

Nightingale, the statistician

Many of you might know Florence Nightingale just as a nurse. I used to think so until I saw a poster at the booth of the statistics department at a fair at Seoul National University to attract high school students to their departments. Even though I was curious to know about what kind of statistics related work she had done, only recently did I search for more information on the Internet.

Florence Nightingale was born to a wealthy English family in 1820, while they were traveling in Florence, Italy. Her first name was named after the Italian city. The next year they returned to England. Her father was a graduate of Cambridge University and took enormous care of the education of their children. Florence was enthusiastic about numbers from an early age. When she was nine, she gathered data from garden fruits and vegetables and recorded them in numerical tables. When she was twenty, she began to receive math instructions from a Cambridge-trained mathematician.

As a child, she daydreamed about hospitals and becoming a nurse to heal the sick. She regarded it as God's calling, and lived single her whole life, rejecting to be tied to upper-class marriage and society. When she was in her twenties, she rejected the supernatural and miraculous aspects of Christianity and awaited the coming of a female Christ. She envisioned actively participating in God's work. To understand God's thoughts, she held, we must study statistics for these are the measure of his purpose.¹ For her, studying statistics was a religious duty.

In 1853, during the Crimean War, Nightingale volunteered to work as "the superintendent of the female nursing establishment in the English General Military Hospitals in Turkey," in charge of 38 nurses. There she found out that sanitation was lacking; rats and fleas were everywhere. Not only that, but the systematic recording of statistics was also lacking. Different hospitals used different classifications for diseases, and the number of deaths was not consistently recorded. She fixed everything. According to some accounts, she was far from being kind, contrary to the image many people would imagine for a devotional nurse. Instead, she was very stubborn when the required supplies were not provided, and argued endlessly with people who opposed her policy until they surrendered.

After she returned to England, she published "Notes on Matters Affecting Health, Efficiency, and Hospital Administration of the British Army." There she published a lot of diagrams showing the statistics vividly. For an example, see Fig. 1.

¹ The Life, Letters and Labours of Francis Galton by Karl Pearson, p 415.

implementation of sanitary improvements.

By collecting and analyzing data, she also found out that the maternal mortality rate (i.e., the proportion of women dead by giving birth) at hospitals was far, far greater than the one at home. This may sound very strange in modern times when virtually all deliveries are taking place in hospitals, at least in developed countries, presumably because deliveries at hospitals are safer and more convenient than at home. But the same was not true in 1871 when she reported her findings in "Introductory notes on lying-in institutions" which are over 100 pages.

In these notes, she complained of "no uniform system of record of deaths." When a mother died, the cause of her death was not recorded, and there was "no common agreement as to the period after delivery within which deaths should be counted as due to [the delivery]." Most hospitals counted the death of mothers as due to the delivery, if it happened while the mother was at the hospital. Think about this. Recording the cause of death is important, because one needs to identify which cause is common among maternal death at hospitals, and which cause is common among maternal death at home. One needs to compare. The same can be said about the agreement on the period after delivery just mentioned. If this criterion is different from hospitals to hospitals and home to home, we can say that the data would never be "fair." There would be a distortion in the data, which hinders precise analysis.

Anyhow, Nightingale considered many factors that could affect the maternal mortality rate, such as the age of the mother, number of pregnancies, duration of labor, and social class of the mother. This is important because one needs to identify the correct cause of the maternal death. For example, one may (erroneously) argue that the maternal mortality at home was higher than the one at hospitals, because the rich people presumably give birth at home while the poor give birth at hospitals. However, the maternal mortality rate for hospitals for poor people was actually *lower* than the one for expensive hospitals.

Through her data, Nightingale showed that there was a higher mortality rate when the mothers were in contact with doctors and medical students, and the wards were crowded. Thus, she recommended that child bearing be made with as little medical involvement as possible, and medical students be completely banned, and wards be less crowded.

Another achievement of Nightingale is the drastic reduction of the death of the British army in India. Regarding the death and the sanitary situation of the British army in India, she wrote the greater part of the Report by collecting data through inquiries and analyzing them. She begged Lord Stanley to provide the armies in India the sanitary conditions provided to the armies at home. She was permitted to print the Report out of her pocket, and distributed it to the queen and the influential members of government. The Report included a lot of details, such as the camp diseases due to

the selection of poor sites, wrong disposal of human wastes, and so on. She convinced that more British soldiers died from diseases than on the battlefield.

She was also interested in the education of the Indian people. As one of the hindrances of popular education, she noted the existence of a hereditary class, which uses their monopoly of education to block out lower classes from gaining power.

Nightingale showed that statistics is crucial to solving social problems. She was the first female member of the Royal Statistical Society and an honorary member of the American Statistical Association.

Further Reading

[1] Lynn McDonald, "Florence Nightingale: Passionate Statistician," *Journal of Holistic Nursing*, vol 16, issue 2, 267 (1998) <https://doi.org/10.1177/089801019801600215>

[2] Eileen Magnello, "Florence Nightingale: The compassionate statistician"

<https://plus.maths.org/content/florence-nightingale-compassionate-statistician>

(a modified version of *Radical Statistics*, 102 (2010) pp 17-32)

[3] Edwin W. Kopf, "Florence Nightingale as Statistician," *Journal of the American Statistical Association*, 1916, 15(116), 388-404

[4] Florence Nightingale, "Introductory notes on lying-in institutions" London: Longmans Green (1871)