

John Graunt at 400

Fighting disease with numbers

Demographers, epidemiologists and statisticians working today are building on foundations laid by John Graunt, a London haberdasher born in 1620, who sought to analyse the many causes of death and calculate life expectancy. By **Timandra Harkness**

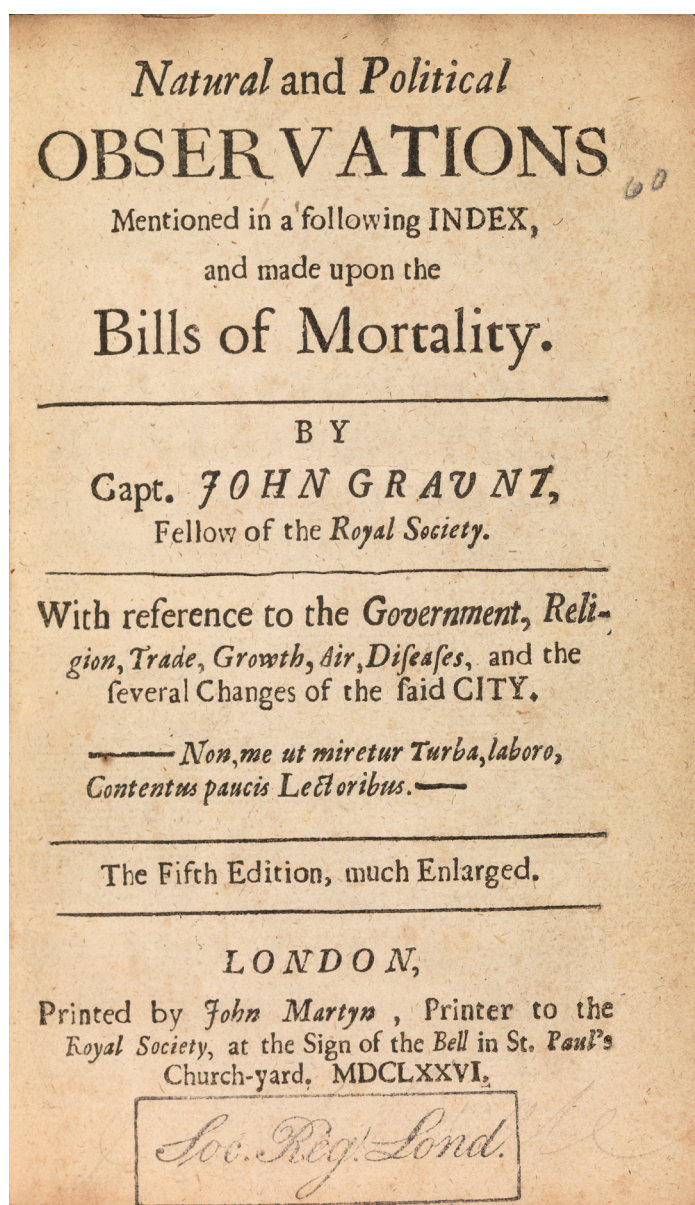
The year 1662 was a memorable one for London haberdasher John Graunt. He buried both his parents a couple of months apart (cause of death: “aged”), and his daughter Frances (cause of death: “consumption”), the second of his children to die. And he published a book which laid the foundations for modern demography and statistics.

The politician and diarist Samuel Pepys bought a copy of *Natural and Political Observations mentioned in a following Index, and made upon the Bills of Mortality by John Graunt*¹ at Westminster Hall in March of that year. By that time Graunt, having presented 50 copies to the Royal Society in February, had been elected a Fellow, in spite of his humble trade. The Royal Society’s founder, King Charles II, recommended “that if they found any more such Tradesmen, they should be sure to admit them without any more ado”.² A second edition was printed later that year, and further editions in 1663, 1665 and 1676.

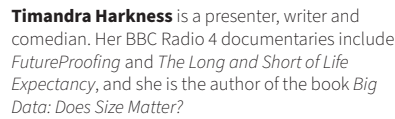
What exactly did John Graunt write that so impressed his contemporaries? Eighteenth-century demographer J. P. Süßmilch compared him to Columbus, in going further than anyone before,³ and F. N. David called him “the first English vital statistician”.⁴ So why is he not more widely recognised as a founder of the statistics of births, marriages and deaths?

Origins

Born in the City of London in 1620, John Graunt was apprenticed to his father at 16, and followed him into both the haberdashery business and the Drapers’ Company, one of the guilds that exerted social and economic power in seventeenth-century London. The city was growing fast, spreading westwards



Left: Title page of the 1676 edition of John Graunt's *Natural and Political Observations... upon the Bills of Mortality*. Photo © The Royal Society



For Graunt, this kind of data was raw material from which scientific inquiry could gather new knowledge of how the plague worked, and much more. His voyage of discovery produced not only new insights, but also the foundations of many methods of inquiry still in use 400 years after his birth.

He even published in a spirit of inviting the critical review of his peers, including his data, saying in his preface that “I have taken the pains ... of setting out those Tables, whereby all men may both correct my Positions, and raise others of their own: For herein I have, like a silly Schole-boy, coming to say

Above: “The Table of Casualties”, from the 1676 edition of Graunt’s *Natural and Political Observations... upon the Bills of Mortality*. Photo © The Royal Society

For example, starting with a comparison of some of the worst plague years, he first introduces the idea that raw numbers of deaths may not be the best guide to which was the worst year. More people died of the plague in 1625 than in 1603: 35,417 deaths recorded as plague in 1625, against 30,561 in the earlier epidemic. But, noting that London's population was growing throughout this period, Graunt looks at the proportion of all deaths recorded as plague. In 1625 it was 35,417 out of 51,758 deaths. But in 1603 the 30,561 plague deaths made up a higher

► proportion of 37,294 total deaths. That is around 80% of all deaths, higher than 1625 (70%) and much higher than 1636 (40%).

Graunt is not content to stop there. By looking at how death numbers vary from year to year, he has spotted an underlying pattern. Some causes exact a fairly steady toll, varying little year to year around what we today would call an average. These causes include what Graunt refers to as “chronical diseases ... Consumptions, Dropsies, Jaundice, Gowt, Stone, Palsie, Scurvy, rising of the Lights, or Mother, Rickets, Aged, Agues, Feavers, Bloody-Flux, and Scowring”, as well as accidents and suicides.

The death tolls from some other causes vary widely from year to year. These “epidemical and malignant diseases” include smallpox and measles, alongside the plague. But in some years, Graunt notices what we would today call excess deaths far beyond any normal variation. In 1625, for example, plague deaths are counted as 35,417, and other diseases as 18,848. But “in the years, both before and after the same, the ordinary number of Burials was between 7. and 8000”.

What could account for the extra 10,000 or so deaths? Graunt puts forward the hypothesis that around a quarter of plague deaths are recorded as some other cause, and backs up his thesis by comparing 1636, another bad plague year, and finding the same 25% under-reporting. From this, he concludes that 1625 was, after all, as bad a plague year as 1603.

Graunt has more to say about inaccurate reporting of causes of death. He is especially keen to point out that deaths from venereal disease, or “French-Pox” (syphilis), must be under-reported, since among the total of 229,250 deaths in the period studied, only 392 deaths by Pox were recorded. Since he believes “a great part of men have, at one time, or other, had some species of this disease”, this number seems improbably low to Graunt.

Examining his data, he finds that the only two parishes reporting deaths by Pox are St Giles and St Martin in the Fields, both notorious parishes for prostitution, “from whence I concluded, that onely hated persons, and such, whose very Noses were eaten of, were reported by the Searchers to have died of this too frequent Maladie”.

The others, he suggests, are mainly put down as consumption, then used to describe

any wasting disease, as “the Old-women Searchers after the mist of a Cup of Ale, and the bribe of a two-groat fee, instead of one, given them, cannot tell whether this emaciation, or leanness were from a Phthisis, or from an Hectick Fever, Atrophy, &c. or from an Infection of the Spermatick parts”.

Graunt is not only seeking the truth from scientific curiosity. He wants the Bills to give an accurate picture because “it is not good to let the World be lulled into a security, and belief of Impunity by our Bills, which we intend shall not be onely as Death’s-heads to put men in minde of their Mortality, but also as Mercurial Statues to point out the most dangerous ways, that lead us into it, and misery”.

However, he is equally keen to reassure those who needlessly “live in great fear and apprehension” about “formidable and notorious diseases” that are very unlikely to kill them. He sets out how many died of each – 22 “frighted”, 86 “murthered”, 6 from leprosy, 14 “poisoned”, 454 “sodainly” and so on – so that readers can set them against the total, 229,250 deaths, to “better understand the hazard they are in”. Very little hazard of being murdered, he points out.

Morality and belief

The moral flavour to his desire to warn of the dangers of syphilis reflects Graunt’s strong religious beliefs. Having grown up Protestant, with Nonconformist tendencies, he later converted to Roman Catholicism, which was not a soft option in a time of strong anti-Catholic prejudice and legal discrimination. Indeed, such prejudice may have skewed the data available to Graunt, particularly the counts of “Christnings” of children. In his discussion of important gaps in the data, he notes that many “Heterodox Believers” did not have their babies baptised in Anglican churches – and he may well have been one of them himself, as there is no parish record of his daughters’ baptism.

Elsewhere in his *Observations* he deduces that Christian monogamy “is more agreeable to the Law of Nature, that is, the Law of God”, than polygamy, because it maximises fertility given the slight excess of males in the human population (which he was the first person to note).⁵

He even infers the age of the world from rates of population growth, concluding that “one couple viz. Adam and Eve, doubling

themselves every 64 years of the 5610 years, which is the age of the World according to the Scriptures, shall produce far more People, then are now in it. Wherefore the World is not above 100 thousand years, old as some vainly Imagine, nor above what the Scripture makes it.”

Not all of Graunt’s conclusions are correct. He also wrongly concludes that the great variation in plague cases from week to week is evidence for its being airborne, not passed between persons. But in his short book, Graunt introduces many ideas of which people working with data today could usefully be reminded. He makes the point that people can die with a disease, though it may not be the disease that kills them; that long-term trends are more informative than short-term fluctuations; and that to understand disease severity, we need to count more than just the number of deaths.

For example, he notes that dying *with* gout is not the same as dying *of* gout, since it is mainly a disease of old age: “there dies not above one of 1000. of the Gowt, although I believe that more die Gowty”.

He also distinguishes between a long-term rising trend, as he sees in cases of rickets, and the odd year-to-year fall, or “starting backwards”. “[S]uch backstartings seem to be universal in all things; for we do not onely see in the progressive motion of the wheels of Watches, and in the rowing of Boats, that there is a little starting, or jerking backwards between every step forwards, but also (if I am not much deceived) there appeared the like in the motion of the Moon, which in the long Telescopes at Gresham-College one may sensibly discern.”

Graunt even tries to derive a case fatality ratio for “an outbreak of malignant fever in Romsey in 1638. Comparing the deaths with the reported shortage of hands for the wheat harvest ... he concluded that ‘seven might be sick for one that died’. This result also helped to convince him that it was really a different disease from the plague, of which ‘more die than recover’.”²

The life table

For all these achievements, Graunt deserves much wider recognition. But if his legacy is acknowledged today, it is usually as the first person to create what we would call a “life table”.

(6)

1624. A general, or great Bill for this Year, of the whole number of Burials, which have been buried of all Diseases, and also of the Plague in every Parish within the City of London, and the Liberties thereof, as also in the nine out-Parishes adjoining to the said City, with the Pest-house belonging to the same. From Thursday the 14. day of December, 1624. to Thursday the 15. day of December, 1625. According to the Report made to the King's most Excellent Majesty, by the Company of Parish-Clerks of London.

LONDON.	Bar.	Plag.	LONDON.	Bar.	Plag.
Albanes in Woodstreet	188	78	Gabriel Fen church	71	14
Alhallowes Barking	397	163	George Botolphs-lane	30	19
Alhallowes Breadstreet	34	14	Gregories by Pauls	976	196
Alhallowes the Great	443	302	Hellens in Bishops-gate	136	71
Alhallowes Honey-lane	18	8	James by Garlick-hith	180	109
Alhallowes the Isle	159	105	John Baptists	122	79
Alkal. in Lunkedstreet	86	44	John Evangelist	7	0
Alhallowes Staining	183	138	John Zacharies	143	97
Alhallowes the Wall	301	117	Jowes Duke place	310	254
Alphage Cripple-gate	240	190	Katherine Coleman	263	175
Andrews Hubbard	116	101	Katherine Creech-church	886	373
Andrews Toderhalt	219	149	Lawrence in the Jewrie	91	15
Andrews by Wardrobe	373	191	Lawrence Pountney	106	127
Annes at Aldergate	196	118	Leonards Eastcheap	55	26
Annes Black-Pier	336	215	Leonards Fotherlode	931	509
Antiholms Pariah	61	31	Magnus Pariah by Bridge	137	81
Austins Pariah	71	40	Margares Louthbury	114	64
Bartol at the Exchange	13	14	Margares Mofes	17	35
Beauners Fink	108	57	Margares new Filthstreet	153	81
Beauners Grace-Church	40	24	Margares Parsons	77	10
Beauners in Duke Ward	116	113	Mary Abchurch	88	48
Beauners Sherlog	24	8	Mary Aldenhambury	126	79
Boston Billings-gate	99	54	Mary Aldernay	91	54
Christ's Church Pariah	171	121	Mary le Bow	15	19
Christopher's Pariah	43	18	Mary Botham	21	14
Clement by Eastcheap	87	72	Mary Colechurch	16	31
Doynts Black-Church	99	59	Mary at the Hill	76	44
Dunfians in the East	333	225	Mary Mounshaw	76	48
Edmunds Lunkedstreet	79	49	Mary Sommer	170	152
Edithbrooke in Bishops-gate	197	161	Mary Staining	70	44
St. Faiths	89	45	Mary Woolchurch	48	15
St. Follers in Fother-lane	149	103	Mary Woolthorpe	31	10

(7)

LONDON.	Bar.	Plag.	LONDON.	Bar.	Plag.
Martins Ironmonger-Lane	151	18	Nicholas Aconers	33	13
Martins at Ludgate	154	164	Nicholas Cole Abbey	87	67
Martins Organs	481	47	Nicholas Olaves	70	43
Martins Outwich	60	39	Olaves in Hartstreet	266	195
Martins in the Vintry	339	108	Olaves in the Jewry	411	151
Marthens Fridaystreet	24	11	Olaves in Silverstreet	141	103
Maudslins in Milkstreet	440	131	Puncheon by Superior	17	8
Maudslins Oldfish-dreet	225	145	Peters in Cheap	68	44
Michael Boddiford	199	139	Peters in Corn-hill	118	78
Michael Corn-Hill	19	79	Peters at Pauls Wharf	97	68
Michael Crooked-lane	114	91	Peters poor in Broadstreet	14	17
Michael Queen-hill	217	157	Servins in Colmanstreet	107	350
Michael in the Queens	13	30	Stevens in Walbrook	21	13
Michael in the Ryall	111	61	Seithens in Loundonmure	99	60
Michael in Woodstreet	189	68	Thomas Apoles	141	107
Mildred, Breadstreet	60	44	Trinity Pariah	148	87
Mildred Poultry	94	45			

Barred within the 97. Parishes within the walls of all Dioceses, whereof, of the Plague. 907.

Barred in the 16 Parishes without the walls, flowing parishes within the Liberties and parishes within the Middlesex and Surrey, and the Pelham, whereof, of the Plague. 1715.

Barred in the nine out-Parishes.

Clements Temple-lane	118	42	Martins in the Fields	1478	972
Giles in the Fields	1333	967	Mary White-chapel	330	137
James at Clerkenswell	1191	963	Magdalens Broomfield	1127	889
Katharins by the Tower	938	744	Savoy Pariah	259	176
Leonards in Shorditch	1991	1497			

Barred in the nine out-Parishes, in Middlesex, and Surrey, whereof, of the Plague. 907.

(8)

The Total of all the Burials of all Diseases, within the walls, without the walls, in the Liberties, in Middlesex and Surrey, with the nine out-Parishes and the Pelham, whereof, of the Plague, this present year, is 35617. Christening this present year is 6983. Buried clear this year, is 1.

5. In the Year 1626. the City of Westminster in imitation of London, was infected. The grosse account of the Burials, and Christenings, with distinction of the Plague, being only taken notice of therein: the fifth, or last Canon, or Lined-space, of the said Bill, being varied into the form following, viz.

Barred	Plague	Christenings
471	13	361

6. In the Year 1629. An account of the Diseases, and Casualties whereof any dyed, together with the distinction of Males and Females, making the sixth Canon of the Bill, was added in manner following.

The Canon of Casualties, and of the Bill for the Year 1629, being of the same forme with that of 1629.

Above: Counts of all burials, and plague burials, December 1624 to December 1625, from the 1662 edition of Graunt's *Observations*. Photos © The Royal Society

The Bills did not record age at death, but Graunt wanted to know the pattern of how long people lived, largely so he could deduce useful information like the number of men of fighting age, or women of childbearing age. So, he worked with the data he had, spelling out his assumptions as he went.

First, he picked out causes of death mainly associated with childhood ("convulsions", "abortives", "chryosomes", "teeth and worms", or simply "infants"), and assumed they were children under 6. He added to them half the deaths from smallpox, swine pox and measles, and about a third of the deaths from plague. From this calculation he concluded that 36% of all children conceived never saw their sixth birthday. His own daughter Susan had been one of the horrifying multitude of infant deaths in 1643.

Next, he adopts a similar approach for the over 70s, to conclude that only one person in a hundred will live beyond the age of 76. But how to estimate the mortality curve, as we would call it? Lacking concrete data, Graunt seems to have guessed that, after childhood, adults face a steady risk of death until old age. Others have calculated from Graunt's table that he assumes that risk to be 3/8 per decade.

For today's population, that would be wildly wrong. Adults today face a risk of death that doubles every 8 years or so, though

in absolute terms it is very much lower than what Graunt and his contemporaries faced. The average life expectancy at birth derived from his table is around 18 years. The equivalent figure for the UK today is well over 80 years. His table may not have been so far off the truth in an era of infectious diseases, rudimentary medicine and endemic malnutrition.

A sad end

Graunt's method underpins the work of demographers, actuaries, public health professionals, epidemiologists and statisticians today. Though we have more and better data, and more sophisticated statistical methods, we are essentially pursuing the same goals: by turning the births and deaths of individual people into numbers, to better understand both individual and social causes of human events and to improve them for future generations.

His life had a sad end, however. Graunt's home, and his business, burned down in the Great Fire of London in 1666. He never recovered financially, in spite of help from his close friend William Petty, was ostracised for his Roman Catholic religion, and twice taken to court for "recusancy" (non-attendance of Anglican church services).

John Graunt died in 1674, aged 53, and his wife had to apply for a pension from the

Drapers' Company on the grounds of poverty. After his death, his book was often credited to Petty (on Amazon it still is).

Four hundred years after his birth, we should remember John Graunt, who laid foundations on which we still build. He is not known to have any descendants, a portrait, or any memorial, but he lives on in the ideas he first brought into the world – ideas that, as he would have wished, help save thousands of people with names and faces from needlessly early deaths. ■

References

1. Graunt, J. (1662) *Natural and Political Observations mentioned in a following Index, and made upon the Bills of Mortality by John Graunt*. London. bit.ly/3i6ddom
2. Glass, D. V., Ogborn, M. E. and Sutherland, I. (1962) John Graunt and his Natural and Political Observations [and Discussion]. *Proceedings of the Royal Society of London, Series B: Biological Sciences*, 159(974), 2–37.
3. Süßmilch, J. P. (1741) *Die göttliche Ordnung in den Veränderungen des menschlichen Geschlechts aus der Geburt, dem Tode und der Fortpflanzung desselben erweisen*. Berlin: Spener. Quoted in Hacking, I. (1990) *The Taming of Chance*. Cambridge: Cambridge University Press.
4. David, F. N. (1962) *Games, Gods and Gambling: A History of Probability and Statistical Ideas*. London: Charles Griffin & Co.
5. Orzack, S. H. (2016) Old and new ideas about the human sex ratio. *Significance*, 13(1), 24–27.