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Professional Responsibility for Spreading Unscientific Knowledge

The Case of the "Ease of Conception" Graph in a Supplementary High School Textbook

TANAKA Sigeto (Tohoku University)

Abstract

The government of Japan and professionals from the fields of obstetrics, gynecology, and reproductive medicine used a graph exaggerating the decline in women's fecundity, professing it begins a sharp linear descent in their mid-20s. It was used in a campaign to promote "accurate" knowledge about the suitable age range for pregnancy and was published in a supplementary textbook of health education for high schools in 2015. The author criticizes the use of the graph as well as the use of other unreliable research findings in the campaign that has resulted in the spread of unscientific knowledge in Japan today.

1. The high school supplementary textbook scandal in 2015 Japan

In August 2015, the government of Japan issued a supplementary textbook for health education classes and distributed it to high schools across the country. The 19th chapter of the textbook featured a life plan for girl students that took into account factors such as the timing of marriage and childbirth and the number of children they desired (Figure 1). The chapter also reported the results of surveys, including a finding that a majority of people thinks having children provides their life with meaning, joy, and passion (following accusations of inaccuracy, the figure depicting this finding was subsequently replaced). Another finding referenced in the textbook postulated that one in every six couples in their 30s undergoes screening or therapy for infertility (no citation was provided). Furthermore, the following chapter featured a graph indicating that a woman's ease of conception（妊娠のしやすさ）peaks at the age of 22 and then sharply declines (Figure 2).

When newspapers reported the contents of the textbook, and when it became available online(1) in PDF format, a storm of criticism ensued. The textbook received criticism for the exhibition of gender bias in presenting an example of a life plan only for women, and for its apparent ulterior motive of coaxing girls into marrying and having children at a young age as a means to improve the nation's birthrate. The most notable

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accusation, as reported in the newspapers, concerned the graph shown in Figure 2, which cited O'Connor et al. (1998). Compared to the graph as it appears in the source material, the graph in the textbook (Figure 2) appears to have been manipulated to present a more emphatic trend, with ease of conception declining more sharply across the mid and late 20s (Nishiyama and Tsuge, 2017: 19–20).

Following the criticism, the government amended the graph. On September 2, 2015, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) uploaded an erratum on its website. On September 30, it updated the online PDF edition of the textbook. The amended graph reproduced the curve as it was originally depicted by O'Connor et al. (1998).

2. The data sources of the "ease of conception" graph and their problems

The data in the "ease of conception" graph came from a study by Bendel and Hua (1978). They estimated the monthly probability of a woman conceiving, referred to as *fecundability*. Their estimation was based on the age-specific marital fertility rate (ASMFR; the number of marital births per year to women in a specified age group). Bendel and Hua (1978) used a probability model for conception-to-birth cycles, extrapolating age-specific probabilities of miscarriage, stillbirth, sterility, and other factors. Their estimation of fecundability for women aged 25 and over was based on surveys from the 1950s and 1960s among North American Hutterite women (Sheps 1965).[(2)] According to Sheps (1965), women in their 30s showed largely the same ASMFR as women in their 20s, as long as they were in the early stages of their marital life (Figure 3).[(3)]

Owing to flaws in the way Bendel and Hua (1978) processed the original data, it is difficult to claim that their findings represent women's biological capacity to conceive (termed *fecundity*). Specifically, when it came to the ASMFR data, they only used data pertaining to women who married in their early 20s. If their analysis had included data on women who married later, as represented by the two dotted lines in Figure 3, they would have found that fecundability remained largely stable until the mid-30s. As it turns out, they only used data pertaining to women who married early, as represented by the two solid lines in Figure 3. Consequently, their results indicated that fecundability declines significantly before the mid-30s, reflecting declining ASMFR with increasing time elapsed from the day of marriage. Generally speaking, couples tend to be the most fertile in their newlywed period and to bear additional children at a slower pace as time goes by, but this does not necessarily represent an age-related decline in women's biological fecundity. Rather, it may be attributable to a decline in the frequency of sexual intercourse and other non-biological influences due to the longer duration of continuous marital relationship.

Subsequently, Wood (1989) used Bendel and Hua's results to illustrate an age-fecundability profile. However, Wood manipulated the curve so that the resulting graph would indicate 22 as the peak age of fecundability. Wood's graph was then inaccurately reproduced in O'Connor et al. (1998). The graph in Figure 2 (i.e., the graph

that appeared in the textbook) includes only seven of the points plotted on the graph by O'Connor et al. (1998). In addition, three of these points, each within the 20s–30s range, were shifted left along the x-axis. These modifications made it appear that ease of conception enters a sharp linear descent immediately after peaking at age 22 (Tanaka forthcoming).

To summarize all the information we know today (Nishiyama and Tsuge 2017: 53–57), the author of Figure 2 is Dr. Yoshimura Yasunori（吉村 泰典）, a professor emeritus at Keio University. Dr. Yoshimura is also a former chairperson of the executive board of both the Japan Society of Obstetrics and Gynecology (JSOG) and the Japan Society for Reproductive Medicine (JSRM). He currently serves as a special adviser to the Cabinet. A graph bearing a close resemblance to the graph in Figure 2 appears in articles published on the website of the Yoshimura Bioethics Institute, a general incorporated association headed by Dr. Yoshimura. These articles present the graph as evidence to support Dr. Yoshimura's theory that women lose fecundity during their 20s. For instance, Yoshimura (2013) uses the graph to argue that if fecundity at age 22 is scaled at 1.0, the value at age 30 will be under 0.6, and at age 40, it will be around 0.3.

The graph in Figure 2 has also been featured in the lobbying activities of allied professional associations. On March 2, 2015, a petition was submitted to the Cabinet Office by JSOG, JSRM, and seven other associations: the Japan Association of Obstetricians and Gynecologists (JAOG), the Japan Society of Maternal Health, the Japan Society of Perinatal and Neonatal Medicine, the Japan Society of Gynecologic Oncology, the Japan Society for Menopause and Women's Health, the Japan Society of Adolescentology, and the Japan Family Planning Association (Nishiyama and Tsuge, 2017: 58). The petition urges the government to introduce certain teaching content on reproduction into junior high and high schools; specifically, the suitable ages for conception and childbirth, and life planning that takes these factors into account. In their petition, the associations refer to a graph that closely resembles Figure 2, to justify their request, along with an annotation stating that a woman's capacity to conceive declines with age.

The falsification of the graph in the high school textbook is in itself a problem of course, but there is another problem that cannot be overlooked: the citation for the graph only says "O'Connor et al. 1998". In the absence of a reference list in the textbook, merely knowing the name of the first author and the date of publication makes it difficult for readers to identify the source material. We nevertheless managed to identify the source as the study by O'Connor, Holman, and Wood (1998), but failed to find any explanation on the data or the method used to arrive at the representation. We then had to use its reference list to trace the data back to Wood (1989) and further back to Bendel and Hua (1978), and finally to the original data sources (Nishiyama and Tsuge 2017: 20–23). To further complicate matters, the research by Wood (1989) was difficult to access, being only available in a handful of libraries in Japan. On the other hand, the paper by Bendel and Hua (1978) was available for purchase online and had detailed explanations of the data and the estimation method. In other words, if only the authors of the textbook had

accurately cited Bendel and Hua, it would have been possible to pinpoint the problems with the graph much earlier. The textbook controversy thus serves as an instructive example of why second-hand references are so problematic, and why it is important to track down and check original sources.

Furthermore, if the authors had properly cited Bendel and Hua (1978), we could have surmised the unreliability of the study without even needing to read the work, by reason of its poor citation impact. *Web of Science* has recorded only 13 citations. In addition, of the 13 works that refer to the study, many either cite it in order to highlight its flaws or to briefly mention it as part of a general review of the literature. Not a single work appraises the study favorably after assessing its data and method (Tanaka 2017). The result of the citation search thus implies that the Bendel and Hua's study does not warrant an uncritical reference in a school textbook.

3. An international comparison of fertility literacy: The impact of IFDMS

To examine the reason for the production of the textbook, we must go back to the governmental document, *Outline of Measures against the Declining Birthrate*（少子化社会対策大綱）, which the Cabinet approved on March 20, 2015. In this *Outline*, the government set out the task of disseminating medically and scientifically accurate information on fertility and childbirth. The *Outline* also states that accurate knowledge should be incorporated into school education. This provision was the basis for including the "ease of conception" item in the textbook.

During the deliberative process for the *Outline*, results from the International Fertility Decision-Making Study (IFDMS), conducted by the Cardiff University research group, served as evidence that Japanese people lack accurate knowledge on fertility and childbirth (and that accordingly, schools should impart this knowledge). It is known today that the Japanese version of the questionnaire used in the IFDMS project contained a number of expressions unnatural to the Japanese (Nishiyama and Tsuge 2017: 146–154). In particular, of the 13 items of the scale that measures the knowledge of fertility (Cardiff Fertility Knowledge Scale), at least 10 were mistranslated in Japanese. Even setting aside the mistranslations, the questionnaire had a number of other problems. For example, the answer option "don't know" was assigned the same score as an incorrect answer (zero), the order of the items was different in the Japanese and English versions, and there was a question for which the correct answer varied by country. In light of these problems, the results from the IFDMS cannot be considered robust or comparable. Nevertheless, the study was treated as if it offered credible scientific evidence.

It was not until 2013 that the findings of the IFDMS appeared in an academic journal (Bunting et al. 2013). However, before then it had already been used in lobbying activities and leaked to the media. In February 2011, the head of the IFDMS project, Jacky Boivin, visited Japan and held a seminar for the media and a lecture for members of the Diet of Japan. Boivin et al. (2011) claimed that these promotional activities demonstrated the social impact of the research. The problems surrounding the IFDMS might thus be

attributable in some respects to the all-too-hasty actions of a researcher, who sought to get public attention by emphasizing the practical utility of the research findings. The findings of the IFDMS were subsequently quoted in the Diet, as well as in JAOG's monthly press conferences (Tanaka forthcoming). In this way, the notion became widespread that Japanese people have the lowest level of fertility literacy among countries of the world. The IFDMS findings also feature in the petition mentioned above that was submitted by the nine associations as evidence that Japan has a lower understanding of fertility and childbirth compared to other countries.

In the years that followed, there was no critical examination of the validity and reliability of IFDMS. Such criticism first emerged in September 2015, after the problems of the textbook came to light. By this time, the Cabinet had already approved the *Outline* to create the policy that would introduce fertility-related knowledge into school education, and public opinion in Japan had already established a self-image as a society lacking knowledge about fertility and childbirth.

4. Professional responsibility

In March 2017, one and a half years since the textbook scandal, MEXT published the FY2016 revised edition of the textbook. This revision removed Figures 1 and 2 and many of the other problematic items from the 2015 edition (Nishiyama and Tsuge 2017: 15). This outcome deserves applause insofar as it resulted from the government's acceptance of the criticisms levied at the information in the textbook.

On the other hand, no explanation has been forthcoming from Dr. Yoshimura and the other professionals. In September 2015, JSRM published a comment on the scandal from the chairperson of its executive board (Irahara 2015), advocating the use of the graph in the textbook. Moreover, the nine professional associations that submitted the aforementioned petition issued a response to a set of questions posed by an activist group investigating the issue (Nishiyama and Tsuge 2017: 60–74). In this response, they maintained that it was appropriate to use an amended version of the graph (a version in which the age of 22 was the peak, as after Wood (1989) manipulated the curve). They also stated that it was appropriate to use the IFDMS findings. However, the associations have never provided any grounds for their statements, so it is still unclear why they consider the use of the graph and the findings appropriate.

When professional associations lobby the government to disseminate certain research findings, the standard approach is to prepare a comprehensive review of the literature in order to deal with any questions people may raise. It is thus the professionals' responsibility to prepare reasonable accounts to justify the basis for considering findings as scientifically grounded. Yet the professional associations mentioned above were unprepared for the ensuing controversy. It appears as if they went no further than finding graphs that would be compelling to a general audience and reusing those graphs without bothering to evaluate the literature. A major challenge currently is to scrutinize the corruption in academic disciplines that might underpin such problematic situations.

Notes

(1) The online edition of the textbook is available from http://www.mext.go.jp/a_menu/kenko/hoken/08111805.htm. Upon each successive revision, the preceding edition is deleted. However, past editions can be found on archive sites such as http://archive.org.

(2) Hutterite is an ethno-religious group that is a branch of Anabaptists. The group is known for its high birth rate owing to the fact that its members shun birth control.

(3) The estimation for women aged 16–24 was based on Taiwanese data using a different method from that applied to the data on Hutterite women aged 25 and above.

Acknowledgement

I discussed three other graphs in the symposium report (http://hdl.handle.net/10097/64282), on which this paper is based. For more details on those graphs, see Tanaka (forthcoming). This article owes a great deal to the efforts of an activist group, which are reported in Nishiyama and Tsuge (2017). I would like to express my appreciation to all those who contributed valuable information and ideas, including anonymous Twitter account holders. English translation and editing services were offered by Editage (www.editage.jp), and covered under the fund from JSPS KAKENHI Grant Number 17K02069.

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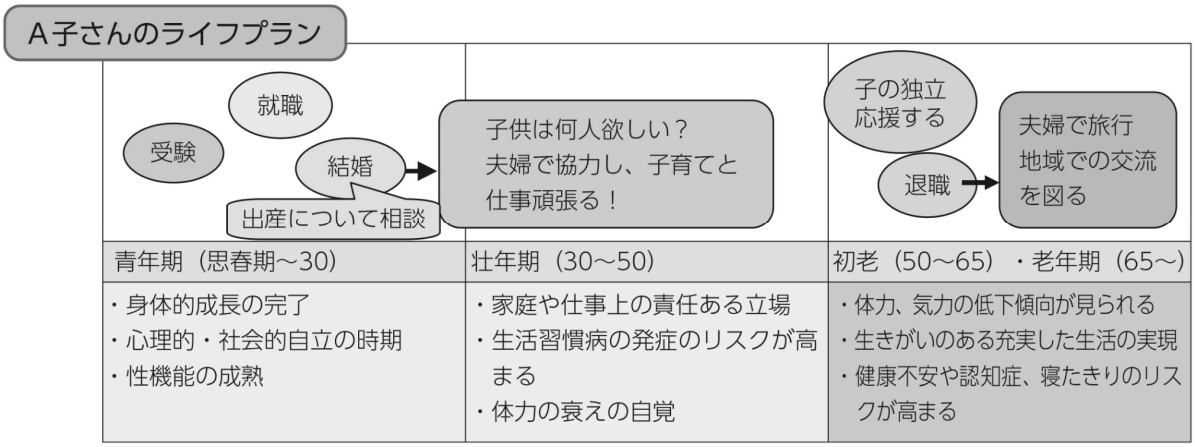
Figures



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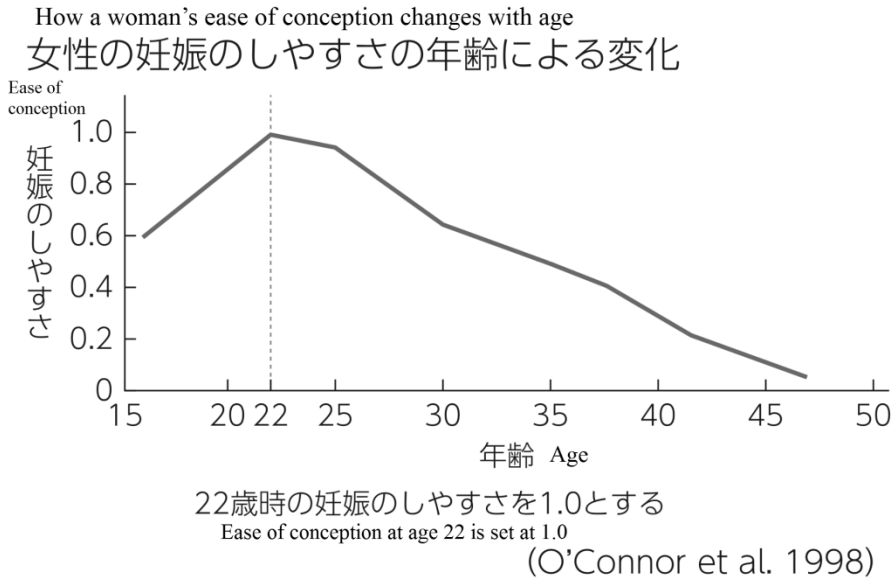
(a) The illustration on page 38 of the supplementary textbook

Miss A's Life Plan

Getting a job Entrance examination for university Marry → (discussion on childbirth)	How many children do I want? My husband and I will work together in childrearing and work!	My children leave home I would like to help them live independent lives Retire → Spend time with husband in a tourist destination Networking in the neighborhood
Young adulthood (adolescence to age 30)	Middle stage of life (30–50)	Early old age (50–65) / Old age (65+)
- Completion of physical development - Period for establishing psychological/social independence - Sexual maturation	- Responsible for family and job - Increased risk of contracting lifestyle-related diseases - Become aware of physical decline	- Signs of physical and mental decline - Finding a meaningful and fulfilling life - Increased risk of ill health, cognitive dementia, bedridden conditions

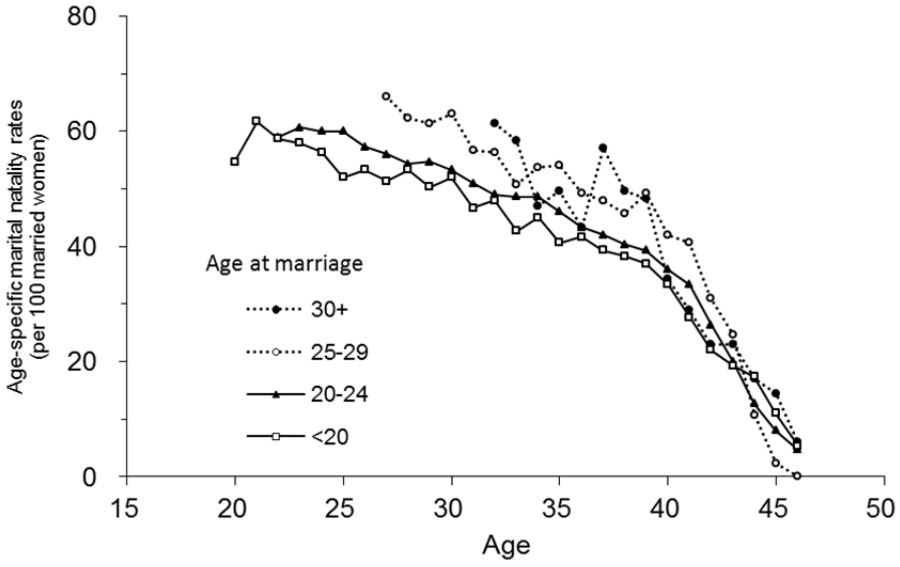
(b) Elements of the illustration translated into English by the author

Figure 1. "Life plan" illustration in the supplementary textbook (note that this is intended only for females)



Adapted from p. 40 of http://web.archive.org/web/20150906021930/http://www.mext.go.jp:80/component/a_menu/education/detail/__icsFiles/afieldfile/2015/08/17/1360938_09.pdf
English translations are inserted by the author.

Figure 2. The graph indicating a woman's "ease of conception" and how it changes with age (the version that appeared in the supplementary textbook, as of August 2015)



Three-year moving averages calculated by the author based on Sheps (1965: Table 2).
See Tanaka (2007: 141, note v).

Figure 3. ASMFR for Hutterite women, classified by age at marriage