DOI: 10.1002/ijgo.14458

SUPPLEMENT ARTICLE

International Journal of Gynecology & Obstetrics FIGO WILEY

Rates of instrumental vaginal birth and cesarean and quality of maternal and newborn health care in private versus public facilities: Results of the IMAgiNE EURO study in 16 countries

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Funding information
This work was supported by the Ministry of Health, Rome - Italy, in collaboration with the Institute for Maternal and Child Health IRCCS Burlo Garofolo, Trieste - Italy

Abstract

Objective: To explore the quality of maternal and newborn care (QMNC) during the COVID-19 pandemic by facility type among 16 European countries, comparing rates of instrumental vaginal birth and cesarean.

Methods: Women who gave birth in the WHO European Region from March 1, 2020, to February 7, 2022, answered a validated online questionnaire. Rates of instrumental birth, instrumental vaginal birth, and cesarean, and a QMNC index were calculated for births in public versus private facilities.

Results: Responses from 25 206 participants were analyzed. Women giving birth in private compared with public facilities reported significantly more frequent total cesarean (32.5% vs 19.0%; aOR 1.70; 95% CI 1.52–1.90), elective cesarean (17.3% vs 7.8%; aOR 1.90; 95% CI 1.65–2.19), and emergency cesarean before labor (7.4% vs 3.9%; aOR 1.39; 95% CI 1.14–1.70) ($P < 0.001$ for all comparisons), with analyses by country confirming these results. QMNC index results were heterogeneous across countries and regions in the same country and were largely affected by geographical distribution of regions rather than by type of facility alone.

Conclusion: The study confirms that births in private facilities have higher odds of cesarean. It also suggests that QMNC should be closely monitored in all facilities to achieve high-quality care, independent of facility type or geographical distribution.

ClinicalTrials.gov Identifier: NCT04847336

KEYWORDS
COVID-19, IMAgiNE EURO, maternal, newborn, quality of care, respectful maternity care, private, public, WHO standards

1 | INTRODUCTION

The role of the private health sector has increased considerably in recent years in many countries in the World Health Organization (WHO) European region.[1,2] Public and private health service providers coexist in most nations in the region, although there are significant differences in the scale and scope of the private sector, both across and within countries.[1–5]

The traditional argument in favor of the private health sector has been competition in the market, which in theory should favor better performance.[1,2] Commonly debated weaknesses in public health management include the lack of sufficient incentives to improve performance, absence of risk of bankruptcy, and lack of accountability to shareholders/owners.[1] However, these arguments have been heavily criticized as too simplistic, and several other arguments have defended the role of public management of the health sector.[1,2] In a seminal paper from 1963, Kenneth Arrow demonstrated that health care violates the principles of a perfect market.[6] Principal-agent theory emphasizes the problem of information asymmetry in the health sector, where consumers do not have sufficient information to know when and to what

extent health care is needed and to compare alternatives in health treatments.[1,2] Additionally, in privately managed health systems, patients may risk catastrophic health expenditures, and this may affect the internal economy.[1,7,8] Notably, the number of people with catastrophic health expenditures—an indicator monitored for the Sustainable Development Goals (SDGs) since 2015—increased significantly in recent years, particularly in middle- and high-income countries.[8] Therefore, even healthcare systems with a high degree of privatization, such as in the USA or Georgia, have some degree of public involvement in regulating, financing, or providing at least essential health services for the most vulnerable.[1,7,8]

Considering evidence on the performance of private versus public health services, recent systematic reviews have not focused specifically on quality of maternal and newborn care (QMNC) nor come to firm conclusions in relation to quality of care. An umbrella review published in 2014[9] of 15 reviews, found overall higher mortality and higher payments to facilities in private for-profit hospitals compared with public and private not-for-profit facilities. More recently, in 2018, two large reviews focused on European countries[1,2] and both agreed on the following: (1) results on quality of care were mixed, without a clear trend for better care either in private or public hospitals; and (2) public hospitals tended to treat patients with lower socioeconomic status and higher levels of comorbidity/complications than patients treated in private hospitals, while patients with higher socioeconomic status had increased access to private hospitals. Kruse et al.[1] also observed that the private for-profit hospital sector seems to react more strongly to financial incentives than other provider types, and concluded that "policymakers either should very carefully develop adequate incentive structures in the health care systems (to favor public facilities), or be hesitant to accommodate the growth of the private hospital sector".[1]

While there is a lack of multicountry studies systematically and comprehensively assessing QMNC in private versus public facilities,[1,2,9] the rate of cesarean—a key indicator for health policies in the WHO European region[10,11] —has been well documented among these two groups, with consistent findings. In 2018, a large epidemiological review based on data from 169 countries found that cesarean was 1.6 times more frequent in private facilities than in public facilities,[12] confirming findings from previous reviews both in low- and middle-income[13] and high-income countries.[14] Evidence from countries in the WHO European region—such as, but not limited to, France, Greece, Italy, Ireland, Kosovo, Portugal, Romania, Spain, and Switzerland—reported higher rates of cesarean in private compared with public facilities.[15–23] However, little information is available on the rate of instrumental vaginal birth (IVB) and, most importantly, on overall maternal perception of QMNC around the time of childbirth, when comparing private versus public facilities.

The IMAgiNE EURO study network was established in July 2020 with the objective of documenting QMNC during the COVID-19 pandemic among countries of the WHO European region. It utilizes two validated questionnaires (for mothers and health workers) to collect information on 40 WHO standards-based quality measures,[24–26] which cover four key domains of QMNC (provision of care, experience of care, availability of human and physical resources, and reorganizational changes due to COVID-19). Previous papers have reported preliminary findings of IMAgiNE EURO.[26–28] The aim of the present study was to compare the rates of instrumental births (i.e. IVB or cesarean), IVB, and cesarean in parallel with overall maternal perspectives on QMNC during the COVID-19 pandemic in private versus public facilities. A better understanding of these two aspects may favor identifying priority actions for improving care among mothers and newborns.

2 | MATERIALS AND METHODS

2.1 | Study design and participants

The IMAgiNE EURO study is a cross-sectional study reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.[29] The STROBE checklist is included as supporting information Table 1.

Women aged 18 and over who gave birth from March 1, 2020, up to the end of the data collection period (February 7, 2022) were invited to participate in an anonymous online survey. Consent to participate was requested and obtained before women answered the questionnaire and was recorded online. Women who did not match the inclusion criteria or who did not give birth in a facility in the WHO European region were excluded.

The online survey was available in more than 20 languages. Women were invited to respond in their preferred language regardless of which country they gave birth in. The survey was actively promoted by project partners through a predefined dissemination plan, which included as the main approaches: social media, organizational websites, and local networks including mothers' groups and nongovernmental organizations. Details on the data collection periods by each country team and language are reported in supporting information Table 2.

2.2 | Data collection tools

Data collection tools have been described elsewhere.[24–26] Briefly, data were collected using a structured online questionnaire based on the WHO standards[30] and recorded using REDCap 8.5.21 (Vanderbilt University, Nashville, TN, USA) via a centralized platform. The questionnaire included 40 questions on each key indicator, equally distributed into four domains: the three domains of the WHO standards[30] (provision of care, experience of care, and availability of human and physical resources) and an additional domain on key organizational changes related to the COVID-19 pandemic.

Questions on the individual characteristics of the participants (e.g. clinical and sociodemographic background) and hospital type (private vs public) were also included. In case of more than one pregnancy/birth during the data collection period, each woman was free to answer the questionnaire for each birth experience separately.

The process of questionnaire development and validation[24,31–33] and previous use has been reported elsewhere.[26–28] The 40 key indicators contributed to a composite QMNC index for each of the four domains evaluated (scoring from 0–100 points, with higher scores indicating higher adherence to WHO standards), to be considered a complementary synthetic measure of QMNC.[26–28]

2.3 | Statistical analyses

The present analysis included women who provided an answer to all 40 quality measures, and five key sociodemographic indicators (i.e. date of birth, age, education, parity, whether the woman gave birth in the same country where she was born). We first performed a descriptive analysis of the participants, comparing participants' characteristics between births in private versus public facilities using χ^2 or Fisher exact test as appropriate.

We analyzed differences between births in public versus private facilities in the rates of instrumental births, IVB, and cesarean and in the QMNC index by domain, in the overall sample and by country. The estimated sample size needed for comparison of the rates of instrumental births, IVB, and cesarean was at least 250 births in each group, based on an expected cumulative rate of 25% versus 40%, with two-tailed z test, a power of 80%, and an alpha of 5%. For the QMNC indexes, at least 143 women in each group were needed to detect a statistically significant difference from 70 to 85 points with a standard deviation of 45, a power of 80%, and an alpha of 5%. The rates of instrumental births, IVB, and cesarean are presented as a frequency, and differences among groups were tested with χ^2 or Fisher exact test as appropriate. The QMNC indexes were calculated based on predefined criteria,[24,26] presented as median and interquartile ranges (IQR), and tested with a Wilcoxon–Mann–Whitney test since they were not normally distributed. The distribution in the QMNC index by domain was tested with the Kolmogorov–Smirnov test.

We also conducted a subgroup analysis looking at the rates of instrumental births, IVB, and cesarean between births in public versus private facilities and QMNC indexes across regions within the same country. The regions were classified according to the Nomenclature of Territorial Units for Statistics (NUTS) level 1 for France, Italy, and Romania and NUTS level 2 for Portugal.[34] For Switzerland, women were grouped by language of survey completion.[35] For Italy, South and Islands were presented as a single group, given the small sample in the Islands.

To take account of differences between sample characteristics in the two groups (private vs public) we performed logistic regressions, calculating the odds ratio of instrumental birth by facility type and adjusting for relevant variables (i.e. maternal age, maternal education, year of birth, women giving birth in the same country where they were born, country of birth, parity, multiple birth). We also performed quantile regressions, adjusting the QMNC index for relevant variables (same list as above, plus newborn admission to the neonatal intensive or special care baby unit, mother's admission to an intensive care unit, mode of birth, and presence of an obstetrician/gynecologist at birth). A forward selection with significance entry level of 0.50 was used in both logistic and quantile regression models to identify variables to be included in the model other than births in private/public facilities.

A two-tailed $P < 0.05$ was considered statistically significant. Statistical analyses were performed using Stata/SE version 14.0 (Stata Corporation, College Station, TX, USA) and R version 4.1.1.[36]

2.4 | Ethical aspects

The anonymous online survey was approved by the Institutional Review Board of the coordinating center, the IRCCS "Burlo Garofolo" Trieste (IRB-BURLO 05/2020 15.07.2020), and by the ethical committees of four other countries: Portugal (Instituto de Saúde Pública da Universidade do Porto, CE 20159), Norway (Norwegian Regional Committee for Medical Research Ethics, 2020/213047), Germany (Bielefeld University ethics committee, 2020–176), and Latvia (Riga Stradins University Research Ethics Committee 22–2/140/2021 16.03.2021). Since this was an online survey that women could decide to join on a voluntary basis, no data elements that could disclose maternal identity were collected, and data were recorded and analyzed in Italy, formal approval was waived by the ethical committee of the other countries. The survey was conducted according to General Data Protection Regulation (GDPR) regulations. Prior to participation, women were informed of the objectives and methods of the study, including their right to decline participation. Each woman provided informed consent before responding to the questionnaire. Anonymity in data collection during the survey phase was ensured by not collecting any information that could disclose the identity of participants. Data transmission and storage were secured by encryption.

3 | RESULTS

3.1 | Participant characteristics

Out of 49 866 women accessing the online questionnaire, 41 536 women met the inclusion criteria. A total of 25 206 were included in the analysis after exclusion of cases missing information on the 40 WHO standards-based quality measures or on key sociodemographic variables, type of hospital, or suspected duplicates (Figure 1). Out of the sample analyzed, 23 098 (91.6%) births occurred in public facilities and 2108 (8.4%) in private facilities.

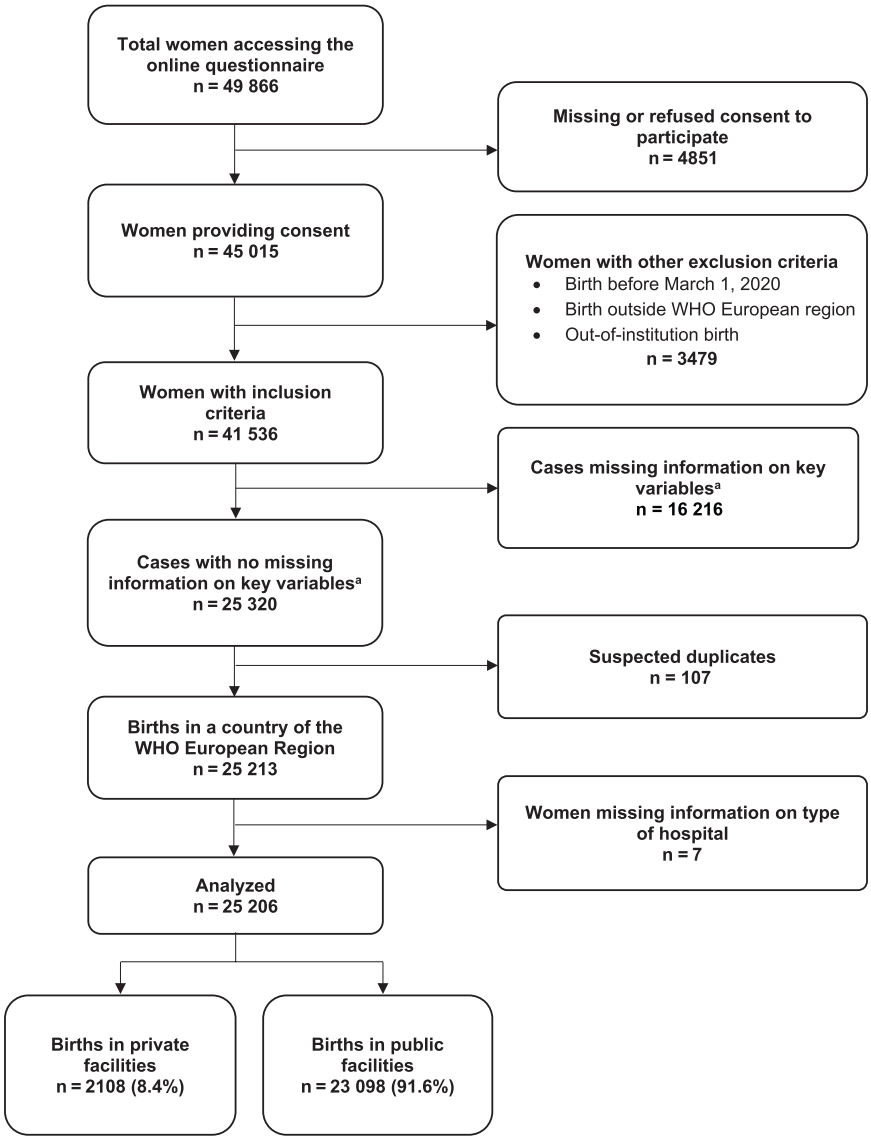

FIGURE 1 Study flow diagram. [a]Missing information on the 40 WHO standards-based quality measures and key sociodemographic variables.

Overall, 16 countries contributed, with a sample of at least 300 births. The rate of births in private facilities varied among countries, with five countries—France, Italy, Portugal, Romania, Switzerland—showing the highest rates of births in the private sector in our sample and contributing with at least 100 births in private facilities, for a total of 9057 births (Table 1) (for details see supporting information Table 3). The expected births in private facilities by country according to national data are reported in supporting information Table 4.

Key differences in the characteristics of women who gave birth in private facilities compared with those who gave birth in public facilities were that: women giving birth in private facilities were older (significant difference in all age stratum from age of 31, $P < 0.001$), had a higher level of education (78.2% vs 70.6% had university or postgraduate education, $P < 0.001$), were more frequently assisted by an obstetrician/gynecologist (77.1% vs 52.9%, $P < 0.001$), and were less frequently admitted to intensive care (0.2% vs 0.8%, $P = 0.006$) (Table 1).

3.2 | Rates of instrumental vaginal birth and cesarean

Women giving birth in private facilities gave birth by cesarean significantly more frequently than women giving birth in public facilities (32.5% vs 19.0%; aOR 1.70; 95% CI, 1.52–1.90; $P < 0.001$), in particular by elective cesarean (17.3% vs 7.8%; aOR 1.90; 95% CI, 1.65–2.19; $P < 0.001$) and emergency cesarean before labor (7.4% vs 3.9%; aOR 1.39; 95% CI, 1.14–1.70; $P = 0.001$) (Table 2 and supporting information Table 5).

Four countries (France, Italy, Portugal, Romania) had an adequate sample to look at country data (Table 2 and supporting information Table 5). In three out of four countries (Italy, Portugal, Romania) the rate of instrumental births was higher in private hospitals compared with public hospitals, with the largest gaps observed in Portugal (72.0% vs 46.0%; aOR 3.27; 95% CI, 2.43–4.44, $P < 0.001$) and Romania (65.2% vs 57.2%; aOR 1.42; 95% CI,

TABLE 1 Characteristics of survey respondents comparing private versus public facilities

	Births in private facilities No. (%) n = 2108	Births in public facilities No. (%) n = 23098	*P* value
Country			
France	477 (22.6)	587 (2.5)	<0.001
Italy	390 (18.5)	4519 (19.6)	0.238
Portugal	300 (14.2)	1054 (4.6)	<0.001
Romania	267 (12.7)	600 (2.6)	<0.001
Switzerland	201 (9.5)	662 (2.9)	<0.001
Poland	82 (3.9)	1360 (5.9)	<0.001
Sweden	69 (3.3)	3907 (16.9)	<0.001
Luxembourg	66 (3.1)	336 (1.5)	<0.001
Spain	66 (3.1)	223 (1.0)	<0.001
Germany	44 (2.1)	873 (3.8)	<0.001
Belgium	32 (1.5)	77 (0.3)	<0.001
Latvia	30 (1.4)	1642 (7.1)	<0.001
Serbia	28 (1.3)	722 (3.1)	<0.001
Croatia	10 (0.5)	1524 (6.6)	<0.001
Slovenia	9 (0.4)	1837 (8.0)	<0.001
Bosnia and Herzegovina	6 (0.3)	356 (1.5)	<0.001
Norway	0 (0.0)	2483 (10.7)	<0.001
Other countries[a]	336 (1.5)	31 (1.5)	0.953
Year of birth			
2020	1465 (69.5)	16776 (72.6)	0.001
2021	636 (30.2)	6170 (26.7)	0.001
2022	7 (0.3)	152 (0.7)	0.070
Women who gave birth in the same country where they were born			
Yes	1899 (90.1)	21361 (92.5)	<0.001
No	209 (9.9)	1737 (7.5)	<0.001
Age range, y			
18–24	66 (3.1)	1209 (5.2)	<0.001
25–30	588 (27.9)	8302 (35.9)	<0.001
31–35	932 (44.2)	9262 (40.1)	<0.001
36–39	396 (18.8)	3374 (14.6)	<0.001
≥40	126 (6.0)	951 (4.1)	<0.001
Educational level[b]			
None	1 (0.0)	8 (0.0)	0.544
Elementary school	5 (0.2)	71 (0.3)	0.834
Junior High school	54 (2.6)	1258 (5.4)	<0.001
High School	400 (19.0)	5467 (23.7)	<0.001
University degree	663 (31.5)	9252 (40.1)	<0.001
Postgraduate degree/Masters/Doctorate or higher	985 (46.7)	7042 (30.5)	<0.001
Parity			
1	1232 (58.4)	13410 (58.1)	0.730
>1	876 (41.6)	9688 (41.9)	0.730

(Continues)

TABLE 1 (Continued)

	Births in private facilities No. (%) n = 2108	Births in public facilities No. (%) n = 23098	*P* value
Type of healthcare provider who directly assisted the birth[c]			
Midwife	1612 (76.5)	20898 (90.5)	<0.001
Nurse	855 (40.6)	8441 (36.5)	<0.001
Student (i.e. before graduation)	180 (8.5)	3541 (15.3)	<0.001
Obstetrics registrar/medical resident (under post-graduate training)	167 (7.9)	4229 (18.3)	<0.001
Obstetrician/gynecologist	1625 (77.1)	12223 (52.9)	<0.001
I don't know	97 (4.6)	2374 (10.3)	<0.001
Other	235 (11.1)	2724 (11.8)	0.398
Other clinical characteristics			
Newborn admitted to neonatal intensive or semi-intensive care unit	31 (1.5)	418 (1.8)	0.260
Mother admitted to intensive care unit	5 (0.2)	176 (0.8)	0.006
Multiple birth	14 (0.7)	185 (0.8)	0.497

[a]Frequencies of births by other countries are detailed in supporting information Table 3.

[b]Wording on education levels agreed among partners during the Delphi. Questionnaire translated and back-translated according to ISPOR Task Force for Translation and Cultural Adaptation Principles of Good Practice.

[c]More than one possible answer.

1.04–1.96; $P = 0.030$). In Portugal, Romania, and Italy the rate of cesarean was significantly higher in private compared with public facilities (Portugal: 46.0% vs 22.1%; aOR 3.04; 95% CI, 2.29–4.04; $P < 0.001$; Romania: 63.7% vs 56.2%; aOR 1.39; 95% CI, 1.01–1.91, $P = 0.041$; Italy: 27.4% vs 23.4%; aOR 1.27; 95% CI, 1.01–1.61; $P = 0.045$).

3.3 | QMNC indexes

When the whole sample was considered (Figure 2), the distribution of the QMNC index significantly differed by domain ($P < 0.001$). When adjusting for relevant variables, the reported median QMNC index was slightly higher for births in private facilities compared with public hospitals for each QMNC domain ($P < 0.001$; detailed results presented in supporting information Tables 6 and 7).

When the QMNC indexes were calculated in each of the five countries with a sufficient sample (France, Italy, Portugal, Romania, and Switzerland) and adjusted for relevant variables, trends in the QMNC indexes varied by country (Figure 3 and supporting information Tables 6 and 7). In Romania and Portugal, all median domains of quality of care scored higher in private facilities ($P < 0.001$), with the largest difference observed in Romania in the domain of resources (median index: +27.5 points in private compared with public facilities; $P < 0.001$). In Switzerland, according to maternal perception, three out of four domains had a higher median QMNC index in private facilities (i.e. experience of care, resources, and reorganizational changes due to COVID-19; $P < 0.001$, $P = 0.002$, and $P = 0.026$, respectively). In Italy, only the domains of experience of care and availability of physical and human resources were rated by women with higher median scores in private facilities ($P = 0.001$ and $P = 0.002$, respectively). No statistically significant differences were observed between private and public facilities in France.

Results of the QMNC index by different regions in each country are reported in Tables 3–5. France could not be further included in this analysis due to the small sample size to compare results across regions (supporting information Table 8).

All countries had significant differences in the QMNC index by region, independent of hospital type (Tables 3–5). When data were further stratified by type of facility and analysis adjusted for relevant variable, different regions within the same country showed different patterns in the comparison of the QMNC index between private and public facilities. For example, in Italy (Table 3 and supporting information Table 9), regions of the North scored significantly better than other regions in all four domains of the QMNC ($P < 0.001$). In the North-West and North-East, differences were not significant in the reported QMNC indexes between births in private and public facilities. In contrast, in Central Italy the domains of experience (90, IQR 76–95 vs 85, IQR 65–90), resources (80, IQR 65–90 vs 65, IQR 45–80), and reorganizational changes (85, IQR 70–95 vs 80, IQR 65–90) were rated with a significantly higher QMNC index in private versus public facilities ($P < 0.02$).

Similarly, in Switzerland (Table 4 and supporting information Table 10), although all groups scored highly on the QMNC, the QMNC index differed between groups ($P = 0.022$) with German-speaking

TABLE 2 Mode of birth in private versus public facilities

	Births in private facilities No. (%)	Births in public facilities No. (%)	Adjusted OR (95% CI)[a]	Adjusted *P* value[b]
Overall (n = 25 206)	**n = 2108**	**n = 23 098**		
Spontaneous vaginal birth	1188 (56.4)	16 993 (73.6)	0.62 (0.56–0.69)	<0.001
Instrumental birth[c]	920 (43.6)	6105 (26.4)	1.60 (1.44–1.78)	<0.001
Instrumental vaginal birth	234 (11.1)	1723 (7.5)	1.07 (0.90–1.26)	0.441
Cesarean	686 (32.5)	4382 (19.0)	1.70 (1.52–1.90)	<0.001
Emergency cesarean before labor	156 (7.4)	908 (3.9)	1.39 (1.14–1.70)	0.001
Emergency cesarean during labor	165 (7.8)	1664 (7.2)	1.10 (0.91–1.31)	0.316
Elective cesarean	365 (17.3)	1810 (7.8)	1.90 (1.65–2.19)	<0.001
France (n = 1064)	**n = 477**	**n = 587**		
Spontaneous vaginal birth	335 (70.2)	429 (73.1)	0.83 (0.62–1.13)	0.244
Instrumental birth[c]	142 (29.8)	158 (26.9)	1.20 (0.88–1.62)	0.244
Instrumental vaginal birth	66 (13.8)	90 (15.3)	0.94 (0.63–1.39)	0.763
Cesarean	76 (15.9)	68 (11.6)	1.43 (0.97–2.10)	0.070
Emergency cesarean before labor	28 (5.9)	17 (2.9)	1.74 (0.89–3.46)	0.109
Emergency cesarean during labor	16 (3.4)	25 (4.3)	0.91 (0.45–1.81)	0.799
Elective cesarean	32 (6.7)	26 (4.4)	1.59 (0.88–2.86)	0.122
Italy (n = 4909)	**n = 390**	**n = 4519**		
Spontaneous vaginal birth	252 (64.6)	3165 (70.0)	0.76 (0.61–0.95)	0.016
Instrumental birth[c]	138 (35.4)	1354 (30.0)	1.31 (1.05–1.64)	0.016
Instrumental vaginal birth	31 (7.9)	297 (6.6)	1.23 (0.82–1.79)	0.304
Cesarean	107 (27.4)	1057 (23.4)	1.27 (1.01–1.61)	0.045
Emergency cesarean before labor	25 (6.4)	214 (4.7)	1.39 (0.88–2.10)	0.139
Emergency cesarean during labor	38 (9.7)	373 (8.3)	1.16 (0.80–1.64)	0.404
Elective cesarean	44 (11.3)	470 (10.4)	1.18 (0.83–1.63)	0.338
Portugal (n = 1354)	**n = 300**	**n = 1054**		
Spontaneous vaginal birth	84 (28.0)	569 (54.0)	0.31 (0.23–0.41)	<0.001
Instrumental birth[c]	216 (72.0)	485 (46.0)	3.27 (2.43–4.44)	<0.001
Instrumental vaginal birth	78 (26.0)	252 (23.9)	1.12 (0.82–1.52)	0.482
Cesarean	138 (46.0)	233 (22.1)	3.04 (2.29–4.04)	<0.001
Emergency cesarean before labor	30 (10.0)	61 (5.8)	1.80 (1.10–2.89)	0.016
Emergency cesarean during labor	27 (9.0)	92 (8.7)	1.12 (0.69–1.77)	0.629
Elective cesarean	81 (27.0)	80 (7.6)	4.32 (3.01–6.20)	<0.001
Romania (n = 867)	**n = 267**	**n = 600**		
Spontaneous vaginal birth	93 (34.8)	257 (42.8)	0.70 (0.51–0.97)	0.030
Instrumental birth[c]	174 (65.2)	343 (57.2)	1.42 (1.04–1.96)	0.030
Instrumental vaginal birth	4 (1.5)	6 (1.0)	1.46 (0.34–5.82)	0.589
Cesarean	170 (63.7)	337 (56.2)	1.39 (1.01–1.91)	0.041
Emergency cesarean before labor	31 (11.6)	91 (15.2)	0.71 (0.44–1.11)	0.143
Emergency cesarean during labor	34 (12.7)	57 (9.5)	1.42 (0.88–2.30)	0.149
Elective cesarean	105 (39.3)	189 (31.5)	1.45 (1.05–1.99)	0.024

[a]Odds ratios are presented for "Births in private facilities", thus taking "Births in public facilities" as the reference category.

[b]Results are adjusted for country of birth (only for the overall analysis), year of birth, maternal age, maternal educational level, parity, and multiple birth.

[c]Any instrumental birth (i.e. instrumental vaginal birth or cesarean).

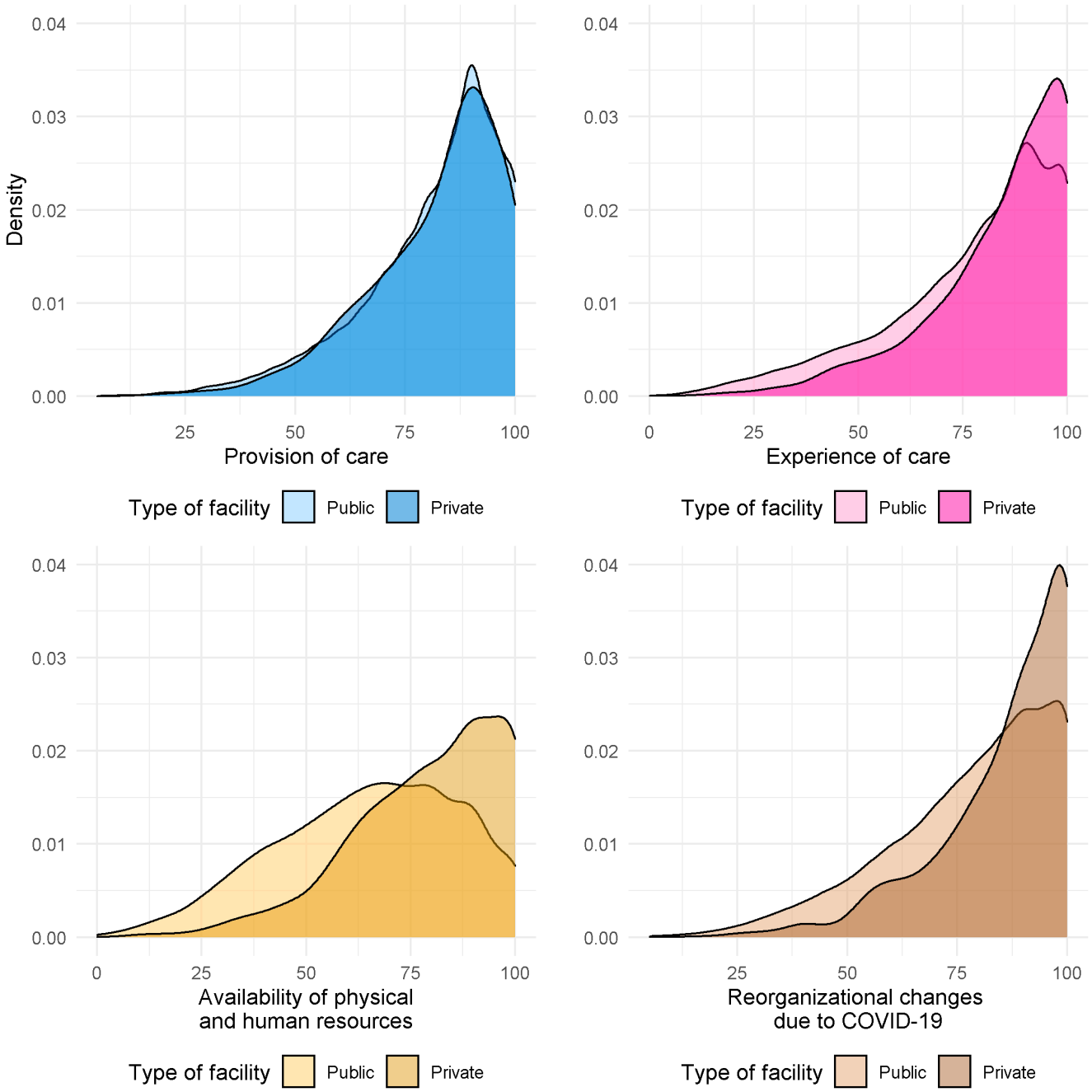

FIGURE 2 Quality of maternal and newborn care (QMNC) indexes in private versus public facilities, whole sample.

scoring slightly better than French- or Italian-speaking. When data were further stratified by facility type, in the Italian-speaking group no significant differences were observed in the QMNC index by hospital type, while the French- and German-speaking groups had at least two domains where a significantly higher QMNC index was attributed by women giving birth in private versus public facilities ($P < 0.05$).

In Romania (Table 5 and supporting information Table 11), significant differences were observed across regions, independent of hospital type, with significant differences for provision of care ($P < 0.001$) and experience of care ($P = 0.019$). When regional data were stratified by facility type, women attributed higher scores on the QMNC indexes to private facilities compared with public facilities in all domains in the East, South, and West regions ($P < 0.001$), while in the North region, private facilities had a higher index only for the provision of care and resources domains ($P = 0.002$ and $P < 0.001$, respectively).

In Portugal (supporting information Tables 12 and 13), significant differences were observed between regions ($P < 0.001$), with Lisbon Metropolitan area scoring higher than other regions in most domains. Only two regions (North and Lisbon Metropolitan Area) could be stratified by facility type, and women attributed higher scores to private facilities compared with public facilities in most domains ($P < 0.030$).

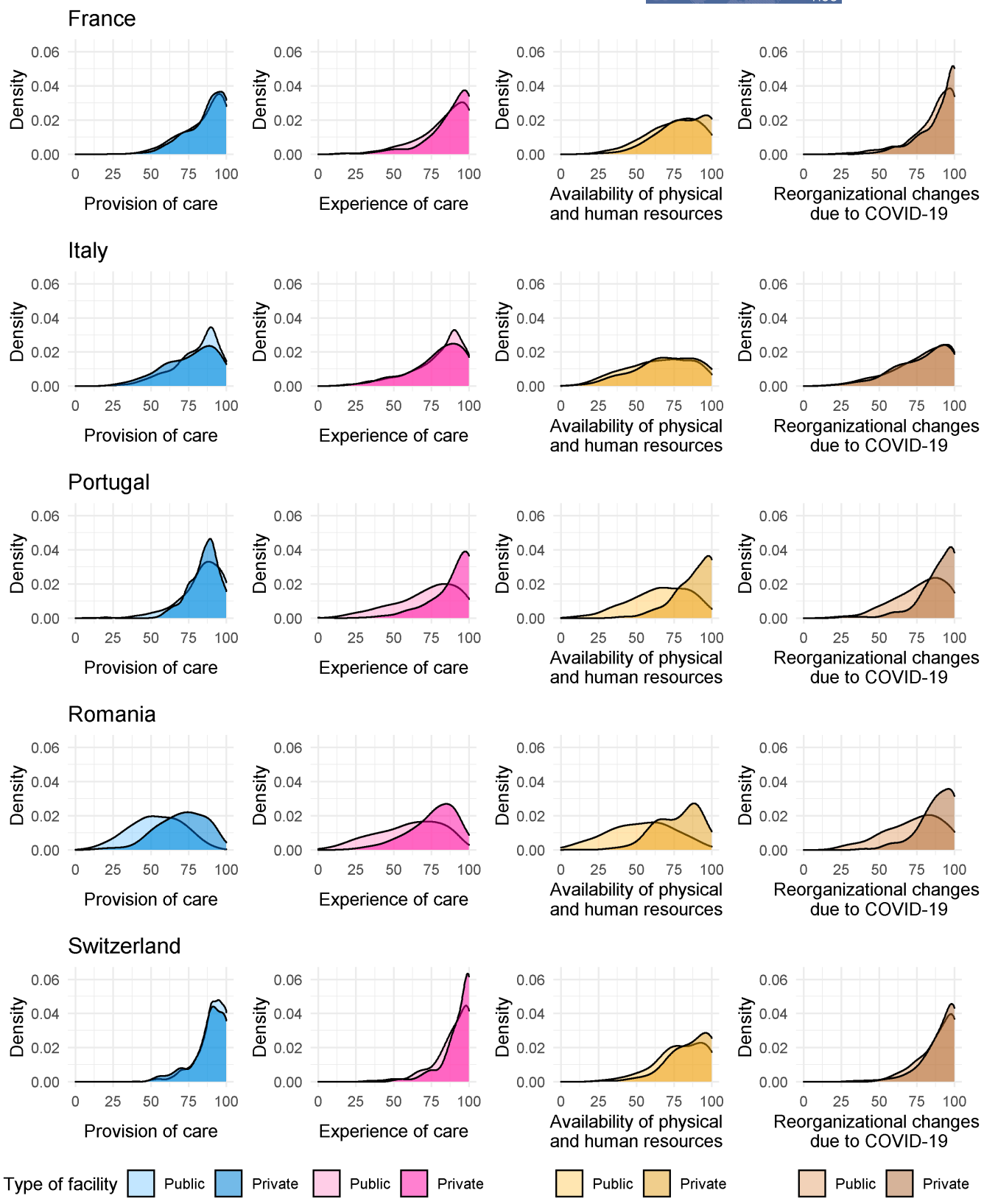

FIGURE 3 Quality of maternal and newborn care (QMNC) indexes by domain in private versus public facilities, country-specific.

TABLE 3 Quality of maternal and newborn care (QMNC) indexes in Italy, by region and facility type[a]

	North-west Median [IQR]			North-east Median [IQR]			Central Italy Median [IQR]			South and Islands Median [IQR]		Adjusted *P* value
Overall	**n = 1478**			**n = 1263**			**n = 888**			**n = 1280**		
Provision of care	85.0 [75.0, 90.0]			90.0 [80.0, 95.0]			85.0 [70.0, 90.0]			70.0 [60.0, 85.0]		<0.001
Experience of care	85.0 [75.0, 95.0]			90.0 [80.0, 95.0]			85.0 [65.0, 90.0]			75.0 [60.0, 85.0]		<0.001
Availability of physical and human resources	70.0 [55.0, 85.0]			75.0 [55.0, 90.0]			65.0 [45.0, 80.0]			55.0 [40.0, 70.0]		<0.001
Reorganizational changes due to COVID-19	85.0 [70.0, 95.0]			85.0 [75.0, 95.0]			80.0 [65.0, 95.0]			72.5 [55.0, 85.0]		<0.001
Total QMNC index	325.0 [285.0, 355.0]			335.0 [295.0, 360.0]			310.0 [255.0, 350.0]			275.0 [220.0, 320.0]		<0.001
Births by facility type	**Private n = 86**	**Public n = 1392**	**Adj *P* value**	**Private n = 48**	**Public n = 1215**	**Adj *P* value**	**Private n = 70**	**Public n = 818**	**Adj *P* value**	**Private n = 186**	**Public n = 1094**	**Adjusted *P* value**
Provision of care	85.0 [75.0. 95.0]	85.0 [75.0. 90.0]	>0.99	85.0 [78.8, 90.0]	90.0 [80.0. 95.0]	0.122	85.0 [70.0. 93.8]	80.0 [70.0. 90.0]	>0.99	70.0 [56.2, 85.0]	75.0 [60.0. 85.0]	>0.99
Experience of care	90.0 [75.0. 95.0]	85.0 [75.0. 95.0]	>0.99	90.0 [80.0. 100.0]	90.0 [80.0. 95.0]	>0.99	90.0 [76.2, 95.0]	85.0 [65.0. 90.0]	0.014	80.0 [65.0. 85.0]	75.0 [55.0. 85.0]	0.174
Availability of physical and human resources	80.0 [61.2, 90.0]	70.0 [55.0. 85.0]	0.089	75.0 [63.8, 90.0]	75.0 [55.0. 85.0]	>0.99	80.0 [65.0. 90.0]	65.0 [45.0. 80.0]	<0.001	65.0 [50.0. 80.0]	55.0 [35.0. 70.0]	<0.001
Reorganizational changes due to COVID-19	85.0 [75.0. 95.0]	85.0 [70.0. 95.0]	0.358	90.0 [80.0. 100.0]	85.0 [75.0. 95.0]	0.317	85.0 [70.0. 95.0]	80.0 [65.0. 90.0]	0.002	75.0 [65.0. 90.0]	70.0 [55.0. 85.0]	0.017
Total QMNC index	330.0 [300.0. 363.8]	325.0 [280.0. 355.0]	>0.99	340.0 [295.0. 370.0]	335.0 [295.0. 360.0]	0.223	337.5 [280.0. 360.0]	305.0 [255.0. 350.0]	<0.001	285.0 [250.0. 330.0]	270.0 [215.0. 315.0]	0.003

Abbreviations: IQR, interquartile range; ICU, intensive care unit; NICU, neonatal intensive care unit; QMNC, quality of maternal and newborn care.

[a]Regions are based on NUTS level 1 with Islands and South collapsed in a single region. Comparisons were adjusted for relevant variables according to the outcome analyzed: results of provision of care were adjusted for regions (only for the overall analysis), mode of birth, parity, NICU and ICU admission, and multiple birth; results of resources and reorganizational changes due to COVID-19 were adjusted for regions (only for the overall analysis), mode of birth, parity, maternal age, maternal educational level, women giving birth in the same country where they were born, presence of an obstetrician/gynecologist at birth, NICU admission, and year of birth (only for reorganizational changes due to COVID-19); results of experience and total QMNC index were adjusted for regions (only for the overall analysis), maternal age, maternal education, year of birth, women giving birth in the same country where they were born, parity, mode of birth, presence of an obstetrician/gynecologist at birth, multiple birth, NICU or ICU admission.

TABLE 4 Quality of maternal and newborn care (QMNC) indexes in Switzerland, by language and facility type[a]

	French Switzerland Median [IQR]			German Switzerland Median [IQR]			Italian Switzerland Median [IQR]		*P* value
Overall	**n = 397**			**n = 288**			**n = 103**		
Provision of care	90.0 [85.0, 100.0]			90.0 [90.0, 95.0]			90.0 [80.0, 95.0]		0.003
Experience of care	95.0 [85.0, 100.0]			95.0 [85.0, 100.0]			95.0 [87.5, 100.0]		>0.99
Availability of physical and human resources	80.0 [70.0, 95.0]			85.0 [75.0, 95.0]			85.0 [70.0, 95.0]		0.003
Reorganizational changes due to COVID-19	90.0 [85.0, 100.0]			95.0 [85.0, 100.0]			90.0 [80.0, 97.5]		<0.001
Total QMNC index	355.0 [330.0, 375.0]			362.5 [340.0, 380.0]			355.0 [325.0, 375.0]		0.022
Births by facility type	**Private n = 97**	**Public n = 300**	**Adj *P* value**	**Private n = 47**	**Public n = 241**	**Adj *P* value**	**Private n = 42**	**Public n = 61**	**Adj *P* value**
Provision of care	90.0 [80.0. 100.0]	90.0 [85.0. 100.0]	<0.99	95.0 [90.0. 100.0]	90.0 [90.0. 95.0]	<0.99	90.0 [85.0. 93.8]	90.0 [80.0. 95.0]	0.097
Experience of care	95.0 [90.0. 100.0]	90.0 [85.0. 100.0]	<0.001	100.0 [90.0. 100.0]	95.0 [85.0. 100.0]	0.044	95.0 [90.0. 100.0]	95.0 [85.0. 100.0]	0.691
Availability of physical and human resources	85.0 [75.0. 95.0]	80.0 [65.0. 90.0]	0.025	90.0 [80.0. 100.0]	85.0 [75.0. 95.0]	0.070	85.0 [75.0. 95.0]	80.0 [65.0. 95.0]	0.051
Reorganizational changes due to COVID-19	90.0 [85.0. 100.0]	90.0 [80.0. 100.0]	0.795	100.0 [90.0. 100.0]	90.0 [85.0. 100.0]	<0.001	95.0 [90.0. 100.0]	90.0 [75.0. 95.0]	0.337
Total QMNC index	360.0 [340.0. 380.0]	355.0 [325.0. 370.0]	<0.001	375.0 [355.0. 390.0]	360.0 [340.0. 380.0]	0.045	360.0 [336.2, 375.0]	355.0 [315.0. 375.0]	0.463

Abbreviations: IQR, interquartile range; ICU, intensive care unit; NICU, neonatal intensive care unit; QMNC, quality of maternal and newborn care.

[a]Regions are based on language of questionnaire completion. Comparisons were adjusted for relevant variables according to the outcome analyzed: results of provision of care were adjusted for regions (only for the overall analysis), mode of birth, parity, NICU and ICU admission, and multiple birth; results of resources and reorganizational changes due to COVID-19 were adjusted for regions (only for the overall analysis), mode of birth, parity, maternal age, maternal educational level, women giving birth in the same country where they were born, presence of an obstetrician/gynecologist at birth, NICU admission, and year of birth (only for reorganizational changes due to COVID-19); results of experience and total QMNC index were adjusted for regions (only for the overall analysis), maternal age, maternal education, year of birth, women giving birth in the same country where they were born, parity, mode of birth, presence of an obstetrician/gynecologist at birth, multiple birth, NICU or ICU admission.

TABLE 5 Quality of maternal and newborn care (QMNC) indexes in Romania, by region and facility type[a]

	North Median [IQR]			East Median [IQR]			South Median [IQR]			West Median [IQR]		Adjusted *P* value
Overall	**n = 146**			**n = 249**			**n = 342**			**n = 130**		
Provision of care	65.0 [55.0, 75.0]			55.0 [45.0, 70.0]			65.0 [50.0, 75.0]			52.5 [35.0, 68.8]		<0.001
Experience of care	70.0 [50.0, 85.0]			65.0 [45.0, 85.0]			70.0 [55.0, 80.0]			75.0 [50.0, 83.8]		0.019
Availability of physical and human resources	65.0 [45.0, 75.0]			60.0 [40.0, 80.0]			65.0 [50.0, 80.0]			55.0 [36.2, 78.8]		0.152
Reorganizational changes due to COVID-19	80.0 [65.0, 90.0]			80.0 [65.0, 90.0]			85.0 [70.0, 95.0]			80.0 [70.0, 90.0]		>0.99
Total QMNC Index	272.5 [226.2, 320.0]			260.0 [205.0, 310.0]			280.0 [231.2, 320.0]			262.5 [200.0, 313.8]		0.011
Births by facility type	**Private n = 29**	**Public n = 117**	**Adj *P* value**	**Private n = 68**	**Public n = 181**	**Adj *P* value**	**Private n = 131**	**Public n = 211**	**Adj *P* value**	**Private n = 39**	**Public n = 91**	**Adj *P* value**
Provision of care	75.0 [65.0. 85.0]	65.0 [50.0. 70.0]	0.002	70.0 [55.0. 85.0]	50.0 [40.0. 60.0]	<0.001	75.0 [60.0. 80.0]	55.0 [40.0. 70.0]	<0.001	70.0 [55.0. 85.0]	45.0 [30.0. 60.0]	<0.001
Experience of care	80.0 [65.0. 90.0]	65.0 [50.0. 80.0]	0.370	82.5 [65.0. 90.0]	60.0 [40.0. 80.0]	<0.001	80.0 [65.0. 85.0]	65.0 [45.0. 75.0]	<0.001	80.0 [70.0. 90.0]	65.0 [45.0. 75.0]	<0.001
Availability of physical and human resources	80.0 [65.0. 90.0]	60.0 [45.0. 70.0]	<0.001	80.0 [65.0. 90.0]	55.0 [35.0. 70.0]	<0.001	80.0 [65.0. 90.0]	55.0 [40.0. 70.0]	<0.001	80.0 [67.5, 90.0]	45.0 [30.0. 60.0]	<0.001
Reorganizational changes due to COVID-19	85.0 [75.0. 90.0]	80.0 [65.0. 90.0]	0.063	90.0 [83.8, 96.2]	75.0 [60.0. 85.0]	<0.001	90.0 [85.0. 100.0]	75.0 [60.0. 90.0]	<0.001	90.0 [80.0. 97.5]	75.0 [60.0. 87.5]	<0.001
Total QMNC index	75.0 [65.0. 85.0]	65.0 [50.0. 70.0]	<0.001	70.0 [55.0. 85.0]	50.0 [40.0. 60.0]	<0.001	75.0 [60.0. 80.0]	55.0 [40.0. 70.0]	<0.001	70.0 [55.0. 85.0]	45.0 [30.0. 60.0]	<0.001

Abbreviations: IQR, interquartile range; ICU, intensive care unit; NICU, neonatal intensive care unit; QMNC, quality of maternal and newborn care.

[a]Regions are based on NUTS level 1. Comparisons were adjusted for relevant variables according to the outcome analyzed: results of provision of care were adjusted for regions (only for the overall analysis), mode of birth, parity, NICU and ICU admission, and multiple birth; results of resources and reorganizational changes due to COVID-19 were adjusted for regions (only for the overall analysis), mode of birth, parity, maternal age, maternal educational level, women giving birth in the same country where they were born, presence of an obstetrician/gynecologist at birth, NICU admission, and year of birth (only for reorganizational changes due to COVID-19); results of experience and total QMNC index were adjusted for regions (only for the overall analysis), maternal age, maternal education, year of birth, women giving birth in the same country where they were born, parity, mode of birth, presence of an obstetrician/gynecologist at birth, multiple birth, NICU or ICU admission.

4 | Discussion

This is the first study to assess IVB and cesarean rates in parallel with overall maternal perception of QMNC in private versus public facilities, across several countries of the WHO European region during the COVID-19 pandemic. Women giving birth in private facilities underwent cesarean significantly more often (aOR 1.70), in particular elective cesarean (aOR 1.90) and emergency cesarean before labor (aOR 1.39), compared with those giving birth in public facilities. The analysis in countries with a sufficient sample (France, Italy, Portugal, Romania) confirmed these findings. Conversely, results from the QMNC were heterogeneous both across and within countries and were largely affected by geographical distribution of regions rather than by type of facility alone, suggesting that QMNC should be closely monitored in both public and private sectors. Future studies should further assess what the determinants are for better or worse quality of care in each setting; for example, whether it is availability of resources or other organizational and cultural factors.

These data need to be interpreted in the light of an important consideration: while the rates of IVB and cesarean are single objective indicators, the QMNC index is a composite measure of QMNC, including 40 different quality measures across four domains. The QMNC index is not weighted for the relative importance of each quality measure (i.e. the scoring system attributes the same scores to all quality measures) and some of its measures may be open to subjectivity. Therefore, we acknowledge that—as recommended in our previous papers[24,26–28] —when assessing QMNC it is critical to evaluate specific indicators (such as the rate of cesarean) as well as overall QMNC score. In the present paper we made the choice to document the rates of IVB and cesarean because they are objective indicators, and reducing cesarean rates while promoting "physiological birth" is identified as a priority by health policies in the European region.[10,11]

Data from our study are to a large extent in line with previous findings. A large body of literature has documented significantly higher cesarean rates in private versus public facilities in Europe,[13–23] as well as among women with private insurance,[37] and a direct correlation with out-of-pocket expenditures.[38] Interestingly, one of the existing systematic reviews, describing 17 studies in 4.1 million women,[14] found that the adjusted odds of birth by cesarean was 1.41 times higher in for-profit hospitals compared with nonprofit hospitals (95% CI, 1.24–1.60) with no relevant heterogeneity between studies ($\tau 2 \leq 0.037$). Results of the present study highlight even higher odds ratios for cesarean and confirm low heterogeneity across countries. Eliminating financial incentives for cesarean is one of the key recommended strategies to reduce the rates worldwide and should be taken into consideration by policymakers together with other multicomponent locally tailored strategies, such as addressing women's and health professionals' concerns, as well as other health system factors.[10,11,39]

Previous systematic reviews[1,2,9] have underscored that evidence on overall quality of care in private versus public facilities is too diverse to make a conclusive statement. The present study adds to previous evidence by bringing data from multiple countries and suggests that QMNC should be actively monitored in all facilities, with the aim of achieving high-quality care independent of facility type or geographical distribution.

Our study confirms previous evidence[1,2,20–22] that populations accessing private facilities significantly differ from those accessing public facilities, i.e. women using private facilities had a higher level of education. This suggests inequity in access and is not aligned with SDG 3.8: "ensuring access to Universal health coverage with quality services".[40] Our questionnaire, for practical reasons of acceptability, lacked extensive data on the socioeconomic characteristics of the participants, as well as other data on the rate of co-morbidities and complications; however, even the minimal amount collected suggests higher complications in the public facility group (increased rate of mothers admitted to intensive care). Future surveys may consider adding these variables to obtain additional information about access to different services based on socioeconomic status and clinical characteristics of women. Case mix should be considered when comparing health outcomes across facilities.

Limitations of the IMAgiNE EURO study have been acknowledged elsewhere.[26–28] Briefly, they include case selection toward women with relatively high levels of education, and a potential selection toward those with a higher interest in participating. Specific to the present study, while the rate of births in private facilities was well aligned with the expected national rate for France (20.0%) and Portugal (17.1%), our sample was over-represented in Italy (18.0% in our sample vs 11.6% in the national statistics) and underrepresented for Switzerland (9.5% vs 20.2%), while no official data are currently available for Romania (supporting information Table 4). For all of these factors, it is unknown in which direction the results may have been affected. Furthermore, the questionnaire was not constructed to distinguish between private for-profit and private non-profit hospitals, and in some settings (e.g. Switzerland) women might not necessarily be aware whether they gave birth in a private or public facility.

It is plausible that women who opted to give birth in private facilities planned this decision and this, more than other maternal characteristics (e.g. education, social and economic background), may have affected their perception of QMNC received, i.e. in favor of rating better care (subjectively) in private hospitals. Other indicators of QMNC should be selected to compare public versus private facilities, such as objective indicators of human resources and equipment and organization of care.

We acknowledge that QMNC may have large variations even among single hospitals within the same country. By reporting national averages, we may mask intracountry heterogeneity in findings; while different dissemination periods among countries may also have affected results. More detailed results by distinct period of the COVID-19 pandemic will be the subject of extensive future publications.

In conclusion, the results of the present study confirm that births in private facilities have higher odds of cesarean, while maternal

perception of overall QMNC is heterogeneous both across and within countries, and more affected by geographical distribution of regions rather than by type of facility alone. Initiatives to better describe overall QMNC within WHO European countries and to monitor it routinely, in both public and private sectors, are key future considerations.

AUTHOR CONTRIBUTIONS

ML conceived the study, with major inputs from EPV and IM and additional input from all other authors. All authors promoted the surveys and supported the process of data collection. IM analyzed the data, with major inputs from ML. ML wrote the first draft, with major inputs from all authors. All authors approved the final version of the manuscript for submission.

ACKNOWLEDGMENTS

This work was supported by the Ministry of Health, Rome, Italy, in collaboration with the Institute for Maternal and Child Health IRCCS "Burlo Garofolo", Trieste, Italy. We would like to thank all the women who took the time to respond to this survey despite the burden of the COVID-19 pandemic, and Dr. Manuela Giangreco—Institute of Maternal and Child Health IRCCS "Burlo Garofolo", Trieste, Italy—for reviewing the methodology in this manuscript. Special thanks to the IMAgiNE EURO study group for their contribution to the development of this project and support for this manuscript.

CONFLICT OF INTEREST

RC was supported by the Social European Fund and Foundation for Science and Technology under a Post-Doctoral Grant (SFRH/BPD/117597/2016). EPIUnit (UIDB/04750/2020), ITR (LA/P/0064/2020), and HEI-LAB (UIDB/05380/2020) are financed by the Portuguese Ministry of Science, Technology and Higher Education. Other authors have no conflicts of interest to declare.

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DATA AVAILABILITY STATEMENT

Data can be made available on reasonable request to the corresponding author.

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The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions, or policies of the institutions with which they are affiliated.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Lazzerini M, Valente EP, Covi B, et al. Rates of instrumental vaginal birth and cesarean and quality of maternal and newborn health care in private versus public facilities: Results of the IMAgiNE EURO study in 16 countries. *Int J Gynecol Obstet*. 2022;159(Suppl. 1):22-38. doi:10.1002/ijgo.14458