Relationship between Decreasing Fertility during the Post-War Period and Maternal Age in a Japanese Population

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KANEKO, M., ALI, M. and USHIJIMA, H. Relationship between Decreasing Fertility during the Post-War Period and Maternal Age in a Japanese Population. Tohoku J. Exp. Med., 2004, 202 (3), 221-226 — This research was performed in an effort to understand the decrease in fertility that has occurred over the past few decades. The objective of the study was to analyze female fertility according to maternal age; data were based on the number of children born per mother. The records of 18-year-old college students were obtained, and the mothers of the students were categorized into age groups according to the year of their birth (1915 to 1949). The number of children born to each mother was then analyzed. The total sample size was 4078. The results showed that an increase in two-children families led to a reduction in the mean number of children per mother. While the decrease in the maternal age at the time of the birth of the last child in the family was observed, the maternal age at the time of the first birth did not increase. Thus, the reduction in fertility may not be the result of delayed motherhood. The group of mothers, who gave birth to the largest number of children, had their highest fertility rate in the twenties. In addition, their fertility rate in the thirties was almost equal to other groups, who had the same fertility level in their twenties. —— fertility decline; late child-bearing; maternal age at first birth; maternal age at last birth

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Japan is one of the world’s most populous and crowded countries, but it also has one of the slowest growth rates. At present, the annual population growth rate is 0.30% (UN 1997 and 1998; UNICEF 2001). The fertility rate in Japan has been declining since the late 20th century. Vital statistics records show a baby boom from 1947 to 49, with a live birth rate of 33 to 34 births per 1000 population. Between 1950-70, however, the live birth rate decreased to 17-19 births per 1000 population. Soon afterwards, a second baby boom occurred. During this time, the highest live birth rate recorded was 19.4 in 1973. Thereafter, the live birth rate declined sharply until 1993,
when a record low live birth rate of 9.5 was recorded in Japan (Statistics and information department 1997).

Until now, investigations regarding the decline in growth rates have been based primarily on demographic models comparing differences in birth and mortality rates (Bongaarts 1982 and 1984; Kuroda 1991; Hayashi et al. 1992; Inaba 1993). In addition to demographics, the role of issues such as public health, social welfare, economics, sociological and psychological aspects have also been examined (Potter 1973; Mason 1987; Bachi 1990; King 1990; Shimouchi et al. 1996). The results of this research indicate that many factors affect fertility, including age, race, region, job earnings, years of schooling and place of residence (Kaneko 1991; Ueki 1995; Meyer 1999).

All data used in this paper are based on the mothers of 18-year-old school girls. The reasons for selecting these mothers are as follows. First, fertility analyses in the past have been almost restricted to a macro-level of analysis (Atou 1982; Onodera 1991; Hiroshima 1992; Ishikawa 1993; Feeney 1994). Macro indexes (e.g., live birth rate and total fertility rate) are represented as averages per population. This study, however, adopts a micro analytical viewpoint and the data used in the study are based on the number of children born per mother.

Second, mothers with 18-year-old girls were assumed to have completed their families. Mothers born between 1915 and 1949 were included in the study. Third, most of the data were obtained from women living in Tokyo or the surrounding areas because the size of the school district was limited.

Fourth, the families of the girls were assumed to have somewhat similar standard of economic situations as they had to pay same school expenses. Thus, since the subjects were assumed to have a similar racial background, area of residence and economic situation, maternal age could be further analyzed to understand the phenomenon of fertility. The objective of this study was to analyze female fertility according to maternal age.

**METHODS**

The study population was created by collecting the student records of 18-year-old students attending a women’s college, in the Tama area of Tokyo. Each grade consisted of 120-180 female students. Most of the students lived in Tokyo or the surrounding areas. Students from other parts of Japan lived in the dormitory of the college and accounted for about 20 students in each grade.

Data on the mothers of female students who enrolled at the college between 1965 and 1992 were obtained. The records were obtained through the student’s affairs section after obtaining consent from the department’s head. The confidentiality of the individual names was also ensured. The family history, including the year of birth for all family members was obtained from the school records. The year of birth of the mothers and the number of siblings in the family were then tabulated. The records of students who were not 18 years old or who did not know the identity of their birth mother were excluded.

The years of birth of the students were distributed between 1947 and 1974. The years of birth of the mothers were approximately distributed between 1915 and 1949. Only a few mothers were born before 1915 or after 1950. The mothers of the students were divided into five groups according to the year of their birth. Group 1 included a sample consisted of 715 mothers born between 1915-24, the Taishou generation, and corresponded to a period of high fertility popularly known as the first baby boom. Group 2 included a sample of 1326 mothers, corresponded to a period of reduced fertility following the first baby boom and consisted of mothers born between 1925-34. Mothers in Group 3 (sample size: 838), Group 4 (sample size: 838), and Group 5 (sample size: 361) were born between 1935-39, 1940-44, and 1945-49, respectively. Group 5 corresponds somewhat to a second baby boom, but samples in this group are based on mothers.
who had their first child in their twenties and do not include those who had their first child in their thirties.

The following four variables were studied to analyze the fertility of mothers according to maternal age; the total number of children born (number of children), the mother’s age at the time of the birth of the first child (mother’s age at first birth), the mother’s age at the time of the birth of the last child (mother’s age at last birth), and the interval between the first and last births (interval between births). The data were analyzed using Microsoft Excel (1995 version) software.

**RESULTS**

Table 1 shows the data for each group, based on both the mothers’ and the students’ year of birth. The mean and standard deviation was calculated for the above-said four variables in each group, and the percentage distribution of the number of children born per mother in each group was estimated (Table 2). The fertility of mothers who bore their first child in their twenties or in their thirties was also calculated (Table 3). Data

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**Table 1. Year of birth for mothers and students**

<table>
<thead>
<tr>
<th>Years of birth</th>
<th>Students</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1 (1915-24)</td>
<td>446</td>
<td>188</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2 (1925-34)</td>
<td>100</td>
<td>357</td>
<td>596</td>
<td>273</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3 (1935-39)</td>
<td>423</td>
<td>415</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4 (1940-44)</td>
<td>468</td>
<td>370</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 5 (1945-49)</td>
<td>361</td>
<td>361</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number: 4078.

**Table 2. Means and standard deviations in the number of children, the age at first birth, the age at last birth and the interval between births and the percentage of children born in each group**

<table>
<thead>
<tr>
<th>Groups (Mothers year of birth)</th>
<th>Samples</th>
<th>Mean number of children***</th>
<th>Age at first birth**</th>
<th>Age at last birth***</th>
<th>Interval between births***</th>
<th>Percentage of children 1 (%)</th>
<th>Percentage of children 2 (%)</th>
<th>Percentage of children ≥3 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (1915-24)</td>
<td>715</td>
<td>2.88±1.02</td>
<td>26.06±3.50</td>
<td>31.99±3.71</td>
<td>5.94±3.47</td>
<td>6.9</td>
<td>28.5</td>
<td>64.6</td>
</tr>
<tr>
<td>Group 2 (1925-34)</td>
<td>1326</td>
<td>2.45±0.83</td>
<td>25.46±3.31</td>
<td>30.03±3.32</td>
<td>4.57±2.88</td>
<td>10.1</td>
<td>44.4</td>
<td>45.5</td>
</tr>
<tr>
<td>Group 3 (1935-39)</td>
<td>838</td>
<td>2.28±0.69</td>
<td>25.64±2.47</td>
<td>29.72±3.00</td>
<td>4.07±2.55</td>
<td>8.2</td>
<td>61.3</td>
<td>30.5</td>
</tr>
<tr>
<td>Group 4 (1940-44)</td>
<td>838</td>
<td>2.26±0.61</td>
<td>25.34±2.13</td>
<td>29.09±2.51</td>
<td>3.75±2.17</td>
<td>5.8</td>
<td>65.0</td>
<td>29.2</td>
</tr>
<tr>
<td>Group 5 (1945-49)</td>
<td>361</td>
<td>2.24±0.68</td>
<td>24.00±1.80</td>
<td>27.54±2.90</td>
<td>3.55±2.66</td>
<td>9.4</td>
<td>61.2</td>
<td>29.4</td>
</tr>
</tbody>
</table>

**p < 0.01, ***p < 0.001: One-way layout ANOVA.**
The data in Table 2 suggest that approximately 65% of the mothers in Group 5 bore their first child in their thirties, whereas most of the mothers in Groups 1-4 bore their first child in their twenties. The fertility level of the Group 1 mothers in their thirties was higher than that of the Group 3 mothers in their twenties. Among mothers who bore their first child in their twenties, the mean number of children was reduced from 2.34±0.90 in Group 1 to 1.70±0.75 in Group 2, and then to 1.83±0.65 in Group 3. However, the fertility level of the Group 1 mothers in their thirties was higher than that of the Group 3 mothers in their twenties. This percentage is higher than those of other groups. The data in Table 3 shows that almost 17% of the mothers in Group 1 bore their first child in their twenties, whereas the fertility level of the Group 4 mothers in their twenties was higher than that of the Group 3 mothers in their twenties. Among mothers who bore their first child in their twenties, the mean number of children decreased from 2.18±0.66 in Group 4 to 2.31±0.68 in Group 5. The mean age at first birth was also reduced from 25.08±2.28 in Group 1 to 25.18±1.88 in Group 5. The reduction in the mean age at first birth confirms the trend toward two-child families. Among Groups 1-5, the number of children per family and the interval between births were statistically significant in one-way analysis of variance (p<0.001). As compared with averages of variables that decreased more slowly than the other three variables.

According to the result in Table 2, the interval of births of the Group 1 mothers in their twenties was shorter than that of the Group 4 mothers in their twenties, whereas the fertility level of the former group was higher than that of the latter one.

**Table 3. Fertility of mothers in their thirties and twenties**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number of mothers in their thirties</th>
<th>Mean number of children</th>
<th>Age at first birth</th>
<th>Age at last birth</th>
<th>Interval between births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (1915-24)</td>
<td>122 (17.1%)</td>
<td>2.34±0.90</td>
<td>31.70±1.67</td>
<td>35.34±2.85</td>
<td>3.64±2.68</td>
</tr>
<tr>
<td>Group 2 (1925-34)</td>
<td>151 (11.4%)</td>
<td>1.70±0.75</td>
<td>31.45±1.67</td>
<td>33.43±2.75</td>
<td>1.98±2.47</td>
</tr>
<tr>
<td>Group 3 (1935-39)</td>
<td>58 (6.9%)</td>
<td>1.83±0.65</td>
<td>30.90±1.12</td>
<td>33.03±1.84</td>
<td>2.14±1.86</td>
</tr>
<tr>
<td>Group 4 (1940-44)</td>
<td>28 (3.3%)</td>
<td>2.18±0.66</td>
<td>30.55±0.63</td>
<td>33.57±2.40</td>
<td>3.07±2.28</td>
</tr>
<tr>
<td>Group 5 (1945-54)</td>
<td>807 (96.3%)</td>
<td>2.26±0.61</td>
<td>25.18±1.88</td>
<td>28.94±2.37</td>
<td>3.75±2.13</td>
</tr>
</tbody>
</table>

Note: the percentages in parentheses shows the number of mothers in their thirties and twenties / total number of mothers.
Mothers in Group 1 had the highest fertility level among all five groups and the highest percentage of mothers in their thirties. The decline in fertility may be attributable to a lower maternal age at the time of the last birth, and not to an increase in the maternal age at the time of the first birth. As the results demonstrate, a decline in fertility is not always due to delayed motherhood. The decline in fertility among Groups 1-5 corresponded to a reduction in the interval between births except for the Group 1 mothers in their thirties.

Group 1 was the only group in which a late child-bearing generation was observed. Firstly, the mean maternal age at the time of the first birth was the highest among the five groups. Secondly, the percentage of mothers who bore their first child in their thirties was about 17% in Group 1, the highest percentage among all the groups. Thirdly, the overlapping of the marriageable age with the period of World War II suggests that the war led to more late marriages.

It is noteworthy that Group 1, the late child-bearing group, showed the highest fertility level. Attention should be focused on the reproductive behavior of mothers in Group 1, since they had the highest fertility level in their twenties and the fertility in their thirties was almost equaled to other groups in their twenties.

The records (Vital Statistics 1949) show that in 1947, approximately 51% of children born was either third child or later in a family. Although this ratio decreased in 1950, the percentage of newborn became about 45%, which was the third child or later of a family. In this study, Group 1 almost included mothers who had babies born between 1947-50. Since the result shows that most of mothers in Group 1 had three or more children, it is considered that on the reproductive behavior, there was a little difference between the two situations.

According to the fertility survey in Institute of Population Problems, Ministry of Health and Welfare (1973), the mean number of children in ages, 45-49 years of mothers was 2.59 in 1972, and in the same way, 2.33 in 1977. This means the period between 1923-32, when they were born, almost corresponded to Group 2 in this study. The mean number of children of the Group 2 mothers was 2.45. In addition, while the mean number of children of mothers born between 1932-42 in the fertility survey was 2.21-2.20, the mean number of children of the Group 3 and 4 mothers in this study was 2.28 and 2.26, respectively. In this point, it is demonstrated that the fertility level in the fertility survey was almost the same as reported in this study.

However, the objective of the past fertility survey was to research how many children each Japanese couple have according to the region and the type of job, and not to analyze according to maternal age.

Birthrates are now less than one-third compared to those in Japan before the 1950’s, when it was common for couples to have three or more children. After the 1950’s, the average number of children per family was reduced to two. If fertility rates continue to decrease, two-children families will also start to disappear.

The decline in the present fertility rate is often explained using the reasoning that women who marry late have fewer children, compared to those who marry young (Kono 1990, 1992). However, the reproductive behavior of Group 1 indicates that the trend towards a decline in fertility affects not only women in the late child-bearing age category, but also those who have babies at a younger age.

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