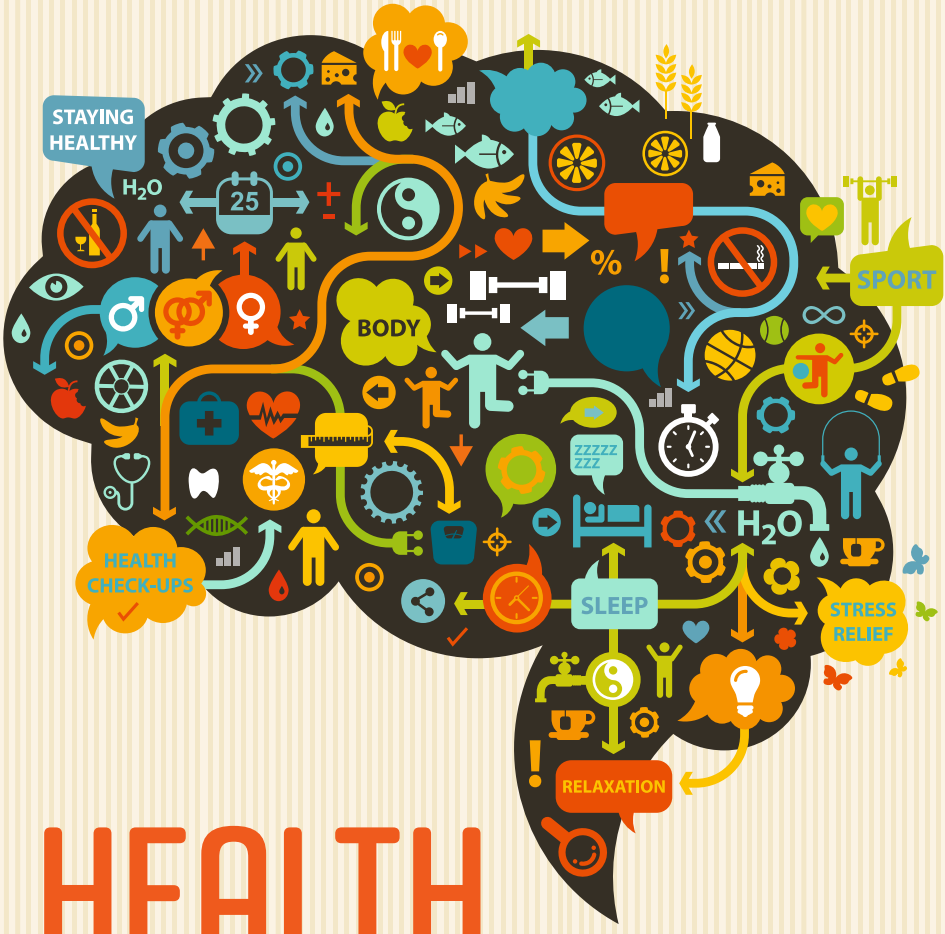
BRIAN S. EVERITT



HEALTH AND LIFESTYLE

SEPARATING THE TRUTH FROM THE MYTH WITH STATISTICS

Springer

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Separating the Truth from the Myth with Statistics

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Brian S. Everitt
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To my daughters Joanna and Rachel and my grandsons Hywel and Dafydd

Medicine is one of science's great contributions to human well-being, with health arguably being more important than education, for it is perhaps better to be alive and ignorant than dead but informed.

Peter Atkins in *On Being.*

Human reason must never be subjugated to a dogma, or to a myth, or to a preconceived idea because for human reason to do so would be for human reason to cease to exist.

Henri Poincare.

Health is merely the slowest possible rate at which one can die.

Samuel Johnson.

Preface

In the early 1950s, 'health', at least in the UK, was an easy matter to deal with. Children, including the author of this book, were given daily doses of welfare orange juice and weekly doses of cod liver oil and told to eat their greens. And on those rare occasions when a child could convince one or other of their parents that they were ill enough to need a doctor, they were carted off to the usually avuncular local GP and, after a generally brief examination, were normally prescribed either a 'tonic' or a laxative. Ailing parents were often prescribed much the same, but perhaps told to take two rather than one teaspoonful of the mixture. Sick child and grateful parent, whilst not quite touching their forelocks, would offer thanks to the doctor, apologize for taking up his valuable time and leave the surgery. And life would carry on.

Roll forward 60–70 years and how things have changed. Health is now big business, and the master–servant relationship between doctor and patient has been replaced by patients often quizzing their doctor in detail about their condition and about his/her proposed treatment. The 'well-informed' patient is a relatively new phenomenon for medics to deal with and parallels the increasingly large amount of information easily available on almost any topic via the Internet. For example, googling 'natural remedies for hay fever' results in a considerable number of suggestions, along with descriptions of how they work. The following three are typical of what appears:

- Honey—the bee pollen can desensitize your body to other pollens (I think what this means is that the pollen collected by bees can desensitize your body to pollens in the environment, as there is no such thing as bee pollen and there is no pollen in honey!).
- Vitamin C—natural *antihistamine*.

- Hot peppers—the active component, *capsaicin*, when eaten opens nasal passages and reduces congestion.
- Chamomile tea—an *antioxidant* and antihistamine.

Each suggested remedy is accompanied by a number of testimonials from hay fever sufferers who swear to how effective it is and who offer up thanks for the relief from their months, even years, of misery endured before discovering a treatment that borders on the miraculous. Often a remedy is enthusiastically endorsed by a presumably qualified clinician.

A potential danger of having so much information at one's fingertips is that for relatively minor health problems, there is a temptation to bypass the doctor altogether and search for a suitable remedy by trawling the Internet. For example, a busy person feeling slightly 'under the weather', and perhaps also worrying about his/her increasing weight and lack of 'essential' nutrients as the result of a 'fast-food' diet, could have hours of fun searching, say, for food supplements and weight loss products. Here are a few that you may come across and the claims made for them:

- Weight Away—A natural aid to support healthy weight loss consisting of glucomannan and green coffee. Aids weight loss by absorbing water in the digestive system.
- MultiVitality—Three essential supplements in a single pack, namely omega 3, pro-live cultures and a premium multivitamin. Developed by experts.
- Dietrim–Suitable for men and women of all ages. Recommended in conjunction with exercise. Each capsule combines 26 bioactive ingredients including conjugated linoleic acid, a fatty acid derived from naturally sourced linoleic acid found in the Safflower plant.

And away from the joys of the Internet, we are all constantly bombarded with recommendations about how to improve our health. How many times, for example, do we see the tag lines 'eat five-a-day for improved health' or 'more fibre is the key to a healthy lifestyle'?

But apart from a few testimonials from users, which is generally referred to as *anecdotal evidence*, and support from unidentified 'experts', there is often little said about how the claims and recommendations made about a treatment or health product can really be justified. The problem is that anecdotal evidence about the effectiveness of a particular treatment for, say, hay fever or the benefits of a particular food supplement, either from patients or experts, is not sufficient. Anecdotal evidence, even if expanded into a series of anecdotes dignified by the title, *case series*, is inadequate for the task. Why? Well the

primary reason is that many health problems improve spontaneously, so that any 'treatment' a person may have received is likely to be credited for this improvement, both by the patient and by the doctor, if one is involved. Generations of physicians would, in all honesty, have reported that 'bleeding' was an effective treatment and would have been supported in this claim by patients lucky enough to have survived the intervention. In any health disorder which is not universally fatal, anecdotal opinion alone will invariably support any treatment claim.

Anecdotal evidence is also of little use in evaluating claims made about possible *risk factors* for health conditions. The type of headlines favoured in the tabloid press, for example, 'My five-year-old developed leukaemia from living next to overhead power lines' or 'Smoking cannabis led to my teenage son becoming schizophrenic', is often backed up only by one or two anecdotes from concerned parents.

In fact, claims made for how well any remedy, treatment or health recommendation works, or warnings about the dangers of a possible risk factors for a health condition, can only be taken seriously if there is supporting *empirical evidence* from a properly designed and performed investigation of the claim or warning. Empirical evidence implies *measurements*, *observations*, *data*—i.e. numbers. It really is numbers that count in evaluating the claims made for both the effectiveness of any 'treatment' and the reality of any warning about the dangers of a particular risk factor. The measurements and observations made need to be transformed into *scientific evidence* for or against the effectiveness of a treatment or the danger of a risk factor. Turning data into evidence needs those foot soldiers of modern science in general and medical science in particular *statisticians*. Experts in handling data, statisticians are an essential part of the correct evaluation of health-related studies. The work of medical statisticians forms the basis of what is now known as *evidence-based medicine*, a movement that aims to help clinicians have a greater chance of providing their patients with the most appropriate treatment for whatever ails them and in distinguishing between dangerous and harmless risk factors.

The details of the methods used by statisticians invariably involve some mathematics, complicated equations and lots of formulae, and this is perhaps one of the reasons why statisticians applying statistical techniques in the areas of health and medicine have their detractors. For example, James Le Fanu, in his otherwise excellent book, *The Rise and Fall of Modern Medicine*, tells his readers that 'statistics are numbers to which complex mathematical formulae can be applied to produce conclusions of dubious veracity and from which all wit and human life is ingenuously excluded'. This seems both a little harsh, implicitly at least implying that statistics (and perhaps statisticians) offer little

to the study of medicine, and rather silly given how much both statistics and statisticians have assisted in the advancement of medicine in the twentieth century and are continuing to do so in the twenty-first century. Is it being overly optimistic to hope that reading this book will help Mr. Le Fanu overcome his obvious scepticism about statistics and then perhaps move on to make friends with some statisticians? Probably!

The aim of this book is to lead the reader through the various types of studies used in medicine, pointing out what they aim to achieve and their strengths and weaknesses and illustrating their use in many health and lifestyle-related areas. In addition, the results from the statistical analyses carried out on the data from some studies will be discussed. The book contains no mathematics beyond the simple arithmetic used to introduce some statistical concepts in Chap. 1; grasping the essence of these concepts will equip readers with enough statistical background to deal with the remainder of the material in the book.

This is not, however, a book for statisticians or for teaching people statistics. Rather, it is a book for people interested in being able to judge sensibly for themselves all kinds of claims and warnings made about health-related issues in the newspapers, television and the media in general. The aim is to help the reader in deciding which of the everyday barrage of health messages might actually be backed by sound evidence and so could be worth acting upon. Hopefully, they will not then be easily led astray by claims that, for example, eating almonds prevents cancer, taking ginseng improves sexual performance and children using mobile phones have an increased risk of developing a brain tumour, when such claims and warnings are not underpinned by strong, scientifically based, evidence.

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Brian S. Everitt

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Some Medical History, a Little Statistics and a Very Small Dose of Genetics

To understand God's thoughts, we must study statistics, for these are a measure of his purpose.

Florence Nightingale.

To be uncertain is uncomfortable, but to be certain is to be ridiculous.

Chinese proverb.

1.1 Galen and His Influence

Claudius Galen (AD 130–200), a Greek physician, who was destined to dominate medicine for many centuries, was a prolific writer and a showman of genius when carrying out dissections, primarily on animals, for the Roman public. Galen was born in Pergamon in Turkey and had taken on a variety of medical teachings when visiting Athens and Alexandria, before moving to Rome in AD 162. He elaborated and popularized the teachings of Hippocrates, the Greek father of medicine born in the fifth century BC and wrote with such conviction and dogmatism that few doctors dared to criticize him.

Galen's views on health and treatment were based on his belief that *phlegm* (produced by the lungs) which makes the body cold and wet and is composed of colourless secretions such as sweat and tears, *yellow bile* (produced by the gall bladder) which makes the body hot and dry, *black bile* (arising from the spleen) which makes the body cold and dry and darkens the blood and the stool and *blood* (from the liver) which makes the body hot and wet constituted the

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body's four basic *humours*. In his work, *On the Temperaments*, Galen argued that the predominance of a particular humour determined a person's temperament which could be either melancholic, phlegmatic, sanguine or choleric and that a short-term excess or deficiency of a humour produced illness. The key to good health was maintaining the humours in a state of balance, not always easy when humoral balance was susceptible to being affected by a variety of influences including, for example, seasonal variation. Physicians would attempt to restore balance by drawing unwanted matter out, via bleedings, purges and vomits or perhaps by adjustments to aspects of lifestyle.

The veneration of dogma proclaimed by Galen and other authoritative people largely stifled any interest in experimentation or proper scientific exploration in medicine until well into the seventeenth century. And even the few who did attempt to increase their knowledge by close observation or simple experiment often interpreted their findings in the light of the currently accepted dogma. When, for example, Andreas Vesalius, a sixteenth-century Belgian physician, first dissected a human heart and did not find 'pores', said by Galen to perforate the septum separating the ventricular chambers, the Belgian assumed the openings were invisible to the eye. It was only several years later after his initial investigation that Vesalius had the confidence to declare the Galen's 'pores' did not exist.

Similarly, the announcement of the discovery of the circulation of the blood by an English physician, William Harvey, in 1628, met with violent opposition because it contradicted Galen's view that blood flowed to and fro in a tide-like movement within arteries and veins. Even when it was admitted, rather grudgingly, that Harvey was probably correct, a defender of the established view wrote that if the new findings did not agree with Galen, the discrepancy should be attributed to the fact that nature had changed; one should not admit that the master had been wrong.

1.2 Treating the Sick in Medieval Times

Medieval life could be unhealthy because of poor hygiene, lack of knowledge as to how diseases spread and how the body functions. A brilliant summary of these times is given in Andrew Scull's impressive work, *Madness in Civilization*;

> This was a world of malnutrition and famine, with mass starvation an ever present possibility and often a reality. So too with disease, whose ravages are most visible in the brute demographic fact of low life expectancy: the medieval man who reached the age of forty-five was the exception, and given the perils of