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Role of the private sector in childbirth care: cross-sectional survey evidence from 57 low- and middle-income countries using Demographic and Health Surveys

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Abstract

OBJECTIVE Maternal mortality rates have decreased globally but remain off track for Millennium Development Goals. Good-quality delivery care is one recognised strategy to address this gap. This study examines the role of the private (non-public) sector in providing delivery care and compares the equity and quality of the sectors.

METHODS The most recent Demographic and Health Survey (2000–2013) for 57 countries was used to analyse delivery care for most recent birth among >330 000 women. Wealth quintiles were used for equity analysis; skilled birth attendant (SBA) and Caesarean section rates served as proxies for quality of care in cross-sectoral comparisons.

RESULTS The proportion of women who used appropriate delivery care (non-facility with a SBA or facility-based births) varied across regions (49–84%), but wealth-related inequalities were seen in both sectors in all regions. One-fifth of all deliveries occurred in the private sector. Overall, 36% of deliveries with appropriate care occurred in the private sector, ranging from 9% to 46% across regions. The presence of a SBA was comparable between sectors (≥93%) in all regions. In every region, Caesarean section rate was higher in the private compared to public sector. The private sector provided between 13% (Latin America) and 66% (Asia) of Caesarean section deliveries.

CONCLUSION This study is the most comprehensive assessment to date of coverage, equity and quality indicators of delivery care by sector. The private sector provided a substantial proportion of delivery care in low- and middle-income countries. Further research is necessary to better understand this heterogeneous group of providers and their potential to equitably increase the coverage of good-quality intrapartum care.

keywords delivery care, private sector, multicountry analysis, Demographic and Health Surveys, skilled birth attendant, Caesarean section

Introduction

Recent estimates suggest that despite an acceleration in the reduction of maternal mortality since 2000, more than a quarter of a million lives were lost to maternal mortality in 2011 [1]. Over 98% of these deaths occurred in low- and middle-income countries (LMICs), and maternal mortality is an offtrack Millennium Development Goal. One of the strategies posited to improve women's survival is ensuring that deliveries are attended by skilled birth attendants (SBAs), which usually happens in health facilities [2, 3]. Providing effective intrapartum care, based on a strategy of having these SBAs conduct deliveries in primary-level institutions (health centres) with access to referral-level facilities, could be an efficient approach to reducing maternal mortality and morbidity [4]. It will also make a critical contribution to reducing the 2.9 million neonatal deaths that occur each year [5]. In practice, however, the proportion of deliveries attended by skilled personnel in LMIC regions is reported to have increased only moderately from 55% in 1990 to 66% in 2011 [6]. Moreover, SBA coverage was the most

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inequitably distributed indicator among twelve key maternal, newborn and child health interventions outlined in an analysis of 54 countries [7]. Strategies aiming to effectively and sustainably reduce maternal mortality and morbidity will need to address inequalities in women's access to quality reproductive and maternal care as well as ensure good quality of such care [8].

The role of private-sector providers in delivering reproductive and maternal services has recently received increased attention [9]. The private sector includes a group of providers whose diverse organisational character (formal, informal, facility-based, home-care providers), ownership and management structures, commercial nature (for profit, not for profit), affiliations [faith-based (FBO), non-governmental (NGO), humanitarian] and interface with the public sector are not well understood [10, 11]. Specifically, it is important to establish whether and how the private sector contributes to coverage of good-quality delivery care and reduction in inequalities in this coverage [12].

We identified 23 studies which assessed the private-sector provision of delivery services across more than two LMICs (Table S2) [13]. These studies included between 3 and 56 countries; the most comprehensive was a report by Gwatkin *et al.* [14] which only looked at broad sector categories and consisted of tabulations without discussion. Most studies examined levels of use by sector with some effort to differentiate between private for profit, FBOs and NGOs. Some assessed inequalities in private delivery-care utilisation and its content (Caesarean section rates and birth attendance); however, none considered these dimensions together. Looking at both of these dimensions and adopting a more nuanced approach to defining and disaggregating private providers of delivery care would allow for a more comprehensive assessment of the role of the private sector in providing delivery care and a greater understanding of inequalities in coverage and quality of private-sector care relative to the public sector.

The main objective of this study was to use the most recent population-level data from a wide variety of LMICs to examine the role of private-sector providers in the provision of appropriate delivery-care services among women who had a birth in the recall period, as described previously [13]. Second, we examined the typology of private-sector delivery providers and analysed the characteristics of private-sector delivery care. In contrast to antenatal care [15], the DHS contain few questions with which to assess delivery-care quality. In our third objective, we used the type of birth attendant and Caesarean section rates as proxies for judging quality of care. Within all three objectives, equity analysis based on quintiles of the DHS wealth score was conducted, comparing public- and private-sector delivery care.

Methods

Data

We used the most recent available Demographic and Health Surveys (DHS) dataset for each country which conducted DHS between 2000 and mid-2013. The DHS are cross-sectional nationally representative household surveys and use model questionnaires which are adapted to each country's circumstances. Their sampling design is based on a multistage cluster strategy, which must be accounted for in statistical analyses. The resulting dataset contained 57 countries (Table S1) from four geographic regions: sub-Saharan Africa, North Africa/West Asia/Europe, South/South-East Asia and Latin America and the Caribbean. For simplicity, in the remainder of this study, we refer to these as sub-Saharan Africa, Middle East/Europe, Asia and Latin America. These regions were constructed based on a classification of countries by Measure DHS, following other analyses of DHS data [16]. Data are generally based on the self-reports of women in reproductive age (15–49 years).

Population

All women aged 15–49 with a live birth in the survey recall period were included in the analysis; delivery care for the most recent birth in the recall period was examined. In previous work, we describe these as women in need of delivery-care services [13]. The recall period was 5 years in all countries except in Vietnam (3 years), and Colombia and Peru (1 year). We decided to analyse circumstances for the most recent birth to provide comparable data to our antenatal care analysis in this Series [15] and to characterise most recent levels of delivery care.

Indicators and definitions

Service use. We considered women to have received an appropriate service type (i.e. met need for appropriate services) if their care complied broadly with what is understood to be an effective service. According to our definition, appropriate delivery-care service was received if women delivered at home or in another non-facility location with a SBA, or if they delivered in a health facility. However, we do not wish to imply that the actual care was necessarily appropriate in terms of quantity or content. Women delivering in a non-facility environment without a SBA were considered to have used a suboptimal service type and therefore had unmet need for delivery care (Table 1).

Delivery attendant. Women listed all people who assisted with the delivery. If multiple cadres of delivery

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Table 1 Classification of women according to need for delivery care, appropriateness of service type and sector, with examples of Demographic and Health Survey (DHS) response options

Need for care	Type of care	Location Category	Birth attendant	Examples of DHS response options	Sector of care
No	-	Did not have birth in recall period			-
Yes	Unknown	Delivery location missing (Women who had a birth but had any of the location, attendant or caesarean section responses missing)			-
	Suboptimal	Non-facility location, non-Skilled birth attendant (SBA) level professional, or delivery location not captured by response	Non-SBA	Delivered at home, in a traditional birth attendant's home, in other location (including abroad, with public or private non-SBA professionals (public health professional, public ambulatory health professional, private health professional), or in public or private providers that were not explicitly designated as health facilities (public other, private other) and without a skilled birth attendant	Suboptimal: not classified
	Appropriate	Non-facility location or delivery location not captured by response, without information on sector	SBA	Delivered at home, in other location, or abroad and with a skilled birth attendant	Unclassifiable
		Public facility	Any	All government, public or social security facilities at all levels (e.g., public provincial/ district/ referral/ rural hospital, public health center, public polyclinic/ woman's consultation, public health unit, public health post/ clinic, dispensary, maternal clinic, maternity home), regardless of delivery attendant	Classifiable: Public
		Public non-facility or public non-SBA-level professional	SBA	Public sector locations not explicitly designated as health facilities (e.g., public other, public ambulatory health professional, public health professional), with a skilled birth attendant	
		Private facility	Any	Private facilities (e.g., hospital/clinic, maternity clinic/hospital, health center), regardless of delivery attendant	Classifiable: Private
		Private health professional: SBA-level	Any	Private providers not explicitly designated as facilities: Service run by SBA (e.g., private midwife, private doctor, private nurse), regardless of delivery attendant	
		Private health professional: Non-SBA-level	SBA	Private providers not explicitly designated as facilities: Service run by non-SBA (e.g., private health professional) and with a skilled birth attendant	
		FBO facility	Any	Faith-based organization or missionary facility (e.g., hospital, health center, health post/dispensary), regardless of delivery attendant	
		NGO facility	Any	NGO facility (e.g., non-governmental organization clinic/hospital), regardless of delivery attendant	
		Private other	SBA	Private sector locations not explicitly designated as health facilities and with a skilled birth attendant	

attendants were present at delivery, we considered the person with the highest level of qualification. To retain as much detail about the qualification of the delivery attendant as possible, we constructed eleven categories (Table 2). We used published literature to place medical professionals from each country in the relevant category, given the lack of comparability in job titles across countries. Three of these categories (doctor, nurse/midwife and auxiliary midwifery staff) were considered to be SBAs in our categorisation, while the remaining

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categories of attendants were not. This corresponds with the World Health Organization definition of skilled delivery care as 'accredited health professional – such as a midwife, doctor or nurse – who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate post-natal period, and in the identification, management and referral of complications in women and newborns' [17]. Although doctors may not have received obstetrics/midwifery training, they are likely to be able to handle complicated deliveries and Caesarean sections. Midwives and nurse-midwives usually have certified or accredited midwifery training, which may or may not include medical or nursing training beyond midwifery skills. Our categorisation also included nurses, who may have completed nursing but not midwifery training, and may not have skills in birth attendance. However, as nurses and midwives are often grouped together in DHS datasets despite having different qualifications in various countries, we could not separate them in this analysis. Auxiliary midwifery staff make up the third category of SBAs and were only considered as skilled in certain countries, according to WHO definitions [18]. In countries where auxiliary midwifery staff are not considered skilled, they were grouped with the traditional birth attendant (TBA) category [19]. All other persons attending deliveries were not considered to be SBAs and were categorised into the following groups, reflecting their qualification in descending order: auxiliary staff, TBAs, community health workers (CHW), traditional practitioners, general facility staff, husband/friend/relative, others and no one. Not all eleven categories of delivery attendants existed in all 57 included countries.

Classification of sector of delivery (public or private). We divided deliveries with an appropriate service type into those delivered at locations for which sector was known (classifiable sector) and those without information on provider sector (unclassifiable sector; Table 1). Women who indicated they had home-based SBA delivery care had an unclassifiable sector of provision. Among deliveries with a classifiable sector, we divided providers into the public or the private sector. Public-sector delivery locations were those occurring in public, government or social security health facilities. Private-sector locations were those occurring in facilities outside the public sector, further divided into five provider categories: private facilities, private health professionals, FBO facilities, NGO facilities and other private facilities (Table 1). Some countries had a category error in the response options whereby women could respond 'private doctor', 'private nurse', 'private midwife' or 'private professional' to the question on *where* they delivered, making the actual location of care unknown,

Table 2 Categorisation of delivery attendants

Category	Examples of DHS response options for delivery attendants	Level of skill	Skilled birth attendant
Doctor	Doctor, obstetrician/gynaecologist, doctor/clinical officer, gynaecologist, paediatrician	Highest – able to attend normal and complicated deliveries/caesarean-sections	Yes
Nurse/midwife	Nurse, midwife, nurse/midwife	High – trained and able to attend normal delivery	
Auxiliary midwifery staff	Auxiliary midwife, auxiliary nurse, professional auxiliary birth attendant	Medium – trained and able to attend normal delivery	
Auxiliary staff	Doctor's assistant, physician assistant, nurse/medical assistant, other health personnel, feldsher	Low - medically trained, but not specifically trained in delivery care	No
Traditional birth attendant	Matrone/professional birth attendant, trained traditional birth attendant, traditional birth attendant	Low - no formal qualification but may have received some training in basic delivery care	
Community health worker	Family welfare visitor, maternal and child health worker, community health mother and child, health extension worker	Low – no formal qualification, less likely to have training in basic delivery care	
Traditional practitioner	Traditional healer, traditional practitioner, hakim	None	
General facility staff	Patient attendant, sanitary		
Husband/friend/relative	Relative/friend, husband/partner		
Other person	Other		
No one	No one		

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while sector was known [20]. These responses were included in the "private health professionals" category. Not all five private-sector provider categories existed in all 57 countries.

Mode of delivery. Women were asked whether they delivered by Caesarean section. Caesarean section births reported by women who delivered in a home environment were re-coded as vaginal deliveries, regardless of who assisted with the delivery. This approach has been used previously [21–23]. Caesarean sections that were reported in facilities, but where the highest level of delivery attendant was reported as general facility staff (e.g. patient attendant or sanitary), husband/friend/relative, other person or no one, were re-coded as missing the mode of delivery.

Equity. Asset ownership grouped into five equally sized groups (wealth quintiles) is a common method used to classify household socio-economic position within countries.[24] Different component variables and cut-offs are applied in each country, and therefore, wealth quintiles are not comparable between countries on an absolute level.

Missing data. All analyses were conducted on the 99.5% of the sample of women with births in the recall period that had non-missing values in the three main indicator variables (delivery location, delivery attendant and mode of delivery). The treatment of missing delivery location, suboptimal service type and locations with unclassifiable sector is detailed in Table 1.

Construction of regional and overall summary measures

Women in each DHS survey have an individual sample weight that is used to calculate country-level representative summary statistics. We also calculated region-level and overall (combining the 57 countries) summary statistics by applying weights that accounted for both country-specific survey design and country population, to ensure that estimates are representative of the population residing in study countries (Appendix S1). To capture the extent of variability, we report ranges and medians across the included countries. Analyses were conducted in STATA/SE v13.

Ethical approval

The DHS received institutional review centrally (ICF International) and approval by every participating country. This study was approved by the Research Ethics Committee of the London School of Hygiene and Tropical Medicine, UK.

Results

We analysed data from 57 countries, which represented a total population of 3 billion people. There were 30 countries in the sub-Saharan Africa region, nine in the Middle East/Europe region, 10 in the Asia region and eight in the Latin America region. The included countries represented 83%, 29%, 88% and 20% of the populations of these four regions, respectively. The combined sample consisted of 865 547 women aged 15–49 years old, 337 208 of whom had a live birth in the recall period and constituted our analysis sample. The countries, year of survey, recall period and sample characteristics are in Table S1. Across the 57 countries, we identified 50 unique delivery locations and 91 unique types of delivery attendant (including 'no one').

Panel a of Figure 1 shows the regional distribution of all women surveyed in the included countries according to their need for delivery care in the recall period. The proportion of women with a birth in the recall period was higher in the sub-Saharan Africa region (53%) compared to the remaining three regions (35% in Middle East/Europe, 36% in Asia and 32% in Latin America). Among women in need of delivery care, there were large regional differences in the proportion of women who used an appropriate service type (Figure 1b) – ranging from 49% in sub-Saharan Africa and Asia, to 79% in Latin America and 84% in Middle East/Europe (Table 3). Among users of appropriate service type, the proportion that delivered in the private sector varied between regions from a low of 9% in Latin America, 20% in sub-Saharan Africa, 31% in Middle East/Europe, and 46% in Asia (Figure 1c), and 36% overall.

Figure 2 is a scatter plot of each country according to the proportion of all births using appropriate service type and the proportion of births with appropriate service type occurring in the private sector. It shows that countries with high proportions of all deliveries with appropriate service type generally have smaller proportions of these deliveries occurring in the private sector. However, within each of the four regions, the levels and ranges of these two indicators differed markedly by country. The sub-Saharan Africa region showed the widest range of proportions of births delivered with appropriate service type, from 12% in Ethiopia to 93% in Gabon. The proportion of appropriate service type deliveries occurring in the private sector ranged between <1% in Sao Tome and Principe and 42% in Swaziland. The lowest proportion

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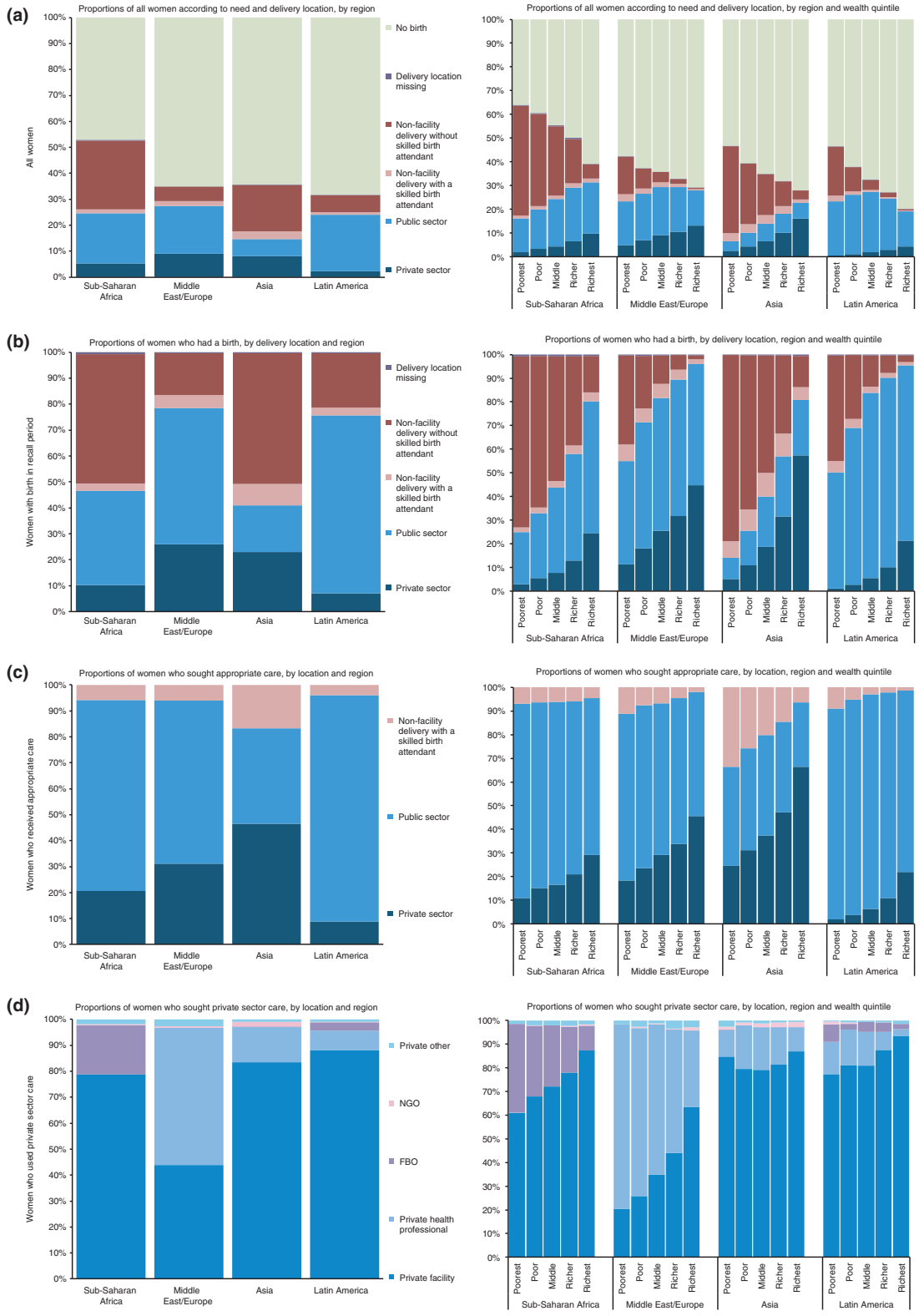

Figure 1 Proportions of all women according to need for delivery care, sector and provider of care, by region and wealth quintile.

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Table 3 Summary of need, use and sector of use for delivery-care services across regions (including overall weighted mean of regions) and countries (median and range)

Coverage indicators (%)	Sub-Saharan Africa	Middle East/Europe	Asia	Latin America	Overall weighted mean of regions	Median (range) across countries
All women						
Not in need for delivery care	47	65	64	68	61	54 (32–84)
Missing delivery location	<1	<1	<1	<1	<1	0 (0–3)
Used suboptimal delivery care	27	6	18	7	18	13 (0–55)
Used appropriate delivery care	26	29	18	25	21	26 (6–59)
Total	100	100	100	100	100	
Selected subcategories						
Use of public-sector service	19	18	7	22	11	19 (4–43)
Use of private-sector service	5	9	8	2	7	4 (0–22)
Use of unclassifiable sector service	2	2	3	1	3	1 (0–10)
Use among women in need for delivery care						
Missing delivery location	1	<1	1	<1	<1	0 (0–5)
Used suboptimal delivery care	50	16	50	21	47	32 (0–88)
Used appropriate delivery care	49	84	49	79	53	68 (12–100)
Total	100	100	100	100	100	
Selected subcategories						
Use of public-sector service	36	53	18	69	28	51 (10–98)
Use of private-sector service	10	26	23	7	19	9 (0–46)
Use of unclassifiable sector service	3	5	8	3	6	2 (0–19)
Sector among women with appropriate service type						
Use of public-sector service	74	63	37	87	52	80 (17–99)
Use of private-sector service	20	31	46	9	36	13 (0–60)
Use of unclassifiable sector service	6	6	17	4	12	4 (0–42)
Total	100	100	100	100	100	
Sector among women using appropriate services with a classifiable sector						
Use of public-sector service	78	67	44	91	60	87 (23–100)
Use of private-sector service	22	33	56	9	40	13 (0–77)
Total	100	100	100	100	100	
Provider categories among women using appropriate, classifiable, private sector services						
Private facility	79	44	83	88	79	95 (0–100)
Private health professional	<1	53	14	8	16	0 (0–100)
FBO facility	19	<1	<1	3	3	0 (0–90)
NGO facility	<1	<1	2	<1	2	0 (0–100)
Private other	2	3	1	1	1	1 (0–40)
Total	100	100	100	100	100	

of deliveries occurring with appropriate service type in the Middle East/Europe region was in Morocco (65%) and several countries approached the 100% mark (Albania, Armenia, Jordan, Moldova and Ukraine). Most of the countries in this region had a relatively small private sector, except for Jordan and Egypt, where the proportion of appropriate service type deliveries occurring in the private sector was 35% and 57%, respectively. In Asia, the proportion of deliveries using appropriate service type ranged from 29% in Bangladesh to 97% in the Maldives. This region had the largest variability between countries in private sector's share of appropriate service type deliveries, ranging from Timor-Leste (2%) to Pakistan (60%). The Latin America region had a relatively high proportion of deliveries with appropriate service type (79%). Haiti was the only country in this region where less than half of all deliveries used appropriate service type (41%), and it also had the largest private sector in the region (accounting for 27% of appropriate service type deliveries). Colombia had the lowest proportion of appropriate service type deliveries occurring in the private sector (<1%) in this region.

Wealth-based inequalities in appropriate service type were present in all four regions in both the public and the private sectors (Figure 1b). The proportion of women using appropriate service type who delivered in a location with unclassifiable sector (largely home deliveries with SBA) ranged from 4% (Latin America) to 17% (Asia), and this proportion was highest among women in the poorest quintile in each region (Figure 1c). The

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Figure 2 Scatter plot of countries according to proportion of all births with appropriate service type and proportion of births with appropriate service type in private sector.

proportion of women who used appropriate service type who delivered in the private sector was higher among women in the richest quintile compared to the poorest in each region.

Understanding private-sector delivery care

We characterised private-sector providers to the extent possible based on the response coding in the DHS (Table 1 and Figure 1d). Private facilities (i.e. private hospital, clinic, health centre) constituted the majority of the private-sector deliveries reported by women in sub-Saharan Africa (79%), Asia (83%) and Latin America (88%), but not in Middle East/Europe (44%). In sub-Saharan Africa, FBOs were the second largest provider of private-sector delivery care (19%), although only nine of the 30 countries in this region had response options listing FBO providers. Other than in sub-Saharan Africa, NGOs and FBOs together provided a very small proportion of private-sector delivery care (accounting for 5% of private-sector delivery care overall).

The category of private health professionals (actual location of delivery unknown) provided the majority of private-sector delivery care in the Middle East/Europe region (53%), although this provider category was reported by women in only two of the nine countries in this region – Egypt and Turkey. Private health professionals were also an important private-sector delivery-care category in Asia (14% of private sector), largely driven by Indonesia. The country ranges and medians (Table 3) show a wide variation in the most important private-sector provider category. In each region, the country with the highest private-sector share of deliveries with appropriate service type had a different category of private provider: Swaziland (FBOs), Egypt (private health professional – doctors), Indonesia (private health professional – nurse/midwives) and Haiti (private facilities).

Characteristics of delivery care provided by the private sector

Delivery attendant. To address the third objective of assessing quality of delivery care, we compared the type

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of care and sector of deliveries in each region (Figure 3). Among deliveries with suboptimal service type, larger proportions of deliveries in Middle East/Europe and Asia occurred with a TBA or CHW than in sub-Saharan Africa and Latin America. In all regions, the majority of deliveries in unclassifiable locations were assisted by a nurse/midwife. The proportion of women who were assisted by a SBA was high (≥93%) among appropriate service type births occurring in both the public and private sectors. The majority of both public- and private-sector deliveries in sub-Saharan Africa were assisted by a nurse/midwife (68% and 59%, respectively). The majority of deliveries in both sectors in the remaining three regions were assisted by a doctor.

Figure 4 shows the delivery attendant for births by service type and sector for the aggregate of 57 countries, disaggregated by women's wealth quintile. In the public sector, the percentage point difference in having a SBA was 3 between the poorest and richest wealth quintiles (95% in poorest and 98% in richest) compared to a 2 percentage point difference in the private sector (97% in poorest and 99% in richest). The proportion of births to women in the poorest quintile attended by a doctor was higher in the private sector than in the public sector (63% and 45%, respectively).

Caesarean section deliveries. We compared Caesarean section rates within each region between the public and private sectors. Figure 5 displays the Caesarean section rates among all deliveries, all deliveries with appropriate service type, deliveries in providers with classifiable sector, public-sector deliveries and private-sector deliveries. The proportions of all births delivered by Caesarean section ranged from 4% in sub-Saharan Africa to 24% in Latin America. In all four regions, the Caesarean section rate was higher in the private than in the public sector. The percentage point difference in Caesarean section rates between the two sectors was smallest in sub-Saharan Africa (2) and widest in Middle East/Europe (21). We examined the Caesarean section rates within the private sector among provider categories with a sample of >100 births in a given region. Figure 6 shows that in all regions except sub-Saharan Africa, the highest Caesarean section rates of the private sector occurred in the private facilities category. In sub-Saharan Africa, rates in FBOs were slightly higher than those in private facilities. In Latin America, Caesarean section rates in FBOs were lower than in private facilities (31% and 49%, respectively). Caesarean section rates in the category of private health professionals were higher in the Middle East/Europe (37%) compared to Asia region (6%).

Analysis of inequalities in Caesarean section rates showed that in every region, the overall Caesarean section rate increased with rising wealth quintile (Figure 7a). Figure 7b shows that a wealth-based gradient in Caesarean section rates among deliveries with appropriate service type existed in all regions, although it was less steep than the gradient in Caesarean section rate for all deliveries. Sub-Saharan Africa had both the lowest Caesarean section rates and the flattest wealth gradients in these two indicators. Figures 7c and 7d examine the wealth quintile-specific Caesarean section rates by sector. In sub-Saharan Africa, public and private sectors showed comparable levels and gradients in Caesarean section rates. Among women from the poorest wealth quintile in the Middle East/Europe region, the Caesarean section rate was twice as high in the private (33%) compared to the public sector (17%). Within the poorest quintile of women in Asia, the Caesarean section rate was higher in the private compared to the public sector, and the gradient across quintiles was steeper in the private sector. Among women from the poorest wealth quintile in Latin America, the Caesarean section rate was comparable between the sectors, but among the richest wealth quintile, women delivering in the private sector had a substantially higher Caesarean section rate (55%) than in the public sector (38%). Figure 8 shows the Caesarean section deliveries, among all women and by wealth quintile, according to which sector provided them. In Middle East/Europe and Asia, the private sector provided approximately half or more of all Caesarean sections (49% and 66%, respectively). The percentage of Caesarean sections performed in the private sector was 23% in sub-Saharan Africa and 13% in Latin America. In all regions, a larger percentage of Caesarean sections provided to richest women was obtained in the public sector than Caesarean sections to poorest women.

Discussion

In this study, we used nationally representative surveys collected since 2000 from 57 LMICs to describe the character and role of the private sector in providing delivery care in four world regions. Overall, we found that one-fifth of all deliveries and two-fifths of deliveries with a classifiable sector occurred in the private sector. The four regions varied in the proportions of all births occurring with appropriate service type and in those occurring in the private sector. The majority of appropriate service type deliveries in sub-Saharan Africa, Middle East/Europe and Latin America regions occurred in the public sector. Asia was the only region in which the majority of appropriate service type births occurred out-

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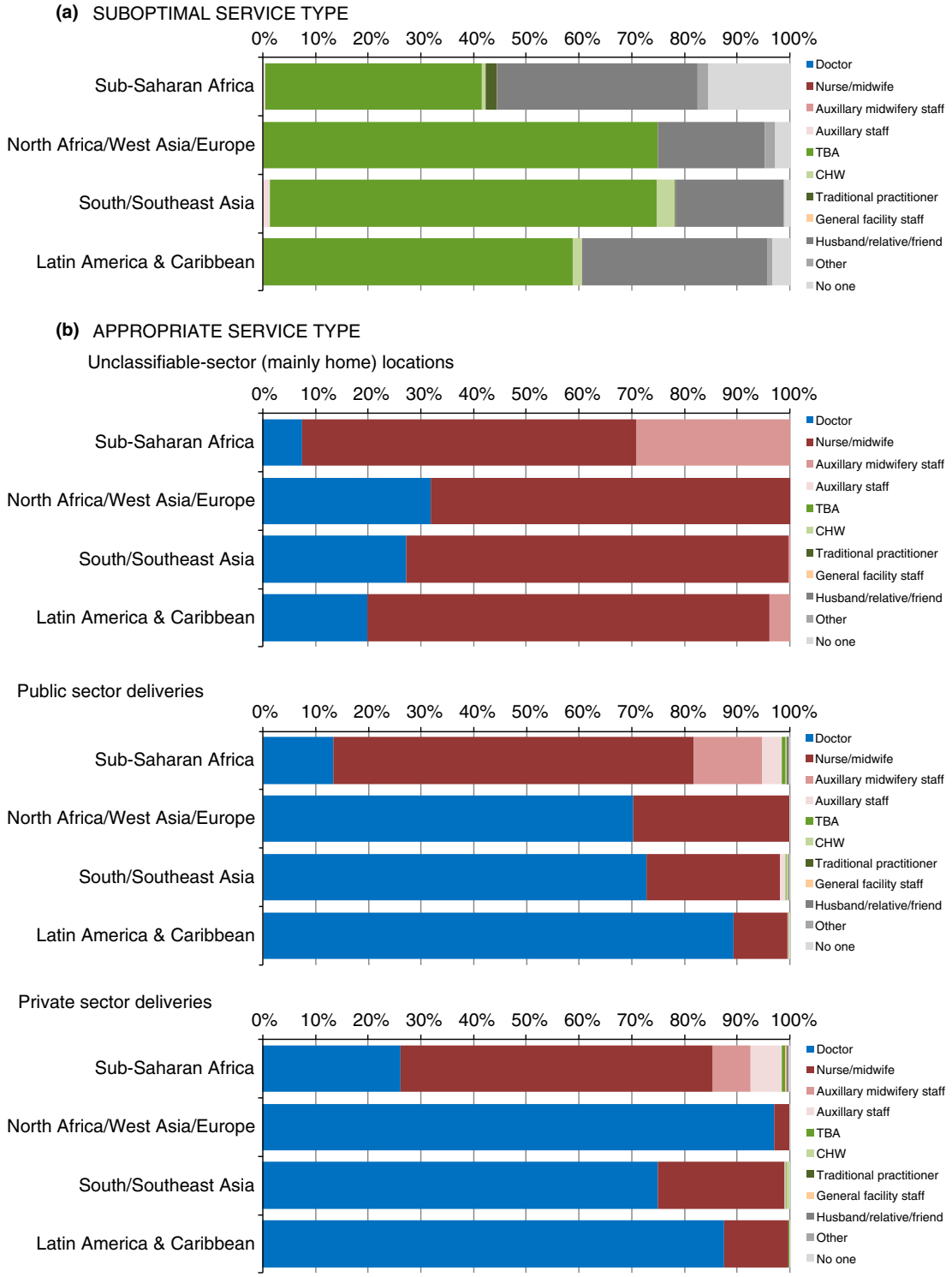

Figure 3 Highest level of delivery attendant for most recent birth, by sector and region.

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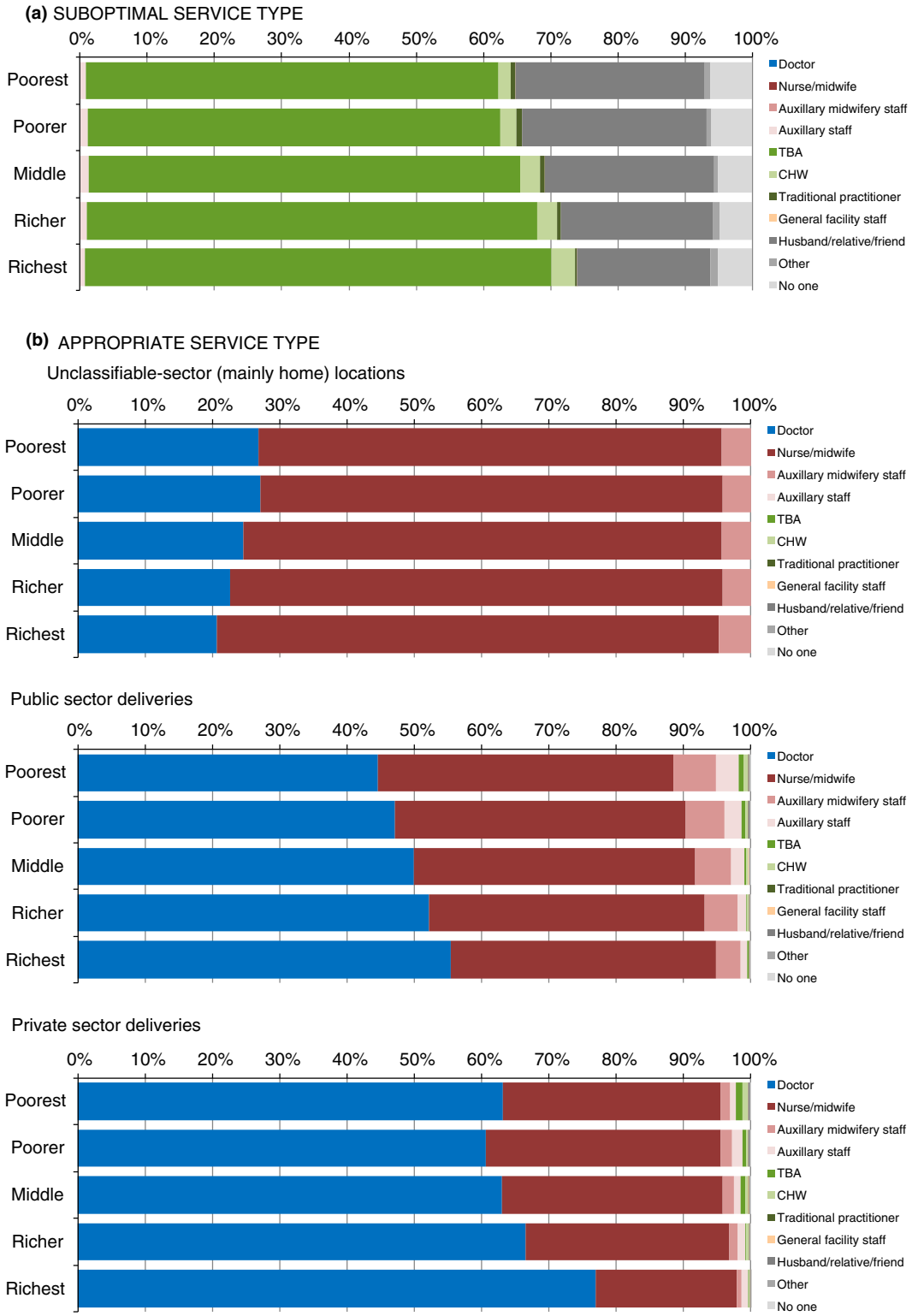

Figure 4 Highest level of delivery attendant for most recent birth, by sector and wealth quintile.

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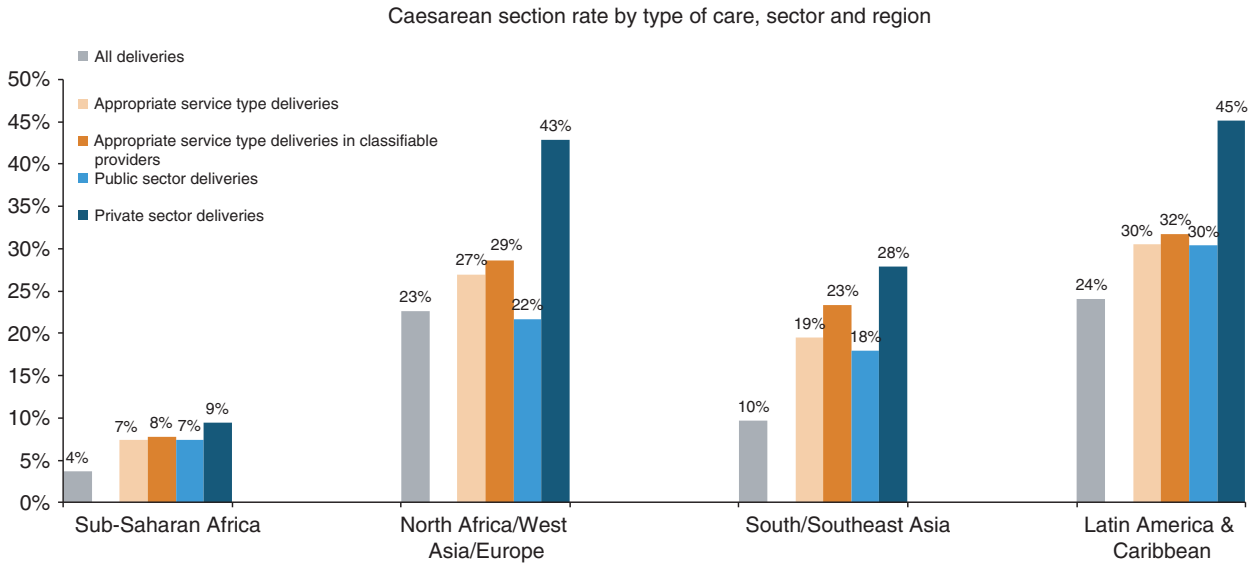

Figure 5 Proportion of births delivered by Caesarean section, by sector and region.

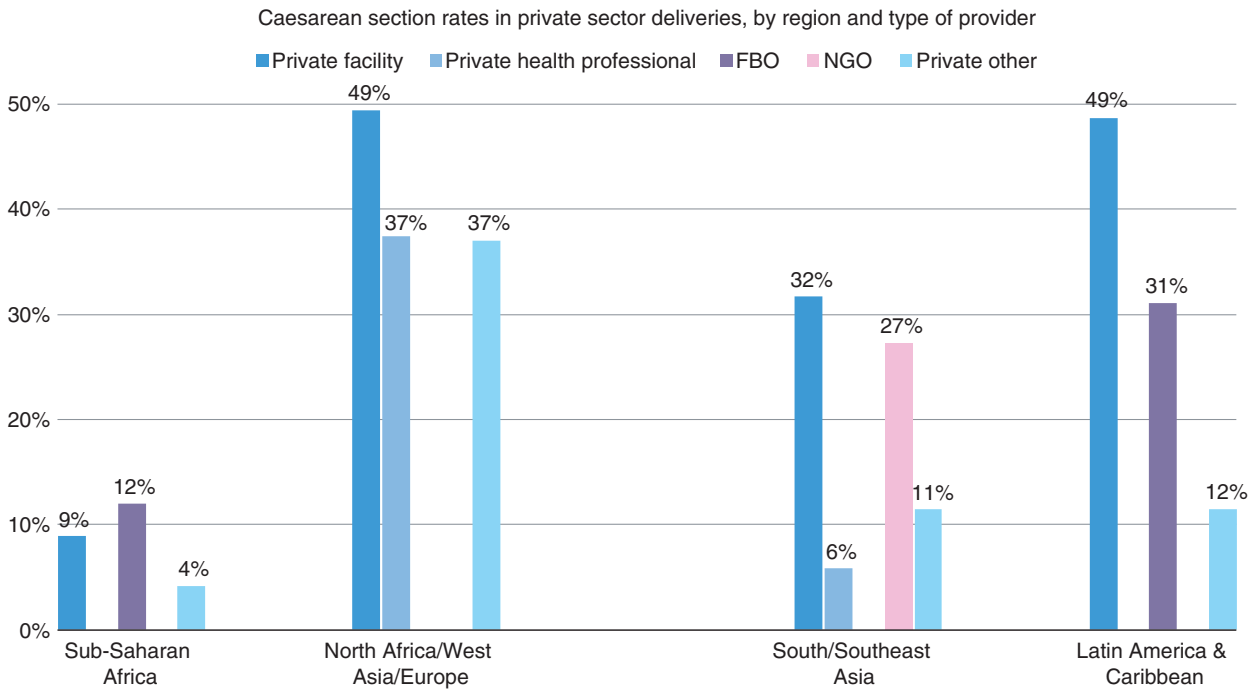

Figure 6 Proportion of births delivered by Caesarean section in the private sector, by provider type and region.

side of the public sector (in either unclassifiable locations or the private sector). The proportion of deliveries occurring with appropriate service type was higher among the richest than the poorest in all four regions, a pattern which held for both public- and private-sector facility deliveries. Private facilities and private health professionals accounted for the majority of private-sector deliveries, and the contribution of NGOs and FBOs was low. The proportions of deliveries assisted by a SBA were similar by sector. In every region, Caesarean section rates

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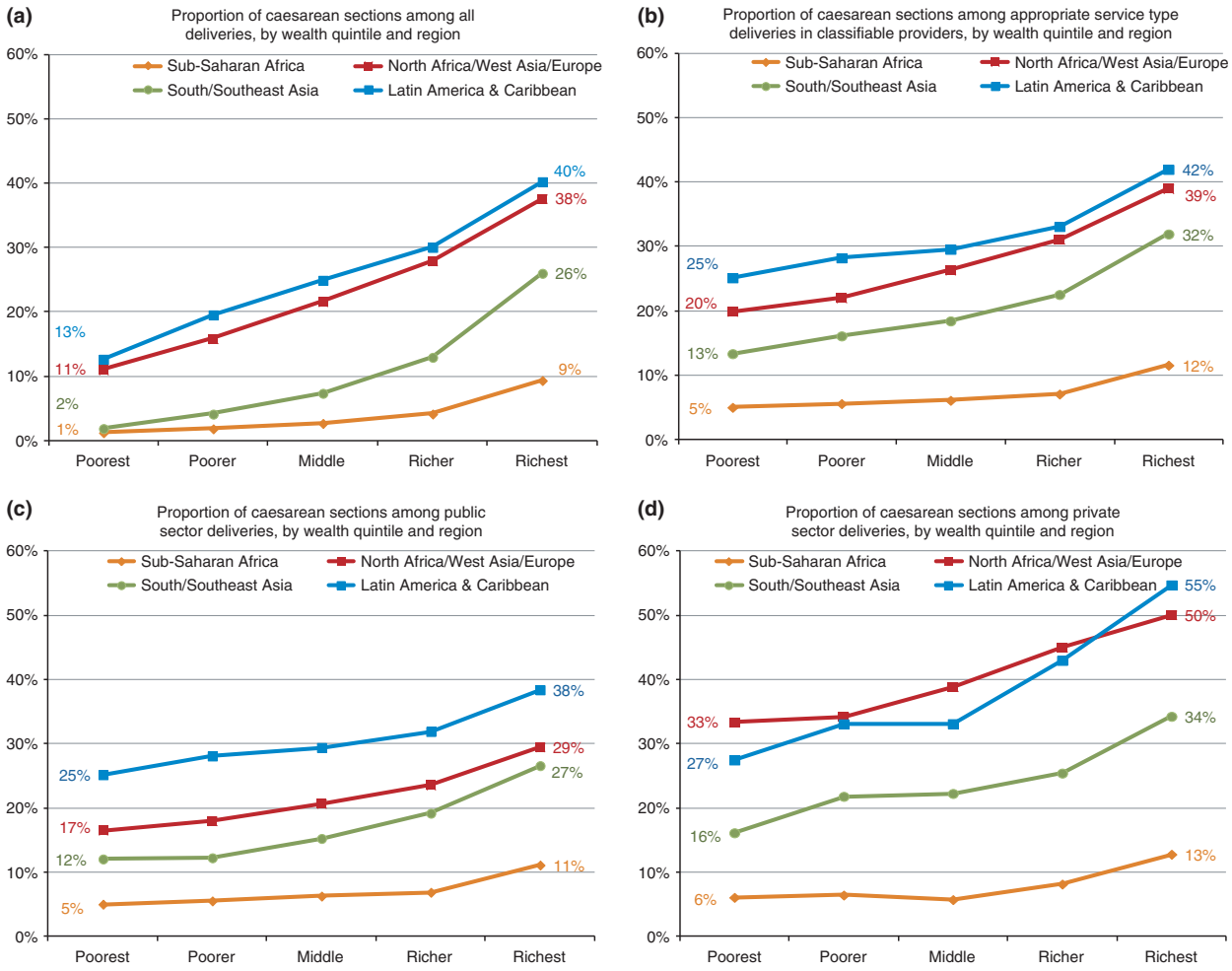

Figure 7 Proportion of births delivered by Caesarean section, by wealth quintile and region.

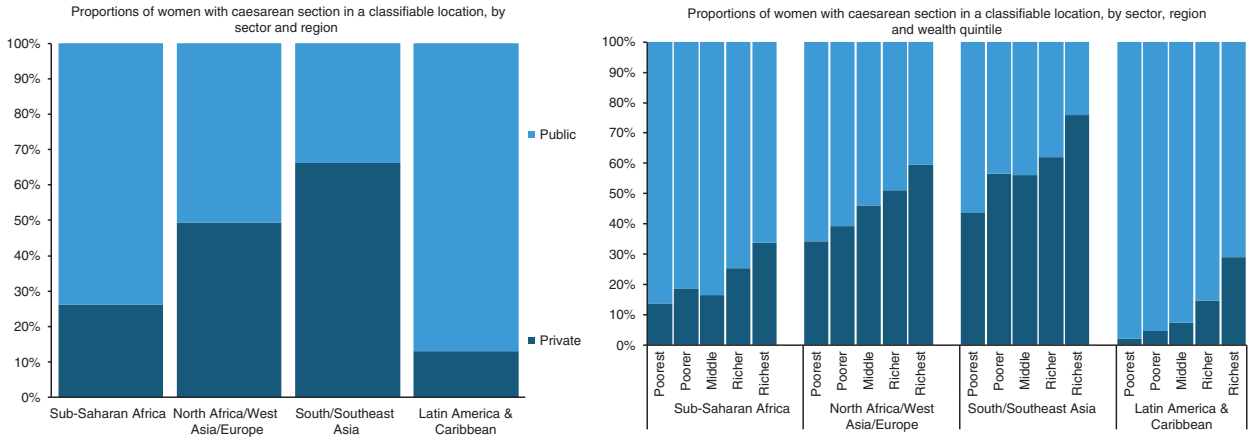

Figure 8 Deliveries by Caesarean section in classifiable providers, by sector and region.

increased with women's wealth quintile and were higher in the private sector. The proportion of Caesarean sections provided by the private sector across the four regions ranged from one-tenth to two-thirds.

As with most secondary data analyses, our study has limitations. First, not all countries in the four regions had a DHS. In the Latin America and the Middle East/Europe regions, only about one-third of the regions' populations were included in our analyses. However, in the regions with the highest global maternal mortality ratios – sub-Saharan Africa and Asia – population coverage was above 80% [25]. Second, the analyses relied on women's recall of their delivery circumstances, information which is rarely validated. Complexities of provider types (such as private doctors practicing in public hospitals or franchised by an NGO) were unlikely to be captured via women's reports, nor did we expect most women to know or recall the exact qualification of their birth attendant [26]. Finally, the DHS did not collect the sector of practice for professionals assisting home births (e.g. doctors or midwives) and, in some countries, the provider categories included a type of birth attendant (e.g. a private health professional) rather than a location (e.g. private hospital) as a valid response option [20]. Our estimates may have therefore underestimated private-sector provision, by between 3% and 8% across the four regions. On the other hand, despite these limitations, this is the most comprehensive study to date (in terms of numbers of LMICs included) to assess various indicators of coverage, equity and elements of quality comparatively between public- and private-sector delivery care. We also went beyond others in categorising the sector of provision and the delivery attendants (based on several sources of information on qualifications on a country-by-country basis [20]).

Our analysis showed the coverage level of private sector in delivery care for each region as well as overall for the 57 countries. The extent of reliance on the private sector for delivery care is less than suggested by some advocates of private sector provision, but is nonetheless substantial [27]. Assessment of the importance of the private sector depends in part on whether it is expressed as a percentage of all deliveries, in which case the coverage is 19% overall (ranging from 7% in Latin America to 26% in Middle East/Europe), as a percentage of deliveries with appropriate service type, in which case the coverage is more substantial at 36% overall (ranging from 9% in Latin America to 46% in Asia), or as a percentage of classifiable sector deliveries, where the private-sector contribution ranged from 9% in Latin America to 56% in Asia. Three other studies constructed regional averages, two of which present regional estimates of private-sector deliveries [14, 28]. The only study which weighted country-level coverage by population presented private-sector use by wealth quintile, but not overall [16]. In geographic regions where we could compare, we found that the proportion of all deliveries occurring in private facilities in sub-Saharan Africa was 10%, whereas Yoong *et al.* estimated this to be 7.7% (weighting unclear) and Gwatkin *et al.* 2007 at 6.1% (unweighted). Gwatkin *et al.* also estimated this proportion for all included countries (8.2%), compared to our estimate of 19%. Our coverage levels are not expected to match those of others, because we differ in the countries included, the approach to producing regional estimates, the survey dates and the classification of sector. None of the identified studies estimated coverage of private sector as a proportion of deliveries with appropriate service type, regionally or overall. We were the first multicountry study that went beyond the categories of home, public and private to define appropriate service type according to location and attendant, and to comprehensively classify all delivery locations, although previously Kagawa *et al.* [29] examined faith-based provision. Our results confirmed that the proportion of private delivery care provided by NGOs and FBOs was surprisingly small (0.9% of all deliveries) and substantial only in sub-Saharan Africa (1.9% of all deliveries, primarily FBOs). A previous study in 31 countries found FBOs provided 2.5% of delivery care, but did not specify whether this was a proportion of all deliveries or only facility deliveries, had coding errors and included different countries [29]. We also showed inequalities between wealth quintiles in the proportion of all deliveries occurring with appropriate service type in all four regions. These findings agree with an analysis in 45 countries that found public- and private-sector use was lower among poorer women and that the poor–rich gradients were larger in private facilities [30], as well as with other studies that examined equity [14, 16, 26, 31–34].

Our proxies for assessing quality of care examined whether deliveries were attended by SBAs and compare their Caesarean section rates, none of which had previously been examined by sector across regions. The global maternal health strategy aims to ensure all women are assisted by a SBA [35]. The proportions delivering with a SBA were comparable across public and private sectors. We found a higher proportion of private- compared to public-sector deliveries were assisted by doctors in three regions. A previous analysis in three sub-Saharan African countries noted more obstetrician/gynaecologist deliveries in NGO/FBO facilities than in government facilities, but showed that comparable proportions delivered by nurse/midwives [36]. Four of six Asian countries analysed by another study had a higher

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proportion of births in the private sector attended by a doctor; the proportion attended by a combined doctor/nurse/midwife attendant was lower in the private sector in three countries and comparable to the public sector in the other three [34].

Caesarean sections save lives of women and newborns, but can be unnecessarily instigated by women or providers in which case they are an indicator of poor quality. While studies report a strong inverse association between Caesarean section rates and maternal, infant and neonatal mortality rates in high-mortality contexts [37–39], optimal Caesarean section rates remain controversial. Betran *et al.* [37] estimated that 15% of births globally occurred by Caesarean section, ranging from a low of 3.5% in Africa to a high of 29.2% in Latin America and the Caribbean. Countries may have reasonable population-level Caesarean rates that mask subpopulations of women who get too many or too few Caesarean sections [40]. We compared rates by sector and found those in the private sector exceeded those in the public in all regions. Previous analyses in Latin American countries [22, 41] and in three of five Arab countries reported similar findings [23]. Two studies demonstrated large socio-economic inequalities in Caesarean sections [21, 40]. Our analysis by sector showed that both sectors had lower Caesarean section rates among poor compared to rich women and that this inequality was wider in the private sector. This may be due to a different case mix between the sectors. The private sector provided a substantial proportion of Caesarean sections in each region. In their analysis of three sub-Saharan African countries, Vogel *et al.* noted that NGO/FBO facilities had higher Caesarean section rates than government facilities, but that women delivering in these facilities had consistently more ANC complications [36]. It would be important to examine the extent to which women with complications are more or less likely to deliver in private-sector facilities, and how this varies across countries and regions. The general literature indicates that private-sector providers may seek to avoid patients with complications [42].

A debate on 'whether private health care is the answer to the health problems of the poor' raises many points salient to the provision of delivery care [43]. Smith *et al.* stated that the private sector is a significant factor in health care and cannot be ignored. We confirm this to be the case for delivery care. Moreover, when characterising the nature of private health services, Hanson *et al.* observed that '[p]rivate health services range from sophisticated inpatient facilities delivering advanced medical care of the highest international standard, through to the individual practices of doctors, nurses, and midwives, sometimes working in parallel with their public practice, and to unqualified peddlers of drugs from market stalls'. They went on to say that '[w]hat evidence there is suggests that poor people are more likely to use the lower-quality, highly dispersed, and fragmented end of this spectrum'. Our findings are also in line with these general observations. In particular, we found that pro-rich inequalities exist and that there was a large variation in the range of private providers. While the level of SBA was comparable across sectors, attendants in the private sector were more likely to be doctors for the rich and unskilled attendants for the poor. The Caesarean section rates above 30% observed in Middle East/Europe and Latin America regions likely reflect unnecessary interventions, and there is evidence to suggest that these are being differentially provided to the rich and higher in the private sector. A substantial literature elucidates how private providers are incentivised to overperform Caesarean sections either because they are financially more lucrative, because they can be conveniently scheduled or because of women's demands for care from one individual [44–46].

An ecological study of sub-Saharan African countries correlated the level of private-sector participation with increased use of healthcare facilities and found a positive association, leading the authors to conclude that greater private-sector participation is associated with better access and equity outcomes without harmful effects [28]. The positive correlation seen is unsurprising because private-sector participation is a subset of total participation, and we therefore remain unconvinced by their conclusions. When we correlated the proportion of appropriate service type deliveries occurring in the private sector with the overall proportion of deliveries with appropriate service type, we found that counties with higher appropriate service type coverage tended to have fewer of these deliveries occurring in the private sector. However, more sophisticated, context-specific and adjusted analyses are needed to disentangle whether and how the private sector contributes to universal coverage. In order for the private sector to increase overall coverage, it will either need to reach those who are currently receiving suboptimal delivery care or substitute for women currently receiving public services, thereby freeing up public services to serve women not receiving appropriate service type. In either case, there are challenges, because such women are likely to be the most difficult to reach, the most rural and the poorest. Such features do not incentivise the commercial private sector, which has to make a substantial investment in infrastructure and staffing while making a return on investment. In many countries, the public and non-commercial (FBOs, NGOs) private sectors also find it difficult to serve such women.

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In conclusion, this is the most comprehensive analysis of the private-sector role in providing delivery care to date. A significant proportion of women in LMICs seek delivery care in the private sector. It is therefore imperative to fully engage with the diverse array of providers in the private sector to promote quality intrapartum care, which is inextricably linked with achieving the Sustainable Development Goals and universal health coverage.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. The 57 countries included, year of survey, union status of women, and recall period.

Table S2. Characteristics of studies which looked at delivery care across multiple low- and middle-income countries.

Appendix S1. Deriving regional population weights.

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