In-depth analysis of the demographic landscape and clinical outcomes of assisted reproductive technologies in Türkiye: a comprehensive survey for the years 2020 and 2021

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Abstract

Objective: To investigate patient characteristics and outcomes of assisted reproductive technology (ART) cycles conducted in Türkiye during the coronavirus disease-2019 (COVID-19) pandemic (2020-2021).

Material and Methods: ART centers in Türkiye were invited to participate in this survey. The questionnaire focused on patient demographics and performance outcomes and was sent to center directors via anonymous Qualtrics™ links.

Results: The survey was sent to 167 centers and data were collected from 15 centers in 2020 and 24 centers in 2021. The clinical pregnancy rate from intrauterine insemination (IUI) procedures remained similar, with 15.1% in 2020 (1,245 IUI cycles) and 14.5% in 2021 (2,023 IUI cycles), while successful delivery rates were 12.5% and 11.5%, respectively. For ART treatments, the clinical pregnancy rate from fresh embryo transfers increased from 45.1% in 2020 (3,119 transfers) to 50.4% in 2021 (8832 transfers), with similar live birth rates, 34.2% vs. 34.4%. Frozen embryo transfers resulted in clinical pregnancy rates of 47.8% in 2020 (2,498 transfers) and 51.9% in 2021 (12,015 transfers), with live birth rates rising from 39.8% to 42.7%. Preimplantation genetic testing cycles resulted in clinical pregnancy rates of 64.2% in 2020 (271 transfers) and 60.8% in 2021 (2,102 transfers), with live birth rates of 53.5% and 48.2%, respectively. Regarding techniques for fertility preservation in females, 11 prepubertal and 61 postpubertal ovarian tissue cryopreservation procedures were reported, alongside 1,346 cycles performed within the same period. In males, 144 post-pubertal testicular tissue, 871 epididymal and 2,480 ejaculated sperm cryopreservations were reported. During the two years, six ovarian tissue transplantations followed by ART were performed, with 96 women using cryopreserved oocytes. In addition, 40 testicular tissue, 298 epididymal, and 238 ejaculated sperm samples were used for ART purposes.

Conclusion: This survey provides a comprehensive overview of ART practices in Türkiye for 2020 and 2021, establishing a long-term, national-level analysis while highlighting the challenges posed by the COVID-19 pandemic. The longitudinal analysis established a foundation for future annual reports and offers critical insights into emerging trends over these two years. [J Turk Ger Gynecol Assoc. 2025; 26(2): 109-15]

Keywords: Assisted reproduction techniques, medically assisted reproduction, in-vitro fertilization, registry, data collection

Introduction

The Centers for Disease Control and Prevention, the Human Fertilization and Embryology Authority, and the European Society of Human Reproduction and Embryology (ESHRE) have been publishing annual reports of assisted reproductive technology (ART) activity, which offer invaluable insights for healthcare policy making and catalyze practice changes (1-3).

2020 was a critical juncture with unique challenges posed by the coronavirus disease-2019 (COVID-19) pandemic. Clinics and healthcare systems had to adapt to a "new normal", which continuously shifted according to the trajectory of the pandemic (4,5). With limited healthcare resources, staffing modifications, and treatment protocol alterations, a comprehensive reevaluation of service delivery was imperative. Regarded as a non-emergency health service by many, fertility promoting treatments were among the first to be suspended.

Given the exceptional conditions, the 2020-2021 biennial ART data may differ significantly from prior years and provide unique insight into the pandemic period. Our recent publication of national ART trends in 2019 sets a baseline for ongoing analysis of ART activity in Türkiye. This study acts as a natural extension, offering an opportunity for direct comparison with the previous year's results (6). Such iterative data collection, a national clinical audit of ART services, is essential for observing longitudinal trends, understanding demographic shifts, and monitoring clinical outcomes.

Material and Methods

We employed the same methodology used in our previous publication on ART trends in Türkiye for 2019 (6). Briefly, questionnaire (Supplementary File 1) invitations were e-mailed to clinic directors of both public and private ART centers, employing a consolidated mailing list from relevant non-profit organizations, such as the society of reproductive health and infertility, the Turkish Society of Clinical Embryology and the Private *in vitro* fertilization (IVF) Centers Society.

Centers who did not respond were followed up including reminder calls. Data was anonymously collected both at the clinic and individual patient levels. The survey adhered to the template provided by the ESHRE (European IVF Monitoring-EIM) consortium and included an online informed consent form. The survey was administered through Qualtrics™, an internet-based commercial survey system featuring artificial intelligence-assisted adaptive inquiry methods to streamline the number of questions. Qualtrics™ incorporates security measures and protocols to prevent multiple submissions from the same participant (7). All research procedures were conducted in accordance with the Declaration of Helsinki and were approved by the Koç University Ethics Committee (approval number: 2022.386.IRB1.141, date: 07.11.2022).

Definition of terms used in the survey

Key outcome parameters for ART were delineated according to the guidelines set forth by the World Health Organization (WHO) and the International Committee for Monitoring Assisted Reproductive Technologies (ICMART). These international standards defined metrics such as clinical pregnancy, delivery timelines, and live birth rates per embryo transfer. The definitions for various categories of preterm deliveries were also incorporated, all based on the WHO/ICMART criteria (8). Ovarian hyperstimulation syndrome (OHSS) was defined and staged according to the Practice Committee of the American Society for Reproductive Medicine guideline on OHSS in 2016 (9).

Statistical analysis

We employed frequency measures such as count and percent in this descriptive study and did not use comparative statistical analyses.

Results

The questionnaire was shared with the directors of 167 ART centers through e-mail, featuring anonymous links supplied by Qualtrics™. Data were collected from 15 centers in 2020 and 24 centers in 2021. Data from six centers in 2020 and five centers in 2021 that provided answers to below 50% of the questionnaire's items were excluded from the final report. Much of the observed changes in treatment and clinical outcome counts between the two years result from an increased number of reporting centers, influencing counts but not rates.

Overall results per ART cycle

The outcomes, categorized by the developmental stage of the embryo at the time of embryo transfer and the number of transferred embryos in both fresh and frozen cycles, are

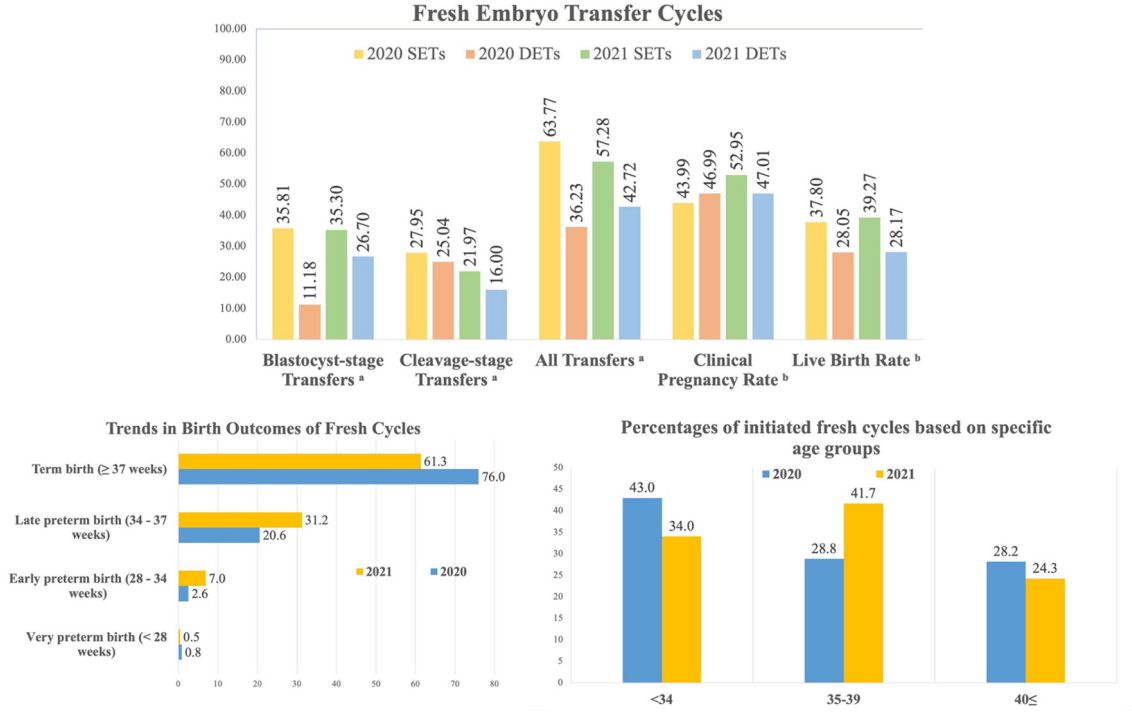

Figure 1. ART applications, trends and clinical outcomes in fresh cycles over a two-year period (all numbers are presented as rates). [a]Rates are based on all fresh embryo transfer cycles. [b]Calculated as the total number of clinical pregnancies divided by the total number of transfers for each category (e.g., clinical pregnancy rate for SETs in 2020 = number of clinical pregnancies from fresh SETs/total fresh SETs)

SET: Single embryo transfer, ART: Assisted reproductive technology

depicted in Figures 1 and 2. These figures further subdivide the data based on patient age and gestational age at delivery. In addition, the annual trend shifts in the characteristics of IVF cycles between 2019 and 2021 are illustrated in Figure 3.

Intrauterine insemination

In 2020, 1,245 intrauterine insemination (IUI) procedures were performed in 16 centers. Most (77.2%) of the female partners were below the age of 35, 20.6% between 35 and 39 years, and

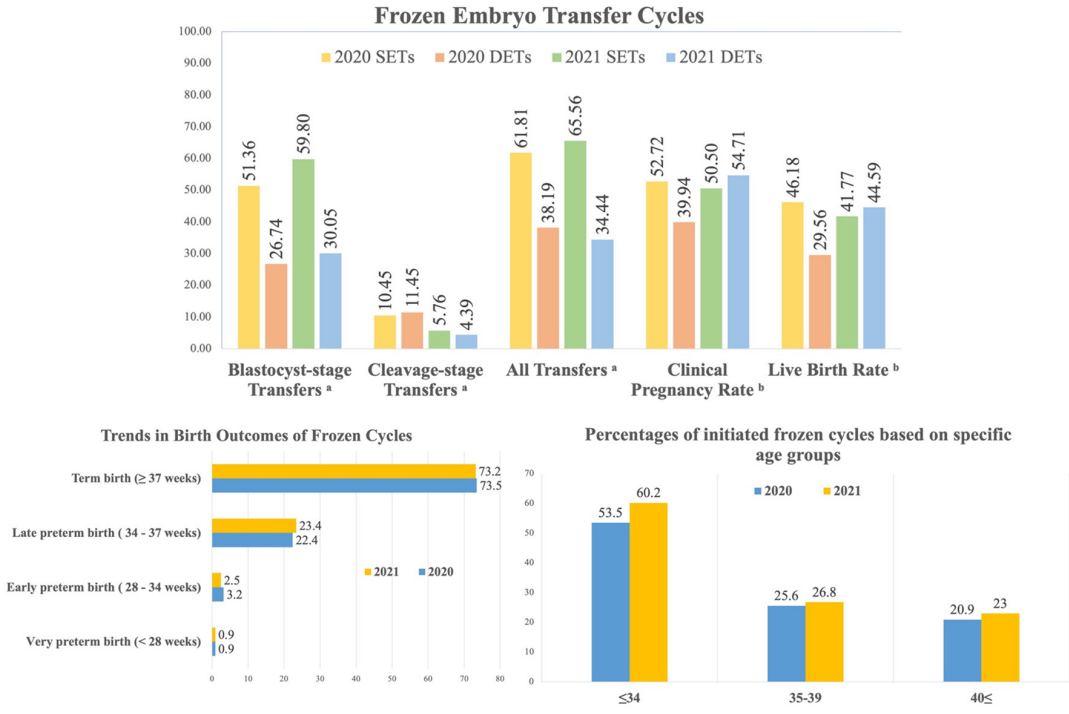

Figure 2. ART applications, trends and clinical outcomes in frozen cycles over a two-year period (all numbers are presented as rates). [a]Rates are based on all frozen embryo transfer cycles. [b]Calculated as the total number of clinical pregnancies divided by the total number of transfers for each category (e.g., clinical pregnancy rate for SETs in 2020 = number of clinical pregnancies from frozen SETs/total fresh SETs)

SET: Single embryo transfer, ART: Assisted reproductive technology

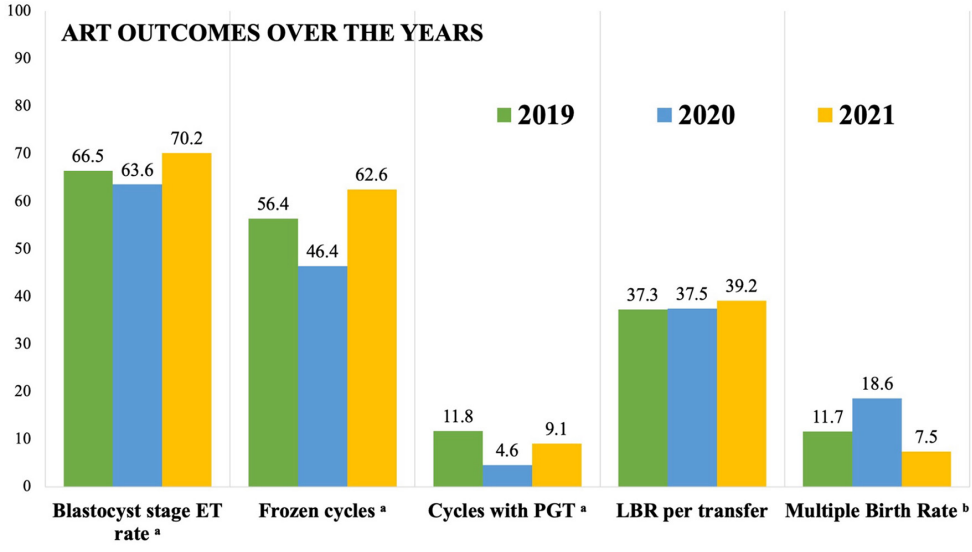

Figure 3. Trend shifts in transfer characteristics and results between 2019 and 2021. [a]Rates are based on all embryo transfer cycles. [b]Rates are based on all deliveries.

ART: Assisted reproductive technology, PGT: Preimplantation genetic test, LBR: Live birth rate, ET: Embryo transfer

only 2.2% were 40 years or older. Of the IUI cycles performed, 188 (15.1%) resulted in a clinical pregnancy, while 156 (12.5%) culminated in delivery. Among these, four were multiple births, while the outcome of seven cycles was unknown.

In 2021, 2,023 IUI cycles were performed in 24 centers, of them, 295 (14.5%) of them led to a clinical pregnancy, while 256 (12.6%) resulted in delivery. Among these births, 22 (8.6%) instances of multiple births were recorded.

Fresh cycles

In 2020, 6,502 oocyte retrieval procedures were performed across 16 centers, leading to 3,119 fresh embryo transfers using IVF or intracytoplasmic sperm injection (ICSI). Surgical sperm extraction methods-including testicular sperm extraction (TESE), micro-TESE, and fine-needle aspiration-were used in 199 instances. Among the fresh embryo transfers, a single embryo was transferred in 1,989 cases (63.7%). There were 1,406 clinical pregnancies (45.1%), with 272 pregnancy losses (19.3%) and 1,069 live births (34.2%) occurred from all fresh transfers. Among deliveries 183 (17.1%) resulted in multiple births. Pregnancy outcomes were missing for 65 cycles.

In 2021, the number of oocyte retrieval procedures increased to 22,368 across 24 centers, leading to 8,832 fresh embryo transfers after IVF or ICSI. Surgical sperm extraction was performed in 1,476 instances. Single embryo transfers were carried out in 5,059 cases (57.2%), showing a slight decrease in the single embryo transfer rate from the previous year. There were 4,453 clinical pregnancies (50.4%), with 400 pregnancy losses (9.0%) and 3,050 live births (34.5%) derived from all fresh transfers. Among deliveries, 314 (10.2%) resulted in multiple pregnancies. While the multiple pregnancy rate was notably decreased compared with the previous year, pregnancy outcomes were missing for a higher proportion of transfers (1003/8832-11.3% in 2021 vs. 65/3119-2% in 2020) cycles.

Frozen cycles

In 2020, 2,573 thawing procedures were carried out, leading to 2,498 embryo transfers. Single-embryo transfers accounted for 1,544 cases (61.8%), 1,195 clinical pregnancies (47.8%), 96 pregnancy losses and 995 live births (39.8%) were derived from frozen embryo transfers. 21.7% of all births resulted in multiple deliveries, and there were 104 cycles with missing pregnancy outcomes.

In 2021, a total of 12,560 thawing procedures were performed, resulting in 12,015 embryo transfers. Out of these transfers, 7,877 (65.5%) were single-embryo transfers. From the frozen cycles, there were 6,242 clinical pregnancies (51.9%), 890 pregnancy losses and 5,135 live births (42.7%). Additionally, 535 (10.3%) of the live births were multiple deliveries. The pregnancy outcomes for 217 cycles were not available.

Cycles with PGT

The survey did not seek information concerning the preimplantation genetic test (PGT) results, i.e., whether the transferred embryo had been diagnosed as euploid or mosaic. In 2020, 174 clinical pregnancies (64.2%) were achieved from 271 PGT transfers, with 145 (53.5%) resulting in live births. In 2021, 1,280 clinical pregnancies (60.8%) were reported from 2,102 PGT transfers, leading to 1,014 live births (48.2%).

Complications during ART and fetal reduction procedures

Over the two years, 119 women were hospitalized for OHSS stage 3 or higher. Of these, 95 women were admitted due to hemorrhage, and 12 were admitted for infections. None of these cases led to mortality, and no selective fetal reduction procedures were performed.

Data from international patients

International patient cycles increased from 1,250 in 2020 to 4,613 in 2021, predominantly from Azerbaijan, Bulgaria and Syria. These couples' primary countries of residence are as follows: Azerbaijan 19.6%, Bulgaria 11.2%, Syria 9.1%, Germany 4.4%, Libya 2.5%, and Iraq 2%-the remaining 3,302 couples, came from other countries. The survey also explored the reasons for seeking treatment abroad, revealing that 1,955 couples (58.2%) chose to undergo treatment in Türkiye primarily due to the lower cost of procedures. Other influencing factors included distance, waiting lists (141 couples-4.1%), treatment quality, and previous treatment failures (1,258 couples-37.5%).

Fertility preservation

The data collection format does not provide information about the storage date of gametes or gonadal tissue that were used in the study period.

In 2020, seven prepubertal and 29 postpubertal ovarian tissue cryopreservation procedures were performed, along with 294 oocyte cryopreservation cycles. Moreover, 94 postpubertal testicular tissue cryopreservation procedures, eight epididymal, and 299 ejaculated sperm cryopreservation procedures were documented. For females, two ovarian tissue auto-transplantation procedures (followed by ART) were performed, and 26 women used their cryopreserved oocytes. For males, 11 testicular tissue, 23 epididymal, and 42 ejaculated sperm samples were used.

In 2021, reports included four prepubertal and 32 postpubertal ovarian tissue cryopreservation procedures, along with 1,054 oocyte cryopreservation cycles. In males, 50 postpubertal testicular tissue cryopreservation procedures, 863 epididymal, and 2181 ejaculated sperm cryopreservation procedures were documented. For females, four ovarian tissue auto-transplantation (followed by ART) were performed, and 70

women used their cryopreserved oocytes. Furthermore, 29 testicular tissue, 275 epididymal, and 196 ejaculated sperm samples were used.

Discussion

Our survey collected data from 15 and 24 ART centers in Türkiye for 2020 and 2021, respectively. The primary objective of the survey was to offer a demographic landscape and a detailed record of ART treatments rather than to rank centers or treatment methods. According to the Turkish Statistical Institute data from 2020-2021, the proportion of women of reproductive age (15-45 years) to the total population was 26.2%, and 1,113,658 births were recorded. Over a two-year period, the total number of reported clinical pregnancies and live births increased, while the live birth rates remained stable. The visible reduction in multiple pregnancy rates in both fresh and frozen cycles is a positive development. It reflects the successful implementation of the single embryo transfer policy and improved embryo selection techniques. However, the increase in number of cycles with missing pregnancy outcomes is a concern, as this may affect the accuracy of success rates and outcome assessments. This highlights the need for improved data collection and patient follow-up protocols in the future to ensure comprehensive reporting.

The society for assisted reproductive technology (SART) released its 2020 reports for infertility treatments in the United States in 2022 (10). Based on these, excluding donation cycles, live birth rates following egg retrieval were 54.5% for women under 35, 39.8% for ages 35-37, 26.1% for ages 38-40, 13.3% for ages 41-42, and 4.0% for those above 42 years old, and overall singleton delivery rate was 94.74%. In comparison, our results show a live birth rate of 48.5% for women under 35, 35.3% for those aged 35-39, and 9.8% for those over 40 years old, and the overall singleton delivery rate was 81.0%, all parameters lower than the SART annual data. This comparison provides a global perspective on the outcomes of ART treatments in Türkiye.

Study limitations

The COVID-19 pandemic had a profound impact on the case volume and practice patterns in in the United Kingdom (11). Private clinics were quicker to reopen, compared with National Health Service clinics (83 vs. 34% respectively). The annual number of fresh cycles decreased by 28%, and storage of embryos increased by 6%, the later being the only ART-related activity showing an increase from 2019 to 2020. Although the resemblances might occur in Türkiye, we cannot demonstrate reopening trends or overall shifts in the total number of ART cycles due to the relatively small numbers of ART clinics contributing to the data collection. This data reflects the real-time impact of the pandemic on ART treatments. The 2021 report features a 14.3% participation rate from ART centers and maintains methodological consistency by employing a robust questionnaire based on ESHRE EIM consortium guidelines. Accumulating data allows for a temporal comparison and also adds fertility preservation as a new and important outcome compared to last year's survey in ART practices. This addresses a limitation in the 2019 survey and enhances the depth of the findings.

Conclusion

This survey provided a comprehensive vision of ART practice in Türkiye, serving as a stepping-stone for long-term, national-level scrutiny in this field. It is hoped that eventually it will offer a comprehensive perspective as the survey evolves and the annual reports continue. Furthermore, capturing the data for the pandemic years allowed a comparison with data from 2019, a pre-COVID-19 baseline year. These ongoing clinical audit efforts intend to lay the foundation for a detailed, more insightful, annual reporting system-one we hope will engage a broader array of participants to provide quality healthcare to patients.

Ethic

Ethics Committee Approval: *All research procedures were conducted in accordance with the Declaration of Helsinki and were approved by the Koç University Ethics Committee (approval number: 2022.386.IRB1.141, date: 07.11.2022).*

Informed Consent: *The survey adhered to the template provided by the ESHRE (European IVF Monitoring-EIM) consortium and included an online informed consent form.*

Footnotes

Author Contributions: *Surgical and Medical Practices: A.Y., B.M.S., B.G., B.S., D.A., D.S., D.K., E.A., E.E., G.H.C., G.I., G.A.S., I.M., K.S., M.S., O.K., S.E., S.Y.E., T.V., U.G., U.B., U.E., B.B., A.B., Concept: B.C., B.B., A.B., Design: B.C., B.B., A.B., Data Collection or Processing: B.C., B.B., A.B., Analysis or Interpretation: B.C., A.B., Literature Search: B.C., B.B., A.B., Writing: B.C., A.B.*

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