BJSM Online First, published on January 21, 2018 as 10.1136/bjsports-2017-098497

Statin wars: have we been misled about the evidence? A narrative review

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Accepted 14 December 2017

ABSTRACT

Statins are the most widely prescribed, cholesterol-lowering drugs in the world. Despite the expiration of their patents, revenue for statins is expected to rise, with total sales on track to reach an estimated US$1 trillion by 2020. A bitter dispute has erupted among doctors over suggestions that statins should be prescribed to millions of healthy people at low risk of heart disease. There are concerns that the benefits have been exaggerated and the risks have been underplayed. Also, the raw data on the efficacy and safety of statins are being kept secret and have not been subjected to scrutiny by other scientists. This lack of transparency has led to an erosion of public confidence. Doctors and patients are being misled about the true benefits and harms of statins, and it is now a matter of urgency that the raw data from the clinical trials are released.

STATIN WARS: HAVE WE BEEN MISLED ABOUT THE EVIDENCE?

Since their introduction in the late 1980s, statins have been an immensely lucrative drug class, with Pfizer's Lipitor being the most profitable drug in the history of medicine.

Despite the expiration of their patents, revenue for statins is expected to rise, with total sales on track to reach an estimated US$1 trillion by 2020.[1]

Statins have now cemented their place in cardiovascular medicine. They are effective at lowering cholesterol and therefore perceived to be the most valuable tool in the prevention of heart disease. But the scientific data have not convinced everyone.

Proponents have described them as one of '*the most important advances in medical history and have prevented untold heart attacks and strokes*'.[2] Yet other cardiologists say statins '*serve no purpose in lowering cholesterol to prevent cardiac problems*' and even labelled them '*unnecessary and toxic*', pointing out the methodological flaws contained within the early statin trials.[3 4]

Now, a chasm has formed between doctors who prescribe statins with unbridled enthusiasm and those who remain unconvinced by the science. Have doctors and patients been misled about the benefits and risks of statins?

THE RISE AND RISE OF STATINS

Statins (*HMG-CoA reductase inhibitors*) were initially recommended for people with existing heart disease (secondary prevention), but manufacturers quickly sought to increase the indications of the drug and capture a larger piece of the market share. The next target population was healthy-people (primary prevention).

An effective way to mandate wider drug prescribing is to exert influence on the committees in charge of formulating the medical guidelines. In the early 2000s, the US National Cholesterol Education Program (NCEP) revised the definition of 'high cholesterol' by dramatically lowering the threshold.[5] Virtually overnight, it meant that millions more people would be eligible for statins. It was not based on any new scientific data but rather the increasingly popular notion that 'less is best' when it came to cholesterol.

The decisive move sparked a furore when it was revealed that eight out of nine members of the 2004 NCEP guideline committee had direct financial ties to statin manufacturers.[6] But it was too late. The ink had already dried and the new guidelines were being widely enforced.

Meanwhile, prominent researchers at Oxford University formed an alliance called the Cholesterol Treatment Trialists' (CTT) Collaboration. Spearheaded by Sir Professor Rory Collins, this group of researchers began periodically publishing their own reviews of the statin data from clinical trials. The reviews were dogmatic about advocating wider use of statins in healthy people (primary prevention).[7] An accompanying editorial argued that 'everyone over 50' should be taking a statin, regardless of their cholesterol levels,[8] and if implemented in the USA would lead to 64 million people, more than half of the population over the age of 35, starting statin therapy.

One prominent cardiologist even published an article in the *American Journal of Cardiology* stating that statins should be offered as condiments at burger outlets, with the suggestion that statins could 'cancel out' the unhealthy effects of the meal.[9]

Soon, doctors began to recommend screening children and infants for high cholesterol to identify potential statin recipients, as well as marketing to kids with 'grape-flavoured chewable' statins.[10–12] There was even a debate in the USA about putting statins in the water supply.

In 2013, the American College of Cardiologists (ACC) and the American Heart Association (AHA) updated their guidelines to recommend that statins be prescribed to patients based on their cardiovascular risk (7.5% over 10 years).[13] Again, serious concerns were raised about the financial conflicts of committee members and the fact that millions more adults would be eligible for statin therapy, most of whom were older people without cardiovascular disease.[14 15] It was referred to as the '*statinisation*' of the population.[1]

Shortly after, the UK's National Institute for Health and Care Excellence (NICE) announced it planned to halve the risk threshold for prescribing

To cite: Demasi M. *Br J Sports Med* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/bjsports-2017-098497

statins (from 20% to 10% over 10 years).[16] Doctors vigorously objected to the changes. A UK survey revealed that two-thirds of general practitioners would be disregarding the advice to offer statins to people at the newly proposed threshold of 10% on the grounds that it was '*not evidence-based*' and could lead to the '*medicalisation of healthy people at the cost of more needy, unwell patients*'.[17] Scepticism was inevitable once it was revealed that 8 out of the 12 panel members at NICE had financial ties to manufacturers of cholesterol-lowering drugs.[18]

Then, evidence emerged that the 'calculators' used to assess atherosclerotic cardiovascular risk were inaccurate. One study examined five risk calculators and demonstrated that four, including the new AHA-ACC risk calculator, showed the overestimation of risk could be as high as 115%, leading to legitimate concerns about the undisciplined overprescription of statins.[19]

Doctors are now seeing the effects of a phenomenon called 'diagnosis creep', whereby simply changing the definition of a disease or lowering the threshold of a surrogate marker turns healthy people into patients and leads to overdiagnosis and unnecessary treatments.

IF THE DATA ARE HIDDEN, CAN WE EVEN HAVE A DEBATE?

Science prides itself on informed debate, but is that even possible if the data are hidden?

Much has been made about the fact that the raw data from statin trials are only available to a single group of researchers—the CTT Collaboration—and they have agreed to keep the data in confidence and will not share anonymised data with independent researchers. This is one of the most contemptible breaches in transparency. Neither the doctors prescribing statins nor the millions of people taking these medications have had access to independent analysis of the efficacy data. In addition, the side effect data were simply not collected in the vast majority of trials.

When asked in 2013, the CTT confirmed that it would not allow other scientists to access the raw statin data to conduct an independent analysis. They wrote:

> The CTT secretariat has agreement with the principal investigators of the trials and, in those instances where trial data were provided directly by the drug manufacturers, with the companies themselves, that individual trial data will not be released to third parties. Such an agreement was necessary in order that analyses of the totality of the available trial data could be conducted by the CTT Collaboration: without such an agreement the trial data could not have been brought together for systematic analysis.

Alarmingly, the widely influential analyses of the CTT Collaboration cannot be verified by independent researchers because most, if not all, of the principal investigators of the individual studies have not agreed to make their data available. Hence, the rest of us are supposed to have faith in the interpretation of the science by this select group of scientists without seeing it for ourselves.

Not even the Cochrane Collaboration had access to the patient-level data when conducting its review of statins in low-risk people,[20] and its conclusions ultimately influenced the prescribing guidelines.

Dr Fiona Godlee, Editor in Chief of the *BMJ*, has called for the release of the raw data into the side effects of statins and has described the discourse as '*a bitter and increasingly unproductive dispute*' because the data for harms have not yet been given the same level of scrutiny as the data for benefits.[21 22] As in the case of the hidden data on Tamiflu, independent scrutiny of individual patient data uncovered new and revealing facts about the benefits and harms of the medications.[23]

EROSION OF PUBLIC CONFIDENCE

The discernible lack of scrutiny surrounding statin side effects has eroded the public's confidence.

In 2015, Professor Collins made a public admission to the media that he had not seen the full data set on statin side effects, despite repeatedly protesting that statins had few troubling side effects like muscle weakness in 1 in 10 000 people.[24]

Several studies have now linked statins to a small but significant increase in type 2 diabetes, leading to a safety label change on statins by the Food and Drug Administration and has sparked multimillion dollar class actions against the statin manufacturers.[25 26]

It is now a matter of urgency that the CTT Collaboration, a branch of the Clinical Trial Service Unit (CTSU) at Oxford, demands that the principal investigators of the statin trials release the raw data on efficacy and side effects. There is growing unease that the CTSU has received over £260 million in research funding from the pharmaceutical industry, the vast majority of it, from manufacturers of cholesterol-lowering drugs.

There has been an over-reliance on the results of studies, which have been funded by industry. A recent Cochrane review showed that sponsorship of drug trials by the manufacturing company leads to more favourable results and conclusions than sponsorship by other sources.[27] In the case of statins, the vast majority of trials are sponsored by industry. Only one major non-industry-funded study on statins has been done (Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT)), which showed pravastatin had no significant benefit in reducing either all-cause mortality or coronary heart disease in primary prevention.[28]

The problem of industry bias has become so serious that Britain's Chief Medical Officer expressed her concerns to the Academy of Medical Sciences. In the letter, Dame Sally Davies wrote:

> There seems to be a view that doctors over-medicate so it is difficult to trust them, and that clinical scientists are all beset by conflicts of interest from industry funding and are therefore untrustworthy too. I have, therefore, reluctantly come to the conclusion that we do need an authoritative independent report looking at how society should judge the safety and efficacy of drugs as an intervention.

If the public demands that scientists declare their conflicts of interest in order to restore confidence, then so should medical journals.

Former Editor in Chief of *The New England Journal of Medicine*, Dr Marcia Angell, famously said,

> "It is simply no longer possible to believe much of the clinical research that is published, or to rely on the judgment of trusted physicians or authoritative medical guidelines. I take no pleasure in this conclusion, which I reached slowly and reluctantly over my two decades as an editor of The New England Journal of Medicine."

In a recent US interview, Dr Angell explained that she began working for the journal in 1979.

> Starting about then, was when you began to see the drug companies assert more power. Over the next couple of decades, they began to treat the researchers as hired hands. They would design the research themselves - you can do a lot of mischief in how you design a trial. Or [they'd say] we'll test this drug and we'll tell you whether it can be published or not, and so if it's a positive study it's published and if it's a negative study, it's not.

In a welcome step towards financial transparency of medical journals, *BMJ*'s Executive Committee has recently approved a proposal to publicly disclose revenues received from

industry sources including the pharmaceutical and devices industries.[29]

SCARE CAMPAIGNS AND CENSORSHIP

Those who publicly challenge the overprescription or side effects of statins in the media are castigated and blamed for undermining public health initiatives. They are compared with reviled groups like 'anti-vaxxers'. In a public statement to the press, Professor Collins said those who spoke out about statin side effects were "*far worse*" and had probably "*killed more people*" than "*the paper on the MMR vaccine*."[30]

A recent article published in *The Lancet* by Professor Rory Collins and colleagues boldly claimed to 'end' the statin debate, once and for all, ostensibly to silence dissenting views.[31] The authors blamed 'media hype' for people allegedly dumping their statin therapy. However, prior to the widespread media coverage, the largest known statin usage survey conducted in the USA found that 75% of new statin users discontinued their therapy by the end of the first year, with 62% of them saying it was because of the side effects.[32]

BMJ's Editor in Chief, Dr Fiona Godlee, was critical of *The Lancet* review, accusing the authors of trying to '*shut down the discussion and award themselves the final word*'.[22] Instead, she rightly drew attention to legitimate questions about the benefit of statins in people at low risk of heart disease, especially given the discrepancy over side effects documented in the clinical trials (reported to be negligible) compared with real-world data.

I have also been criticised for questioning the overprescription of statins for healthy people. A documentary I produced was labelled 'biased' because it gave prominence to the views of University of California San Francisco Cardiologist Professor Rita Redberg and Harvard University's Dr John Abramson, who disagree with prescribing statins to healthy people at low risk of heart disease. Even though the programmes were factually accurate, a small but vocal group of doctors, many of whom received funding from statin manufacturers, launched an orchestrated attack. One cardiologist stated "*the ABC has blood on its hands*" for broadcasting the documentary, while another medical commentator claimed "*people will die*" as a result of the programme.[33 34] Later, a report coauthored by the same doctor who tried to have the programme censored, speculated on the potential number of deaths which may have resulted after the programme aired.[35] Several months later, the television network capitulated to pressure and removed the programme from its website, despite government data showing that statin prescriptions had not fallen in the months following the programme's broadcast.[36] Recently, a British cardiologist reflected on the controversy regarding the programme, describing the reaction of critics as '*complete nonsense designed to smear*' those with dissenting views.[37]

In 2013, a similar situation occurred in France after there was intense controversy about statins in the media. An alarmist report claimed the 'controversy' had the effect of causing a ~50% increase in statin discontinuation that year compared with previous years.[38] Extrapolations predicted that it would cause 10 000 people to die unnecessarily from statin cessation. Fortunately, these claims were refuted when a subsequent report of the 'actual' death rate from national statistics showed a significant *decrease* in the number of deaths that year.[39] The authors concluded that it was '*not evidence-based to claim that statin discontinuation increases mortality*' and that in future, scientists should assess '*real effects of statin discontinuation rather than making dubious extrapolations and calculations*'.[39]

STATISTICAL DECEPTION

It may not always be intentional, but non-transparency is often a tactic used to manipulate or persuade people into taking statins.[40]

For example, when patients are told about the benefits of statins, they will be quoted 'relative risk reduction' (eg, 30%), rather than 'absolute risk reduction' (eg, 2%), because it sounds more impressive and is more likely to persuade the patient. In contrast, when patients are told about statin side effects, they are often quoted 'absolute risk' figures. This kind of 'mis-matched' statistics is mischievous. A 2007 analysis of three major journals between 2004 and 2006 found one in three articles contained 'mis-matched' statistics, where the benefits were expressed as *relative* risk and the harms were reported as *absolute* numbers.[41]

According to Professor Gerd Gigerenzer, director of the Harding Center for Risk Literacy,[41] "*It is an ethical imperative that doctors and patients understand the difference between relative and absolute risks to protect patients from unnecessary anxiety and manipulation*." In fact, failure to do so would be "*unethical*."

Another example of statistical trickery has arisen from a change in the expression of statin benefits. The CTT collaborators report statin benefits with each drop of '1 mmol/L in Low Density Lipoprotein-cholesterol (LDL-c)'. Rather than observing the rates of cardiovascular disease in a randomised population of people (as was performed in the original clinical trials), the CTT Collaboration recalculates the results as if everyone experienced a 1 mmol/L drop in LDL-c. However, the cardiovascular effect of statins can be unrelated to the degree of LDL-c drop and it says nothing about the broader primary prevention population, some of whom will not respond to LDL-c lowering on statins. Therefore, it has raised concerns that the CTT collaborators simply revisit old data, perform statistical '*acrobatics*' and retailor questions to arrive at different conclusions.[42] This may explain why the CTT Collaboration found a mortality benefit in low-risk people taking statins and is at odds with three other independent analyses.[43–45]

Unless doctors understand and relay to their patients the number needed to treat (NNT) for people to benefit from a drug and the number needed to harm (NNH), people will continue to be oversold on the benefits of statins. TheNNT.com is a valuable resource that can assist in shared decision-making.[45]

UNDERPLAYING THE RISKS

There are simple ways to design a clinical trial in order to minimise the harms of the drug. One example is the use of a run-in period, such as in the Heart Protection Study which assessed the efficacy of simvastatin therapy and vitamin supplementation on reducing the risk of cardiovascular disease.[46] During the run-in period, all participants took a placebo for 4 weeks, then a statin for a further 6 weeks prior to randomisation. At the completion of the run-in period, 36 % of the participants were excluded from the trial, the vast majority of these choosing not to participate or were not compliant. It i s plausible that they declined to participate because the statins caused unacceptable side effects. The authors said the run-in period was to assess '*the LDL-lowering responsiveness of each individual*'.

Many have questioned whether it is scientifically valid to remove those participants whose cholesterol levels did not 'respond' to statin therapy or who did not tolerate statin therapy. The act of excluding a large group of people from clinical trials *after* they have taken the drug for several weeks is not only legal, but it is an accepted practice. The explanation for designing trials with run-in periods is so that it allows

assessment of people who are compliant. But if people are not taking the medication because of unacceptable side effects and removed from the study, then surely it results in a study that grossly underestimates the *actual* rate of side effects associated with statins?

Furthermore, when recording side effects during a trial, questions may not be 'designed' to enquire about complaints that are not spontaneously reported. This may additionally explain why the rate of side effects in statin trials is wildly different from the rate of side effects seen in real-world observations.

Also, women are under-represented in clinical trials. For example, the Scandinavian Simvastatin Survival Study (4S) trial showed benefits for statins in secondary prevention, but when women were analysed separately there was a non-statistical increase in mortality. This result was obfuscated when male and female groups were combined, but doctors still impute the benefits of statins to women based on these results.

Another way of underplaying the risks of a drug is by excluding trials from meta-analyses. For example, the CTT Collaboration performed a meta-analysis of 18 686 people with diabetes from 14 randomised trials of statin therapy. However, there was a glaring omission of two significant trials, namely, the Atorvastatin Study for Prevention of Coronary Heart Disease (ASPEN) and Deutsche Diabetes Dialyse Studie (4D) trials.

Both ASPEN and 4D trials, which had been specifically designed and powered to assess the effect of statins in diabetes, failed to demonstrate a mortality benefit. Interestingly, the CTT collaborators did consider including them in their meta-analysis. The CTT collaborators wrote:

> Since both [ASPEN & 4D trials] reported apparently unpromising results, we considered whether their inclusion would have been likely to change our conclusions.

Their rationale for excluding these trials was because the group on statins did not respond with a significant reduction in LDL-c. The CTT wrote:

> Our main conclusions, therefore, are not materially affected by the results of ASPEN and 4D trials.

This is problematic for two reasons. First, if the exclusion of a trial is based solely on the fact that the intervention arm did not demonstrate a reduction in LDL-c, then a trial like the Lyon Diet Heart Study would have also been ruled a failure since it showed a dramatic reduction in cardiovascular disease associated with the adoption of a Mediterranean-style diet, despite *no* change in cholesterol levels. Second, if ASPEN and 4D trials would *not* have altered the CTT's conclusions, why wouldn't they have just included the trials for the sake of scientific integrity?

A recent study showed that people who took a daily statin for 5 years only increased their life expectancy by 4.1 days (in secondary prevention) or 3.2 days (in primary prevention).[47] Statin proponents claim that the benefits would have accumulated if the statins were taken beyond 5 years. However, it is disingenuous to claim that the benefits accumulate in the absence of accumulating side effects. In fact, the longer the trial, the more likely it is that other diseases (which take longer to develop) would emerge, such as cancer and neurocognitive dysfunction.

IN CONCLUSION

The egregious lack of transparency surrounding the raw data on statins has meant that doctors have been misled about the evidence and it has divided medical opinion. While there is more agreement on statins for secondary prevention, the debate about primary prevention remains divisive.

Few argue that statins are very effective at lowering cholesterol, but the ultimate goal is to improve quality of life and longevity. Dr Rita Redberg explains:

> The marketing [of statins] concentrates on the fact that you can lower your cholesterol as if that was the end in itself, which it is not. Cholesterol is just a lab number. Who cares about lowering cholesterol unless it actually translates into a benefit to patients?

LDL-cholesterol is merely a surrogate marker, and its causative role in the development of cardiovascular disease is increasingly being questioned by prominent cardiologists.[48 49] Clinicians speculate that the benefits of statins are independent of lowering cholesterol and that it is more likely to be their anti-inflammatory (pleiotropic) effects. More recently, the distrust in statins comes from those who assert that the early trials are flawed, and that since more stringent reporting regulations were introduced in 2005, the subsequent trials have been inconsistent and underwhelming.[3 50]

There must be shared decision-making between patients and doctors about statins. Patients often report being 'fired' by their doctors when they complain about the side effects of statins and feel threatened by claims that 'they will die' if they do not continue with their medication. Often, the side effects can be vague, for example, patients might complain of mind fog and fatigue. Doctors won't connect these symptoms to statins and blame it on 'normal ageing'. It only becomes apparent when the patient stops the medication and the symptoms resolve. Doctors can then rechallenge with a statin to verify the drugs' side effects.

All medications come with risks, which is why doctors need to be extra vigilant about prescribing them to healthy people. If we accept that clinical trials use run-in periods to exclude participants who cannot tolerate statins, they exclude people with comorbidities, they exclude people taking other medications, and the vast majority of trials are industry-funded and lack transparency lending to biased results, then we must also accept that perhaps we have been too quick to label statins as the most safe and effective way to reduce the risk of heart disease.

The acrimonious debate about the risks and benefits of statins will continue, but until the raw data on statin efficacy and side effects are released, we are deluding ourselves if we think that we are even having a reasonably informed debate.

Meanwhile, doctors prescribing statins should remain inherently sceptical because the majority of those taking statins are 'healthy' people at low risk, where the benefits are vanishingly small and the raw data on side effects are kept hidden.

What is already known?

- Statins are among the most widely prescribed drugs in the world and have cemented their place in preventative cardiology.
- An aggressive and myopic focus on lowering LDL-cholesterol, a surrogate endpoint of heart disease, has led to the overprescription of statins to millions of healthy people at low risk.

Contributors The author would like to thank Professor Rita Redberg, Dr John Abramson, Dr Fiona Godlee and Dr Aseem Malhotra for reviewing this article.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

What are the findings?

- Dissenting views about statins have been publicly derided and effectively silenced by proponents who are often funded by statin manufacturers.
- Doctors and patients cannot have an informed debate about statins because the raw data are being kept hidden, and it is now a matter of urgency that the data are released.

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Br J Sports Med published online January 21, 2018