

Transcript of interview with Professor Tony McMichael

Voice-over: Welcome to the National Health and Medical Research Council podcast series, a conversation with some of the great minds and leaders in Australian medical research. The NHMRC is Australia's leading funding body for health and medical research. We provide the government, health professionals and the community with expert and independent advice on a range of issues that directly affect the health and wellbeing of Australians.

Interviewer: Professor Tony McMichael is an NHMRC fellow, and he is also a professor at the Australian National University within the National Centre for Epidemiology and Population Health. He's led the development of a program of epidemiological research on the environmental and genetic influences on immune disorders, with a particular focus on autoimmune diseases such as multiple sclerosis, and he's continued his pioneering research into the health risks of global climate change. This was developed in conjunction with his leadership of the assessment of health risks for the recently released United Nations Intergovernmental Panel on Climate Change and as part of that report he shared, along with many other co-authors, part of the 2007 Nobel Prize. Tony, thanks for joining us today on this NHMRC podcast.

Prof. McMichael: That's a pleasure.

Interviewer: Tony, I wonder if we could start with a bit of a macro view of the issue. Climate change is on everybody's lips at the moment and at the forefront of our minds. But we don't often think about the effect of climate change and the potential this has on the emergence of infectious diseases. So could you just give us a picture of what the problem is that you see emerging.

Prof. McMichael: Well, I think the basic problem, that you've alluded to already, is that we really haven't got the full measure of what the significance, the impacts, of climate change, and indeed the various other global environment changes of which climate change is just part of the syndrome. We haven't got the measure of what they really signify. We've been fretting about the impact on the economy, disruption of economic activity, loss of jobs in some sectors. We worry about the threat to tourism, to physical infrastructure, to iconic species, and those things are all important.

But I think what we haven't done is to realise that now that we've started to disrupt the world's climate system and very many other of the great natural systems that are this planet's life support system, we are actually beginning to change the conditions of life on earth. And that's a big deal. That's what I would regard as the most important aspect of the climate change story. And we're just now starting to realise that as we begin to see that in addition to all the other impacts that climate change has already begun to have, we can see effects on human wellbeing, human health, in some parts of the world, and we're expecting that there'll be many more in the future. It includes infectious diseases as an important part of the story, but it's only part. There will be a whole range of adverse health effects.

Interviewer: You were part of the latest report from the Intergovernmental Panel on Climate Change. And what was the statement in there about this particular area?

Prof. McMichael: Well, the evidence has been stiffening up over the last decade as slowly an increasing number of epidemiologists and others have begun to engage in this question of how

might climate change affect patterns of health and disease around the world. So this time around, this was the fourth five-year cycle of the Intergovernmental Panel on Climate Change, the evidence was much broader and much stronger than it had been when I first got involved in the early 1990s when the story was really a new one and, indeed, one that wasn't much on the radar scheme for science at large, it was really the province of just a few marginal epidemiologists, who had a sense that this was going to become an important story. So we're now much more confident that we are beginning to get the measure of the risks to human health, but we also are beginning to realise that in addition to trying to model the ways in which future climate change would affect patterns of disease around the world that in fact it's already beginning to happen in some parts of the world and we've got to work among ourselves as researchers, but work with government, with policy makers, to develop risk lessening strategies, what we call adaptive strategies.

Interviewer: Now it comes to mind that a couple of examples might be something like malaria. I would imagine with climate change we could disrupt the areas, or widen the areas even, where malaria is a real issue. Have you any comment on that?

Prof. McMichael: Yes. The infectious diseases that are spread by mosquitoes and other little creatures like ticks, midges, they're very sensitive to climatic conditions, and not surprisingly one of the major concerns is that malaria, as a mosquito-borne disease, and dengue fever, which is another mosquito-borne viral disease, which are already huge public health problems in many parts of the world, will increase their geographic range and their seasonality. And there's some evidence that that's beginning to happen in some parts of the world, and it's not surprising. This is what we were predicting 10 years ago, and I think we're now starting to see some of this at the margins with some of these vector-borne infectious diseases.

Interviewer: What are those areas that you've referred to?

Prof. McMichael: Well, there is evidence in the highlands of eastern Africa that malaria has begun to move to higher altitude. There is evidence in Scandinavia that a tick-borne viral disease called tick-borne encephalitis has been moving progressively further north as the winters, which are the critical time for the development of the tick as the vector for this disease, those winters have been getting warmer. We've had a report in the last couple of years that schistosomiasis, which is an infectious disease spread by water snails, has been moving north in the region just north of Shanghai in association with warming in that eastern part of China. So there are quite a few bits of suggestive evidence now that some of these infectious diseases are beginning to respond to the change in the world's climate.

Interviewer: And there have been reports over the years that dengue could have a greater impact in Australia and move down the eastern coast?

Prof. McMichael: Yes, dengue, a mosquito-borne viral infection, has become increasingly a worry at large within the world, because it has been spreading in recent decades. It was previously confined pretty much within parts of Asia and a small part of central America. But it has been spreading widely, particularly in the south Asian and the South-East Asian region over the last couple of decades. Now it's very probable that the warming that's been going on and the increased rainfall and intensity of rainfall in some parts of those regions has contributed to this, but, of course, it's a mixed picture and this is something that we as epidemiologists always have to be alert to.

There are many things that will influence a disease like this, such as people movement, urbanisation patterns, patterns of trade - some of the mosquitoes are clever enough to lay their eggs in shipping containers and used tyres and things that get transported across the oceans. We've changed some of our public health practices. There's been a relaxation of mosquito spraying programs in some countries. All of these things have probably contributed to this rather worrying and marked spread of dengue in recent times. But we think that climate change is already contributed to that and will do so increasingly in future and in Australia our concern is that whilst it's been pretty much confined in the north of Queensland over recent decades, that as conditions get warmer and as rainfall increases down the eastern and the western coasts, that this disease will be able to spread further south in Australia.

Interviewer: Now clearly governments all around the world are concerned and they need to have a response to these emerging issues. What's your take on what governments are trying to do in terms of preparedness scenarios for the emergence of these particular problems?

Prof. McMichael: Well, I should say at the outset that of course the problem is rather wider than infectious diseases. They capture a lot of our attention and we know that they're sensitive to climate. And it includes mundane things like food poisoning, salmonella food poisoning, also very temperature sensitive, and which we would expect to increase, particularly in poorer and more remote parts of this country. But we're also talking about the effect of increasing frequency and intensity of heatwaves and extreme weather events. We're talking about the effect of climate change on our fresh water supplies in this country, how that's going to continue to do damage to our rural sector, our food production. We know that the disruption of productive life in some parts of rural Australia is exacerbating mental health problems. There's always the tragedy of suicide lurking in the background as farmers lose livelihoods and families get displaced. So it's a pretty wide spectrum of risks to health that we have to be concerned about.

I think it would be fair to say that up until pretty recently our governments in this country and elsewhere have been slow to realise that this is an important part of the story. There's been an undue preoccupation with protecting local economies and not enough recognition that we now face actually a threat to our wellbeing, to our health, and in some parts of the world to our survival. And I must say in this part of the world there is also increasing concern in the background that the effects of climate change, along with population pressures and depletion of fresh water aquifers, exhaustion of agricultural soils, depletion of ocean fisheries, that all of these things will add up to severe food shortages, fresh water shortages, in the region around us, causing destabilisation, most probably, increased flow of environmental refugees. It could lead to lots of tensions and conflicts. And that, of course, inevitably has a range of adverse health consequences. So, you know, it's a big picture and governments really need to get serious about understanding that climate change carries huge risks increasingly over the coming decades to wellbeing and health of human populations.

Interviewer: And, of course, these changed conditions could also lead to the emergence of more virulent forms of disease in animals, which could potentially cross into the human population?

Prof. McMichael: Yes, the story gets increasingly complex as we think about all those possibilities, but certainly there is evidence in Europe very recently that the blue tongue virus has been spreading north in association --

Interviewer: What does that do?

Prof. McMichael: Well, that causes disease in livestock, sheep and cattle. It's a very serious infection and one that we're always on our guard for in this country. We've managed to keep it out. It's a devastating disease. It's been spreading north in Europe affecting livestock there as the midge population that spreads the virus has been moving north with warmer conditions. So, yes, there are many ways in which infections in animals and, indeed, infections in plant crops will also respond to changing climatic conditions, and that has consequences for human wellbeing, human health, via effects on livelihood, also via the possibility of an increased risk of what we call zoonotic infections, new infections that can spread from animal sources into the human population - such as has happened, of course, in the last few years with things like SARS, the severe acute respiratory syndrome, in the Asian region, and this emergence of the more virulent form of bird flu H5-N1, most probably due to intensive production methods. But remember the wild bird populations that spread this sort of virus are beginning to change some of their migration patterns in response to changing climatic conditions.

Interviewer: And isn't that what we saw with that last outbreak of the avian influenza virus, that it quickly - a lot of those birds moved, more migrated into Europe, and we started to see pockets of that emerge in Europe?

Prof. McMichael: Yes, it spread right around the world. In fact, some of those bird populations carrying the virus ultimately extended down into northern Africa and I think there were concerns that some might have been on the way, or indeed have arrived in the southern parts of sub-Saharan Africa. So it was very widespread throughout the great Eurasian continent by bird populations, and changes in climatic conditions and in other great environmental conditions that include our management or mismanagement of forests and wetlands, coastal ecosystems, river systems, all of these things affect bird life and patterns of bird breeding and bird migration.

Interviewer: There was recently a report of a less virulent form of Ebola which has been emerging. Some people might say a less virulent form is good news. In fact, it's just the opposite, because less virulent forms can transmit more rapidly through populations and have a wider distribution area?

Prof. McMichael: Yes, this is a complex relationship between infectivity and virulence and, of course, it's in the interests of the bacteria, or the virus, to find the right balance between infectivity and virulence, the capacity to cause serious biological damage, to get the right balance to that it actually can infect somebody, but also has the best chance of being passed on to another person, because these infectious agents, they have no malicious intent, they're doing what we all do on earth, they're trying to optimise their chances of survival and reproduction. And in the case of something like Ebola virus it can be a disadvantage, depending on the density of population in which it's operating, but it can be a disadvantage if you kill your infected human host too quickly before that person has had a chance to pass the virus on to another person.

Interviewer: And that's the same with the influenza virus, the avian influenza virus, which was a quite virulent virus and probably didn't spread initially beyond those little pockets where it was first found?

Prof. McMichael: Yes, and in that sense the virus might have got it wrong by being too virulent for its own good.

Interviewer: But they can change so quickly, viruses, as we know, and the big concern is that it will change and the human could become the host?

Prof. McMichael: Yes, we talk about it perhaps in words that imply it's a deliberate policy on the part of the virus when we say it can change. Of course, what it's doing is just responding via Darwinian evolution to those old imperatives, that those strains that can survive longest and reproduce best will be the ones that are then passing on their genes to future generations of bacteria or viruses.

Interviewer: Now your research here at the National Centre for Epidemiology and Population Health is broader than the area that we've just talked about and there are other research programs that you've had in place for a long time, but linking back to the environment, so you're looking at influences on immune disorders, autoimmune diseases such as multiple sclerosis. Could you talk a little bit more about some of those research programs and what we're learning about the environmental impacts on these particular, I guess, disorders?

Prof. McMichael: Well, I think an interesting general observation is that research into environmental influences on rates of disease in populations has been a bit of a Cinderella area for a number of decades. In my trade, epidemiology, most of the focus of activity, most of the excitement in the last few decades has been, really, on trying to understand how differences in individual behaviours - cigarette smoking, alcohol consumption, use of oral contraceptives, dietary practices, whether you wear seatbelts or not - how those things translate at the individual level into greater or lesser risk of disease occurrence. In the background, of course, we've got these broader influences via things like air pollution or levels of heavy metals or pesticides in our drinking water or our food supplies that exert influences that create risks for whole communities, whole populations. That's not so easy to study, and fewer epidemiologists have applied themselves in that area, unfortunately, because it's my view that in the long run it's those larger-scale influences that impinge on whole communities, whole populations, that are really important in determining the prospects for future health, in determining changes in rates of disease over time.

I must say that it's over the last couple of decades with the emergence of these larger-scale environmental changes, quite unusual in their scale and type, things like climate change and the disruption of ecosystems and the depletion of food producing resources and so on, the emergence of those things has really helped to refocus our minds on the importance of thinking about the environmental influences on human health. So that my work on climate change now is in that sense an extension of my earlier interests in studying the effects of environmental lead exposure in a very large lead smelting community in South Australia, Port Pirie, on the early intellectual development of young children; in studying the effects of radioactive exposures in uranium miners to risks of lung cancer in the miners from Radium Hill in South Australia; and more recently in looking at the ways in which patterns of exposure to sunlight, ultraviolet radiation from the sun, actually influence a number of immune-related disorders. Interestingly one of the things ultraviolet radiation does is actually suppress, to dampen down, immune system activity, so that that can be both detrimental and beneficial. It can be detrimental, of course, in that it could reduce the effectiveness of vaccination programs by having a lazier immune system that doesn't respond so well because it's been damped down by exposure to sunlight.

Interviewer: Are you saying that Queenslanders are more immune lazy than, say, Tasmanians?

Prof. McMichael: Yes, and that's actually something that underlies some work that we're doing at the moment, looking at this very interesting geographic gradient for a serious disease, multiple sclerosis, where historically the record shows that the rates have been about five or six times higher in Tasmania than they have been in Queensland, with intermediate rates in between as you move up and down the eastern coast. Our hypothesis is that this reflects the differences in

average levels of ultraviolet radiation exposure and that in Queensland, because there's more exposure to sunlight, ultraviolet radiation, the immune system activity is lower, lazier, as we said, in Queenslanders than in Tasmania. And that's a good thing when it comes to the autoimmune diseases where the body's immune system mistakenly attacks some of the body's own tissues, so if your immune system has been dampened down, then there'll be a lesser level of that misdirected attack.

Interviewer: Is there a similar pattern in the northern hemisphere?

Prof. McMichael: Yes, there is. It's been well observed in Europe that again the autoimmune diseases like multiple sclerosis, rheumatoid arthritis, type 1 diabetes in children, the rates all increase again as you move away from the equator, move to higher latitudes. So in the northern hemisphere the rates, of course, get higher as you move north. In Australia, the rates get higher as we move south. So, yes, it's a constant pattern. But the interesting thing about Australia is that it provides a much more homogeneous background environment in which to study these things. Once you get into Europe, of course you're dealing with very different cultures across the landscape as you move from south to north and differences in ethnicity, differences in the cultural and genetic origins of those populations, so it's a much noisier system and much easier to study.

Interviewer: How do you filter out in your studies the conflicting issues of lifestyle, which must interfere, must give you background noise? I was thinking of diabetes linked with obesity, for example?

Prof. McMichael: Well, we like to think that we're good at anticipating that problem, as epidemiologists. In fact, we like to think that that's what makes epidemiology such a challenging form of research. One might say it's relatively easy to do a controlled experiment in a laboratory with 100 rats, divide them into two groups and apply substances A and B, but hold everything else constant and then look for a difference in outcome. We mostly can't do that in epidemiology. We're working in the real world. There is a lot of that background noise. We have to understand what, in addition to sunlight, might be affecting the risk of multiple sclerosis in this study that we're doing, and therefore measure those things, and that includes differences in diet, which could influence that disease process, differences in childhood infectious disease experiences, which tend to influence the early development of the immune system, which then would have effects on autoimmune diseases. So in our study we're measuring all of those things in addition to our prime interest in the environmental exposure of ultraviolet radiation.

Interviewer: How would your findings translate into some sort of preventative measure for a disease like multiple sclerosis?

Prof. McMichael: Well, that's a challenging question, because clearly we're not going to want to move into a world in which we are advising people to spend as much time out in the sun as possible in order to damp down their immune activity and reduce their risks of multiple sclerosis, because we know that that presents an increased risk of skin cancer, and that's a serious issue, particularly in Australia. So really it's a matter of getting the balance right. We need to understand on a risk-benefit analysis where the optimum exposure level might be and how that might vary across different stages of life. We're particularly interested to try and understand how vitamin D - which, of course, is directly influenced by our exposure to ultraviolet radiation - might be an important mediating factor for risks of sunlight-related disease. That might then provide us with an opportunity to modulate the risks of these diseases not by changing the

amount of time we spend in the sun, but by changing the levels of vitamin D in our bloodstream, which we can do via other dietary means, for example.

Interviewer: This past year you were awarded an Australian Fellowship from the NHMRC. What does that mean for you and what is the work that you're going to continue doing?

Prof. McMichael: Well, the first thing it means, of course, is it provides a wonderful opportunity for me to think within a five-year time frame in the first instance, because I have funding for that period, and it's very generous funding, so it's an opportunity to develop a full-blown program of research, particularly around the topic of climate change and human health. I must say the timing is also quite auspicious.

Just within this past 12 months we've seen really an upturn, a very dramatic upturn, in awareness that climate change and health is an important research issue. We're now starting to see governments, and particularly health departments, responding to this. It's surprising that within the last 12 months there have been just so many workshops, conferences, consultations, on this topic at the state, national and international levels. So the timing is very good from my point of view.

What I'm in the process of doing now is recruiting a research team, developing this program, so we can engage not just within Australia, where our primary focus is, but also within the region at large begin to engage more with Asian and Pacific countries in developing a better understanding and making better use of comparative data from populations in different geographic and climatic circumstances, to get a better understanding of the risks that exist and a better capacity to model those risks, to understand how the disease patterns could change in future. Out of all of that, of course, to begin to work increasingly with government in the development of appropriate adaptive strategies to lessen risks to populations.

Interviewer: It's quite an exciting time for epidemiology, because we interviewed on this series recently John Hopper, in Melbourne, and we discussed the comment about being an epidemiologist you're often looking backwards. But in fact you're going to be looking backwards and forward at the same time, so this is almost like a new dimension.

Prof. McMichael: It is. It's quite challenging in that respect, in that very often when you're dealing with environmental health problems the agenda really is to understand from recent experience what the health risks have been and then to take appropriate action to eliminate that exposure. Now for something like climate change, of course, we can't realistically talk about eliminating the exposure, no matter what we do - and we now understand this better than we did five or 10 years ago. No matter what we do, climate change is going to continue for the next few decades and I must say on current appearances and the difficulties national governments around the world are having in achieving a radical and progressive way of curtailing the problem, that it's going to escalate foreseeably for a number of decades. So this is really an unusual challenge for epidemiologists to have to engage not just in studying the world as it is around us at the moment, but trying to work with mathematicians, modellers, climate scientists and others, social scientists, to try and foresee the ways in which these risks will play out and to develop strategies for lessening those risks.

Interviewer: What inspired you to start on a research career? I note that you initially did a medical degree?

Prof. McMichael: Yes.

Interviewer: And I'm not sure whether you've ever practised medicine?

Prof. McMichael: I didn't practise it for very long, because I got caught up in the hurly-burly of student politics, and I moved to being the full-time president of the National Union of Australian University Students in the year after I graduated in medicine. I did do some general practice in Victoria for a couple of years, but then I moved to Monash University to do a PhD in the newly created Department of Social and Preventive Medicine. And it was during that time, actually, that I began to read some quite stimulating and ground-breaking works in the area of environment and the consequences for human societies. I particularly remember a book by Paul and Anne Ehrlich on population resources and environment, published in about 1970, I think. And I had a friend who was editing a new newspaper - his name was Richard Walsh; he was editing *Nation Review*. I offered to do a review of the book in that newspaper. He liked it and said, 'Would you like to write a regular column?' So then, whilst finishing my PhD, I wrote a column called 'Spaceship Earth' for the next couple of years, a weekly column.

Interviewer: And it was on?

Prof. McMichael: Well, it was really on environmental issues, the spaceship earth notion that we live within this closed system, this little planet, and the damage that we do to the environment around us will have ways of coming back to bite us, and particularly as the scale of that damage begins to increase we will start to see systemic changes on a larger scale that would have wider ranging consequences for human health both now and into the future. And I suppose the climate change story which I started to notice about 15 years later, in the mid 1980s, was really an extension of that longstanding interest. And I saw it coming over the horizon and I thought this is, firstly, very interesting, I must find out about it, but secondly this looks to me as if it's going to have very important consequences for human health. So I got involved in reading about it. I remember when I was president of the Public Health Association of Australia in the late 1980s I actually concentrated on it in my presidential address and said we need to take notice of this. Not many people did at that stage. But in the subsequent decade or two, it's really come clearly on to the agenda. And now it's fair square on the agenda and I'm hoping to really carry it forward with this new program of work.

Interviewer: Of course, there was that marvellous book that was published by the author Laurie Garrett in 1994 called *The Coming Plague*, which was picked up by the media and, I think for the first time - it seemed to be a very well-researched book, and for the first time the public really started to hear about this confluence of climate change, environmental change and potentially the emerging disease issues. I think it was probably one of the key triggers, I think, in trying to raise public awareness.

Prof. McMichael: It was; it was very effective. She's a very racy writer, of course, that American style with lots of personal anecdote, very colourful. But it was very timely.

Interviewer: That's what you need to engage the public.

Prof. McMichael: It is, yes. And it was very timely because we'd been through a few decades in the late '60s, '70s, into the early '80s, when we had the misplaced view that we'd conquered infectious disease and now we only needed to concentrate on the non-infectious diseases like heart disease and cancer and so on. But then in the late '70s and throughout the '80s, there was a surprising increase in what appeared to be newly identified infectious diseases in human populations in many parts of the world and I think Laurie Garrett picked that up early and thought, 'This is pretty important. We are changing the ways that we live, the ways that we

disrupt the environment, patterns of interaction between human populations internationally, such that risks of infectious diseases are increasing now on quite a wide front and we see climate change coming over the horizon and that's going to add to the disruptive processes.' So she said, 'We face a world of coming plagues.'

Interviewer: And we've seen signs of that already?

Prof. McMichael: Well, certainly there's been a continuing increase in the identification of many previously non-existent or unidentified infectious diseases in human populations and, of course, sadly we've seen the resurgence of a number of old infectious disease scourges - malaria, tuberculosis, dengue fever, longstanding problems, but they've all been on the increase in recent times and probably reflecting the sorts of large-scale influences that Laurie Garrett was talking about.

Interviewer: It seems like a great time to think about a career for younger people in the area of epidemiology. It doesn't matter what their background is - if you're a mathematician, as you say, or a computer modeller, or interested in the environment, this would be a great time to get into the game. Any advice to any younger people who are trying to think about what they could do in the future and why should they become an epidemiologist?

Prof. McMichael: Well, I think the first advice is don't be fainthearted. You don't have to imagine that you've got to have a lot of specialist skills. This is an area in which we're all learning. I've had to pick up ideas, information, from a range of disciplines in the last decade - climate scientists, oceanographers, ecologists. I've been listening to them all and reading their stuff. I didn't have specialised skills in those areas, but I've learnt enough to be able to integrate it now with my epidemiological research and to know with whom I should collaborate. I mean, this is an area in which we need multidisciplinary collaboration. So young people shouldn't imagine that they're entering a terrifying world of science in which they're going to be solely responsible for carrying out research. It'll be a team effort and it'll be good fun and it will be very important.

It's interesting for me to see that there's now quite an upsurge in inquiries that my group is receiving from young people wanting to come on and do PhDs. We weren't getting this five years ago. But I think a number of young people can now see that this is not just a scientifically interesting and challenging area, but this is actually something that has enormous social relevance, enormous consequences for human futures, including the futures of themselves as young people and the families that they might have in future. So there's concern, there's engagement, and there's going to be enormous opportunity. These problems are going to escalate, unfortunately, for the next few decades. We're seriously understaffed. We need a lot more young people coming in to work in the area. So I'd encourage anyone with an inkling of interest in this area to get into it. We need them and they would be doing something very interesting and hugely important.

Interviewer: On that upbeat note I thank you very much for your time and wish you well with your Australian Fellowship. It sounds like you're going to enjoy it. And all the best for the future.

Prof. McMichael: Thank you very much. It's going to be a challenging five years, but it's timely and I think we're going to do some good and important work.

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