The Origin of a Chart Indicating the Likelihood of Conception Linearly Declining with Age

A Literature Survey

TANAKA Sigeto (Tohoku University)

Abstract

BACKGROUND: A chart indicating the likelihood of conception linearly declining with age (86% for women aged 20–24, 78% for 25–29, 63% for 30–34, 52% for 35–39, 36% for 40–44, 5% for 45–49, and 0% for 50 and over) is widely used on Internet fertility sites and by medical professionals. Its origin has been unknown until now.

OBJECTIVE: To explore the origin of the chart.

METHODS: A literature survey.

RESULTS: Among the seven points on the curve, three are based on data that are not the likelihood of conception, while four are probably derived from oversimplified description of fecundability estimates for Hutterite and Taiwanese women in the 1950s and 1960s. Two professionals contributed to the making of these data.

CONCLUSIONS: The chart was fabricated and exaggerates the effect of age on the likelihood of conception. At least two professionals are responsible for the fabrication.

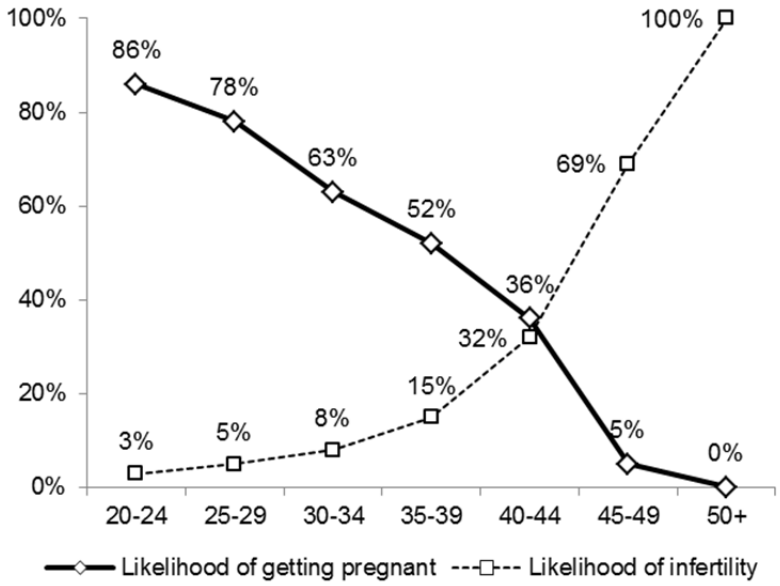
CONTRIBUTION: This paper describes a case of misinformation about demographers' research results. It issues a warning against misuse of demographic knowledge in medical, commercial, educational, and political contexts.

Keywords: fecundability, natural fertility, popular science, misinformation, research ethics, fabrication, obstetrics, gynecology, reproductive medicine, demography

1. The Chart in Question

Figure 1 is a chart adapted from images on the Web (BabyCenter 2007; Epigee 2005). It contains two curves: a downward curve for the "Likelihood of getting pregnant" and an upward curve for the "Likelihood of infertility." This chart is widespread among Internet articles on so-called "fertility sites," authored or supervised by medical experts. The Google image search yields more than 200 hits of this chart (November 5, 2016). It has also been publicized through a book (Phillips and Grifo 2016: 7) jointly written by Kyra Phillips, a news anchor of Cable News Network (CNN), and Jamie Grifo, the program director of New York University Fertility Center (with a modification in the horizontal axis scale). It has even been featured in an article published on an academic journal (Findeklee et al. 2015: 1244).

Figure 1 would have a great impact on people who are seeking information for decision-making regarding the feasibility of their efforts toward fertility. Indeed, Yamagata (2013: 177–82) used the chart in a research project on young women's future prospects and reports that it would force them into a life plan of having children during their early 20s.



Adapted from figures on the Web (BabyCenter 2007; Epigee 2005)

Figure 1. The chart in question.

However, the origin of the chart is unknown, because it has been used without data description. Its grounds and validity have yet to be tested. This literature survey sought to resolve these questions through careful examination.

2. Tracing the Origin

Some versions of the chart (BabyCenter 2007; Epigee 2005) cite M. Sara Rosenthal's book, *The Fertility Sourcebook*. The second (Rosenthal 1998: 5) and third (Rosenthal 2002: 5) editions of this text offer a table of "Likelihood of Getting Pregnant" and "Likelihood of Infertility." This table is not found in the first edition (Rosenthal 1996).

The figures of "Likelihood of Infertility" show demographers' estimation of sterility (Henry 1965: 338; Vincent 1950: 54; Bongaarts and Potter 1983: 42; Khatamee 1988: 250) based on the parity progression process of couples in several natural fertility populations. *Natural fertility* is a term of demography to indicate that people do not deliberately limit how many children they have (Henry 1961). Those figures are identical with the original, except for discrepancies in the values of age (Figure 2B). The curve of "Likelihood of infertility" in Figure 1 is thus grounded on findings by demographic studies (though the horizontal axis scale contains errors).

On the other hand, the data for "Likelihood of Getting Pregnant" in Rosenthal (1998, 2002) — 100%, 94%, 86%, 70%, 36%, 5%, and 0% — are problematic. These figures are based on age-specific marital fertility rates (Henry 1961; Coale and Trussell 1974) from a number of natural fertility populations, converted into ratios to the baseline at the early 20s (Bongaarts and Potter 1983: 22; Khatamee 1988: 249; Menken and Larsen 1986: 153; Menken, Trussell, and Larsen 1986: 1390). Accordingly, they are not proper figures to indicate one's 'likelihood of getting pregnant.' For instance, the value is "100%" for women aged 20–24, because it is selected as the baseline for comparison. For women aged 45–49, the value is "5%," because the reported average marital fertility rate (Coale and

Trussell 1974: 188) for these ages (0.024) is about 5.2% of the rate at the baseline (0.460 for the early 20s). Thus, these percentages do not reflect the probabilities at which women get pregnant. In this respect Rosenthal falsified the heading of the table (Figure 2B). In addition, Rosenthal (1998: 5; 2002: 5) appended a note "presuming optimum health" below the table, although such information was not in the original data (Henry 1961).

Moreover, among Rosenthal's seven numbers for 5-year interval age classification, the first four (for the 20s and 30s) are different from those of Figure 1. These numbers in the chart could have their roots in any other source.

Another citation of the chart (BabyCenter 2007; Epigee 2005; Findeklee et al. 2015) is given to Helen A. Carcio's book, *Management of the Infertile Woman*. In that book, Table 2-5 on page 39 carries four numbers — 86, 78, 63, and 52 — under the heading of "Percent Conceiving Within 12 Months" (Carcio 1998: 39). These data (Figure 2A) correspond to the first four points of the downward curve on Figure 1. We can thereby conclude that the "Likelihood of getting pregnant" curve in the chart is a composition of four percentages from Carcio's book and three from Rosenthal's (Figure 2).

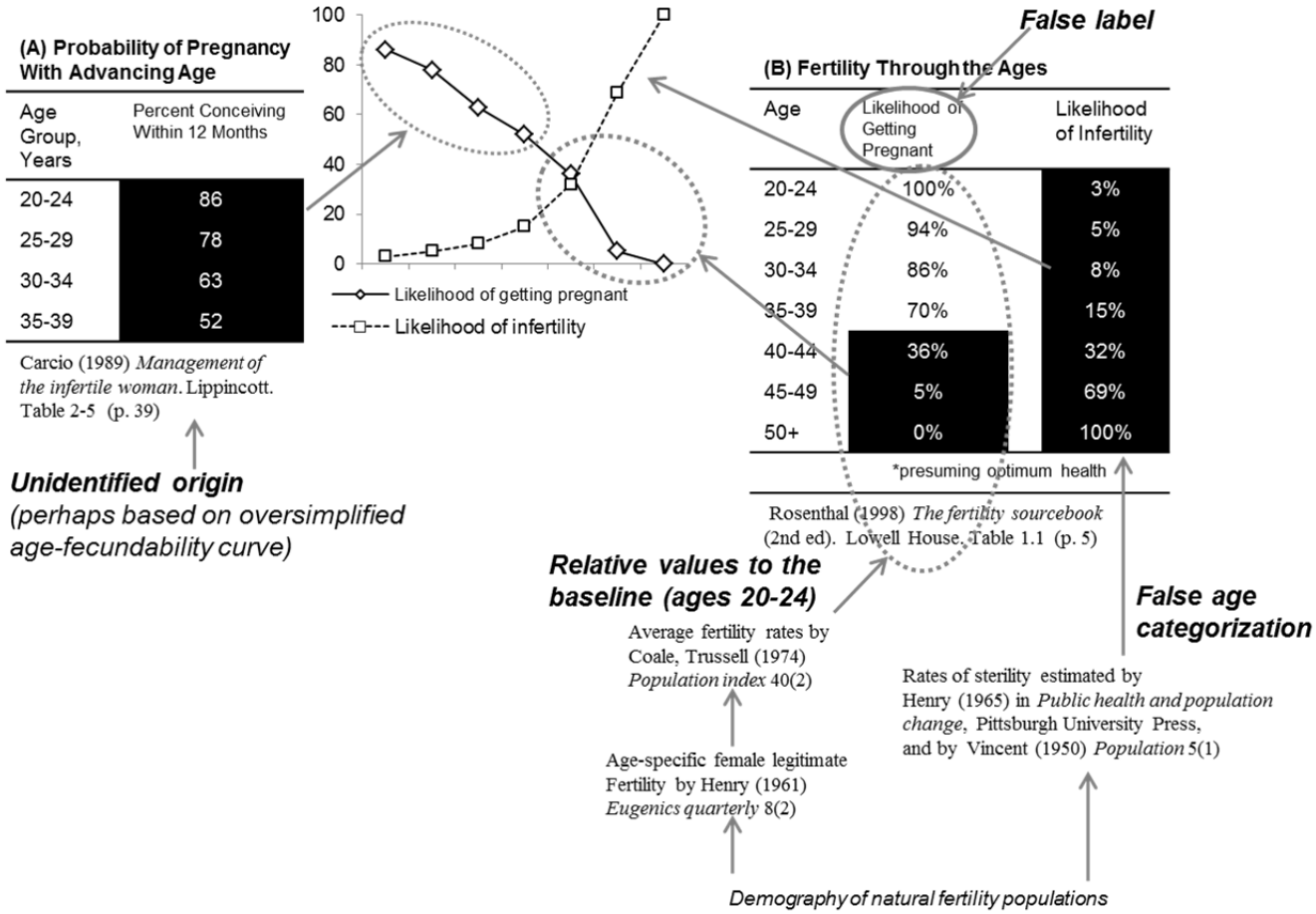


Figure 2. Making of the chart

The next problem is that Carcio specifies no data source. The book simply states "It is well documented that there is diminished fecundity with increasing age (Table 2-5)" (Carcio 1998: 38). Where did these four values come from? I asked this question directly

to Carcio, but received a reply that she did not remember the data source (September 19, 2016 by e-mail).

3. Read the Figures as Fecundability

Carcio's table shows probability for 12 months. However, the probability of conception is usually calculated for a month or a menstrual cycle, to which we refer as *fecundability* (Baird 2013: 193; Speroff and Fritz 2005: 1013). Converting Carcio's annual probability (y) into monthly one with the formula $1 - (1 - y)^{1/12}$, we obtain the values of fecundability as 15%, 12%, 8%, and 6% respectively for women aged 20–24, 25–29, 30–34, and 35–39. These are almost on a straight line, with a decrease of about 3 percentage points per 5 years (with a slight fluctuation), starting with the value of 15%.

This value, 15%, is at a low level in comparison with most studies of human fecundability reporting values at a level of 20% or higher (Baird 2013: 195). Within this field of literature, a survey of Taiwanese women in the 1960s (Jain 1969) yielded a result almost equal to the average fecundability of 15% for women aged 20–24. Using this value as the baseline, Bendel (1978: 66–8) and Bendel and Hua (1978: 216) draw an age-fecundability curve (with American Hutterites[1] data in the 1950s and 1960s (Sheps 1965) in addition to Taiwanese data (Jain 1969)). Their paper verbally describes it as "(1) that a woman's fecundability declines immediately after the first half of her twenties and (2) that the decline is approximately linear all the way to the zero level near her menopause" (Bendel and Hua 1978: 217).

If these are not a coincidence, Carcio's data may be a translation of Bendel and Hua's text into figures. That is, fecundability is at the maximum of 15% in the early 20s, and then decreases linearly. This line, however, deviates from the exact estimates by Bendel and Hua (1978: Table 2), which show two concatenated upward convex curves. It is a very rough approximation to describe the result as linear. In addition, their estimation has a fundamental defect, as they removed the data that represented women who married in their late 20s or later (Tanaka 2017). Bendel and Hua thereby fail to distinguish the effect of age from that of duration of marital life. They may have overestimated the age effect for women in their 20s and 30s (James 1979: 333).

4. Evaluation

We have thus confirmed that the "Likelihood of getting pregnant" curve in Figure 1 is a fabrication. Among the seven points plotted on the curve, three are based on data that never indicate the likelihood of getting pregnant. The other four are of an unidentified origin, which may be entirely fictitious or derived from an oversimplification of previous research results (Figure 2). It is still unclear who compounded them into a curve. However, it is clear that Rosenthal (1998, 2002) and Carcio (1998) are responsible for publishing those falsified or groundless data.

The consequence of this fabrication of data is that this chart exaggerates the effect of age. In contrast to the linear decline shown in Figure 1, demographic studies of natural

[1] Hutterite is a religious group of Anabaptist, known for their high fertility (Sheps 1965).

fertility populations (Coale and Trussell 1974; Henry 1961; Menken and Larsen 1986; Sheps 1965) have established the upper convex curve of women's age-fertility profile. One European multicenter study (in 1992–1996) of daily probability of conception (Colombo and Masarotto 2000: 12, 36) also find no large decline during women's ages between 18 and 39. There is no evidence to indicate that women's fecundability shows a linear decline starting from their mid-20s (Speroff and Fritz 2005: 1015–6).

Nonetheless, as Carcio (1998: 38) stated, the groundless linearly declining figures could have been widely used for long years in the field of obstetrics and gynecology. Not only has it been the case in the United States (Phillips and Grifo 2016: 7), but there are also cases of these figures being quoted in a German academic journal (Findeklee et al. 2015: 1244; Müller et al. 2009: R69). In Japan Yamagata (2013: 177–82) provides an example of abusive usage: an educational use of the chart to encourage young women to get pregnant earlier. The linearly declining figures may have harmed people who received information from fertility sites and experts worldwide.

This study thus revealed how professionals fabricated Figure 1 from publications in the field of demography. It would not be an isolated case. With the growing concern about infertility issues today, professionals often talk on the age-fertility relationship in an oversimplified way. In 2015 a similar chart, falsified from the Bendel-Hua estimation by an influential obstetrician/gynecologist, was used in high school educational material published by the government of Japan (Tanaka 2017, Forthcoming). This material indicates that women's fecundability peaks at age 22, and then rapidly decreases (Fassbender 2016: 137–8). Such kind of information with a sensational impact is easily used to further a political agenda and distributed throughout the media. Once such information spreads as purportedly scientific, it is difficult to then correct the error. Professionals should be held responsible for preventing the spread of such misinformation to the society.

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