







# Quality of maternal and newborn care around the time of childbirth in Luxembourg during the COVID-19 pandemic: Results of the IMAGiNE EURO study

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## Abstract

**Objective:** To investigate the quality of maternal and newborn care (QMNC) during childbirth in Luxembourg from women's perspectives.

**Methods:** Women giving birth in facilities in Luxembourg between March 1, 2020, and July 1, 2021, answered a validated online WHO standards-based questionnaire as part of the multicountry IMAGiNE EURO study. Descriptive and multivariate quantile regression analyses were performed.

**Results:** A total of 493 women were included, representing 5.2% of women giving birth in the four maternity hospitals in Luxembourg during the study period. Most quality measures suggested high QMNC, although specific gaps were observed: 13.4% ( $n = 66$ ) of women reported not being treated with dignity, 9.1% ( $n = 45$ ) experienced abuse, 42.9% ( $n = 30$ ) were not asked for consent prior to instrumental vaginal birth, 39.3% ( $n = 118$ ) could not choose their birth position, 27% ( $n = 133$ ) did not exclusively breast-feed at discharge (without significant differences over time), 20.5% ( $n = 101$ ) reported an insufficient number of healthcare professionals, 20% ( $n = 25$ ) did not receive information on the newborn after cesarean, and 41.2% ( $n = 203$ ) reported lack of information on newborn danger signs before discharge. Multivariate analyses highlighted higher reported QMNC indexes among women born outside Luxembourg and delivering with a gynecologist, and significantly lower QMNC indexes in women with the highest education levels and those delivering in the hospital offering some private services. **Conclusions:** Despite maternal reports suggesting an overall high QMNC in Luxembourg, improvements are needed in specific aspects of care and communication, mostly related to maternal autonomy, respect, and support, but also number and competencies of the health workforce.

## KEYWORDS

birth, breastfeeding, childbirth, COVID-19, IMAGiNE EURO, Luxembourg, maternal health, newborn health, quality of care

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## 1 | INTRODUCTION

Luxembourg is a small country in Europe, with 634 700 inhabitants and 6460 infants born to residents per year (2020).<sup>1</sup> It operates a compulsory social health insurance (SHI) system, covering the majority of maternity costs.<sup>2,3</sup> All women in Luxembourg consult with obstetrician/gynecologists (OB/GYNs) as their main healthcare providers during pregnancy, rather than midwives, and attending five prenatal visits to an OB/GYN is required by the State to receive a prenatal allowance.<sup>4,5</sup> In addition, most of the out-of-hospital midwifery prenatal and postnatal services are only reimbursed upon presentation of a medical prescription<sup>6,7</sup> (medical prescription in Luxembourg means a prescription by a medical doctor for medicines, laboratory tests, other diagnostic tests, physiotherapy, or for midwifery care). Maternal care is provided by OB/GYNs working mostly in private practice and contracted for birth assistance by one of the maternity hospitals. Women usually opt to give birth in the hospital where "their" doctor, with whom they have a long-standing relationship, can be present for birth.<sup>3</sup> The four maternity hospitals in Luxembourg all provide care that is reimbursed. Reimbursed care is also provided by one hospital that was privately founded but operates within the SHI system, albeit retaining certain private connotations related to the previous name of the facility and the offer of some first-class superior rooms. SHI covers stay in a two-person room, but all hospitals also offer single rooms. The single room choice implies additional formal fees that are not covered by the SHI for the stay and for the doctor's extra compensation. The overnight presence of the partners of birthing women also bears extra costs. There are less than 0.25% planned home births per year.<sup>8</sup>

The health workforce is marked by strong dependence on neighboring countries: around two-thirds of nurses and one-quarter of doctors practicing in Luxembourg live outside the country.<sup>2</sup> Furthermore, around 47.2% of inhabitants hold a foreign nationality.<sup>1</sup> For 46.5% of infants born in Luxembourg neither of the parents has Luxembourg nationality.<sup>1</sup> Given the high volume of the workforce commuting daily from outside countries, around 10% of births in Luxembourg are to parents not residing in the country, which combines to give a total of 7108 infants born per year, according to the last national estimates in 2019 (unpublished perinatal statistic of the Ministry of Health).

The COVID-19 pandemic affected Luxembourg from March 2020 onward, with a sharp increase in deaths registered from October 2020.<sup>9,10</sup> However, during the pandemic no official national recommendations were issued as a guidance for hospitals on how to organize maternity care in the country, resulting in a variety of unpublished policies that varied from hospital to hospital and over time.<sup>10</sup> Previous preliminary studies conducted in the early phases of the pandemic reported better access to health services and quality of care in Luxembourg compared with other countries.<sup>11,12</sup> Nonetheless, Luxembourg did not participate in the WHO survey on continuity of essential health services, therefore information on the resilience of the health system during the pandemic is limited.<sup>13</sup> While there have been reports of deterioration of mental

health indicators in the general population,<sup>14</sup> data focusing on maternal and perinatal outcomes during the pandemic are still lacking in Luxembourg compared with other countries, even though this information has crucial public health implications.<sup>15</sup>

Although some data on the views of service users on aspects of maternity care in Luxembourg have been previously published by nongovernmental organizations (NGOs), no previous studies have reported maternal perspectives gathered through a comprehensive set of measures describing the quality of maternal and newborn care (QMNC) in the country.<sup>16,17</sup>

In 2016, the World Health Organization (WHO) developed a set of standards and quality measures for improving the QMNC.<sup>18</sup> The IMAGiNE EURO study is a multicountry project, including partners from numerous countries of the WHO European Region, which developed a questionnaire aimed at collecting the perspective of women on a key set of WHO standards-based quality measures. The questionnaire was validated and used as an online survey.<sup>19,20</sup> The aim of the present study was to investigate QMNC during childbirth from the perspectives of women who gave birth in Luxembourg during the COVID-19 pandemic.

## 2 | MATERIALS AND METHODS

This was a cross-sectional study and is reported according to the STROBE guidelines and checklist (supporting information Table S1).<sup>21</sup>

Women aged 18 years and older who gave birth in Luxembourg between March 1, 2020, and July 1, 2021, were invited to participate in an online survey. Women who gave birth outside the hospital setting were excluded.

The process of questionnaire development, validation, and previous use has been reported elsewhere.<sup>20,22</sup> Briefly, the questionnaire included 40 questions (each on one single quality measure), equally distributed across four domains: provision of care, experience of care, availability of human and physical resources, and key organizational changes related to the COVID-19 pandemic. The 40 quality measures contributed to a QMNC index, with higher scores indicating higher adherence to WHO standards.<sup>18</sup> Basic sociodemographic information was also collected.

The questionnaire was made available in 23 languages, and women were invited to complete the survey in their preferred language. The survey was promoted through a predefined dissemination plan, using the following main approaches: posters and flyers made visible in hospitals, social media, websites of national networks (e.g. mothers' groups and NGOs), and radio interviews.

Data were analyzed in line with previous publications of the IMAGiNE EURO network.<sup>19,20,22,23</sup> Briefly, for the primary analysis, suspected duplicates and questionnaires missing 20% or more answers on 45 key variables were excluded. A descriptive analysis was performed, calculating absolute frequencies and percentages for each variable, as well as assessing the distribution of different languages chosen to answer the questionnaire.

For women providing data on all quality measures, a QMNC index was calculated based on the predefined criteria.<sup>19</sup> The QMNC index could range from 0–100 in each of the four domains, with the total ranging from 0–400. The QMNC indexes are presented as median and interquartile ranges (IQRs) because they are not normally distributed. In addition to the primary analysis, two sensitivity analyses were conducted: (1) including only women who answered 100% of the 45 key variables; and (2) including women with up to 90% missing answers on 45 key variables, as has been done by similar studies.<sup>19</sup>

We developed multivariable regression models with the QMNC index as the dependent variable and sociodemographic variables (i.e. parity, woman giving birth in the same country she was born, type of facility, maternal age, maternal educational level, year of birth), mode of birth, and presence of an OB/GYN directly assisting childbirth as independent variables. We conducted a multivariable quantile regression with robust standard errors (SEs) and we modeled the median, the 0.25th and 0.75th quantile, given statistical evidence of heteroskedasticity for parity, mode of birth, place of birth of the mother (Breusch-Pagan/Cook-Weisberg test  $P < 0.05$ ,  $H_0$ : homoskedasticity). The categories with the highest frequency were used as reference.

A subgroup analysis of women born in the country and women not born in the country was conducted to evaluate the differences in sociodemographic characteristics, quality measures, and the QMNC indexes using a  $\chi^2$  test and Wilcoxon–Mann–Whitney test.

Two additional exploratory analyses were also conducted. We analyzed whether there were differences between primiparous and multiparous women in their evaluation of the impact of COVID-19 on access to antenatal care, barriers to accessing the facility, and perceived quality of care (three indicators in the domain of key organizational changes related to the COVID-19 pandemic) using a  $\chi^2$  test. Furthermore, we analyzed changes in the quality measures related to exclusive breastfeeding at discharge over time (three time periods, reflecting the subsequent waves of COVID-19 in Luxembourg: March 2020 to June 2020; July 2020 to December 2020; January 2021 to June 2021) with a Cochran–Armitage trend test.

A two-tailed  $P$  value  $< 0.05$  was considered statistically significant. Statistical analyses were performed using Stata/SE version 14.0 (Stata Corp, College Station, TX, USA).

## 2.1 | Ethics statement

The IMaGiNE EURO study was approved by the Institutional Review Board of the coordinating center: IRCCS “Burlo Garofolo” Trieste (IRB-BURLO 05/2020 15.07.2020). The survey was an online anonymous questionnaire that woman could decide to join on a voluntary basis; no data elements that could disclose maternal identity were collected, answers were recorded directly into a centralized platform hosted in Italy, and no data were treated in Luxembourg, so no further ethical approval was required in Luxembourg. The survey was conducted according to the rules of the General Data Protection

Regulation (GDPR). Prior to participation, women were informed of the objectives and methods of the study, including their rights to decline participation, and each provided consent before responding to the questionnaires. Data transmission and storage were secured by encryption.

## 3 | RESULTS

### 3.1 | Characteristics of respondents

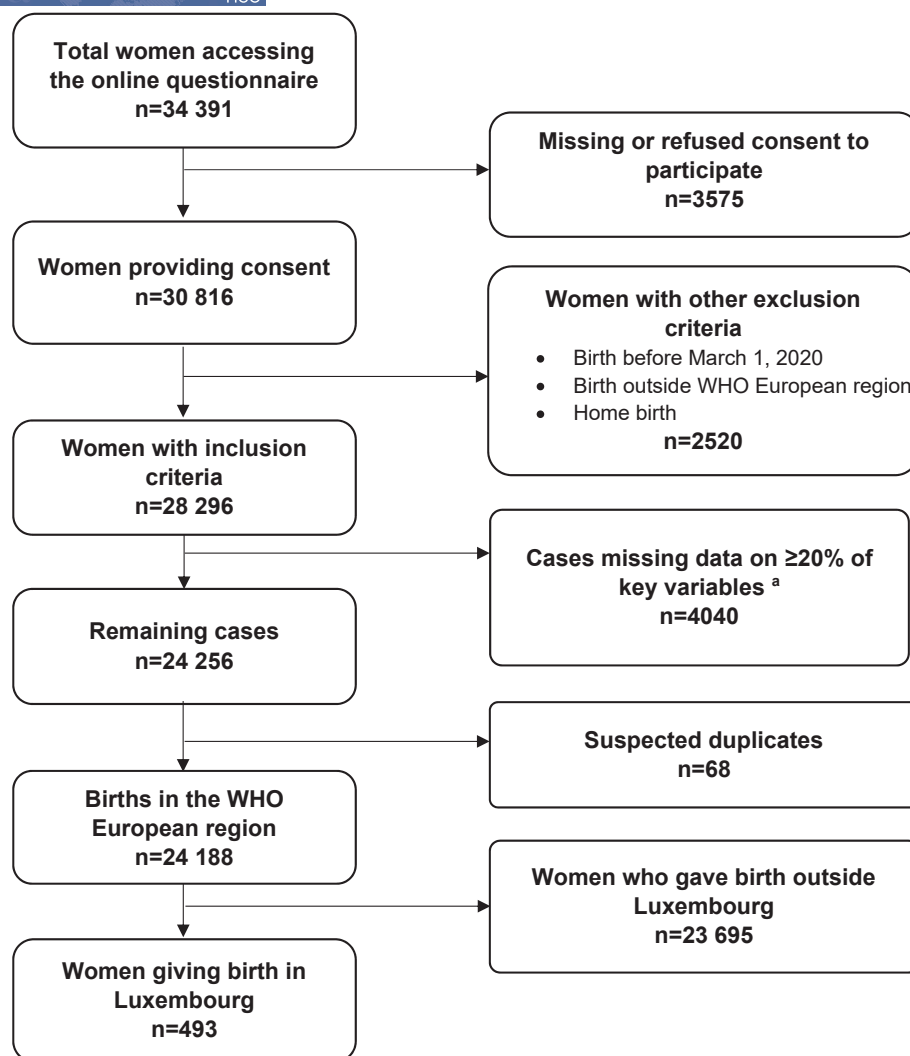
Of 34 391 women accessing the online questionnaire in all participating countries, 28 296 women fulfilled the inclusion criteria, and responses from 493 women giving birth in Luxembourg were analyzed after data cleaning (Figure 1). The sample accounted for 5.2% of total births expected in Luxembourg in the study period (unpublished perinatal statistics 2019 of the Ministry of Health). The German questionnaire was chosen by 55.2% ( $n = 272$ ) of women, 26.8% ( $n = 132$ ) chose the French, and the rest (18.0%,  $n = 89$ ) opted for one of the other available languages during the study period (supporting information Table S2).

Overall, most women (92.5%,  $n = 456$ ) were aged between 25 and 39 years and had a high level of education (72.4%,  $n = 357$  with a university degree or higher); 56.0% ( $n = 276$ ) were primiparous (Table 1). Overall, 34.5% ( $n = 170$ ) of women were not born in Luxembourg. Frequencies of spontaneous vaginal birth (SVB) and instrumental vaginal birth (IVB) were 60.9% ( $n = 300$ ) and 14.2% ( $n = 70$ ), respectively, while frequencies for cesarean during labor, elective, and emergency cesarean before labor occurred were 10.8% ( $n = 53$ ), 10.5% ( $n = 52$ ), and 3.7% ( $n = 18$ ), respectively.

### 3.2 | WHO standards-based quality measures

Key results for the domain of provision of care (Table 2) were as follows: 10.4% ( $n = 44$ ) of women who experienced labor and 11.4% ( $n = 14$ ) who had a cesarean complained of inadequate pain relief; 30% ( $n = 21$ ) of women with IVB reported fundal pressure during childbirth; 15% ( $n = 45$ ) of women with SVB had an episiotomy; 0.6% ( $n = 3$ ) of women did not experience skin-to-skin contact with their newborn; 5.3% ( $n = 26$ ) reported no early breastfeeding; 27.0% ( $n = 133$ ) were not exclusively breastfeeding at discharge, and 16.2% ( $n = 80$ ) reported inadequate breastfeeding support.

In the domain of experience of care: 14.2% ( $n = 60$ ) of women reported no freedom of movements during labor; 39.3% ( $n = 118$ ) reported no choice of birth position during SVB; 18.6% ( $n = 13$ ) reported that no consent was asked for vaginal examinations before prelabor cesarean, while 42.9% ( $n = 30$ ) reported no consent request for IVB; 21.7% ( $n = 107$ ) stated that they were not involved in choices around care or treatment and 20.3% ( $n = 25$ ) did not receive information on the newborn after cesarean. Lack of clear or effective communication from healthcare professionals (HCPs) was experienced by 16.4% ( $n = 81$ ) of women and 10.1% ( $n = 50$ ) experienced



**FIGURE 1** Study flow diagram. <sup>a</sup>Percentage of missing data for each woman was calculated over mandatory questions ( $n = 45$ )

limitations on privacy. Overall, 19.7% ( $n = 97$ ) of the women did not feel emotionally supported during childbirth, 13.4% ( $n = 66$ ) reported not being treated with dignity, and 9.1% ( $n = 45$ ) experienced physical, verbal, or emotional abuse. The presence of a companion of choice was not permitted for 21.1% ( $n = 104$ ) of women and 22.7% ( $n = 112$ ) reported inadequate visiting hours; 8.3% ( $n = 41$ ) had to make additional payments.

In the domain of availability of resources: 11.0% ( $n = 54$ ) did not receive timely care at facility level at arrival; none reported inadequate room comfort, while a small percentage reported too many women per room (4.3%,  $n = 21$ ), inadequate bathrooms (1.6%,  $n = 8$ ), and inadequate cleaning (1.2%,  $n = 6$ ). Lack of information on maternal and newborn danger signs was reported by 29.4% ( $n = 145$ ) and 41.2% ( $n = 203$ ), respectively.

In the domain of organizational changes due to COVID-19, 36.1% ( $n = 178$ ) of women had difficulties attending routine antenatal visits and 30.6% ( $n = 151$ ) encountered barriers in accessing the facility. Inadequate ward reorganization and inadequate room reorganization were mentioned by 16.6% ( $n = 82$ ) and 18.7% ( $n = 92$ ),

respectively. Insufficient numbers of HCPs to guarantee adequate assistance despite the COVID-19 pandemic was reported by 20.5% ( $n = 101$ ), while a reduction in quality of care due to COVID-19 was expressed by 39.4% ( $n = 194$ ). Communication on how to contain COVID-19-related stress was rated inadequate by 25.2% ( $n = 124$ ) of women. The lack of a hand-washing station or HCPs not using personal protective equipment (PPE) was reported by 5.3% ( $n = 26$ ) and 5.5% ( $n = 27$ ), respectively.

### 3.3 | QMNC index and multivariate analysis

The total reported median QMNC index was 355 (IQR 335–375), with lower scores observed in the domain of availability of physical and human resources (median 85, IQR 75–95) compared with other domains ( $P < 0.001$ , Table 3). Findings of the sensitivity analyses were substantially similar to the findings of the primary analysis (supporting information Tables S3–S6 and supporting information Figures S1 and S2).

TABLE 1 Characteristics of participants

	Overall (n = 493) No. (%)	Women born in Luxembourg <sup>a</sup> (n = 314) No. (%)	Women not born in Luxembourg <sup>a</sup> (n = 170) No. (%)	P value
Year of birth				
2020	414 (84.0)	270 (86.0)	144 (84.7)	0.898
2021	67 (13.6)	43 (13.7)	24 (14.1)	0.702
Missing	12 (2.4)	1 (0.3)	2 (1.2)	0.251
Maternal age, year				
18–24	9 (1.8)	6 (1.9)	3 (1.8)	>0.99
25–30	136 (27.6)	102 (32.5)	34 (20.0)	0.004
31–35	218 (44.2)	141 (44.9)	77 (45.3)	0.934
36–39	102 (20.7)	57 (18.2)	45 (26.5)	0.032
≥40	19 (3.9)	8 (2.5)	11 (6.5)	0.034
Missing	9 (1.8)	0 (0.0)	0 (0.0)	NA
Maternal educational level <sup>b</sup>				
Less than high school	21 (4.2)	19 (6.0)	2 (1.2)	0.010
High school	106 (21.5)	84 (26.8)	22 (12.9)	<0.001
University degree	159 (32.3)	111 (35.4)	48 (28.2)	0.112
Postgraduate degree/Master/ Doctorate or higher	198 (40.2)	100 (31.8)	98 (57.6)	<0.001
Missing	9 (1.8)	0 (0.0)	0 (0.0)	NA
Maternal parity				
1	276 (56.0)	193 (61.5)	83 (48.8)	0.007
>1	207 (42.0)	121 (38.5)	86 (50.6)	0.011
Missing	10 (2.0)	0 (0.0)	1 (0.6)	0.351
Type of facility where the birth occurred				
Public	398 (80.7)	257 (81.8)	141 (82.9)	0.804
Private	86 (17.4)	57 (18.2)	29 (17.1)	0.804
Missing	9 (1.8)	0 (0.0)	0 (0.0)	NA
Labor				
Yes	423 (85.8)	272 (86.6)	142 (83.5)	0.355
No	70 (14.2)	42 (13.4)	28 (16.5)	0.355
Mode of birth				
Spontaneous vaginal <sup>c</sup>	300 (60.9)	183 (58.3)	111 (65.3)	0.131
Instrumental vaginal	70 (14.2)	46 (14.6)	22 (12.9)	0.606
Emergency cesarean during labor	53 (10.8)	43 (13.7)	9 (5.3)	0.004
Emergency cesarean before going into labor	18 (3.7)	10 (3.2)	8 (4.7)	0.399
Elective cesarean	52 (10.5)	32 (10.2)	20 (11.8)	0.594
Health professional directly assisting childbirth <sup>d</sup>				
Midwife	465 (94.3)	304 (96.8)	161 (94.7)	0.371
Nurse	140 (28.4)	86 (27.4)	54 (31.8)	0.364
Student	89 (18.1)	64 (20.4)	25 (14.7)	0.157
Obstetrics registrar/ medical resident (under postgraduate training)	41 (8.3)	14 (4.5)	27 (15.9)	<0.001

(Continues)

TABLE 1 (Continued)

	Overall (n = 493) No. (%)	Women born in Luxembourg <sup>a</sup> (n = 314) No. (%)	Women not born in Luxembourg <sup>a</sup> (n = 170) No. (%)	P value
Obstetrician/Gynecologist	434 (88.0)	281 (89.5)	153 (90.0)	0.985
I do not know (healthcare providers did not introduce themselves)	10 (2.0)	5 (1.6)	5 (2.9)	0.332
Other	32 (6.5)	20 (6.4)	12 (7.1)	0.921
Other characteristics				
Multiple birth	6 (1.2)	3 (1.0)	3 (1.8)	0.428
Newborn admitted to neonatal intensive care unit	26 (5.3)	21 (6.7)	5 (2.9)	0.125
Women admitted to intensive care unit	1 (0.2)	0 (0.0)	1 (0.6)	0.351
Stillbirth	0 (0.0)	0 (0.0)	0 (0.0)	NA

<sup>a</sup>Information regarding maternal country of birth is missing for 9 women (1.8%).

<sup>b</sup>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.

<sup>c</sup>Spontaneous vaginal births include all noninstrumental vaginal births independently of spontaneous or induced onset of labor.

<sup>d</sup>More than one possible answer.

Multivariate analysis showed that when adjusting the QMNC indexes for other variables, in general only minor differences among groups were observed (Table 4). Significantly higher QMNC indexes were reported on selected centiles for women who were not born in Luxembourg (+8.9 and +10 in the 50th and 75th centile respectively,  $P = 0.019$  and  $P = 0.006$  respectively) and had an OB/GYN present at the time of delivery (+10 in the 25th centile,  $P = 0.32$ ). Significantly lower QMNC indexes were reported by women delivering in the hospital with some private offers (−40 in the 25th centile,  $P = 0.01$ ) and by women with the highest education levels (−10 in the 25th centile,  $P = 0.05$ ).

### 3.4 | Subgroup and exploratory analyses

At subgroup analysis, women not born in the country were typically older than women born in Luxembourg, had a higher education level (57.6% vs 31.8% held a postgraduate degree,  $P < 0.001$ ), and had higher parity (50.6% vs 38.5% were multiparous,  $P = 0.011$ ) (Table 1). There were only a few differences in the reported quality measures between the two groups (Table 2): women not born in Luxembourg more frequently lacked information on their newborns after cesarean (32.4% vs 15.3%,  $P = 0.031$ ), while women born in Luxembourg more frequently reported informal payments (10.5% vs 5.9%,  $P = 0.012$ ), lack of timely care (13.1% vs 5.9%,  $P = 0.021$ ), barriers to accessing the health facilities (33.8% vs 24.7%,  $P = 0.050$ ), and reduced quality of care due to COVID-19 (44.3% vs 28.8%,  $P = 0.001$ ). Women not born in Luxembourg reported a significantly higher total QMNC index (365, IQR 340–380) compared with those born in Luxembourg (355, IQR 330–370) ( $P = 0.005$ ), as well as a higher QMNC index in the subdomains of availability of physical and human resources

( $P = 0.034$ ) and of reorganizational changes due to COVID-19 ( $P = 0.003$ ) (Table 3).

Multiparous women were more likely to report barriers to accessing the facility during the pandemic compared with primiparous women (36.2% vs 26.1%, respectively;  $P = 0.016$ ) (Table 5).

No statistically significant differences were found when comparing breastfeeding indicators over the three waves of the pandemic (Table 6 and Figure 2).

## 4 | DISCUSSION

This is the first study in Luxembourg to use a WHO standards-based validated questionnaire to comprehensively document QMNC during the COVID-19 pandemic, collecting the perspectives of women as key service users. Most quality measures suggested high QMNC in Luxembourg, although specific gaps were observed, mostly related to maternal autonomy, respect, and support, but also to number of healthcare professionals. Multiparous women reported more barriers to accessing the facility during the pandemic compared with primiparous women—a result of comparison of experiences before the pandemic. It is important that measures to keep healthcare facilities accessible during further pandemics are implemented.

While some of the findings of this study related to quality of care may have been exacerbated by the pandemic, for others there is no proof that the observed gaps in QMNC are related to the pandemic, or rather, there is some previous evidence of similar findings; for example, the observed rate of women not exclusively breastfeeding at discharge (27%) is in line with a previous national survey where 29% of all breastfed babies received supplementary feeding during the hospital stay.<sup>24</sup> The data underscore that, for breastfeeding success,



TABLE 2 Results for WHO standards-based quality measures<sup>a,b,c</sup>

	Overall (n = 493) No. (%)	Women born in Luxembourg (n = 314) No. (%)	Women not born in Luxembourg (n = 170) No. (%)	P value
<b>Provision of care</b>				
1. No pain relief during labor (SVB, IVB, EC before labor)	44/423 (10.4)	27/272 (9.9)	16/142 (11.3)	0.789
2. Mode of birth				
2a. SVB	300 (60.9)	183 (58.3)	111 (65.3)	0.131
2b. IVB	70 (14.2)	46 (14.6)	22 (12.9)	0.606
2c. EC after labor	53 (10.8)	43 (13.7)	9 (5.3)	0.004
2d. EC before labor	18 (3.7)	10 (3.2)	8 (4.7)	0.399
2e. Elective cesarean	52 (10.5)	32 (10.2)	20 (11.8)	0.594
3a. Episiotomy (in SVB)	45/300 (15.0)	28/183 (15.3)	13/111 (11.7)	0.389
3b. Fundal pressure (in IVB)	21/70 (30.0)	15/46 (32.6)	5/22 (22.7)	0.403
3c. No pain relief after cesarean	14/123 (11.4)	8/85 (9.4)	6/37 (16.2)	0.278
4. No skin-to-skin contact	3 (0.6)	3 (1.0)	0 (0.0)	0.672
5. No early breastfeeding	26 (5.3)	21 (6.7)	4 (2.4)	0.043
6. Inadequate breastfeeding support	80 (16.2)	53 (16.9)	26 (15.3)	0.748
7. No rooming-in	29 (5.9)	20 (6.4)	9 (5.3)	0.783
8. Not allowed to stay with the baby as wished	1 (0.2)	0 (0.0)	1 (0.6)	0.351
9. No exclusive breastfeeding at discharge	133 (27.0)	92 (29.3)	38 (22.4)	0.124
10. No immediate attention when needed	101 (20.5)	68 (21.7)	30 (17.6)	0.353
<b>Experience of care</b>				
1a. No freedom of movements during labor	60/423 (14.2)	41/272 (15.1)	19/142 (13.4)	0.639
1b. No consent requested for vaginal examination before prelabor cesarean	13/70 (18.6)	7/42 (16.7)	6/28 (21.4)	0.616
2a. No choice of birth position (in SVB)	118/300 (39.3)	69/183 (37.7)	47/111 (42.3)	0.430
2b. No consent requested (for IVB)	30/70 (42.9)	17/46 (37.0)	13/22 (59.1)	0.085
2c. No information on newborn (after cesarean)	25/123 (20.3)	13/85 (15.3)	12/37 (32.4)	0.031
3. No clear/effective communication from HCP	81 (16.4)	50 (15.9)	28 (16.5)	0.979
4. No involvement in choices	107 (21.7)	68 (21.7)	37 (21.8)	1.000
5. Companionship not allowed	104 (21.1)	74 (23.6)	27 (15.9)	0.062
6. Not treated with dignity	66 (13.4)	49 (15.6)	16 (9.4)	0.077
7. No emotional support	97 (19.7)	65 (20.7)	30 (17.6)	0.492
8. No privacy	50 (10.1)	36 (11.5)	13 (7.6)	0.241
9. Abuse (physical/verbal/emotional)	45 (9.1)	27 (8.6)	17 (10.0)	0.729
10. Informal payment	41 (8.3)	33 (10.5)	6 (3.5)	0.012
<b>Availability of physical and human resources</b>				
1a. No timely care by HCPs at facility arrival	54 (11.0)	41 (13.1)	10 (5.9)	0.021
2. No information on maternal danger signs	145 (29.4)	92 (29.3)	51 (30.0)	0.955
3. No information on newborn danger signs	203 (41.2)	130 (41.4)	70 (41.2)	1.000
4. Inadequate room comfort and equipment	0 (0.0)	0 (0.0)	0 (0.0)	1.000
5. Inadequate number of women per rooms	21 (4.3)	19 (6.1)	1 (0.6)	0.003
6. Inadequate room cleaning	6 (1.2)	5 (1.6)	1 (0.6)	0.670
7. Inadequate bathroom	8 (1.6)	5 (1.6)	1 (0.6)	0.786
8. Inadequate partner visiting hours	112 (22.7)	77 (24.5)	31 (18.2)	0.141
9. Inadequate number of HCPs	42 (8.5)	24 (7.6)	16 (9.4)	0.616
10. Inadequate HCP professionalism	8 (1.6)	5 (1.6)	2 (1.2)	1.000

(Continues)

TABLE 2 (Continued)

	Overall (n = 493) No. (%)	Women born in Luxembourg (n = 314) No. (%)	Women not born in Luxembourg (n = 170) No. (%)	P value
Reorganizational changes due to COVID-19				
1. Difficulties in attending routine antenatal visits	178 (36.1)	117 (37.3)	57 (33.5)	0.473
2. Any barriers in accessing the facility	151 (30.6)	106 (33.8)	42 (24.7)	0.050
3. Inadequate info graphics	8 (1.6)	5 (1.6)	2 (1.2)	1.000
4. Inadequate ward reorganization	82 (16.6)	55 (17.5)	25 (14.7)	0.505
5. Inadequate room reorganization	92 (18.7)	60 (19.1)	28 (16.5)	0.552
6. Lacking one functioning accessible hand-washing station	26 (5.3)	19 (6.1)	6 (3.5)	0.326
7. HCP not always using PPE	27 (5.5)	21 (6.7)	5 (2.9)	0.093
8. Insufficient HCP number	101 (20.5)	72 (22.9)	27 (15.9)	0.086
9. Communication inadequate to contain COVID-19-related stress	124 (25.2)	77 (24.5)	44 (25.9)	0.826
10. Reduction in QMNC due to COVID-19	194 (39.4)	139 (44.3)	49 (28.8)	0.001

Abbreviations: EC, emergency cesarean; HCP, healthcare professional; IVB, instrumental vaginal birth; PPE, personal protective equipment; QMNC, quality of maternal and newborn care; SVB, spontaneous vaginal birth.

<sup>a</sup>All the indicators in the domains of provision of care, experience of care, and resources are directly based on WHO standards.

<sup>b</sup>Indicators with a specified denominator identified (e.g. 3a, 3b) were tailored to take into account different mode of birth (i.e. spontaneous vaginal, instrumental vaginal, and cesarean). These were calculated on subsamples (e.g. 3a was calculated on spontaneous vaginal births; 3b was calculated on instrumental vaginal births).

<sup>c</sup>Indicator 6 in the domain of reorganizational changes due to COVID-19 was defined as: at least one functioning and accessible hand-washing station (near or inside the room where the mother was hospitalized) supplied with water and soap or with disinfectant alcohol solution.

TABLE 3 QMNC index and subdomains

	Overall (n = 391) Median [IQR]	Women born in Luxembourg (n = 241) Median [IQR]	Women not born in Luxembourg (n = 146) Median [IQR]	P value
Total QMNC index	355 [335–375]	355 [330–370]	365 [340–380]	0.005
Subdomains				
Provision of care	90 [85–95]	90 [85–95]	90 [85–95]	0.464
Experience of care	90 [85–100]	90 [80–100]	92.5 [85–100]	0.474
Availability of physical and human resources	85 [75–95]	85 [75–95]	90 [75–100]	0.034
Reorganizational changes due to COVID-19	90 [82.5–100]	90 [80–95]	95 [85–100]	0.003

Abbreviations: IQR, interquartile range; QMNC, quality of maternal and newborn care.

skin-to-skin contact and rooming-in are not enough. Implementation and revitalization of the whole Baby-friendly Hospital Initiative (BFHI) package is needed, as well as higher competencies of HCPs through continuous education efforts and improvements in initial training, with special focus on detecting good latch and swallowing, counseling, and reducing supplementary feeding.<sup>25</sup> Notably, in our study, the rate of exclusive breastfeeding at discharge, as well as reports of adequate breastfeeding support did not change significantly over time, suggesting that these results on breastfeeding rates may not be due to the pandemic.

In relation to measures of experience of care, particularly regarding aspects of communication and autonomy, our findings are in line with previous studies conducted in Luxembourg.<sup>26,27</sup> A previous online survey with 136 postpartum women revealed that 43% of the women reported that doctors did not take adequate time for explanations and 37% were not ready to talk about alternatives to the recommended care, while 34% of women reported not receiving adequate counseling on the advantages or risks of the proposed treatments.<sup>26</sup> In another online survey carried out in 2013–2014, only 58.4% of women reported having received sufficient information on standard procedures.<sup>27</sup>



TABLE 4 Multivariate quantile regression estimates (n = 384)

	25th centile		50th centile (median)		75th centile	
	Coefficient (95% CI)	P value	Coefficient (95% CI)	P value	Coefficient (95% CI)	P value
Maternal parity						
1	Ref		Ref		Ref	
>1	10 (−3.9; 23.9)	0.159	−1.7 (−9.0; 5.7)	0.655	0 (−7.2; 7.2)	>0.999
Women born in Luxembourg						
Yes	Ref		Ref		Ref	
No	5 (−3.3; 13.3)	0.237	8.9 (1.5; 16.3)	<b>0.019</b>	10 (2.9; 17.1)	<b>0.006</b>
Type of facility						
Public	Ref		Ref		Ref	
Private	−40 (−70.3; −9.7)	<b>0.010</b>	−11.7 (−24.6; 1.2)	<b>0.076</b>	−5 (−17.6; 7.6)	0.437
Maternal age, year <sup>a</sup>						
18–30	−5 (−19.9; 9.9)	0.510	−7.2 (−14.7; 0.3)	0.060	−5 (−13.7; 3.7)	0.261
31–35	Ref		Ref		Ref	
>35	0 (−9.0; 9.0)	>0.999	3.9 (−5.6; 13.4)	0.421	0 (−7.7; 7.7)	>0.999
Maternal educational level <sup>a</sup>						
High school or lower	−5 (−15.1; 5.1)	0.329	2.2 (−5.2; 9.6)	0.557	−5 (−14.0; 4.0)	0.277
University degree	Ref		Ref		Ref	
Postgraduate degree/master/doctorate or higher	−10 (−20.0; 0.1)	<b>0.051</b>	2.8 (−5.3; 10.8)	0.497	0 (−7.8; 7.8)	>0.999
Year of birth						
2020	Ref		Ref		Ref	
2021	−5 (−19.0; 9.0)	0.481	1.7 (−11.9; 15.2)	0.809	5 (−2.8; 12.8)	0.207
Mode of birth						
Spontaneous vaginal <sup>b</sup>	Ref		Ref		Ref	
Instrumental vaginal	−10 (−24.8; 4.8)	0.186	−9.4 (−18.9; 0.0)	0.050	−10 (−20.8; 0.8)	0.069
Cesarean	−15 (−33.2; 3.2)	0.106	−7.2 (−14.7; 0.02)	0.057	0 (−12.3; 12.3)	>0.999
OB/GYN directly assisting the birth						
No	Ref		Ref		Ref	
Yes	10 (0.9; 19.1)	<b>0.032</b>	9.4 (−2.5; 21.4)	0.121	5 (−3.1; 13.1)	0.226
Intercept	335 (318.5; 351.5)	<b>&lt;0.001</b>	350.6 (337.4; 363.7)	<b>&lt;0.001</b>	370 (359.6; 380.4)	<b>&lt;0.001</b>

<sup>a</sup>Some categories of age and educational level were collapsed due to low number.<sup>b</sup>Spontaneous vaginal births include all noninstrumental vaginal births independently of spontaneous or induced onset of labor.TABLE 5 Evaluation of the impact of COVID-19 on care received, by parity<sup>a</sup>

	Primiparas (n = 276) No. (%)	Multiparas (n = 207) No. (%)	P value
Reorganizational changes due to COVID-19			
Difficulties in attending routine antenatal visits	101 (36.6)	73 (35.3)	0.763
Any barriers in accessing the facility	72 (26.1)	75 (36.2)	0.016
Reduction in QMNC due to COVID-19	108 (39.1)	80 (38.7)	0.914

<sup>a</sup>Missing data for 10 women.

TABLE 6 Breastfeeding indicators over time<sup>a</sup>

	March 2020–June 2020 (n = 158) No. (%)	July 2020 – December 2020 (n = 256) No. (%)	January 2021 – June 2021 (n = 65) No. (%)	Trend test P value
Inadequate breastfeeding support	26 (16.5)	43 (16.8)	10 (15.4)	0.901
No exclusive breastfeeding at discharge	38 (24.1)	72 (28.1)	20 (30.8)	0.255
No early breastfeeding	8 (5.1)	12 (4.7)	5 (7.7)	0.560

<sup>a</sup>14 additional women with missing date of birth.

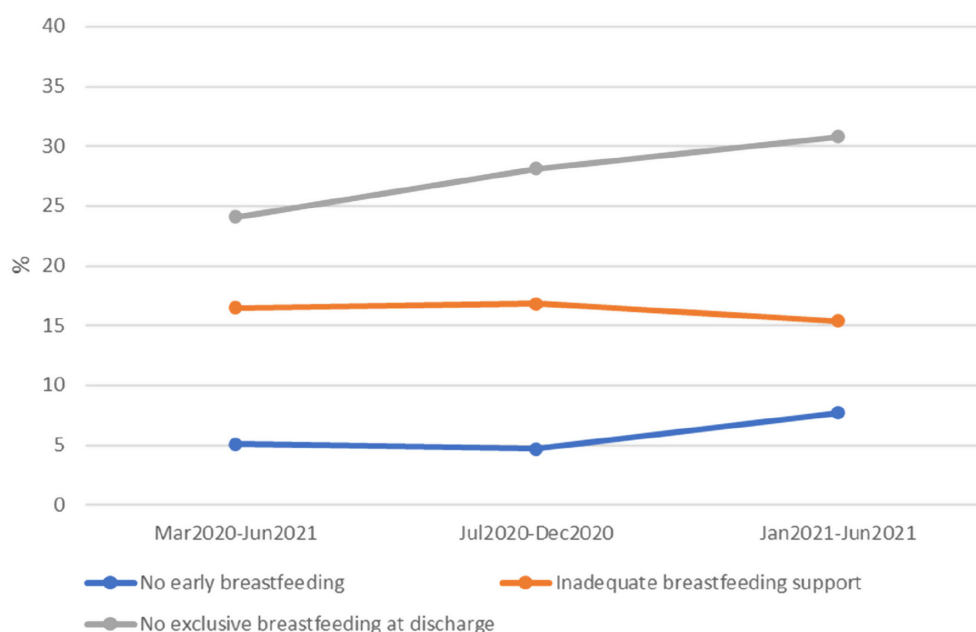


FIGURE 2 Breastfeeding indicators over time

Findings of this study (e.g. those related to women's autonomy, involvement in care choices, consent request for procedures, dignity, privacy, and lack of information on danger signs for women and newborns) are in line with findings from other European countries.<sup>28–30</sup> However, it strongly suggests that the Luxembourg law on patients' rights adopted in 2014 is still not fully implemented.<sup>31</sup> HCP practices such as lack of communication and consent request, and not providing information or immediate attention for patients, may be the result of large gaps in effective provider supervision as well as in training on patients' rights and communication strategies.<sup>32</sup> This study highlighted several areas in which vast improvements are warranted, for the health and well-being of women and infants. Further studies should explore health workers' perspectives as an integrative view of QMNC.<sup>33</sup> While it is true that Luxembourg shows some of the best indicators of QMNC across Europe, decision-makers at all levels should address the existing gaps.<sup>19,34–40</sup>

Strengths of this study include the use of a standardized validated questionnaire, based on the WHO standards.<sup>18,22</sup> The sample also appropriately captures the multiethnic population in Luxembourg, and the expected age of women.<sup>1</sup>

Limitations of the multicountry IMAGINE EURO survey have been noted elsewhere.<sup>19,20,22,23</sup> Specific limitations to this study in Luxembourg are as follows: the sampled population included a greater number of highly educated and primiparous women and a smaller number of women who delivered by cesarean compared with the average expected for women giving birth in the country.<sup>1</sup> However, it is difficult to predict in which direction this may have affected results on the reported QMNC, as women with a lower level of education may have had better or worse experiences than women in the sample. Data reflect maternal perception of care, which may be affected by culture and expectations; future studies should aim to triangulate the data using other methods and perspectives. Improvements in the future might occur related to the July 2021 document authored by the Woman's Health Working Group of the Scientific Council of Health of Luxembourg recommending the implementation of the WHO standards for QMNC,<sup>41</sup> as well as the reimbursement of new acts and services carried out by midwives, effective February 1, 2022, allowing a midwifery care model to start.<sup>42</sup>

In conclusion, this study adds to previous evidence of findings related to QMNC in the Luxembourg context. It highlights the need for further efforts regarding the number and competencies of the health workforce. Competencies include provider knowledge of women's

rights, of effective communication during care including the need to disclose adequate information about newborns, and implementation of adequate practices of informed consent as well as greater respect for women's choices. While WHO standards should be monitored regularly to assess progress over time—including collecting the views of the users in independent studies—decision-makers at all levels of the healthcare system, including individual HCPs, should take immediate action to ensure high QMNC for all women and newborns.

## AUTHOR CONTRIBUTIONS

ML conceived the IMaGiNE EURO study, with inputs from MA, BC, IM, EPV. MA and BT supported the process of data collection, with inputs from BC and EPV. All authors conceived the analyses presented in this paper. IM analyzed data, with major inputs from all other authors. MA, ML, and FC wrote the first draft, which major inputs from all authors. AL reviewed the draft and provided some unpublished national statistics. All authors approved the final version.

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## CONFLICT OF INTEREST

The authors have no conflicts of interest.

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## DATA AVAILABILITY STATEMENT

Data are available upon reasonable request to the corresponding author.

## DISCLAIMER

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.

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