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# The first nationwide website survey of the availability and costs of medical and non-medical oocyte cryopreservation in Japan

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A R T I C L E I N F O

*Keywords:*
Oocyte cryopreservation
Annual storage cost
Medical
Non-medical
Fertility preservation

A B S T R A C T

*Research question:* How does the cost-related oocyte cryopreservation (OoC) vary by the facility in Japan, and what data is provided on the websites about OoC procedures?

*Design:* Website survey. The websites of all 621 facilities that provide assistive reproductive technology registered in Japan were surveyed in 2021. Data included the rates of explicit statements regarding the provision of OoC for only medical reasons (medical only group) or non-medical reasons (non-medical group). Based on whether or not facilities that perform OoC clearly stated the cost on their websites, we compared the costs of OoC and annual storage cost between medical only and non-medical groups. Furthermore, we examined the stated number of OoC procedures performed and their clinical outcomes.

*Results:* Of the 621 facilities, 146 (23.5%) clearly stated that they offer OoC on their websites. Of the 88 medical only groups and 58 non-medical groups, 24 (27.3%) and 42 (72.4%) clearly stated the OoC cost, and 27 (30.7%) and 44 (75.9%) clearly states the annual oocyte storage cost, respectively. The OoC costs were significantly higher for the non-medical group than in the medical group. In the medical only group, the annual storage cost remained almost the same regardless of the number of oocytes, while in the non-medical group, the annual storage cost was 2–3 times higher than in the medical only group. Only 16 facilities (16/146, 11.0%) had mentioned the number of OoC procedures, and five facilities (3.4%) provided information on the clinical outcomes after OoC.

*Conclusion:* Costs related to OoC are higher for the non-medical group in Japan. In addition, the websites contain scant information on the costs and clinical outcomes of OoC.

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## 1. Introduction

In the context of oocytes cryopreservation (OoC) for non-medical reasons, indications, age restrictions, registration systems, and subsidy programmes vary widely from country to country. In some countries, OoC is regulated by law, while in others, OoC is practically regulated only by the opinions of academic societies [1]. In Japan, medical OoC requires registration with the Japanese Society of Obstetrics and Gynecology (JSOG); however, non-medical OoC does not require registration, a medical specialist, or other certifications. There are limited means for those who wish to obtain accurate information on OoC, and the exact number of facilities in Japan that provide this service remains ambiguous [2]. OoC is considered as an established option in the European Society of Human Reproduction and Embryology's (ESHRE) fertility preservation guideline, and its demand for OoC for reasons other than oncofertility preservation is expected to increase in the future [3,4]. Furthermore, the American Society for Reproductive Medicine's Ethics Committee stated that planned OoC for future infertility due to aging is ethically permissible in 2018 [5]. The introduction of commercialism is also understood very differently in each country, which significantly influences the availability of OoC.

In addition, although many OoC applicants refer to websites, such as those of individual facilities, whether the websites contain accurate information desired by the patients remains ambiguous. In fact, it has been reported that the information provided on the websites is inadequate [6]. An analysis of websites on elective OoC in the United Kingdom in 2021 reported that the actual cost and other information were inadequately described for most clinics [7]. Although the cost of OoC is considered a matter of high interest to applicants, reports on the details of cryopreservation costs and annual storage cost remain scant. On such example is a report from Canada on the annual oocyte storage costing $300-$500 in 2015 [8]; however, only few international comparisons of the annual oocyte storage costs have been conducted. In addition, the policies regarding OoC cost and annual oocytes storage cost differ from facility to facility. The cost may vary depending on the number of cryopreservation oocytes. Therefore, it is important for each facility's website to state such information for applicants. The percentage of facilities in Japan that include such information on their websites remains hitherto unknown. In Japan, assisted reproductive technologies (ART), such as in vitro fertilization (IVF) procedures, were not covered by national health insurance in March 2022. However, the national health insurance has covered many ARTs, such as IVF under 43 years old, from April 2022, a significant change from the previous system. With the new insurance coverage, the government also set cryopreservation embryo costs and annual embryo storage costs. The cryopreservation embryo costs vary depending on the number of embryos to be cryopreserved. The cost for one embryo is 55,000 JPY (396 Euro, EUR), whereas the cost for two to five embryos is 77,000 JPY (554 EUR). Similarly, the cost for six to nine embryos is 112,200 JPY (808 EUR). The cost increases to 143,000 JPY (1030 EUR) for ten or more embryos. The annual embryo storage cost has a flat rate of 38,500 JPY (277 EUR), regardless of the number of embryos. However, OoC and annual storage costs for unfertilised oocytes were not included in the insurance coverage.

In this study, we surveyed the OoC status and cost setting of assisted reproductive technology (ART) facilities in Japan before the introduction of insurance coverage in April 2022, using each facility's website. Medical OoC aimed at fertility preservation before cancer treatment is not covered by insurance, but the national government and local prefectures subsidized some of the costs from 2021. On the other hand, no public subsidies for social or planned non-medical OoC have been provided. The difference in cost setting between facilities that perform only medical OoC and those that also perform non-medical OoC is informative. This is the first survey of all the websites of ART facilities in Japan (2021), which compares data on OoC.

## 2. Methods

The study included all 621 facilities registered with the Japanese Society of Obstetrics and Gynecology for ART as of July 1, 2021. All ART facilities in Japan are registered with the JSOG, and their names are published in the society's journal in Japanese [9]. Of the 621 centres, 148 were also registered to cryopreserve unfertilised oocytes for medical reasons. In this study, we compiled data based on the information provided on the official website of each medical institution. The website of each medical institution was carefully viewed, and data collection was conducted by the board certificated specialist (S·H) of the Japan Society for Reproductive Medicine (JSRM) between October 1 and October 15, 2021.

The following data were collected from the websites: whether they clearly state that they perform OoC, whether facilities that perform OoC also state that they perform OoC for non-medical reasons, whether institutions state the cost of OoC, whether they state the annual storage cost, and the number of OoC conducted at the facility in the past. The medical only group was defined as facilities that cryopreserve oocytes for medical reasons only, while the non-medical group was defined as facilities that cryopreserve oocytes for non-medical reasons with or without medical reasons. In 2014, in Japan, the JSOG defined the medical only group of OoC as patients who are expected to lose fertility due to surgical therapy, chemotherapy, or radiation therapy for malignant tumors. This 2014 JSOG committee opinion was slightly updated in 2019 and is still in effect [10]; we utilise this definition in our study. The non-medical group includes facilities that perform social OoC, planned OoC, and OoC for age-related fertility loss. Each institution's background was examined separately for university and non-university hospitals (private clinics and prefectural hospitals). The two groups, the medical only group and the non-medical group, were statistically compared for each indicator. The non-medical group includes facilities registered with JSOG for medical OoC and facilities that are not registered as medical OoC facilities but perform OoC only for non-medical reasons. In the non-medical group, facilities registered with JSOG as medical OoC facilities were further divided into the combined group, and facilities that conduct OoC only for non-medical reasons were further divided into non-medical only group. The primary comparison was conducted between the medical group and the non-medical group (comprising the combined group and the non-medical only group).

OoC cost and annual oocyte storage cost were calculated for one, five, and ten oocytes based on the facility's website description. Under the insurance reimbursement for ART in Japan (which began in 2022), the cost of embryo cryopreservation depend on the

number of embryos described above. Previous reports on the cost of OoC have ranged widely from $4992–18,327 which includes the cost of a series of cycles, such as medications for controlled ovarian stimulation, oocyte retrieval procedure, and egg culture [11]. Since including many steps would result in a rough cost presentation, we focused on the cost of OoC, which does not include the costs of the other steps mentioned above. We also examined the percentage of facilities with a fixed cost for OoC and annual oocyte storage, regardless of the number of oocytes. Furthermore, the correlation between annual oocyte storage cost and OoC cost was statistically examined, considering the institutional background.

In this study, conversion between Japanese yen (JPY) and Euro (EUR) was based on September 2022 exchange rate.

### 2.1. Statistical analysis

SPSS software, version 21.0 (SPSS, Chicago, IL, USA) and GraphPad Prism 9 for macOS, version 9.4.0 (GraphPad Software, San Diego, CA, USA) were used for statistical analysis. The data were analyzed using the Fisher's exact test and Wilcoxon rank-sum test to compare the cost of OoC and annual storage cost of the medical and non-medical groups. A Kruskal-Wallis test was conducted to compare the three groups, that is, the medical only group, combined group, and non-medical only group, followed by pairwise tests with Bonferroni correction. The relation between the OoC cost and the annual storage cost was determined using Spearman's rank correlation coefficient. Spearman's rank correlation coefficient was indicated by $r_s$, and $p$ values $< 0.05$ were considered statistically significant.

## Ethical approval

This survey was conducted by collecting publicly available online information that did not include patients' personal information and human subjects. Thus, the study is exempted from the requirement of ethics approval by the ethical review committee and the authors have no conflicts of interest relative to this survey.

## 3. Results

Of the 621 facilities, two did not have an institutional website. Eighty-eight facilities in the medical only group mentioned on their website that they perform OoC only for medical reasons. In contrast, 58 facilities in the non-medical group indicated on their website that they were conducting OoC for non-medical reasons. Therefore, among the 58 facilities in the non-medical group, there were 21 facilities in the combined group and 37 in the non-medical only group. Taking the medical and non-medical groups together, 146 of 621 facilities (23.5%) in Japan clearly stated that they offer OoC on their websites. Table 1 shows that 41 institutions (46.6%) in the medical only group were university hospitals. On the other hand, only two institutions (3.4%) in the non-medical group were university hospitals, indicating that non-university hospitals were significantly higher in the non-medical group ($p < 0.001$).

Of the 146 facilities, 66 (45.2%) clearly stated the cost of cryopreservation on their websites. Twenty-four of 88 (27.3%) in the medical only group and 42 of 58 (72.4%) in the non-medical group clearly stated the cost of OoC. Among the non-medical group, the percentages of the explicit mention of cryopreservation cost in the combined groups and non-medical only group were 66.7% (14/21) and 75.7% (28/37), respectively. The percentage of explicitly stated OoC costs was significantly higher in the non-medical group ($p < 0.01$). In addition, of the 146 facilities, 71 (48.6%) clearly stated the annual oocyte storage cost on their websites. Twenty-seven of 88 (30.7%) in the medical only group and 44 of 58 (75.9%) in the non-medical group clearly stated the annual oocyte storage cost. Among the non-medical group, the percentages of the explicit mention of the annual oocyte storage cost in the combined group and non-medical only group were 76.2% (16/21) and 75.7% (28/37), respectively. The percentage of explicitly stated annual storage costs was also significantly higher in the non-medical group ($p < 0.01$). Fig. 1 shows the rate of the clear indication of OoC cost and annual oocyte storage costs for each hospital based on whether it is a university hospital or a non-university hospital. The non-university hospitals in the medical only group displayed a significantly lower rate of cost disclosure for OoC (12.8%) and annual oocyte storage (17.0%), compared to the rates of non-university hospitals in the non-medical group ($p < 0.01$; see Fig. 1).

The percentages of facilities with fixed cryopreservation cost independent of the number of oocytes were 37.5% (9/24) and 14.3% (6/42) in the medical and non-medical groups, respectively. The percentage of facilities with fixed cryopreservation cost was

**Table 1**
Background of the establishment of each medical institution that performs oocyte cryopreservation in Japan.

| | total number of hospitals | the number of university hospitals (%) | the number of non-university hospitals (%) | |
|---|---|---|---|---|
| | | | private clinics | prefectural hospitals |
| Medical only group | 88 | 41 (46.6)* | 43 | 47 (53.4) 4 |
| Non-medical group | 58 | 2 (3.4)* | 56 | 56 (96.6) 0 |
| Total | 146 | 43 (29.5) | 99 | 103 (70.5) 4 |

Medical only group, they perform oocytes cryopreservation (OoC) for medical reasons only; non-medical group, they perform OoC for non-medical reasons; * means $p < 0.001$ by Fisher's exact test.

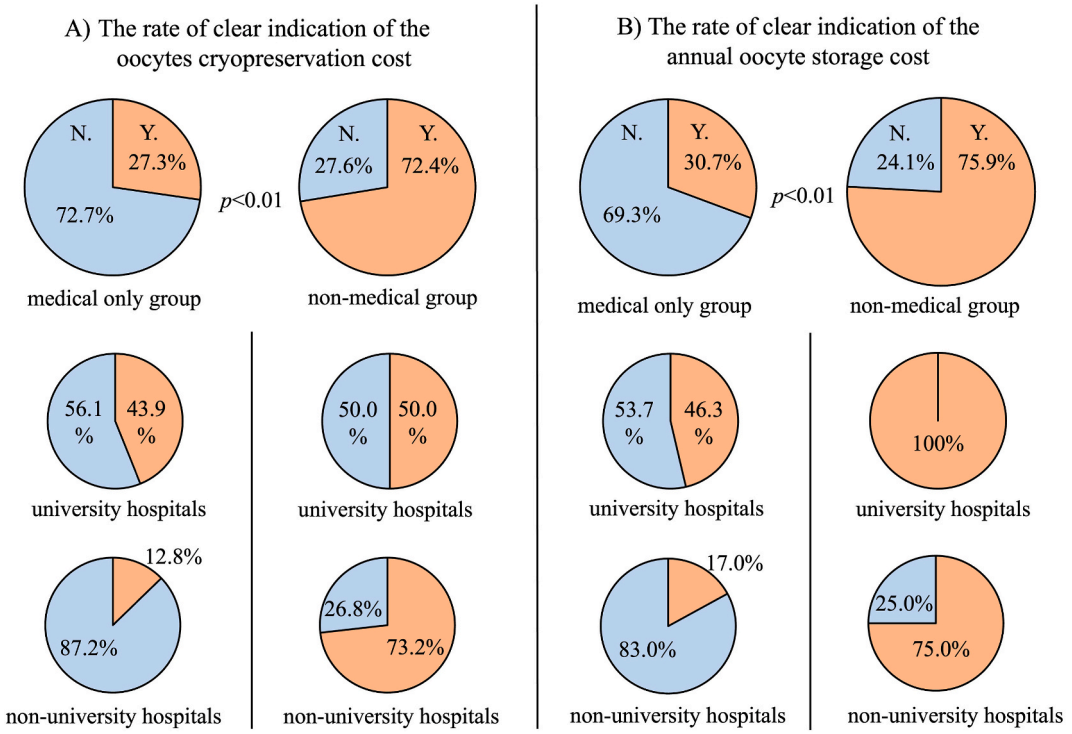


**Fig. 1.** The rate of clear indication of oocyte cryopreservation cost and annual storage cost between the medical group and non-medical group based on the institution's background. (A) The rate of clear indication of the oocyte cryopreservation cost. (B) The rate of clear indication of the annual oocyte storage cost. Medical only group (n = 88), non-medical group (n = 58), university hospitals in medical only group (n = 41), non-university hospitals in medical only group (n = 47), university hospitals in non-medical group (n = 2), non-university hospitals in non-medical group (n = 56). N, none; Y, yes.

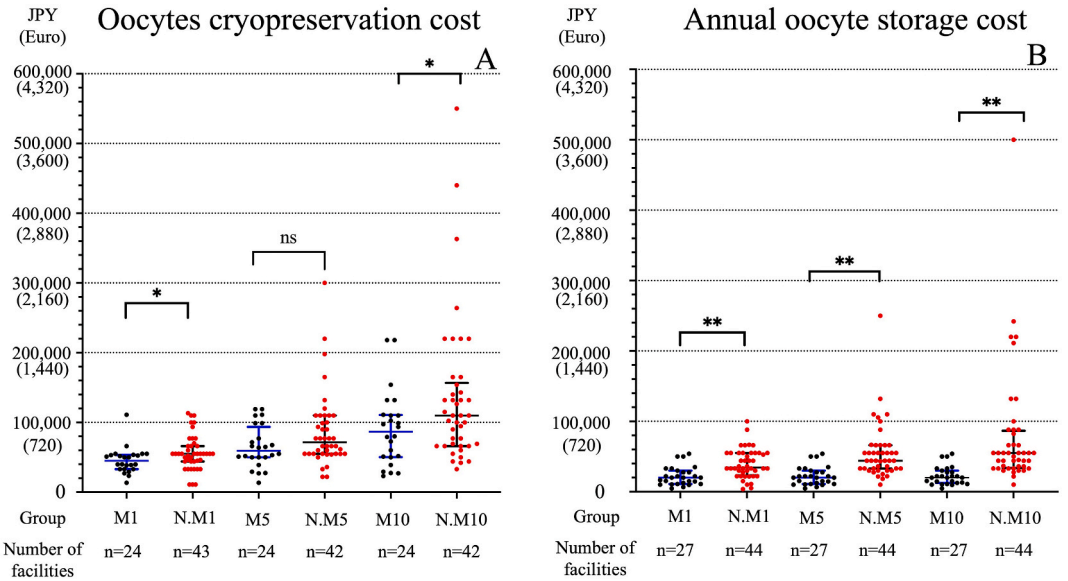


**Fig. 2.** Oocytes cryopreservation cost and annual storage cost in the medical only group and the non-medical groupHe. The black dot plot represents each facility in the medical only group, and the red dot plot represents each facility in the non-medical group. * means $p < 0.05$ by Wilcoxon rank-sum test; ** means $p < 0.01$ by Wilcoxon rank-sum test. The blue and black lines indicate median and interquartile ranges, respectively. (A) Oocyte cryopreservation costs for one, five, and 10 oocytes. JPY, Japanese yen; M, the medical only group; N.M, non-medical group; M1 means oocytes cryopreservation cost for one oocyte in the medical only group. (B) Annual oocyte storage costs for one, five, and 10 oocytes. JPY, Japanese yen; M, the medical only group; N.M, non-medical group; M1 means annual oocyte storage cost for one oocyte in the medical only group.

significantly higher in the medical only group ($p < 0.05$). The number of facilities that stated the fixed annual oocyte storage costs on their website, regardless of the number of oocytes, was 25 (25/27, 92.6%) in the medical group and 30 (30/44, 68.2%) in the non-medical group, with a significantly higher proportion in the medical only group ($p < 0.05$).

Fig. 2A and Table 2 show the results for the medical only group (n = 24) and the non-medical group (n = 42), wherein the cost of OoC was explicitly stated on the website. Similarly, results for the medical only group (n = 27) and the non-medical group (n = 44) regarding their annual oocyte storage costs are shown in Fig. 2B and Table 2. The OoC costs were significantly higher in the non-medical group for one and 10 oocytes ($p < 0.05$). In addition, the differences between facilities were substantial in the non-medical group, with several facilities showing outliers in the interquartile range shown in Fig. 2. In the medical only group, the annual storage cost remained almost the same regardless of the number of oocytes, while in the non-medical group, the annual storage cost was two to three times higher than in the medical only group, as shown in Table 2 ($p < 0.01$). The non-medical group was subdivided into the combined and non-medical only groups, and their results were compared with the medical-only group. The results are shown in Table 2. No significant difference was found in the OoC cost among the three groups. However, the annual storage cost was significantly higher in the combined and non-medical groups than in the medical only group ($p < 0.01$). Furthermore, no significant difference was found in both the OoC cost and the annual storage cost between the combined group and the non-medical only group.

Of the 146 facilities only 16 (11.0%) mentioned the number of OoC procedures performed in the past on their website. In addition, only eight facilities (8/146, 5.5%) provided detailed information on the number of OoC procedures performed over multiple years, and a mere five facilities (5/146, 3.4%) provided information on the clinical outcomes after thawing of the cryopreserved oocytes. These five facilities were in the non-medical group: three were in the combined group and two in the non-medical only group. These five facilities also explicitly stated the OoC and annual storage costs on their websites.

Finally, we showed the correlation between the OoC cost and the annual oocyte storage cost for the 23 facilities in the medical only group and 41 in the non-medical group. These facilities had explicitly stated the cost of cryopreserving 10 oocytes and the annual storage cost for 10 oocytes on the website (Fig. 3). As shown in Fig. 3A, analysis of 64 facilities indicated that there was a significant positive correlation between OoC cost and annual storage cost ($rs = 0.422$, $p < 0.01$). However, as shown in Fig. 3B, the medical group showed a significant positive correlation ($rs = 0.553$, $p < 0.01$) in the overall study, while the non-medical group showed no significant correlation ($rs = 0.275$, $p = 0.08$).

## 4. Discussion

A recent report on the current status of fertility preservation in Japan for medical reasons, which covered 68 facilities, did not examine the detailed costs associated with OoC [12]. This survey is the first of its kind in that it reveals the percentage of Japanese OoC facilities with properly informative websites in 2021. Unfortunately, there are few detailed reports on the percentage of ART facilities

**Table 2**
Comparison of oocyte cryopreservation cost and annual storage cost between the medical group and non-medical group-composed of the combined group and non-medical only group.

| | The number of oocytes | Medical only group | Non-medical group | *p* value | Combined group | Non-medical only group |
|---|---|---|---|---|---|---|
| The oocytes cryopreservation cost JPY (EUR) Number of facilities | 1 | 45,527 ± 18,695 (328 ± 135) n = 24 | 56,822 ± 25,020 (409 ± 180) n = 43 | <0.05 | 57,613 ± 26,402 (415 ± 190) n = 15 | 56,398 ± 24,734 (406 ± 178) n = 28 |
| | 5 | 65,179 ± 30,397 (469 ± 219) n = 24 | 86,752 ± 53,342 (624 ± 384) n = 42 | 0.07 | 83,036 ± 51,734 (598 ± 373) n = 14 | 88,611 ± 54,967 (638 ± 396) n = 28 |
| | 10 | 90,311 ± 53,814 (650 ± 387) n = 24 | 136,550 ± 106,352 (983 ± 766) n = 42 | <0.05 | 120,492 ± 97,871 (868 ± 705) n = 14 | 144,579 ± 111,189 (1042 ± 801) n = 28 |
| The annual oocyte storage cost JPY (EUR) Number of facilities | 1 | 22,326 ± 13,338 (161 ± 96) n = 27 | 40,178 ± 20,734 (289 ± 149) n = 44 | <0.01 | 43,879 ± 16,605* (316 ± 120) n = 16 | 38,063 ± 22,775* (274 ± 164) n = 28 |
| | 5 | 22,531 ± 13,238 (162 ± 96) n = 27 | 55,793 ± 40,349 (402 ± 291) n = 44 | <0.01 | 53,367 ± 25,451* (384 ± 183) n = 16 | 57,180 ± 47,197* (412 ± 340) n = 28 |
| | 10 | 22,771 ± 13,043 (164 ± 94) n = 27 | 79,091 ± 85,530 (570 ± 616) n = 44 | <0.01 | 68,217 ± 58,898* (491 ± 424) n = 16 | 85,304 ± 98,047* (615 ± 706) n = 28 |

Values represent mean ± standard deviation. JPY, Japanese yen; EUR, euro.
*p* value was calculated by Wilcoxon rank-sum test for medical only group and non-medical group.
The asterisk (*) indicates a significant difference ($p < 0.01$) with the medical group in the pairwise tests using Bonferroni correction conducted after performing the Kruskal-Wallis test among the three groups: the medical only group, the combined group, and the non-medical only group.

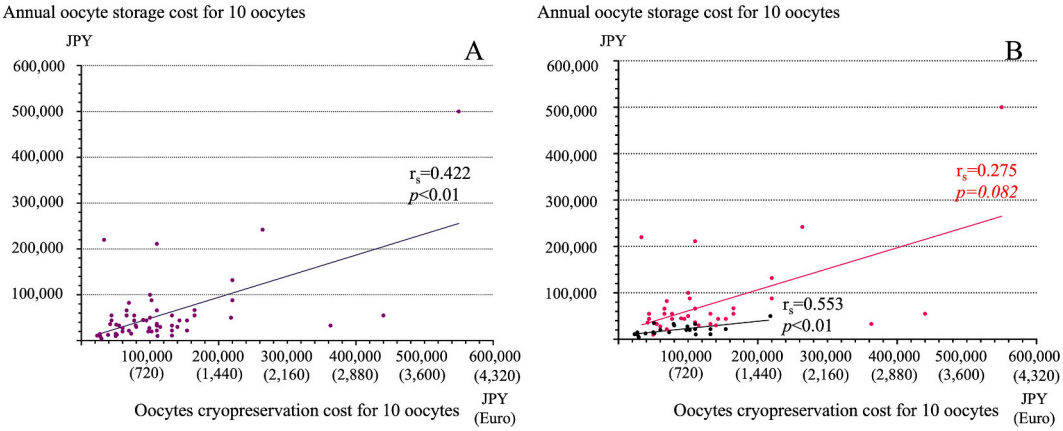


**Fig. 3.** The relationship between the annual oocyte storage cost and oocytes cryopreservation cost. (A) The correlation between the annual oocyte storage cost for 10 oocytes and oocytes cryopreservation cost for 10 oocytes for the 64 facilities. $r_s$ means Spearman's rank correlation coefficient. (B) The correlation between the annual oocyte storage cost for 10 oocytes and oocytes cryopreservation cost for 10 oocytes for the medical only group (n = 23) is indicated by black dots, and the non-medical group (n = 41) is indicated by red dots. $r_s$ means Spearman's rank correlation coefficient.

that perform OoC and their cost comparisons in Japan. More than half of the fertility units in the U.S. offer OoC, mostly of them do so for non-medical reasons [13]. On the other hand, in Japan, there are no explicit restrictions on non-medical oocyte cryopreservation, and until now, the actual implementation of OoC for non-medical reasons has not been explicit. Additionally, extant studies have examined cost comparisons for fertility preservation in other countries using the information provided on the website [11,14]. Therefore, using website information to study OoC cost and annual storage cost in Japan—a country where ART is implemented the most—will provide new insights into the said field. Although studies have examined the cost-effectiveness of OoC [11], it believed that the cost setting of OoC is different in each country. In addition, storage cost is also essential when considering cost-effectiveness; consequently, it is important to examine the current status of OoC in each country to make international comparisons.

An extant study has reported the cost of a 5-year average oocyte storage as $1618 (range, 0-$3238). Simple calculation yields an annual average cost of $323.6 (around ¥46,400) [14]. Table 2 and Fig. 2 show that Japan's annual oocyte storage cost is not excessively high compared to the cost overseas. In this study, in the medical group, 92.6% of the institutions had a fixed annual oocytes storage cost, averaging less than around ¥23,000 ($160, 165EUR), which is a low cost compared to other countries. A cost-effectiveness study comparing ovarian freezing, embryo freezing, and oocyte cryopreservation has been reported for fertility preservation methods [8,14,15], and it is crucial to recognise institutional and regional differences in cryopreservation and annual storage costs when considering cost-effectiveness.

It is assumed that there is a difference in the number of mature meiosis II oocytes cryopreserved in the non-medical group, which has more opportunities for multiple oocyte retrieval, and in the medical only group, where fertility preservation time is limited by treatment of malignant disease, and that there is a difference in annual oocyte storage costs. No reports have compared medical and non-medical reasons and their association with oocyte storage costs as in this survey. In a European survey, 14 out of 27 countries provided public subsidies for OoC for medical reasons [16]. In Japan, there is a public subsidy system for OoC for fertility preservation for medical reasons, as written above. The Japanese government provides financial support for OoC for medical reasons, and ¥200,000 ($1,400, 1,440EUR) is subsidized for each OoC, facilitating two OoC cycles. On the other hand, there is no national financial support for OoC for non-medical reasons in both Japan and Europe. Thus, it is necessary to consider how the high-cost burden may hinder access to OoC. Further, there is a need to recognise the difference between medical OoC which is restricted by the treatment of the disease, and non-medical OoC, which is not restricted in terms of time and can take longer to gather information.

Recently, a report from Australia examined the pros and cons of the public burden of OoC for non-medical reasons [15]. There are various arguments surrounding the matter, and it is necessary to consider the background of institutions and cost differences, and reflect them in policies and other measures. In addition, following Google's and Facebook's provision of OoC assistance to their female employees as a benefit in 2014 [17], some companies in Japan have started to offer similar benefit programmes. For women's reproductive autonomy, it is necessary to clarify the cost of OoC in each country and improve access to such information. In case of a medical OoC, it is assumed that healthcare professionals will present the options and the time to select a facility is limited. On the other hand, while non-medical OoC are not restricted by the factor of time, obtaining adequate information regarding the number of OoC procedures conducted in the past and their clinical outcomes remains difficult because this information is not publicly available.

Only few studies exist on fertility clinics' website information, such as that conducted in Australia in 2020 [6] and the U.K. in 2021 [7]. Such studies found that the quality of the information provided was poor and often did not include the actual costs of OoC. In our study, OoC and annual oocyte storage costs were significantly less explicitly stated on the websites of facilities in the medical only group than the non-medical group. As shown in Fig. 1, the medical only group had a lower percentage of explicitly stated costs on the websites of non-university hospitals and university hospitals. There have been no reports comparing medical and non-medical reasons

for specifying oocyte cryopreservation-related costs on websites, and our survey in Japan is the first such report to date. In addition to the trend toward fertility preservation due to malignant diseases and aging, there has also been an increasing demand for fertility preservation in the face of benign diseases such as endometriosis [18,19]. As our survey revealed, there are significant differences in the costs associated with OoC between institutions for medical and non-medical reasons. Furthermore, Fig. 3B does not depict any significant correlation between OoC cost and annual storage cost in the non-medical group including many private clinics, indicating that the cost setting differed significantly among facilities even in the non-medical group. We also found that the percentage of each facility's website that specifies the cost of OoC also varies depending on the background of each facility's establishment. In the present study, the non-medical group was further divided into a combined group and a non-medical only group. The percentages of explicitly stated OoC for both the groups were high, ranging from 66 to 76%, and there was no significant difference between the two groups regarding the costs investigated in this study. One possible reason for the similar results is that out of the 58 facilities in the non-medical group, only 2 (3.4%) were university hospitals, indicating few significant differences in the institutional backgrounds between the combined group and the non-medical only group.

The medical information featured on healthcare facility websites may be utilised by patients to gather supplementary information for making choices about the facility and treatment options. Therefore, it is essential that these websites provide accurate information. In case of medical OoC, patients often obtain medical information directly from their attending physicians due to limited time and choices for selecting facilities. This could explain the low percentage of explicitly stated cost of the procedure on the websites of institutions in the medical only group. In a survey of graduate students in the U.S., it was reported that the biggest concern in egg freezing was cost [20]. It has been observed that physicians and patients are influenced by information found online; thus, it is crucial to examine the current state of websites [21]. In 2019, a study evaluated 21 websites according to several categories recommended by the Society of Obstetricians and Gynaecologists of Canada to assess the quality of web pages on fertility preservation [22]. It was found that more than half of the websites did not include descriptions in accordance with the evidence. Table 1 shows that more than 90% of the facilities in the non-medical group in Japan are private clinics. Subsequently, the low percentage of explicitly stated cost of the procedure for the medical only group could be attributed to the fact that most of these facilities are university hospitals, which provide lesser information on their websites compared to private clinics.

In our study, data was collected by the board certificated specialist of JSRM, who is familiar with fertility preservation. We found that most websites did not clearly state the cost of OoC, which made it difficult for the patient to access the necessary information. Since there are no clear advertising guidelines for reproductive medicine in Japan, it is believed that the JSOG and JSRM will establish evaluation categories for websites such as SOGC in the future. However, as mentioned above, non-medical OoC is not eligible for state subsidies, so it may be difficult to impose the same criteria for website content as for medical OoC. In both medical and non-medical OoC, it is important for the patients to consider outcomes, such as the number of cases performed by a facility. Our study found that the percentages of explicitly stated number of cases performed and their clinical outcomes were low, ranging from 3 to 10%. Thus, future studies should examine the disclosure of the number of cases performed and their clinical outcomes to produce a more critical discussions on the criteria for website descriptions.

One limitation of this survey is that it was a web-based survey that referred to each medical institution's website and did not obtain responses directly from each institution. In previous studies that evaluated the cost-effectiveness of fertility preservation and OoC, we used the cost of website postings from each institution as a reference; we have used the same in this study [11,14]. A response-type questionnaire survey of all facilities by JSOG, JSRM, and other organisations is required to completely grasp Japan's actual situation and compare it with other countries. For example, a website review conducted in the U.K. in 2021 found a discrepancy between the cost of OoC listed on the website and the actual cost borne by patients [7]. This is a similar concern in Japan. In addition, no facility in the survey described costs separately for medical and non-medical reasons on their website. However, some facilities that do not specify costs may have different cost settings for medical and non-medical reasons. Thus, further investigation is needed to provide more insights.

In conclusion, we examined the actual cost of OoC in Japan and the percentage of information disclosed on websites. In Japan, the rate of OoC cost clarification on websites is low, at less than 30% in the medical group. It was also found that costs concerning OoC differed significantly between the medical and non-medical groups, particularly for annual storage costs. Unfortunately, there have been few studies on the actual cost of OoC in Japan and other countries, and it is essential to accumulate reports like ours to compare costs in different countries. In addition, to respect the patient's right to self-determination for OoC, medical facilities are expected to enhance the provision of accurate cost information.

## Author contribution statement

Hiromitsu Shirasawa: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. Yukiyo Kumazawa; Wataru Sato; Takuya Iwasawa; Ayaka Fujishima: Analyzed and interpreted the data. Kazue Togash; Natsuki Ono; Kazumasa Takahashi: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data. Yukihiro Terada: Conceived and designed the experiments; Analyzed and interpreted the data. Eri Maeda: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

## Data availability statement

Data will be made available on request.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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