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Relationship between socioeconomic class and access to Assisted Reproductive Technology in Japan



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Abstract

This paper examines the relationship between access to fertility treatment, access to Assisted Reproductive Technology (such as in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI)) and socioeconomic class in Japan using data from an internet monitoring survey conducted by the author. The analysis revealed that (1) the probability of use of fertility treatment was higher for households with higher levels of annual household income, and (2) the probability of use of Assisted Reproductive Technology was higher for women with higher educational backgrounds. In Japan, insurance coverage was extended to cover fertility treatment in April 2022. Insurance coverage for fertility treatment is expected to partially reduce the financial burden on couples using this service. However, the results presented here suggest that bridging the social stratification gap in access to Assisted Reproductive Technology (ART) will not be achieved solely by reducing the financial burden on the patient.

Keywords

Assisted Reproductive Technology, Fertility treatment, Socioeconomic stratification, Social inequalities, Japan

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1. INTRODUCTION

The number of couples undergoing fertility treatment is increasing around the world. Among infertility treatments, Assisted Reproductive Technology (hereinafter referred to as ART) such as in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI) are the most prominent. Whether ART are covered by insurance differs from country to country, but in many cases, the patient must bear high costs. Therefore, the relationship between socioeconomic stratification and access to ART has been repeatedly examined in developed countries.

Japan has the highest annual total number of ART procedures in the world [Chambers et al. 2021]. However, in Japan, little is known about the relationship between socioeconomic stratification and access to ART, which has principally accumulated in developed countries. Therefore, this paper clarifies the relationship between socioeconomic class and access to ART in Japan.

2. PREVIOUS STUDIES

In the U.S., two main variables, namely race and socioeconomic class, have been used to assess access to fertility treatment and ART (and its outcomes). In line with the aim of this paper, I present a study that empirically demonstrates the impact of socioeconomic class on access to fertility treatment and ART. Smith et al. (2011) found that higher household income and women's higher education mediated access to more advanced treatment and more frequent treatment, leading to higher pregnancy rates [Smith et al. 2011]. In addition, Tierney et al. (2019) examined the rate of births resulting from ART from birth statistics data covering 2010 to 2017 and noted that level of education had an impact across all age groups but was characterized as having the greatest impact on the 35-39 and 40-44 age groups [Tierney et al. 2019].

In the United Kingdom, the association between socioeconomic class and seeking medical help regarding infertility has been repeatedly examined. Although the results are inconsistent due to differences in survey timing and sampling methods, relatively recent studies have noted an association

between higher educational attainment and professional status and seeking medical help regarding infertility. Morris et al. (2011) analyzed response data from women who had conceived or attempted to conceive and noted that educational level and social status were not associated with seeking medical support for infertility. [Morris et al. 2011]. On the other hand, analyzing a cross-sectional survey of men and women between the ages of 16 and 74 in the United Kingdom, Datta et al. (2016) found that higher educational level and professional status were associated with a greater tendency to seek medical and professional help to treat infertility [Datta et al. 2016].

In addition to the U.S. and U.K. studies reviewed above, the association between socioeconomic stratification and ART has been examined in Australian and Scandinavian studies. In Australia, for example, the association between socioeconomic measures and access to ART has been examined using The Index of Relative Socioeconomic Advantage and Disadvantage [Harris et al. 2016]. Harris et al. (2016) found that those with higher socioeconomic status were more likely to access ART, even after controlling for age at first birth as a proxy indicator of the need for fertility treatment. Furthermore, the association between socioeconomic class and the accessibility of ART has also been examined in Denmark. Denmark has both public and private sector ART clinics. Interestingly, even in public sector clinics, where the financial burden on individuals is quite light, higher levels of education and income have been found to be associated with access to ART [Brautsch 2022]¹.

As described above, the determinants of access to fertility treatment and ART have been repeatedly examined from the perspective of socioeconomic inequality in developed countries. Although the findings have been inconsistent due to differences in survey timing and sampling

¹ This paper also found that women's participation in the labor market increased their odds of using ART.

methods, it has been noted that, in general, the higher the socioeconomic status of a person is, the higher the percentage of access to fertility treatment and ART.

Based on the above results, I review the previous studies on this issue in Japan. Iba et al. (2021) examined the relationship between access to infertility treatment and household income using data from The 15th Japanese National Fertility Survey (Iba et al. 2021). The results revealed that the percentage of medical facility visits increases linearly from low-income groups (less than 4 million yen) to high-income groups (8 million yen or more). In particular, households with annual incomes of 6-8 million yen or more show a higher percentage of medical visits than those with annual incomes of less than 4 million yen. In other words, in Japan, as in Europe and the U.S., the higher that the household income is, the higher the probability to accessing fertility treatment. However, there are limitations to the previous studies conducted in Japan. Specifically, the dependent variable used in these studies was "whether the couple received infertility treatment or not," and no data were used to distinguish whether the couple received general fertility treatment or ART. Therefore, this paper examines the relationship between socioeconomic stratification and access to fertility treatment by dividing the dependent variable into groups according to whether or not they have previously utilized general fertility treatment and whether or not they have previously utilized ART.

3. METHOD

3.1. DATE

The data used in this paper come from an internet monitoring survey for which the author designed the questionnaire. The conducting the survey was commissioned to Macromill, Inc by the auther. The sample consisted of 30's women who were either "married," "childless," and "have thought about fertility treatment or fertility control ("Ninkatu" in Japanese)," and was assigned according to the population size of eight areas in Japan (Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, and Kyushu). The survey was conducted from March 26, 2020 to March 27, 2020. The number of valid responses was 1,034. The main questions asked regarded the annual income and educational

background of the respondents and their spouses and whether they had experience with general fertility treatment and ART.

3.2. VARIABLES

The dependent variables are a dummy variable for experience with fertility treatment and a dummy variable for experience with assisted reproductive technology. The former was defined as 1 if the respondent had experienced any of the following fertility treatments: (1) Testing, 2) Timed intercourse, 3) AIH, 4) IVF, and 5) ICS; it was set as 0 otherwise. The latter was defined as 1 if the respondent had experience with either or both IVF and ICSI and 0 otherwise.

The explanatory variables were defined as follows. Household income was measured with a question asking each couple's annual income in units of 1 million yen. The figures were calculated by converting each couple's annual income to the median of their class and adding them together and categorizing the results into five variables: less than 4 million yen (low), 4 million yen to 6 million yen (lower-middle), 6 million yen to 8 million yen (middle), 8 million yen to 10 million yen (upper-middle), and 10 million yen or more (high). Educational background was measured by the question "Which of the following schools did you and your spouse last attend? Please treat dropouts and in-school enrollments the same as graduation." Specifically, the response categories were 1) junior high school/high school graduate, 2) vocational school/junior college/technical college graduate, and 3) university (4-year degree), graduate school, or college (6-year degree). The number of years of marriage was a three-valued categorical variable including the levels of "less than 5 years," "5-9 years," and "more than 10 years," based on the question "how long has it been since the respondents were married." The wife's employment was captured by a dummy variable that reflected whether the

respondent was currently employed, with 1 indicating yes and 0 indicating no. The region of residence² was a categorical variable based on a question that asked respondents to indicate their place of residence at the time they registered as monitors, and the response options included Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu. The reference category was Kanto. The wife's age of 35 and older dummy was a categorical variable that used 0 for ages 30 to 34 and 1 for ages 35 to 39³.

4. RESULTS

In this paper, I proceed with the analysis taking the following steps. (1) Descriptive analysis is conducted through cross tabulations of the association between socioeconomic strata and the presence or absence of experience with fertility treatment and ART. (2) A multivariate analysis is conducted using binomial logistic regression analysis with the presence or absence of experience with fertility treatment and ART as the dependent variables.

4.1. DESCRIPTIVE RESULTS

Before the multivariate analysis is presented, the descriptive statistics are reviewed in this section. Tables 1 through 6 show the cross-tabulation tables for "household income" and "education background of men" and "education background of women" with "fertility treatment" and "assisted reproductive technology." Significant differences at the 5% level are shown in Table 4: Cross-tabulation of household income and experience with ART and Table 5: Cross-tabulation of educational background of women and experience with ART. Confirming each of these results, Table 4 shows that

² Respondents chose their region of residence when they registered as monitors with the survey company, not when they responded to the specific monitoring survey analyzed in this paper.

³ As noted above, the sample consisted of women in their 30 s.

the higher the annual household income is, the higher the percentage of respondents utilizing ART. Table 5 shows that the higher a woman's educational background is, the more likely she is to utilize ART. In other words, when fertility treatment and ART were considered separately, there was no significant association between whether or not a couple had experienced fertility treatment and either their annual household income or the couple's respective educational background, but a significant association was confirmed between ART and both annual household income and the educational background of women.

Table1: Cross Table of Household Income and Experience with Fertility Treatment

		No experience with fertility treatment	Experience with fertility treatment	Total	N
<i>Household income</i>	<i>Low</i>	42.1%	57.9%	100.0%	76
	<i>Lower - middle</i>	38.6%	61.4%	100.0%	215
	<i>Middle</i>	37.7%	62.3%	100.0%	236
	<i>Upper - middle</i>	40.2%	59.8%	100.0%	164
	<i>High</i>	27.4%	62.3%	100.0%	877
<i>Pearson's χ2 = 9.185</i>		<i>(p=0.057)</i>		<i>Cramer's V= 0.102</i>	

Table2: Educational background of women and Experience with Fertility Treatment

		No experience with fertility treatment	Experience with fertility treatment	Total	N
<i>Educational background of women</i>	<i>vocational school/junior college/technical college</i>	36.2%	63.8%	100.0%	268
	<i>university/graduate school</i>	35.8%	64.2%	100.0%	455
		<i>Pearson's χ2 = 0.738</i>	<i>(p=0.691)</i>	<i>Cramer's V= 0.029</i>	

Table3: Cross Table of Educational background of men and Experience with Fertility Treatment

		No experience with fertility treatment	Experience with fertility treatment	Total	N
		junior high school /high school	36.2%	63.8%	100.0%
Educational background of men	vocational school/junior college/technical college	37.0%	63.0%	100.0%	154
	university/graduate school	36.6%	63.4%	100.0%	549
<i>Pearson's χ² = 0.023</i>		<i>(p=0.989)</i>		<i>Cramer's V= 0.005</i>	

Table4: Cross Table of Household Income and Experience with ART

		No experience with ART	Experience with ART	Total	N
		Low	90.8%	9.2%	100.0%
Household income	Lower - middle	85.6%	14.4%	100.0%	215
	Middle	86.9%	13.1%	100.0%	236
	Upper - middle	82.9%	17.1%	100.0%	164
	High	75.8%	24.2%	100.0%	877
<i>Pearson's χ² = 13.722</i>		<i>p < .01</i>		<i>Cramer's V= 0.125</i>	

Table5: Cross Table of Educational background of women and Experience with ART

		No experience with ART	Experience with ART	Total	N
		junior high school /high school	92.2%	7.8%	100.0%
Educational background of women	vocational school/junior college/technical college	84.0%	16.0%	100.0%	268
	university/graduate school	80.9%	19.1%	100.0%	455
<i>Pearson's χ² = 10.888</i>		<i>p < .01</i>		<i>Cramer's V= 0.111</i>	

Table6: Cross Table of Educational background of men and Experience with ART

<i>Educational background of men</i>		<i>No experience with ART</i>	<i>Experience with ART</i>	<i>Total</i>	<i>N</i>
		89.7%	10.3%	100.0%	174
	<i>junior high school /high school</i>	89.7%	10.3%	100.0%	174
	<i>vocational school/junior college/technical college</i>	83.8%	16.2%	100.0%	154
	<i>university/graduate school</i>	82.0%	18.0%	100.0%	549
<i>Pearson's χ2 = 5.755</i>		<i>(p=0.056)</i>		<i>Cramer's V= 0.081</i>	

4.2. MULTIVARIATE ANALYSIS

In this section, the results of the multivariate analysis are presented.

Table7: Descriptive statistics of variables used in multivariate analysis

	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>S.D.</i>
All fertility treatment	0.00	1.00	0.6340	0.48199
Assisted Reproductive Technology	0.00	1.00	0.1619	0.36858
Household income				
Low	0.00	1.00	0.0867	0.28150
Lower - middle	0.00	1.00	0.2452	0.43042
Middle	0.00	1.00	0.2691	0.44374
Upper - middle	0.00	1.00	0.1870	0.39013
High	0.00	1.00	0.2121	0.40902
Wife's educational level				
High school education or less	0.00	1.00	0.1756	0.38070
Vocational or junior college education	0.00	1.00	0.3056	0.46092
University education or higher	0.00	1.00	0.5188	0.49993
Husband's educational level				
High school education or less	0.00	1.00	0.1984	0.39903
Vocational or junior college education	0.00	1.00	0.1756	0.38070
University education or higher	0.00	1.00	0.6260	0.48414
Wife's employment	0.00	1.00	0.6796	0.46690
Wife's age over35years	0.00	1.00	0.4401	0.49669
Length of the marriage, years				
< 5	0.00	1.00	0.6454	0.47867
5-9	0.00	1.00	0.2588	0.43825
≥ 10	0.00	1.00	0.0958	0.29446
Residential region				
Hokkaido	0.00	1.00	0.0399	0.19586
Tohoku	0.00	1.00	0.0525	0.22306
Kanto	0.00	1.00	0.4287	0.49518
Chubu	0.00	1.00	0.1676	0.37374
Kinki	0.00	1.00	0.1608	0.36753
Chugoku	0.00	1.00	0.0433	0.20371
Shikoku	0.00	1.00	0.0205	0.14187
Kyusyu	0.00	1.00	0.0867	0.28150

N=877

Table8: Binomial logistic regression analysis estimation results [dependent variable: fertility treatment experience dummy]

	Model1			Model2		
	B	Exp (b)	S.E.	B	Exp (b)	S.E.
	0.518	1.679	0.173	1.030 **	2.800	0.347
Wife's employment	-0.176	0.838	0.156	-0.350 *	0.705	0.172
Wife's age over35years	-0.113	0.893	0.153	-0.134	0.875	0.155
Length of the marriage, years						
< 5	ref.			ref.		
5-9	0.481 **	1.617	0.173	0.553 **	1.738	0.177
≥ 10	0.854 **	2.350	0.287	0.892 **	2.441	0.291
Residential region						
Hokkaido	-0.294	0.745	0.364	-0.199	0.819	0.372
Tohoku	0.249	1.283	0.342	0.398	1.488	0.350
Kanto	ref.			ref.		
Chubu	0.103	1.109	0.206	0.197	1.218	0.211
Kinki	0.224	1.252	0.212	0.280	1.323	0.217
Chugoku	-0.572 †	0.564	0.346	-0.508	0.602	0.350
Shikoku	0.121	1.129	0.518	0.290	1.337	0.524
Kyusyu	-0.235	0.791	0.259	-0.112	0.894	0.265
Household income						
Low				-1.031 **	0.357	0.327
Lower - middle				-0.677 **	0.508	0.237
Middle				-0.611 **	0.543	0.225
Upper - middle				-0.607 *	0.545	0.237
High				ref.		
Wife's educational level						
High school education or less				ref.		
Vocational or junior college education				0.232	1.261	0.220
University education or higher				0.165	1.179	0.213
Husband's educational level						
High school education or less				ref.		
Vocational or junior college education				-0.041	0.960	0.241
University education or higher				-0.101	0.904	0.200
N	877			877		
-2Log-Likelihood	1127.376			1111.612		
Cox-Snell R ²	0.028			0.045		
Nagelkerke R ²	0.038			0.062		

†p< .10, *p<.05, **p<.01, ***p<.001

Table9: Binomial logistic regression analysis estimation results [dependent variable: ART experience dummy]

	Model1			Model2		
	B	Exp (b)	S.E.	B	Exp (b)	S.E.
	-1.881 ***	0.152	0.229	-2.555 ***	0.078	0.509
Wife's employment	-0.286	0.751	0.197	-0.619 **	0.538	0.221
Wife's age over35years	0.182	1.199	0.204	0.140	1.150	0.212
Length of the marriage, years						
< 5	ref.			ref.		
5-9	0.927 ***	2.528	0.209	1.181 ***	3.256	0.221
≥ 10	0.854 **	2.350	0.313	1.046 **	2.846	0.331
Residential region						
Hokkaido	-0.840	0.432	0.629	-0.799	0.450	0.650
Tohoku	-0.645	0.525	0.501	-0.229	0.795	0.525
Kanto	ref.			ref.		
Chubu	0.415 †	1.514	0.244	0.715 **	2.044	0.259
Kinki	-0.332	0.717	0.293	-0.203	0.816	0.305
Chugoku	-0.098	0.907	0.475	0.040	1.041	0.487
Shikoku	0.377	1.458	0.598	0.799	2.222	0.623
Kyusyu	-0.514	0.598	0.406	-0.132	0.877	0.420
Household income						
Low				-1.552 **	0.212	0.483
Lower - middle				-0.739 *	0.478	0.294
Middle				-0.914 **	0.401	0.285
Upper - middle				-0.443	0.642	0.288
High				ref.		
Wife's educational level						
High school education or less				ref.		
Vocational or junior college education				0.950 **	2.585	0.366
University education or higher				1.097 **	2.996	0.356
Husband's educational level						
High school education or less				ref.		
Vocational or junior college education				0.519	1.680	0.355
University education or higher				0.394	1.483	0.301
N	877			877		
-2Log-Likelihood	733.625			693.530		
Cox-Snell R ²	0.048			0.091		
Nagelkerke R ²	0.082			0.154		

†p< .10, *p<.05, **p<.01, ***p<.001

First, Table 7 displays the descriptive statistics of the variables used in the multivariate analysis. Table 8 then presents the estimation results of the binomial logistic regression analysis with the dummy variable for experience with fertility treatment as an independent variable, and Table 9 presents the estimation results of the binomial logistic regression analysis with the dummy variable for experience with ART as an independent variable. In both analyses, only control variables were included in Model 1, while the variables related to socioeconomic stratification (annual household income and the couple's respective educational background) were included in Model 2. As can be seen in both Table 8 and Table 9, the -2Log-Likelihood values are lower and the Cox-Snell R² and Nagelkerke R² values are higher for Model 2 than for Model 1. In other words, the explanatory power of the model is increased by the inclusion of variables related to socioeconomic stratification in Model 2.

Let us now review the results by comparing Tables 8 and 9. First, the presentation of Model 2 in Table 8 shows that the probability of experiencing fertility treatment decreases with decreasing annual household income when controlling for employment status of the woman, the woman's age, the number of years married, and the region of residence. On the other hand, the educational background of the wife and husband is not statistically significant to the probability of access to fertility treatment.

We next review the results displayed in Table 9, where the ART experience dummy variable is as the dependent variable. Reviewing the presentation of Model 2 in Table 9, we find that the effect of household income tends to be similar to that in Table 8. That is, the lower that the household income is, the lower the probability of utilizing ART. However, the effects of educational background show different trends in Tables 8 and 9. Table 9 shows that the probability of experiencing ART varies with the wife's educational background. Specifically, the probability of experiencing ART is approximately 2.6 times higher for those with a vocational or junior college education and approximately 3.0 times higher for those with a university education or higher than it is for those with a high school education or less.

Checking the effect of educational background on the probability of experiencing fertility treatment shows no statistically significant difference. On the other hand, the analysis using the dummy variable for experience with assisted reproductive technology as the dependent variable confirms a statistically significant difference in the effect of the woman's educational background. Using the category of junior high school/high school graduate as the reference category, the odds ratio is approximately 2.6 times higher for those with junior college/technical school/technical college level education and approximately 3.0 times higher for those with college/graduate school level education in terms of the odds ratio for the probability of having previously utilized ART. Women's higher educational background increases their odds of experiencing ART, while men's educational background has no statistically significant effect on their odds of experiencing ART.

5. DISCUSSION

This paper examined the relationship between access to fertility treatment and ART and socioeconomic class in Japan. The relationship between access to ART and socioeconomic class has been repeatedly examined in developed countries. On the other hand, the socioeconomic strata of couples who use ART have not been clarified, although Japan annually performs the highest total number of ART procedures in the world.

The results of this paper can be summarized in the following three points. First, when controlling for a wife's employment status, a wife's age, years of marriage, and region of residence, the results show that the lower the household income is, the lower the probability of utilizing either fertility treatment or ART. Second, while we could not confirm a significant effect of the wife's educational background on access to fertility treatment, we could confirm an effect of the wife's higher educational background on access to ART. Third, the husband's educational background had no statistically significant effect on either access to fertility treatment or to ART.

Based on the above results, two perspectives will be considered, namely, insurance coverage of fertility treatment and the effect of a woman's educational background. First, I would like to discuss

the trend of insurance coverage for fertility treatment. In Japan, insurance coverage of fertility treatment (including ART) became applicable in April 2022. The data used for the paper's analysis were obtained from a survey conducted in 2020, which means that the data were obtained before insurance coverage of fertility treatment was introduced. Therefore, it is necessary to examine what changes occur (or not) in the relationship between access to fertility treatment (including ART) and socioeconomic stratification as a result of the insurance coverage of fertility treatment. Second, I would like to discuss the effects of women's educational backgrounds on access to fertility treatment. In this paper, we found that male educational background has no statistically significant effect on access to either fertility treatment or ART, while female educational background positively impacts the probability of access to ART. The reason that a woman's higher educational background leads to a higher probability of accessing to ART is not clear in this paper. However, if we are to aim for a society in which ART is available to all who wish to use it, regardless of socioeconomic class, then it will be necessary to clarify the mechanism of the effect of women's higher educational background on their access to ART.

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