists almost entirely of fish and other marine produce such as whale and seal which are rich in vitamin D. Herring shoals that used to sustain the Scots with vitamin D are now badly depleted[17] and even in Shetland, home of North Sea fishing, fish is now expensive.

BOX 1

Words or phrases describing rain:
rain, drizzle, precipitation, shower, spit, pissing down, bucket down, torrent, downpour, driving rain, Scotch mist, raining cats and dogs, pouring down, sprinkle, drop, hail, flood, deluge, barrage, Monsoon, mizzle, sleet, drop, pelting down, cloudburst, drencher, flurry, heavy dew, sheets, spate, stream, patter.

Words or phrases describing cloud and fog
cloud, fog, haze, mist, vapour, smog, spray, miasma, murk, harr (sea mist), brume, overcast

Few other foods contain much vitamin D. There are small amounts in eggs, meat and margarine, but it is impossible for people with typical modern diets to get more than about 5% of the vitamin D they need for optimum health from food. So in Britain we are dependent on the sun for our vitamin D.

A white skin enables Europeans to make vitamin D during an extended summer season compared with dark-skinned people. At the beginning and end of the northern summer dark-skinned people are unable to benefit from the weak sun while a white skin will still make vitamin D. Despite our cloudy weather, a white skin has enabled us to survive in Europe for thousands of years as hunter gatherers and farmers. But, since cities have grown up in the last few hundred years the delicate balance which allowed human beings to live healthy lives and flourish in Europe has changed. Today most of us work in offices and don't go out in the sun in the middle of the day when it is strongest – except perhaps at the weekends. We have also been advised to stay out of the sun in the middle of the day for fear of skin cancer[18,19]. Even nudists slap on sun cream which blocks the penetration of ultraviolet light into skin, so blocking synthesis of vitamin D. The result is that today almost everyone in the UK gets insufficient vitamin D[20].

When I was a boy we wore short trousers up to the age of 12 or 13. Today, boys of all ages generally wear long trousers and girls often wear tights and leggings which reduce the amount of sun their skins can get. In addition television, computers, cars, and air conditioning all encourage indoor living in the summer months. Many cosmetics now contain sunblock that reduces the amount of vitamin D to be obtained by casual exposure of the face to the sun. These changes

are almost certainly responsible for a decline in vitamin D levels in the population and, at least in part, for much of the increase in chronic disease which we are seeing now. Multiple sclerosis, diabetes, certain cancers and asthma, for example, have increased dramatically in the last generation and are now occurring on an epidemic scale[21-27]. Other factors such as genetics and virus infections are or may be factors in these diseases, but the key factor in many seems to be vitamin D insufficiency.

Many women avoid the sun in order to preserve a youthful skin[28]. This can have adverse consequences. Gwyneth Paltrow, the 37-year-old star of *Shakespeare in Love*, *Iron Man* and other movies, suffered a severe tibial plateau fracture and a bone scan showed that she had osteoporosis. Doctors gave her a vitamin D prescription and she was told to spend more time in the sun. She told fans that the advice left her confused: "I was curious if this was safe, having been told for years to stay away from [the sun's] dangerous rays."

Gwyneth Paltrow is just one of thousands of victims of extreme advice to avoid the sun coming from cancer charities and the dermatology industry.

So how is vitamin D made in the body? Energy from the sun turns a chemical in our skin called 7-dehydrocholesterol into pre-vitamin D3 which changes spontaneously into vitamin D in skin[29,30]. This is carried by the blood to the liver where it is changed into 25(OH)D. This is the form of vitamin D that is normally measured in diagnosis of blood levels. In the kidneys 25(OH)D is transformed into active vitamin D – this is 1,25 dihydroxyvitamin D, or calcitriol, a potent steroid hormone. This series of metabolic steps is tightly controlled by feedback mechanisms which ensures we cannot get an overdose of calcitriol after spending a long time in the sun.

During the last decade this classic picture has been found to be only a small part of the story. Ground-breaking laboratory studies have shown that the active hormone form of vitamin D interacts with receptors in more than 30 tissues and organs of the body and influences the action of some 1000 or more genes[31]. By these means vitamin D controls not only calcium homeostasis but another five physiological systems: the immune system, pancreas beta cells, heart and blood vessels, muscle development and strength, and brain development[29]. In addition vitamin D has direct effects on cell activity[29]. It facilitates cell differentiation and apoptosis, that is, it regulates cell death. Together with calcium it has a profound effect on cellular adhesion and initiation of cancer[32].

Insufficient vitamin D causes various different kinds of failure in these six

physiological systems, apart from effects on bone health and initiation of cancer. Insufficient vitamin D is an important risk factor for cardiovascular disease[33-36], hypertension[37], type 2 diabetes[38,39] and infections[40-43]. We also have strong evidence that vitamin D is a risk factor for multiple sclerosis, Crohn's disease[44,45], arthritis, type 1 diabetes[39] and psoriasis. There are many other immune system diseases and vitamin D is probably a factor in many of them[14] as well as playing an important role in resistance to disease including tuberculosis[40], colds[46,47] and flu[43].

In the early 1970s two young Americans, Frank and Cedric Garland, who were studying science and medicine, made an epic journey across America from San Diego, California, to John Hopkins Medical School on the east coast. The brothers rode proudly in a 1972 Mustang Sprint Fastback with blue trim. As they crossed the country from west to east, returning from their Christmas vacation, they could not help noticing the dramatic change in weather from sunshine to snow. It was this journey that gave the Garland brothers the first clue about the cause of bowel cancer.

At that time the most popular scientific theory was that insufficient dietary fibre was the cause of bowel cancer. The English surgeon, Dennis Burkitt, gained fame from his animated lectures illustrated with snapshots of African faeces. He pointed out that colorectal cancer is rare in Africa and was relatively rare in modern industrial countries before the 19th century. Burkitt argued that colorectal cancer is a disease of civilisation caused by refined diets. His message was widely accepted and many people started to eat more fibre, especially in the form of bran. The food industry showed what they can do when given a clear lead – many foods began to appear on supermarket shelves with added fibre, especially bran.

In an important article on diseases of civilisation in the *British Medical Journal*[47a] in 1973 Burkitt said that a carcass in the African bush is most easily discovered by locating telltale vultures and the same approach is needed in medical research. In fact Burkitt was misled by his vultures, at least so far as bowel cancer is concerned. The hard stools passed by civilised Britons do not seem to be the primary cause of colon cancer. It was the Garland brothers who, following their epic journey in the Ford Mustang, obtained the first evidence showing that it is lack of sunshine and vitamin D that are a more significant cause of bowel cancer.

At John Hopkins, the Garlands examined a map plotting the incidence of colorectal cancer in the United States and saw that deaths from the disease are most frequent in the north-east of the United States. They saw a rough correlation

with latitude and hence with hours of sunshine. We now know that there is least UVB in the north-east United States in wintertime because of a thicker ozone layer and more sulfate aerosols.

Frank Garland, who sadly died in August 2010, told me: "Everyone else was thinking bowel cancer must be caused by something that people ate, like the amount of fibre or meat burnt on the barbecue. We were alert to the difference in climate because we had direct experience of it."

The Garland brothers went on to show with scientific rigour that bowel cancer is linked to sun exposure. They spent six years assembling their evidence and in 1980 published an article in the *International Journal of Epidemiology*[48]. Later they showed that breast and ovarian cancers are also less frequent in sunny regions[49]. The Garland brothers were free spirits and truly independent thinkers. Their findings contradicted conventional wisdom and so were largely ignored. At the time, their observations were too simple for doctors and scientists, dazzled by DNA and other modern wonders, to pay much attention. So it was 25 years before their discovery was taken seriously outside a small circle[50,51]. Now this simple idea, which has taken a lifetime's work to establish, is crashing through medical research and bringing a revolution in thinking about the way cancer is initiated. Some 14 or more cancers have now been found to follow this general geographical pattern in the United States, and there are similar north/south gradients in other countries or continents, including the UK[52,53].

For many years mutation has been thought to be the initial event in the origin of a tumour. Now the Garlands suggest that the initial event is cell proliferation which occurs when vitamin D and calcium are in short supply[23]. Mutagenesis has generally been considered to be the primary event in formation of a tumour. It now seems likely that insufficient vitamin D allows unregulated proliferation of cells and this is an important factor allowing mutations to become established and accumulate to form a malignant cell line and ultimately a tumour. Indeed this proliferation may be the key event in tumour formation, more important than mutagenesis. We must remember that tar from tobacco smoke is not only mutagenic, it is also an irritant that causes inflammation and cell proliferation, a twofold carcinogenic action.

Jacqueline du Pré was one of the world's most accomplished cellists. Her performance of Elgar's cello concerto had a unique power and haunting beauty. But tragically she developed multiple sclerosis and stopped playing at the age of 28. She became restricted to a wheelchair and died prematurely at the age of only 42 after some 16 years of illness.

MS is a very common disease affecting one in 750 people in the UK. In Scotland MS is even more common, affecting around one in 500 – the highest incidence of MS in the world[54]. Half of those who have suffered from MS for 15 years are unable to walk without help and after 25 years half are in a wheelchair. The cost to the UK of this terrible disease is somewhere around £4 billion per year. At one time it was thought that multiple sclerosis might be caused by diet. We now know that multiple sclerosis is almost certainly caused by insufficient sunlight and/or insufficient vitamin D, probably combined with a brief virus infection[55,56].

As a child Jacqueline du Pre spent many hours practising her cello. At 11 she won a scholarship which required her to practice four hours a day. This must have made it difficult for her to go out in the sun as most other children do. So the dedication that enabled her superb talent to emerge and flourish may also have carried the seeds of her later illness.

Studies of migrants moving from high latitude countries with a high incidence of MS to sunny low latitude countries, for example from the UK to South Africa, show that the risk of MS may be reduced if the migration occurs before later teenage years[55]. This tells us how important it is for children in the UK to get out and play in the sun. However the deprivation of vitamin D, that is almost certainly the cause of MS, may occur first in pregnancy[55,57]. Scientists in Oxford have shown that a gene associated with a high risk of MS may become modified epigenetically by interaction with vitamin D[58]. This seems to be how the disease may start.

A higher proportion of babies born in the UK in May than at other times of year develop MS later on[59]. The same seasonal effect has been found in several other countries in the northern hemisphere while a corresponding increase in MS births in early summer occurs in the southern hemisphere. These babies go through the last three months in the womb at the end of winter when vitamin D levels in their mothers' bodies' are lowest. During those last three months the babies bones are growing rapidly and so vitamin D in the body is working hard to mobilise calcium for bone growth[60]. But vitamin D is also needed for the healthy growth of the brain and the immune system and insufficient vitamin D at this time, which is not made up later, seems to be an important cause of MS.

November is the best month in which to be born. A smaller proportion of babies born in November develop MS compared with babies born at other times[59]. These November babies benefit from extra vitamin D that their mothers accumulate during the summer holidays in July and August. The vitamin migrates from the skin into the circulation reaching its highest level in the blood in September.

Faye Dunaway won an Oscar for the 1976 movie *Network*. At 66 she has a beautiful complexion saved from the sun and doubtless maintained with expensive creams and surgery. But her hands tell another story. They are wracked with arthritis – a painful and progressively crippling disease. As the *Daily Mail* put it "fate has not granted her a handshake to match her timeless smile".

Lack of sunshine and insufficient vitamin D appear to be significant factors in causing arthritis[61,62] which generally progresses to involve other joints. Arthritis has a low incidence in sunny countries and a north/south gradient[63]. Randomised trials have shown that symptoms of arthritis are reduced by vitamin D supplements and progress of the disease is slowed by vitamin D[64].

Many records were broken at the 1968 Olympic games in Mexico City which is located near the equator at an altitude of 7,400 feet. Bob Beamon, for example, put an amazing 55 cms on to the long jump record in Mexico. Lower air pressure may have been a factor in the large number of records gained in the 1968 Olympics, but the intense sun during training must also have maximised vitamin D levels so that too could have been a factor.

Vitamin D is vital for optimum function of nerve and muscle. Evidence was gathered by Russians and Germans in the years before World War II suggesting that vitamin D can improve athletic performance in people who have less than optimum levels[65,66]. Athletes training in Europe commonly have a fall off in fitness in the autumn and winter when vitamin D levels are lowest.

Four out of the first 10 men in the London Marathon in 2009 came from Kenya or Ethiopia. Every year they do well. The Kenyan and Ethiopian runners train at high altitude near the equator where the UVB radiation is intense. This is the climate in which *Homo Sapiens* is believed to have first evolved. Now sports doctors are asking if these athletes from the Kenyan and Ethiopian highlands may be benefiting not only from a boost to the oxygen-carrying capacity of the blood but also from extra high vitamin D levels. Scientific evidence suggests that vitamin D may improve reaction times, muscular strength, balance, coordination and endurance, as well as reduce risk of winter infections that interrupt training[65].

The Chicago Blackhawks ice hockey team have been given a vitamin D supplement of about 5,000 IUs per day. Team members believe that the vitamin D has not only helped their athletic performance but also reduced the number and severity of lower respiratory infections and repetitive use injuries. The Blackhawks had been on a losing streak; but after they started on vitamin D the game's fans watched

them come out of nowhere and reach the top of the Western League finals. I am not putting this forward as any kind of scientific evidence. No doubt other drastic measures were taken by the team's managers to improve the team's performance after a bad season. It simply shows that sports people are learning about vitamin D and expecting it to help them. In the UK too, elite athletes are now beginning to take vitamin D supplements.

Maybe we should not be surprised that vitamin D can help athletes when we already know that it is metabolised into a potent steroid hormone. However because training in the sun could not be forbidden under international sports rules vitamin D supplements could not be forbidden, although steroid hormones in general are against the rules. Unlike steroid hormones, excess dosage of vitamin D does not seem to be possible. This is because the synthesis of the active steroid, calcitriol, from vitamin D is tightly controlled by metabolic feedback mechanisms.

Many UK athletes, like most others in the UK, must be getting sub-optimal levels of vitamin D and they may be expected to benefit from sunbathing or taking a vitamin D supplement. Swimmers and gymnasts who train mostly indoors are among those most likely to benefit. But excessive doses of vitamin D above the optimum can not be expected to produce additional benefit because of the metabolic feedback control.

A British GP, Dr Edgar Hope-Simpson, who was a self-taught epidemiologist, first documented carefully how epidemics of flu always occur in winter in both hemispheres. The flu virus spreads all year round but in winter the dormant virus becomes more active, and infections flare up[41,42].

The Hong Kong virus arrived in Britain in August 1968 but despite being a new antigenic variant in a non-immune population did not cause significant illness until winter that year. It had spread widely during the summer without causing epidemic illness, only to emerge when winter came and vitamin D levels in the population dropped. In fact the largest epidemic of Hong Kong flu did not occur until the following winter of 1969. Flu epidemics invariably occur in winter whether in the northern or southern hemisphere. A major factor in these winter epidemics of flu, and colds, is almost certainly low vitamin D levels in the population.

Now a randomised controlled trial in Japan has shown that taking a vitamin D supplement reduces the risk of going down with flu[43]. Vitamin D modulates the immune system, increasing resistance to infection by causing, for example, the production of innate antibiotic substances such as cathelicidin[67,68]. Scientific

evidence suggests that vitamin D provides resistance to a number of other infectious diseases including colds and tuberculosis[40].

Sir Austin Bradford Hill developed well-known criteria for inferring causality from observational data. Bradford Hill's criteria include consistency, strength of association, a dose response, and the existence of a plausible biological model at the cellular level. Insufficient vitamin D satisfies Bradford Hill's criteria with regard to several cancers[52,53], so establishing that insufficient vitamin D and/or sunshine is a major cause of cancer. Cancers that closely meet his criteria are those of the breast, colon, rectum, bladder, oesophagus, gallbladder, stomach, ovary, kidney, uterus, and lymphoma[52]. This is the first level of proof linking vitamin D insufficiency to chronic disease.

There is a well-established precedent for the use of Bradford Hill's criteria. They have been used to establish that smoking is the cause of lung cancer and other diseases. But, unlike smoking where clinical trials are not possible, in the case of vitamin D, subjects may be given vitamin D and compared to others taking a placebo. We already have some evidence from randomised controlled trials and about 100 more are in the pipeline.

Clinical trials have shown that when effective dosage and compliance is taken into account, high dose vitamin D supplements given to older people reduce their risk of fractures or falls[69-71]. Trials with negative findings have generally used lower doses of vitamin D, or only achieved low blood levels because of poor compliance, or they have obtained low blood levels of vitamin D because they start with very low baseline levels. We now know that levels of vitamin D needed for optimum health are much higher than was previously thought necessary. Clinical trials have also shown the efficacy of vitamin D in reducing symptoms of arthritis[72], raised blood pressure[72], and cancer[73], although the methodology and interpretation of the cancer trial is disputed.

Observations suggesting that vitamin D may prevent cancer, heart disease and other life-threatening illness are supported by a meta-analysis of deaths in trials undertaken to test efficacy of vitamin D in prevention of fractures, osteoporosis and falls[74]. Phillipe Autier and others at the International Agency for Research in Cancer in Lyon, found a seven per cent reduction in deaths of those taking a vitamin D supplement over a period of six months to seven years. Most of the trials used rather low doses of vitamin D and so there is an expectation that higher levels of vitamin D taken over a longer period might be expected to reduce mortality even more.

Vitamin D is now being recognised as an important risk factor in heart disease which is the commonest cause of death in industrial countries. Individual clinicians are enthusiastic, although the importance of vitamin D in heart disease still lacks wide recognition. For example: an article published recently in the *Journal of the American College of Cardiology* had the title: "*Vitamin D Deficiency: An Important, Common, and Easily Treatable Cardiovascular Risk Factor?*"[75]. The author, James H. O'Keefe, MD, from the Mid America Heart Institute in Kansas City, said: "Vitamin D deficiency is an unrecognised, emerging cardiovascular risk factor, which should be screened for and treated."

Here are some details: Vitamin D protects against cardiac hypertrophy and dysfunction in rodents[36]. Vitamin D suppresses the renin angiotensin system giving better regulation of blood pressure[33]. It suppresses genes associated with cardiac hypertrophy[36]. Low serum levels of vitamin D are a risk factor for cardiovascular mortality in prospective observational studies[34,76]. Both vitamin D and UVB radiation have been shown to lower blood pressure in placebo controlled randomised trials[35].

Some 30 to 40 diseases, many of them very common, may be caused at least in part by vitamin D insufficiency[29,77,78]. Insufficient vitamin D is one of the big players in the league of risk factors for chronic disease. It is the basic cause of an insidious pandemic bringing untold illness that reaches right through the modern world.

As people everywhere adopt modern lifestyles, vitamin D insufficiency increases. It is not just schoolchildren in Los Angeles or Liverpool who become deficient in vitamin D because they spend more time indoors in front of screens instead of playing outside.

In New Guinea, tribespeople abandon traditional practices. They no longer go about nearly naked but wear clothes so shading themselves from the sun. And some New Guinea mothers introduce solid food early to their babies, depriving them of the vitamin D in their milk. The babies are then more vulnerable to pneumonia in the rainy season when there is little or no sun[79-82].

In the Arctic, Inuit abandon traditional lifestyles because they are working for oil companies or on defence contracts. Instead of eating fish and seal they take to modern industrial foods lacking vitamin D and so put their health at risk. Vitamin D insufficiency should be in the list of urgent problems recognised by the World Health Organisation and by governments worldwide along with smoking, alcohol, obesity and diet – but it is seldom mentioned.

In fact the UK Government does have policies on sunshine and vitamin D – but sadly they are either faulty or they don't work. The result is an unnecessary early death for many and chronic disease costing billions of pounds. The cost of disease caused by vitamin D insufficiency in the UK has been estimated to be £27 billion annually[83], several times the annual cost of smoking diseases which is only some £6 billion.

Five failures of public health policy on vitamin D in the UK

■ **Failure No. 1**: Present government policy decrees that healthy adults leading normal lives in the UK need take no vitamin D supplement[84] – this cannot possibly be right when we know that in winter 86% of English people and 92% of Scots fail to maintain optimum levels of vitamin D[20,85].

The Canadian Cancer Society now recommends that all Canadians take 1000 IUs of vitamin D per day in winter, and the same in summer if they get little exposure to sunlight[86]. In March 2010 the Canadian Vitamin D Society together with an organisation called Grassroots Health convened a panel of 40 health experts to consider suitable doses of vitamin D supplement[87]. They recommended to the government of Ontario that individuals take an amount of vitamin D that would achieve a serum level of 100 to 120 nmols/l of vitamin D in serum (measured as 25(OH)D). To achieve this they recommended that adults take 5000 IUs per day, adolescents 4,000 IUs, children 1- to 9-years-old 1000 to 2000 IUs, and babies 600 IUs. Ontario is a large province but most of the population live at a latitude similar to France. So their latitude together with their continental climate give Ontarians more sun than we get in the UK. It is logical therefore that in the UK we should adopt a vitamin D dosage that is no less than that recommended for Ontarians.

The importance of vitamin D for people in the UK has been recognised by Bupa, Britain's biggest supplier of private healthcare. Bupa's expert assessment, made "after analysing years of independent research", is that: "Vitamin D helps protect against certain cancers such as breast, bowel, prostate and colon. For people to obtain enough vitamin D naturally, they need either to expose their skin to lots of summer sun or eat large quantities of oily fish".

Dr Virginia Warren, a medical director of Bupa, said: "Nobody wants to eat four tins of mackerel every day to get their vitamin D from oily fish. The alternative is to take vitamin D supplements, at least 1,500-2000 IUs a day, which may be

expected to reduce the chance of developing cancer by 26 per cent. People have to act now to take preventative measures against cancer for their future long-term health."

Dr Warren added: "Cancer is today's biggest killer and we need to protect our bodies from it as much as we can. Taking vitamin D supplements are an effective, inexpensive and easy way of doing that."

However, many people don't like to take supplements, can't be bothered, or don't remember. So encouraging people to expose their skin to the sun, which is our natural source of vitamin D, is also important.

■ **Failure No. 2**: Breast fed babies in the UK get very little vitamin D in the first six months because breast milk of UK women is low, if not deficient, in vitamin D[88,89]. Why? Breast milk isn't all the same. In the UK mothers generally get very little sun exposure and so their milk contains little vitamin D. Mothers and babies need vitamin D in these early months but, scandalously, mothers are told in official advice from government and midwives that their babies don't need a vitamin D supplement until they are six months old[1,90-94].

This advice is based on the assumption that the mother passes on vitamin D stores to the baby that provide for the first six months. But when mothers have low vitamin D the baby too is low in the vitamin at birth. Furthermore the half-life of vitamin D is six to 10 weeks and so by six months the baby's vitamin D store, such as it is, may be reduced to less than a quarter of what it was at birth. Bottle-fed babies obtain a vitamin D supplement in their formula but breast-fed babies are at risk because breast milk is generally a poor source of vitamin D[95,96].

I know of no other country in the world giving advice not to start vitamin D supplements before six months. The practice has no scientific foundation that I am aware of. In other countries, such as the United States, Canada and many European countries, the need for vitamin D supplements for babies is well-recognised and babies are started on vitamin D in the first week of life. Provision of a vitamin D supplement from the first few days of life may reduce the risk of multiple sclerosis and diabetes type 1, but we are failing to do it here in the UK[55,97,98].

■ **Failure No. 3**: The Government aims to provide free vitamin D under the Healthy Start scheme to pregnant women under 18 and those on income support and to children of mothers on benefits up to the age of four. However, the scheme has been badly implemented, does not work adequately, and ignores the needs of

mothers and children who are not on benefits and so do not qualify for the Healthy Start vitamins.

In 2004 Prime Minister Tony Blair joked in Parliament about the nanny state providing cod liver oil, suggesting it was silly and unnecessary[99]. In fact, provision of cod liver oil to all British children in 1942 was part of a heroic wartime effort to feed the nation when we were besieged by German submarines. It was an important advance showing how the state could provide health for all by abolishing rickets which had been a scourge of the city poor for more than a century.

Cod liver oil was eventually replaced by NHS infant vitamins containing vitamins A, C, and D[1]. The infant vitamins were given free to mothers and babies on benefit and up to the 1990s could be purchased by others. Then about 10 years ago these NHS infant vitamins were abolished. They were replaced about four years ago with the Government's Healthy Start scheme. According to government literature this provides mothers in need and infants over six months old with vitamin D. Scandalously, this doesn't mean that mothers who really NEED the vitamin get it – that would be virtually all mothers. It means the vitamin goes only to mothers on benefit and mothers under 18 years of age – if they are lucky.

This new scheme has replaced the NHS infant vitamins which were available to all. The scheme is now struggling to recover from an abysmal start. In 2008 after the scheme had been going for several years, the Healthy Start vitamins were still supplied to only about 160 women and about 500 babies in the whole of England[1]. When we consider that some 650,000 babies a year are born in England you can see that the government scheme was a farce. It is doing a bit better now but will never reach more than a small minority of women unless it is radically extended.

The emerging Welfare State cured rickets with cod liver oil more than half a century ago. Oddly Tony Blair's family are said to have taken cod liver regularly against colds[100]. What a pity Mr Blair did not understand more about the nutritional virtue of this distasteful substance! Now rickets is reappearing[101], but much worse than that: babies are dying today of heart failure because they are not getting vitamin D[102].

Kaylee Davidson, Britain's first baby heart transplant is now a thriving young woman in her twenties. Transplantation has become a recognised treatment for babies with severe heart failure in the UK. And one of the causes of severe heart failure in babies is vitamin D deficiency. It occurs because mothers and

babies are not given vitamin D supplements in pregnancy and the first months of life as in other European countries.

Dr Michael Burch, of Great Ormond Street Hospital, London, has estimated that some 25% of babies with heart failure have reached that state of extremis because of vitamin D deficiency. He collected 16 cases of babies with heart failure or cardiac arrest caused by deficiency of vitamin D[102]. The babies, admitted to hospital in south-east England as emergencies, had very low levels of vitamin D and calcium. Ten had radiological evidence of rickets. Two were scheduled for heart transplants but they recovered rapidly when they were given vitamin D, calcium and medication. Tragically three of the 16 babies died before the vitamin D began to work.

The 16 babies tended to fit a pattern. All had been breast-fed. They had obtained minimal amounts of vitamin D because the mothers had dark skin and so were less able to benefit from the weak sunlight we have in the UK. Most of the babies were born in late winter when vitamin D levels are lowest. Dr Burch said: "Life threatening heart failure occurring in babies in 21st century London, just from failure to be given a vitamin, is a shocking fact."

Britain has the worst death rate of children under five in Western Europe – 5.3 per 1,000 children[103]. Twice that of Sweden. Giving adequate vitamin D in pregnancy and early life is a simple, inexpensive measure that we could take to improve this.

■ **Failure No. 4**: Milk is not fortified with vitamin D in the UK. Supplementation of a commonly consumed foodstuff has been the method chosen by many countries for ensuring the whole population is protected from nutrient insufficiency. The United States and Canada have had milk fortified with vitamin D since the 1930s. In the UK the only foods to be fortified with vitamin D are margarine, some breakfast cereals, some processed cheeses and yogurts, and they contain almost negligible amounts. The Food Standards Agency in the UK has said that there needs to be an assessment[104] but has taken no measures to consult on the issue. Finland and the Irish Republic have recently introduced fortification of milk and Israel is making it a legal requirement. Jordan is fortifying bread. If these countries can do it – why can't we do it? *What's the problem?*

Mandatory fortification would be sure to engender opposition in the UK of the kind that has for many years opposed fluoridation of water. But fortification does not need to be mandatory. Government could easily find ways of encouraging the food industry to develop non-mandatory fortification of foods. Regrettably

government has shown no interest in exploring this possibility, probably because the SACN (Scientific Advisory Committee on Nutrition) report on vitamin D failed to give any encouragement to the idea[84].

■ **Failure No.5**: Government and Cancer Research UK have until recently warned only of risks of sun exposure while largely ignoring the benefits[1]. In fact they have exaggerated the risks because most, if not all, the risk of melanoma, the most serious form of skin cancer, is associated with burning and not with tanning.

I have a picture of a father and son relaxing in the sun in the middle of the day wearing only bathing suits. I like showing it to people because father and son are both so happy, enjoying themselves in the sun. And they are well-tanned. This is a common enough sight in summertime on beaches anywhere in the world. But this father and son, like many thousands of others, are disobeying frightening advice given over many years by Cancer Research UK and the British Government.

Most but not all dermatologists maintain, I believe quite wrongly, that a tan is unhealthy. Sadly, Cancer Research UK has accepted this misguided advice uncritically and so has wrongly advised the public on sun exposure over a long period – advice which we can say with hindsight must have caused many deaths and the loss of many millions of pounds spent on illness caused by vitamin D insufficiency[1,5].

Russians sun themselves at the first opportunity they have in March while snow is still on the ground. They brave chill air temperatures to enjoy the feeling of sun on skin outside the Peter and Paul Fortress in St Petersburg. Russian citizens continued to be able to do this throughout the Soviet era without anyone telling them not to. In fact we may even be programmed by evolution to seek the sun, despite all the well-meaning but ill-considered advice to the contrary here in the UK.

Consider the humble panther chameleon, *Furcifer pardalis*. Experiments with this creature support my speculation that some animals, including possibly human beings, may be programmed by evolution to seek the sun. Panther chameleons that have eaten crickets dusted with vitamin D powder spend less time in the sun than chameleons given ordinary non-dusted crickets[105]. Their bodies seem to tell them when they have had sufficient exposure.

In fact, many animals sunbathe. Cats and dogs regularly bask in the sun and so do hens which stretch out their wings to get maximum exposure. So perhaps it is not so surprising that people in the UK, who are mostly very low in vitamin D, are

inclined to seek the sun when it does come out – and love going on holiday in the Mediterranean.

Girls Aloud is be one of the UK's most successful pop groups with a string of 20 consecutive top 10 singles (including four number ones) and two number one albums to their name. Two of the Girls Aloud, Nicola Roberts and Kimberly Walsh have opposite approaches to sun exposure and to fashion in skin colouring.

Nicola is a natural redhead with beautiful pink skin. It seems she has decided to avoid the sun altogether. Many people in the UK with pale sensitive skins are deficient in vitamin D because scare stories have made them afraid of the sun. Their pale skins have evolved to make maximum use of the little sun we get, but they are at risk of serious diseases if they get none at all. Nicola's friend, Kimberley, was, as the *Daily Mail* put it, the colour of a well-polished Chippendale sideboard. But her tan is so even it looks as if it is a spray-on product which, unfortunately, is likely to prevent much UV reaching the skin. So I fear that both young women may be getting insufficient vitamin D.

Understandably the public is confused because they have been advised over many years to stay in the shade – which is what most of us do all the time anyway working in offices. Now Cancer Research UK is changing its view and is starting to tell people to spend "a few minutes" exposing the face and arms to the sun in the middle of the day[106]. But a few minutes are not enough and baring just face and arms is not enough.

To get good vitamin D levels we need to spend as much time in the sun as we can without burning and expose as much skin as is possible and suitable in the circumstances[1]. It is burning and not simple skin exposure that is most clearly associated with the risk of melanoma.

Reductio ad absurdum – sometimes we can show that a proposition or indeed a policy is false because we can see that it is absurd when taken to its logical conclusion. This is the case with advice to avoid the sun that has been given to us over the years. The unreconstructed advice from cancer charities, still current in 2005, was to put on suncream 20 minutes before leaving the house, wear a shirt with sleeves to cover the arms, trousers to cover legs, and wear a hat.

In this way, with only face and hands exposed a person should, according to this frightening advice, stay in the shade between 11am and 3pm. Favourite

CRUK slogans were: ''Keep your shirt on'' and ''There's no such thing as a healthy tan."

These measures were interpreted by some as meaning that children should be protected by full body suits of reflective white material together with a hat in the French Foreign Legion style with a flap to cover the neck. This type of clothing has emerged from advice given in Australia to avoid exposure to the sun. Australians gave their advice the snappy name SunSmart. The name and the advice was copied here in the UK by Cancer Research UK despite our very great differences in climate.

Such "no-sun" precautions[106a], if followed carefully, could be guaranteed to make a person deficient in vitamin D with a high risk of serious chronic illness in the long term.

Cancer Research UK changed their advice slightly in 2006 (Box 2). Enough to show that they realised their previous advice was unwise, and might lead to lawsuits. But they did not change it enough to make a serious improvement in vitamin D gain from the sun. Cancer Research UK now advises that we SPEND TIME in the shade and AIM to cover up. But CRUK has not announced its change of message and insists: ''We never told people to avoid the sun."

BOX 2:
Darkness at Noon. The Sunsmart policy

Pre-2006	After-2006
● Stay in shade between 11am and 3pm	● Spend time in the shade between 11am and 3pm
● Always cover up	● Aim to cover up with T-shirt, hat
● Then use factor 15 sunscreen	● Then use factor 15+ sunscreen

The new CRUK advice is less dogmatic, but it simply tells people to do what they are likely to be doing anyway, spending time in the shade, as most of us do in offices, homes and other buildings, most days. In fact, people in Britain need to be told to go out into the sun whenever they can and expose as much skin as possible so that they get the maximum amount of vitamin D, while of course taking care not to burn. It makes no sense to expose only hands and face as the Government and Cancer Research UK have advised in the past because that limits the amount of vitamin D it is possible to get.

I have developed some detailed advice which I recommend to replace Cancer Research UK's SunSmart advice. I call it the SunSafe advice (Box 3, on facing page)[1,107] because I believe it safeguards health much more effectively than the SunSmart advice. SunSafe encourages people to enjoy the sun safely while avoiding burning.

Sunbathing can substantially increase a person's gain in vitamin D during the summer putting him or her in the best condition to avoid chronic disease[1]. It may also put a person in a position to survive the winter with fewer, or less virulent, infections. Basically the SunSafe advice tells people in the UK to sunbathe without suncream for a few minutes to an hour or more each day depending on time of day, season, previous exposure and skin type, and to enjoy the sun, but to take care not to burn.

This advice is based on scientific evidence and a thorough appraisal of the scientific literature[1,5]. It has been published in two peer-reviewed articles[1,108]. I have also written two books marshalling the evidence behind this advice and they are available as free downloads from my website[5,14]. The first book, *Sunlight Robbery*, challenged the consensus that we should avoid the sun. The second book was about Scotland's poor health which goes across all social classes and cannot be explained by smoking, drinking, diet or poverty. Scots die on average five to 10 years earlier than English people and I believe that this may be explained in large part by insufficient vitamin D.

Sir Richard Doll and colleagues showed in a clinical trial that vitamin D reduces the risk of fractures. He also found a non-significant but consistent reduction in mortality in those who took it[109]. Sir Richard, who died in 2005 at the age of 92, was sufficiently impressed by these results to take a vitamin D tablet regularly himself, along with a baby aspirin which was another part of his routine. In this, like so many things, he has proved to be a visionary, ahead of his time.

In 2005, I went with Professor Julian Peto to see Sir Richard to talk about vitamin D. One of the memorable things he said was: "This isn't difficult science. We need to have answers." Since then many more answers have been obtained linking vitamin D insufficiency with chronic disease. The basic idea is certainly not difficult, but some of the science, showing for example that disease genes are linked to a vitamin D regulator, has turned out to be anything but simple[58]. Nevertheless, I believe, the complexities would have pleasantly surprised Sir Richard. While this science is difficult, it serves to reassure that the basic thesis is correct: vitamin D has a fundamental role in regulating the genome, in the

BOX 3:
The Sunsafe advice

1. Sunbathe safely without burning – every day if you can.

2. The middle of the day is a good time for sunbathing, especially at the beginning and end of the summer when the sun is too weak at other times of day to form any vitamin D. Also, midday is often the most convenient time to sunbathe.

3. Start by sunbathing for 2-3 minutes each side. Gradually increase from day to day up to 20 or 30 minutes each side depending on your skin and the strength of the sun.

4. Don't use sunscreen while sunbathing because it blocks the UVB rays which make vitamin D.

5. If feeling hot or uncomfortable expose a different area to the sun, cover up with clothing, move into the shade – or use sunscreen if you can't move out of the sun.

6. When abroad, where the sun is generally stronger, stay in the sun for shorter times until you find out from experience how much is safe.

7. When wearing briefer clothes than usual take special care not to overexpose parts that have had little or no sun previously.

8. Children benefit from sun exposure, but need guidance to avoid burning.

9. A tan is natural and is generally associated with good health.

multiplication of cells, and in the physiology of at least half a dozen organ systems.

After reading my first book, *Sunlight Robbery*[5], Sir Richard said to me that he was sure vitamin D was important. But he said that he expected further investigation would show that some of the suspected links between vitamin D insufficiency and disease outlined in my book would prove to be a matter of chance association. I thought he was likely to be right and accumulating evidence would whittle down the links that appeared to exist at that time. But I have been astounded, as this field has grown, to see how many more diseases have been drawn into the net until it seems that vitamin D is an important risk factor not only in many common chronic diseases but perhaps even in most.

Anthony Norman, a leading international expert in vitamin D at the University of California, Riverside, does not miss an opportunity to tell the world about the importance of vitamin D. A vanity number plate on his car proclaims the message: VITMN D. Professor Norman together with Belgian expert, Professor Roger Bouillon, proposes worldwide policy changes in daily vitamin D intake in order to reduce the frequency of many diseases[29]. They suggest a dose of 2000 to 4000 IUs per day for adults.

Professor Norman said that taking such a dose of vitamin D would "increase the quality and longevity of life and significantly reduce the cost of medical care worldwide" and "it could favourably impact multiple sclerosis, type-1 diabetes, tuberculosis, metabolic syndrome, cardiovascular risk factors and most cancers". He added: "It is high time that worldwide vitamin D nutritional policy, now at a crossroads, reflects current scientific knowledge about the vitamin's many benefits and develops a sound vision for the future."

So is vitamin D a panacea – the cure-all of Greek mythology? Or to take a Gothic analogy – is it perhaps a silver bullet? Paul Ehrlich's pioneering work in haematology and immunology was one of the foundations of modern medicine. He discovered Salvarsan, the first drug to provide a cure for syphilis. He called it a magic bullet. In folklore a silver bullet is the only means of killing mythical monsters such as the werewolf. In technology a silver bullet has become a metaphor for a means of curing a major problem. Vitamin D comes into that category. It has an unprecedented effect in reducing the risks of many diseases, and possibly in treating some as well. It would not be right to call it a panacea, but if the clinical trials now in progress produce positive results they will demonstrate that there is nothing comparable to vitamin D in its efficacy in preventing and ameliorating disease. So it may, I believe, earn the title silver bullet.

Summary: The conclusions presented here are based on new scientific findings, theories and ideas, many of which have emerged in the last decade. It has taken time for all these ideas to be brought together in a new synthesis which makes sense of what we know and gains strength because it is broadly consistent. These new ideas include:

● A new model of human evolution: The "out of Africa" hypothesis, which anthropologists have argued about for years, has proved to be correct. We can now be certain that modern human beings evolved in Africa and migrated out of Africa to people the world. The evolution of white skin in Europe is a relatively recent development in the last 20,000 years.

● A new understanding of vitamin D biochemistry: We now know that vitamin D has a role way beyond its classical one concerned with calcium absorption and bone growth. Vitamin D receptors have been found to be present in more than 30 tissues and organs and the active hormone form of vitamin D is known to be produced within a number of organs.

● The optimal requirement of vitamin D is much greater than was generally thought a few years ago. Dosages of 200-400 IUs, based originally on the amount of vitamin D in a teaspoon of cod liver oil, remain the basis of current official advice. We now know from pharmacodynamic and other studies that this advice is out by a factor of about 10. 2000-4000 IUs a day are required for optimal health, more in the case of pregnant and nursing mothers.

● Diet cannot give us enough vitamin D: A healthy balanced diet cannot provide more than about 10% of our optimal vitamin D requirement (taken here to be 3000 IUs per day). For most people diet provides only 5% of the optimal requirement.

● A new model of cancer: Cells fail to adhere when they have insufficient vitamin D and calcium. They proliferate and fail to differentiate fully. These direct effects of vitamin D on cell growth may be as important as mutation for understanding how tumours generally begin.

● A new model of environment/gene interaction: studies of MS show that vitamin D interacts directly with genes to control autoimmune reactions and disease in a way not anticipated by previous ideas about action of genes or vitamins or of nature versus nurture.

● Conclusions from ecological and observational studies over many years: Vitamin D has been identified as a risk factor for some 40 human diseases. Vitamin D insufficiency is a major new issue in public health.

● The impossibility of getting sufficient vitamin D from diet together with evolutionary considerations tell us that sunlight is our natural source of vitamin D. This means that advice to avoid the sun given over many years by cancer charities is wrong. It must be urgently reassessed and new evidence-based advice provided to the public.

We now have important answers which, I believe, would have pleased Sir Richard Doll. The problems are well-defined. Science has shown the way. We know that some 90 per cent of the UK population get too little

vitamin D. We know that this is the likely cause of a wide range of chronic disease – sometimes it is a contributory cause, sometimes it may be the primary cause, and sometimes it may be a unique cause. Much remains to be proved. But we can now be certain that vitamin D insufficiency is an important cause of disease and death in the British Isles.

Much of this vitamin D deficiency disease, estimated to cost the UK billions of pounds annually, is preventable. In 1942 the Government started along the right track with the distribution of cod liver oil to all children. Since then the need for vitamin D has been confused with the strictures of poverty. Tony Blair bleated about the nanny state. NHS infant vitamins were withdrawn. So now, 65 years after a comprehensive wartime policy, we still only have a token programme.

Individuals are of course free to take their own action to improve their vitamin D levels. But government action is needed for maximum improvement in health and for financial savings that will benefit us all. Billions of pounds could be saved and much misery prevented. We know what to do. Smaller countries like the Irish Republic and Finland have begun to take serious measures. So why aren't we doing it in the UK?

What we need to do:

● Make sure that all pregnant and nursing mothers know the value of vitamin D supplements and have access to suitable high dose products.

● Give doctors more information and make suitable ethical products available for them to prescribe for patients with vitamin D deficiency disease.

● Advise all cardiology, diabetes, cancer and arthritis patients, among others, to take vitamin D with the aim of optimising their blood levels. To do this successfully doctors must be prepared to arrange blood tests so that both they and their patients know when the optimum blood level is reached.

● Create new guidelines for the UK recommending doses of 2000-4000 IUs of vitamin D per day for all adults to be taken at least during the eight non-summer months and all year round by those who do not sunbathe. Doses of 400-1000 IUs or more need to be recommended for children under 10.

● Tell the food industry to wake up and make added-value, vitamin-D-fortified, products – and profits.

● Promote SunSafe advice on benefits of sunshine.

● Encourage summer fashions for men and women and school uniforms that allow the baring of arms, shoulders and legs. For example, short sleeves should be encouraged throughout the summer term.

● Make sure children's school playgrounds provide sunshine as well as shade.

● Encourage outdoor sports and games for all ages.

● Preserve parks, playing fields and all outdoor leisure spaces from development. Provide sheltered sunny nooks in parks and in planning new developments.

● Ensure that whenever possible new-build apartments have balconies both front and back to provide sun and shade throughout the day.

● These aims can only be achieved if we all spread the word about the importance of sunshine and vitamin D to friends, colleagues, and those with influence: MPs, doctors, and health authorities: for example, the chief medical officer, the chief pharmacist, those who run the National Health Service including local committees of obstetricians and paediatricians.

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Synopsis: A balanced diet is not enough for good health. Most people obtain only about 5% of the vitamin D they need for optimum health from their diet. And even a diet with extra items rich in vitamin D can provide only about 10% of the optimum level. Only Inuit eating a traditional diet providing fish or marine produce such as seal or whale at every meal can get near to an optimum supply of vitamin D from diet. The rest of us living in the British Isles, where cloud frequently obscures the sun and the summer season is short, should for optimum health take a vitamin D supplement (3,000 to 5,000 IUs per day for adults). Few of us have enough time or opportunity, but we may obtain sufficient vitamin D if we make sure to sunbathe whenever possible wearing as few clothes as possible and then take a supplement in winter. Provided care is taken not to burn, the risk of skin cancer from sunbathing is minimal. Scientific evidence suggests that blood levels of vitamin D above 80 to 100 nmols/l may be achieved by such measures and that these levels will provide protection against numerous diseases including: diabetes, heart disease, raised blood pressure, certain cancers, arthritis and a number of autoimmune diseases including: Crohn's and lupus erythematosus, as well as the classic bone diseases of rickets, osteomalacia and osteoporosis, and the fractures that may result from weak bones. Government advice on vitamin D and sun exposure needs a full revision so that it is based on scientific evidence. New advice and provision of vitamin D supplements for all pregnant women and babies are urgently needed because experts now accept that multiple sclerosis, diabetes type 1, and possibly other diseases, are caused by insufficient vitamin D during pregnancy and early life.

Biographical note: Oliver Gillie is a scientist and writer. He obtained BSc and PhD degrees in biological sciences and genetics from Edinburgh University and then went to work at the National Institute for Medical Research, Mill Hill. He was medical correspondent of The Sunday Times for 14 years and joined The Independent as health editor when it was launched. He started The Independent's Health Page which was an immediate success and was copied by all the other national quality dailies. He has won 17 awards for his scientific and medical writing in national newspapers. His work over the last seven years has been to pass on information about vitamin D insufficiency to scientists, doctors, and journalists and to lobby government and organisations such as Cancer Research UK for a rational evidence-based public health policy on sunlight and vitamin D. He is collaborating with Professor Julian Peto, of the London School of Hygiene and Tropical Medicine, in the development of scientific trials of vitamin D. He is an associate editor of the Journal of Public Health Nutrition and vice chairman of the Caroline Walker Trust. In 2009 he was elected health champion of the year by the Medical Journalists' Association for his campaign to inform the public and professionals about vitamin D insufficiency diseases.

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