Infertility in Italy: Calibrating Nonprobability Survey Data for Population-Level Estimates

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Introduction

In recent decades, high-income countries have witnessed a notable delay in childbearing (Beaujouan and Sobotka, 2022; Tocchioni et al., 2022). Postponing pregnancy reduces the likelihood of success, thereby increasing infertility or sub-fertility issues due to the age-related decline in fecundity. Infertility imposes substantial psychological, economic, and social burdens—including an elevated risk of divorce (Payne et al., 2019; Thoma et al., 2021). As a result, growing reliance on Assisted Reproductive Technology (ART) to achieve desired family size has intensified research into the diffusion of and access to fertility care (Cozzani et al., 2025; Lazzari et al., 2021). The current limited awareness of the magnitude of infertility hinders the assessment and enhancement of fertility care services and undermines the protection of individuals' freedom to determine family size and the timing of childbearing (Cox et al., 2022). Quantifying the prevalence of infertility in the population is vital for effective management, but it is also challenging.

As reported by Cox et al. (2022), previous studies that attempted to estimate the number of affected individuals spanned from approximately 48.5 million couples worldwide in 2010 (Mascarenhas et al., 2012) to as many as 186 million women who have ever been married in developing countries in 2002 (Rutstein and Shah, 2004). However, they varied considerably in how infertility was defined and estimated (Feng et al., 2025; Liang et al., 2025; Mascarenhas et al., 2012). These discrepancies reflect differences in the various components of infertility's definition, including: the duration of exposure to the risk of pregnancy; whether intercourse is assumed or verified to be intended for conception; the restriction to particular union-status subgroups (e.g., married/cohabiting) versus all individuals; whether success is defined by pregnancy or, more narrowly, by live birth; and using respondent sex versus a couple-based approach. Yet heterogeneous definitions, varied measurement methods, and practical data-collection hurdles in quantifying infertility—e.g., underreporting and misreporting due to the sensitivity of the topic—hinder the production of reliable and comparable prevalence estimates (Gurunath et al., 2011).

In Italy, a country where the two-child ideal still prevails but exhibits a realized fertility of 1.18 children per woman, the absence of robust national-level estimates of infertility is a major obstacle to evidence-based policymaking. Since the pioneering study by Neyman (1934), probability sampling represents the gold standard for drawing population inferences. However, such designs require costly and lengthy setups and are increasingly affected by declining response rates. At the same time, over the past two decades, new and diverse data sources have emerged. Nowadays, the spread of digital technologies allows the collection of real-time data, but at the expense of the inferential strength of probability samples. Among the new data sources are web-administered surveys, which are gaining popularity due to their reduced cost, rapid implementation, and capacity to improve response rates (Tourangeau et al., 2013). Nevertheless, because they are based on non-probability samples, they may be affected by selection bias and cannot alone guarantee external validity. Yet, valid methodologies for drawing inferences from non-probability samples have been proposed (Chen et al., 2020; Wu, 2020), yielding robust and efficient estimators. These include: (i) the estimation of the propensity to be included in the sample, using either an explicit or implicit model (as in calibration); (ii) the specification of an outcome model; and (iii) doubly robust methods, which model both the propensity and the outcome. These methods enable valid inference from non-probability surveys that explore topics often neglected by traditional probability-based designs, provided that auxiliary variables common to a probability survey on the same target population are available. Under these conditions, such methods can yield reliable estimates of descriptive parameters that are unknown or cannot be estimated from probability sources alone; allowing, in our case, to address the current challenges in producing population-level estimates of infertility. Starting from these considerations, we propose a replicable approach to estimating infertility prevalence that is advantageous for its feasibility—relying on data readily collected in nonprobability surveys—and for its rigor—focusing on intentional exposure to the risk of conception.

Data

The analysis relies on data from an Italian web survey on Attitudes toward Assisted Reproductive Technologies (A-ART), conducted in July-October 2024 by the survey company Demetra opinion.net within the Age-It Research Program (Ageing Well in an Ageing Society). The target population comprised Italian heterosexual individuals aged 25–49 who were in a relationship (married, cohabiting, or non-cohabiting). The survey employed a quota sampling design based on a web panel, with quotas defined by 5-year age groups, gender, region, and education by gender. As reliable quotas for individuals in heterosexual couples were not available, the quotas were derived from the distribution of the Italian population aged 25–49. Upon completion of the data collection, the final sample included 5,012 respondents. The survey collected information on couples' infertility according to the WHO definition, namely "a disease of the male or female reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse" (WHO, 2023). Notably, we can directly identify couples intending to conceive, generating a valuable and rigorous measure of infertility ideal for assessing the correlated medical needs (White et al., 2006). Respondents were also asked whether they had taken any actions to assist conception, such as medication or fertility treatments. Unfortunately, no probability survey referring exactly to the same target population was available. Therefore, the reference probabilistic sample was drawn from the Aspects of Daily Life Survey (Aspetti della Vita Quotidiana, AVQ)—an annual, cross-sectional ISTAT survey whose target population includes all individuals residing in Italy. We relied on the 2023 wave, which is the most recent release, based on a sample of about 18,563 households and 41,750 individuals. We therefore assumed that the phenomena of interest remained broadly stable between 2023 and 2024 (the data collection year for A-ART).

The analysis started by identifying the sub-samples corresponding to the common segment of the target population within both surveys. In AVQ, information on individuals in a relationship was available only for those living together, and respondents' age was recorded in 10-year categories (e.g., 25-34, 35-44, 45-54). Our selection reflected these constraints: we retained AVQ respondents in cohabiting couples aged 25–44 (N=4,106), while excluding LAT individuals and those aged 45–49 from the A-ART survey (N=2,849). The set of variables common to both surveys and serving as auxiliary information was identified and comprised gender, age, region, education, employment, union status, and number of children. **Table 1** reports the weighted estimates of the frequency distributions for the auxiliary variables in AVQ, based on population weights, and the (unweighted) distributions for the same variables among A-ART respondents (regions were aggregated at the macroregion for brevity). Comparing the two distributions, it emerges that the A-ART sample is younger, more highly educated, and has higher employment rates. It includes a larger share of cohabiting individuals and childless respondents. Overall, it appears socio-economically privileged, with a demographic profile consistent with later family formation. Therefore, the A-ART sample is not representative with respect to these variables and, since infertility is likely associated with them, it is potentially not representative of infertility either.

Table 1 Distributions of auxiliary variables in the AVQ and A-ART surveys.

Auxiliary Variable	% AVQ (weighted)	% A-ART (unweighted)
Gender		
Male	43.30	49.21
Female	56.70	50.79
Age class		
25-34	31.68	40.65
35-44	68.32	59.35
Macroregion		
North-West	27.59	27.83
North-East	21.24	18.71
Center	18.85	19.69
South	22.21	22.67
Islands	10.11	11.09
Educational level		
Not available	2.08	0.00
Primary	1.26	0.18
Lower secondary	23.07	13.97
Upper secondary	46.08	47.42
Tertiary	27.51	38.43
Employment status		
Employed	72.47	85.33
Unemployed	9.44	8.95
Not employed	17.03	5.72
Not available	2.08	0.00
Union status		
Cohabitation	29.01	48.44
Marriage	70.99	51.56
Number of children		
0	23.81	40.86
1	31.59	30.22
2	34.40	24.15
3+	10.21	4.77
Individuals	4,106	2,849

Expected Findings

Adopting a doubly robust estimation approach, we will leverage auxiliary information from the reference survey to derive population-level estimates of people experiencing couple infertility and those receiving medical treatments for infertility. This study sought to advance practical tools for integrating multiple data sources—combining timely and cost-effective nonprobability surveys with high-quality probability surveys—and propose a general framework for standardized and comparable population-level estimates that is portable across countries. For Italy, the resulting population estimates of infertility will inform policy on family formation and offer crucial inputs for debates on, for example, access to and regulation of fertility treatments.

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