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## Impact of maternity unit closures on access to obstetrical care: The French experience between 1998 and 2003<sup>☆</sup>

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### ABSTRACT

As in many other countries, the number of maternity units has diminished substantially in France, raising concerns about the reduced accessibility of obstetric services. We describe here the impact of closures on distance and mean travel time between pregnant women's homes and maternity units.

We used data from the 1998 and 2003 French National Perinatal Surveys and from vital registries to measure indicators of accessibility: straight-line distance to the nearest maternity unit, number of units within a 15-km radius and reported travel time to the unit for delivery. We analyzed these measures for all births, births in rural versus urban areas and according to regional rates of maternity closures.

From 1998 to 2003, 20% of maternity units closed (reducing the number from 759 to 621) with regional variations in the rate of closure from 0.0% to 36.0%. Mean distance to the nearest maternity unit increased (6.6–7.2 km,  $p < 0.001$ ). The proportion of women living more than 30 km from a maternity ward was low; but rose from 1.4% to 1.8%. The number of maternity units with a 15-km radius of the place of residence fell (median, 3 to 2). Differences were more marked in rural areas and in regions highly affected by closures. However, reported travel time did not increase and even declined slightly for women from urban areas and in regions moderately affected by the closures.

As such, the closures do not appear to have had a negative impact on the geographic accessibility of maternity units. Pregnant women were faced with a reduction in the number of maternity units near their homes and our results suggest that they more often chose their maternity units based on proximity. A full assessment of the impact of closures on accessibility to obstetric services would require information on how these changes affected available choices for care during pregnancy and delivery.

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### Introduction

As in the rest of Europe and Northern America (Bosanquet, Ferry, Lees, & Thornton, 2005; Nesbitt, 1996; Neto, 2006), the number of maternity units in France has diminished regularly since the 1970s (Bréart, Puech, & Rozé, 2003; Rumeau-Rouquette, Rabarison, du Mazaubrun, & Blondel, 1984). This trend is associated with several factors including policies to close small maternity units, deemed to be less safe, and also for financial reasons resulting, in part, from increased security regulations related to personnel or equipment which make maternity services less profitable

for the private sector. In 1972, regulations promulgated as part of the “Dienesch decree”, related to the standards applicable to private maternity facilities, aimed to ensure adequate levels of equipment and care (MOH, 1972b). These measures were extended to the public sector (MOH, 1972a) and were then reinforced for all maternities in 1998 (MOH, 1998b). Government policies to reduce the costs of health service provision may also have contributed to closures or mergers of units. Another factor aggravating the problem is an insufficient number of gynaecologist obstetricians and midwives. As early as 1974, a group of specialists reported a shortage of qualified obstetricians in France (Amiel et al., 1974), and the situation has considerably worsened since that date (Bréart, Puech, & Rozé, 2003). These changes primarily affect maternity units with a low delivery volume or not meeting equipment or staffing standards.

Studies have shown that delivery in small or less specialized maternity units is associated with higher mortality (Albers & Savitz, 1991; Berg, Druschel, McCarthy, LaVoie, & Floyd, 1989; Bouvier-Colle, et al., 1996; Merlo et al., 2005; Moster, Lie, & Markestad, 1999, 2001), although not in all contexts (Baird, Jewell, & Walker, 1996; Cole & Macfarlane, 1995; Mayfield, Rosenblatt, Baldwin, Chu, & Logerfo, 1990; Viisainen, Gissler, & Hemminki, 1994). This research suggests that the closure of these units could improve perinatal health. However, hospital closures and mergers could also have negative consequences. In particular, they may increase the distance and travel time between the home and place of delivery, especially in rural areas, and thus limit pregnant women’s access to maternity facilities.

In obstetrics, as in all medical specialties that involve management of life-threatening emergencies, a reduction in accessibility of care can have repercussions on population health (Gulliford et al., 2002). Rapid access to obstetrical care is necessary to respond to emergencies threatening the life of mother and fetus and to avoid accidental deliveries outside of hospitals, as shown in Finland (Viisainen, Gissler, Hartikainen, & Hemminki, 1999). Long travel time may also affect decisions about seeing the doctor during pregnancy for routine monitoring or for complications and to influence the decision to hospitalize a patient. Moreover, research on access to care in obstetrics and from other disciplines shows that the impact of distance and travel time are highest for users from socially disadvantaged backgrounds (Attar, Hanrahan, Lang, Gates, & Bratton, 2006; Field & Briggs, 2001; Hyndman & Holman, 2000; Hyndman, Holman, & Dawes, 2000; Jones & Bentham, 1999; Jordan, Roderick, Martin, & Barnett, 2004; Maheswaran, Pearson, Jordan, & Black, 2006). Poor accessibility of care may therefore contribute to social inequalities in content of care and health (Chishty & Packer, 1995; Kaminski, Blondel, & Saurel-Cubizolles, 2000).

While a reduction in the accessibility of maternity services is put forward as the major risk associated with closures, the extent to which closures affect accessibility is rarely measured or reported. Our objective is thus to assess the impact of maternity unit closures in metropolitan France (the part of France located in Europe, including Corsica) between 1998 and 2003 on geographical accessibility and to identify groups of pregnant women who were

most affected by these changes. We use several easily computed measures of accessibility: straight-line distance between the woman’s home and the hospital nearest to her home, the number of maternity units near her home and the time it takes her to reach the hospital for delivery.

## Materials and methods

### Data

We used two data sources: the last two French National Perinatal Surveys (NPS) from 1998 and 2003 and vital records registries.

### National perinatal surveys

All French maternity units participate in these surveys, which include all births during one week. For each birth, the survey collects information about the mother’s social and demographic characteristics, health care utilization, as well as medical data about the delivery and the newborn. Information is also collected on her place of residence recorded at the level of French administrative districts (*département*). The data come from an interview after delivery and from medical files. The last two national perinatal surveys took place in December 1998 and in October 2003; their methodology has been described elsewhere (Blondel, Norton, du Mazaubrun, & Bréart, 2001; Blondel, Supernant, du Mazaubrun, & Bréart, 2005). The 1998 survey included 13 718 births and the 2003 survey 14 737 births.

In both years, all women were asked: “how long did it take you to get from your home to the hospital for delivery?” The interviewer noted the response in minutes. This question was not asked of women already hospitalized at delivery, nor in cases of maternal transfer. We also excluded values we considered unreliable, such as a travel time of less than 2 min (42 responses excluded in 1998 and 49 in 2003). Overall, this information was available for 92% of births in 1998 (12 643) and in 2003 (13 584).

The analysis covered all the maternity units participating in the surveys. One maternity facility had no births during the 1998 survey week. One maternity ward in 1998 and two in 2003 refused to participate. The net closure rate was calculated as the ratio of the difference in the number of maternity units between the two surveys to the number of units open in 1998. A maternity ward closure was defined as the permanent disappearance of the facility, that is, without any replacement on the same site. A new maternity ward was thus defined as one opening where none had previously existed. These net closure rates between 1998 and 2003 were calculated by administrative region (Metropolitan France is divided into 22 such regions) and included new facilities.

The perinatal surveys provide information on the following characteristics of maternity units: geographic location (commune where the maternity ward is located), size in annual volume of deliveries and legal status. Legal status was classified as university hospital centre or UHC, other public hospital, private hospitals participating in public service (PHPS) and other private hospital. We

calculated the distance from each maternity facility to the next nearest facility.

#### *Vital registry data*

To model the trends in obstetric care supply in France during the study period, we used the 1998 and 2003 data on births according to commune of residence, provided by the National Institute for Statistics and Economic Studies (INSEE). The commune is the lowest level of administrative division in France; there are currently 36 569 communes in metropolitan France. Annual statistics for births are drawn from statistical forms completed at the time of the birth at the vital registry office of the commune where it occurred.

#### *Distance measurements*

We used the vital record data to calculate the distance between the communes where maternity units were located and those where the women lived. Using birth statistics classified by the mothers' places of residence, we estimated the distance to the nearest maternity ward in 1998 and in 2003 and the number of maternity units in a 15-km radius around the commune of residence. This radius was chosen because three-quarters of all women give birth within 15 km of their home in France (Doisneau, 2003). Finally, we calculated the percentage of women who had a "long" distance to the nearest maternity unit, defined as more than 30 km and more than 45 km.

These distance calculations were made with a geographic information system (MapInfo GIS 8.5), software that makes it possible to pinpoint information with a spatial dimension on a map. We geocoded the location of each hospital open in 1998 and in 2003 and of each birth, placing them on the map at the centre of the commune. We calculated the distances between the centres of the relevant communes in kilometres as a straight line.

#### *Definition of rurality*

Because we only knew the department of residence of the women in the National Perinatal Surveys, we estimated the degree of rurality at the level of each department (there are 96 departments in Metropolitan France, grouped into the 22 administrative regions) classifying them according to the proportion of births that took place in rural communes. INSEE defines an urban commune as a commune or a group of communes that includes a built-up area of at least 2000 inhabitants where no building is further than 200 m away from its nearest neighbour. In addition, more than half the population of each commune must reside in this built-up area (Insee, 2007). Accordingly, all other communes are considered rural. We considered departments to be rural if more than 35% of their births took place in rural communes, chosen because half of all births took place in departments with this level of rurality. We also grouped departments into three groups based on this measure of rurality and redid the analysis to see whether this alternative grouping would affect our conclusions. As the results were very similar, the simpler classification into two groups is presented here.

## **Analysis strategy**

We first analyzed the changes in the size and status of maternity units between 1998 and 2003. We then studied the impact of closures on the distance between the women's homes and maternity units, calculated from vital records data, and of travel time, collected in the national surveys.

We analyzed the distance and travel time for different populations: all women who gave birth, those who lived in rural or urban departments and those who lived in regions slightly or highly affected by the closures. More precisely, the regions were classified into three groups according to maternity unit closure rates: low (<14%), moderate (14–23%) and high ( $\geq$ 24%). Each group included one-third of the regions. Travel time was also analyzed for the group of women at low risk, defined as those with a singleton pregnancy, not hospitalized during pregnancy, who delivered a child with a birth weight of 2.5 kg or more and a gestational age of 37 weeks or more. In principle, these women had no medical risk factors that should have affected their choice of maternity facility.

During the analysis, we observed that the proportion of births rose in urban regions over the study period. This change could entail a reduction in the mean distance to the nearest maternity ward, independently of the diminution in availability due to closures. To measure the independent effect of such a population trend between the two dates, we simulated the distance to the nearest maternity ward and the number of maternity units within a 15-km radius for the births in 2003 with facilities available in 1998 and we compared the results with those observed in 1998.

The percentages between the two periods were compared using the chi-square independence test and the mean distances by a t-test. We set the risk of a type-1 error at 5% (STATA software 9 SE).

## **Results**

Table 1 shows the number and characteristics of maternity units in 1998 and 2003 and of those that closed over the study period. In all, 153 maternity units closed between 1998 and 2003, a reduction of 20%. The units that closed accounted for 87 343 births in 1998, that is, 12% of all births (data not in table). Half of the units that closed had an annual delivery volume of less than 500 babies a year in 1998 and nearly 90% had less than 1000. Thus, between the two periods, the proportion of maternity units with fewer than 1000 deliveries a year fell; this decrease was especially pronounced for those with fewer than 500 deliveries (from 26.9% to 14.3%). On the other hand, the proportion of units with more than 2000 deliveries a year more than doubled over this period (from 8.1% to 17.5%). The private sector alone accounted for nearly seven of every 10 closures (69.3%) and declined from 40.0% of the total in 1998 to 33.8% in 2003.

This contraction in supply modified the spatial distribution of facilities, measured by the change in the average distance between two maternity units. Accordingly, the percentage of maternity units less than 10 km from the next nearest facility fell from 38.3% in 1998 to 33.8% in

**Table 1**

Characteristics of existing maternity units and of units closed between 1998 and 2003

	Maternity units in 1998		Maternity units in 2003		Maternity units closed <sup>a</sup>	
	N	%	N	%	N	%
Total number of maternity units	759	100	621	100	153	100
<i>Size</i>						
<300 del/year <sup>b</sup>	59	7.9	26	4.2	24	15.7
300–499	143	19.0	62	10.1	51	33.3
500–999	286	38.1	210	34.0	63	41.2
1000–1499	131	17.4	140	22.7	11	7.2
1500–1999	71	9.5	71	11.5	3	2.0
2000+	61	8.1	108	17.5	1	0.6
<i>Status</i>						
UHC <sup>c</sup>	54	7.1	49	7.9	3	2.0
Other public	362	47.7	328	53.0	36	23.5
PHPS <sup>d</sup>	40	5.2	33	5.3	8	5.2
Other private	303	40.0	209	33.8	106	69.3
<i>Distance to nearest maternity unit<sup>e</sup></i>						
<10 km	290	38.3	209	33.8	36	24.5
10–29 km	342	45.1	261	42.2	40	27.2
30+ km	126	16.6	148	24.0	71	48.3

Source: National Perinatal Surveys.

<sup>a</sup> Characteristics in 1998 for the maternity units closed between 1998 and 2003.

<sup>b</sup> Deliveries per year.

<sup>c</sup> UHC: University Hospital Centre.

<sup>d</sup> PHPS: Private hospital participating in public service.

<sup>e</sup> Distance between two maternity units.

2003. At the same time, the proportion of units for which the next closest unit was 30 km or more away increased over the study period (from 16.6% to 24.0%).

Fig. 1 presents the geographic variations in the rate of maternity unit closures during the study period and shows that closures during this period were not equally distributed across France. Regional closure rates varied from 0.0% to 36.0%. Some regions (Corsica and Limousin) had no closures at all, while in Franche-Comté and Burgundy, major changes occurred (closure rates of 33.3% and 36.0%, respectively). The supply of obstetric facilities fell by more than 17.9% in half the regions (11 regions).

Table 2 presents the minimum distance and available supply of units for the different population sub-groups in 1998 and 2003. Between 1998 and 2003, the mean minimum distance between the home and the maternity unit of birth increased by less than 1 km (from 6.6 to 7.2). This increase was nonetheless significant in all population groups and was most marked in rural areas. In rural areas, the mean minimum distance increased from 9.3 to 10.7 km. The minimum distance to the closest maternity unit exceeded 30 km for about 2% of births. However, this proportion increased significantly between 1998 and 2003, especially for rural populations (from 2.3% to 3.4%) and regions highly affected by closures (1.7–2.5%). The number of distances longer than 45 km, which affect less than 1% of

all births, did not change significantly during the study period.

The median number of maternity units within a 15-km radius fell during the study period (from 3 to 2 overall). Pregnant women without a maternity unit within a 15-km radius increased between 1998 and 2003 (from 15.6% to 18.1%), and this change affected most specifically the rural population (from 27.6% to 32.9%) and those living in regions highly affected by the closures (from 24.6% to 29.6%). Inversely, the proportion of births in areas with a high supply of maternity facilities nearby (more than three in a 15-km radius) diminished for all subpopulations – from 53.2% to 48.6% in the general population, from 25.8% to 19.8% in rural areas and from 36% to 22% in the highly affected regions.

Table 3 compares the travel time, in minutes, that women reported for reaching the maternity ward where they gave birth. Overall, reported travel times changed very little between 1998 and 2003 from an average of 18.4 to 18.2 min. For all sub-groups, there were no marked differences in mean travel time, with a range from 17 to 19 min in both periods. About one-fifth of all women had to travel 30 min or longer to get to their maternity unit for delivery. This proportion diminished slightly but significantly between 1998 and 2003 (from 21.6 to 21.1). In 1998, 7.1% of all women reported travelling 45 min or more versus 6.3 in 2003, again a slight, but significant decrease. The decrease in travel time over 45 min is significant principally for women from urban areas and in regions moderately affected by the closures.

Additional analyses were undertaken to assess whether changes in travel time could reflect the fact that the increasingly urban population lived closer to maternity units in 2003 than in 1998. A simulation applying the distribution of births by place of residence in 2003 to the maternity units available in 1998 showed, however, that the mean minimum distance did not fall. For the total population, it was 6.7 km in the 2003 simulation compared with 6.6 km observed in 1998 and the median number of maternity facilities in a 15-km radius was 3 and 3, respectively (data not shown). These findings were constant for all the subpopulations studied.

## Discussion

The objective of this work was to describe the recent evolution in the supply of maternity units in metropolitan France and to assess its impact on geographic accessibility. Our analysis showed major changes in the supply of maternity units over the 5 years covered by this analysis: 20% of maternity units closed, deliveries became more concentrated in high volume facilities and maternity units were situated further apart. These changes led to slight increases in the minimum distance between home and maternity unit for pregnant women and to decreases in the number of maternities situated within a 15 km radius of their homes. These changes in the spatial configuration of maternity units were not accompanied, however, by increased travel times for the population of pregnant women. Mean travel time and the proportion of women reporting a trip of 45 min or longer even decreased slightly

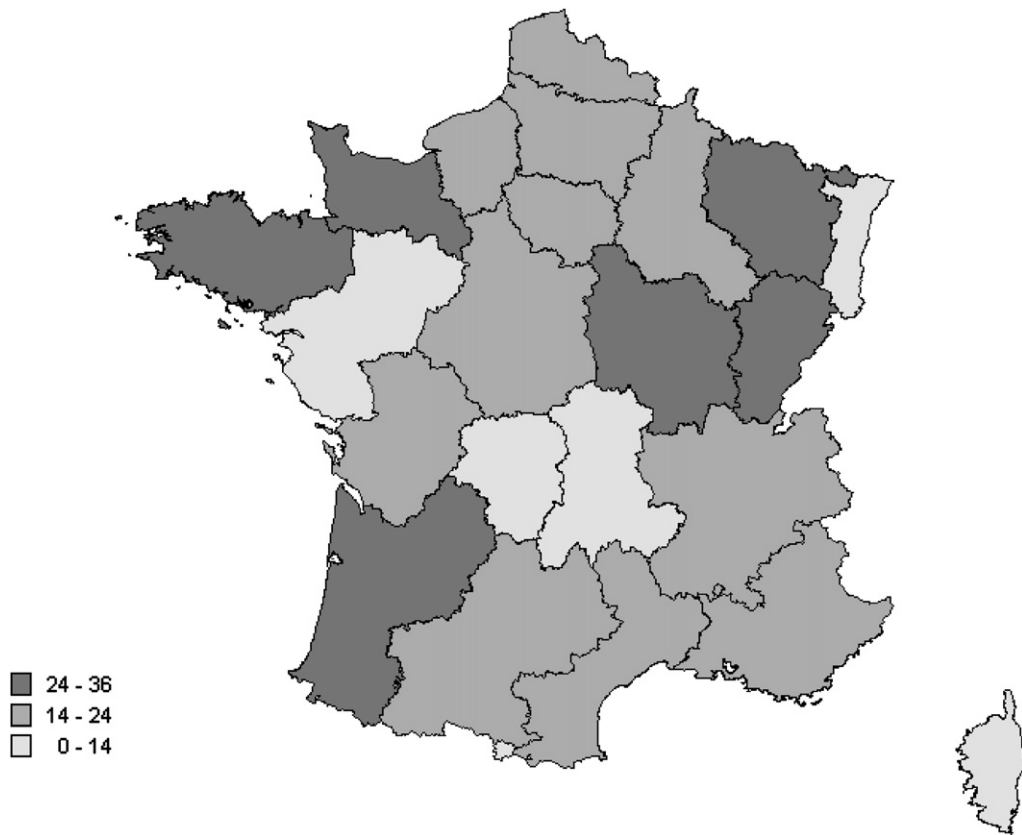


Fig. 1. Rate of closure of maternity units (%) in France by administrative regions, 1998–2003.

Table 2

Minimum distance between women's commune of residence and closest maternity and available supply of units for different population sub-groups in 1998 and 2003 classified by rurality and rate of maternity closures by region (calculated on all births in France)

Year	Total population		Rurality				Closure rate					
	1998	2003	Rural		Urban		≥24%		14–23%		<14%	
N	736 440	759 935	230 853	236 823	505 587	523 112	142 094	143 919	509 897	527 494	84 449	88 522
<i>Minimum distance to closest maternity unit</i>												
Mean (km)	6.6	7.2	9.3	10.7	5.3	5.6	9.0	10.1	5.5	5.9	9.1	10.0
	<i>p</i> < 0.001		<i>p</i> < 0.001		<i>p</i> < 0.001		<i>p</i> < 0.001		<i>p</i> < 0.001		<i>p</i> < 0.001	
>30 km (%)	1.4	1.8	2.3	3.4	1.0	1.0	1.7	2.5	1.1	1.4	2.8	3.2
	<i>p</i> < 0.02		<i>p</i> < 0.001		NS		<i>p</i> < 0.02		NS		NS	
>45 km (%)	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.4	0.4
	NS		NS		NS		NS		NS		NS	
<i>Number of maternity units in a 15-km radius</i>												
Median	3	2	1	1	5	4	2	1	4	3	2	1
0 (%)	15.6	18.1	27.6	32.9	10.1	11.4	24.6	29.6	11.5	13.2	25.4	28.6
1 (%)	16.3	18.5	25.2	27.1	12.3	14.7	24.3	30.2	13.0	14.6	22.7	23.2
2 (%)	14.9	14.8	21.5	20.2	11.9	12.4	15.1	18.2	14.3	13.6	18.2	16.5
3 or more (%)	53.2	48.6	25.8	19.8	65.7	61.6	36.0	22.0	61.2	58.6	33.7	31.7

Sources: Vital registry data and National Perinatal Surveys.  
NS: not significant.

**Table 3**  
Reported travel time (minutes) for reaching the maternity unit for sub-groups of women classified by perinatal risk, rurality and rate of maternity closures, by region, in 1998 and 2003

Year	Total population		Low risk		Rurality		Closure rate							
	1998	2003	1998	2003	Rural	Urban	>=24%		14–23%		<14%			
					1998	2003	1998	2003	1998	2003	1998	2003		
N	12 643	13 584	8598	9372	4026	4269	8568	9278	2391	2503	8670	9349	1533	1695
Mean travel time, (min)	18.4	18.2	18.1	17.8	18.9	19.3	18.1	17.7	18.3	19.0	18.2	17.8	19.2	19.2
		NS		NS		NS		$p < 0.02$		NS		$p < 0.02$		NS
Mean travel time $\geq 30$ min (%)	21.6	21.1	21.1	20.1	24.2	24.3	20.3	19.6	22.6	24.3	20.9	19.6	23.6	24.8
		$p < 0.02$		NS		NS		NS		NS		NS		NS
Mean travel time $\geq 45$ min (%)	7.1	6.3	6.7	5.7	7.4	6.8	6.9	6.0	6.7	6.6	7.0	6.1	7.9	6.7
		$p < 0.001$		$p < 0.001$		NS		$p < 0.001$		NS		$p < 0.001$		NS

Sources: Vital registry data and National Perinatal Surveys.

NS: not significant.

in urban areas and in the regions moderately affected by closures.

The closing of maternity units between 1998 and 2003 was unequal across the country. Some regions had very high closure rates, while others kept nearly all their facilities. In the regions most affected by closures, mean minimum distance increased by 1 km, the proportion of women with no nearby maternity ward increased from 24.6% in 1998 to 29.6% in 2003 and those with three or more units nearby fell from 36.0% to 22.0%. However, even in these regions, reported travel time did not change significantly: the mean increased from 18.3 to 19.0 min, the proportion of women with a travel time of 30 or more minutes rose from 22.6% to 24.4% and the proportion of women travelling 45 min or more stayed constant (6.7 and 6.6%).

The substantial reduction in the number of maternity units and the decrease in the proportion of the private sector between 1998 and 2003 is a continuation of a general trend observed since the application of the Dienesch decree in 1972. That year, there were 1747 maternity units in France of which 489 maternity units had fewer than 300 deliveries per year (compared with 26 in 2003) and the private sector accounted for 52% of maternity units (compared with 33.8% in 2003; Rumeau-Rouquette et al., 1984).

There are several limitations to our study. First, closures are not the only factor that modified obstetrical care supply over the study period. Maternity units were also, for example, opened or created by the merger of facilities. Furthermore, some “small” maternity units were no longer so small in 2003. These changes have produced the apparent inconsistencies in the total of the columns in Table 1. More importantly, straight-line calculations of distances are not always an accurate representation of reality. What appears far by a straight line may not be if the transportation network is taken into account and vice versa. This may be particularly true in more urban areas. Nonetheless, studies have showed that this type of calculation is a good estimate of reality (Fone, Christie, & Lester, 2006; Hyndman, Holman, & de Klerk, 1999; Phibbs & Luft, 1995), even though more sophisticated models give slightly better results in some settings (Martin, Wrigley, Barnett, & Roderick, 2002).

Measuring accessibility by women's reported travel time may also provide a biased estimate of actual time. It expresses a subjective notion of time and by definition is not exact. There are no specific studies, to our knowledge, on the quality of travel time measurements reported several days after a trip. British researchers observed, however, that the travel times reported by patients with chronic diseases going to hospital consultation, in non-emergency conditions, fairly well reflected the real travel time (Haynes, Jones, Sauerzapf, & Zhao, 2006). During labour, a woman's priority is to get to the maternity unit, rather than to assess the time it takes to do so and this may lead to greater imprecision of recall than in other settings. The question was asked in the same way in 1998 and 2003, however, and it seems improbable that recall bias would differ in the two surveys.

Finally, this study covered all of metropolitan France and our results thus apply to average trends and assess the

overall impact of the closures. The disadvantages of a study on this scale, however, are that it smoothes the reality of particular local situations, such as urban areas, characterized by small physical size, high population density, and a dense transportation network, as well as especially isolated areas (e.g., mountainous zones or zones with other constraints to access). Our analysis cannot focus on extreme situations, which may affect some of the over 13 000 pregnant women who live more than 30 km from a maternity unit (1.8% of the total).

We did not find any increase in reported travel time between the two periods despite the spatial contraction, albeit slight, of obstetrical services. Several reasons may explain this result, including factors besides supply that influence travel time. One of these is the urbanization of the population of childbearing age. The French population became increasingly urbanized throughout the 1990s and this development is an underlying trend (Bessy-Pietri & Sicamois, 2001; Julien, 1998). However, this hypothesis was refuted when we modelled the distance between facilities in 1998 and births in 2003 and did not find shorter minimum distances. Nonetheless, it is possible that improvements in transportation and road networks reduced travel time and thus offset the slight increases in travel distances.

Another explanation may be that women who might have been ready to rely on a criterion other than distance in the choice of their maternity ward decided to go to the closest facility when they were faced with a reduction in supply. When women have more nearby choices, other criteria, such as technical level, reputation, or the recommendations of their treating physician might play a more important role in the decision and spatial proximity may be relegated to secondary considerations. On the other hand, when the facilities are further away, proximity may be more important. This phenomenon has been observed previously in the literature about health care facility closures, principally in North America (Kane, 1969; Studnicki, 1975). A study of the choice of maternity units in France found that proximity was mentioned more often as the principal criterion for choosing a facility in rural areas (Comber et al., 2004). This hypothesis is supported here by the lack of increase in travel time shown in our data for the population of women without any medical indications that might constrain their choice of place of delivery.

The reorganization of maternity hospital supply is a sensitive topic for public opinion in France, as it is elsewhere in Europe (Hencke, 2007; O'Dowd, 2007). The closure of maternity units is often considered to be a form of territorial and social injustice. In France, the disappearance of the only maternity ward in a community is strongly felt by the population. Accordingly, some authors have gone so far as to talk of a crisis for maternity units – demographic, medico legal and financial (Papiernik, 2003). We find that the large reduction in maternity units from 1998 though 2003 did not have a major negative impact on accessibility, as measured by distance to the nearest maternity or on travel time. This could be due to a national consensus on the importance of maintaining accessibility to maternity services (Bréart, Puech, & Rozé, 2003) and the planning efforts of regional health authorities, in cooperation with

local partners. The planning conducted as part of the regional health care organization schemes (SROS) has aimed to adjust the supply of neonatology and obstetrics care to the reality in the field. They may have been able to attenuate the effects of closures in the most affected areas and in those where supply was already very low.

It is also possible that maternity closures begin to show an impact on accessibility only after a specific level of low spatial concentration of supply has been reached. This situation may not yet exist in France, as there are still large numbers of maternity units in the country in comparison with other European countries (Wildman, Blondel, Nijhuis, Defoort, & Bakoula, 2003). Our study shows, however, that there are cases where further reductions would have severe consequences such as in those regions most affected by maternity closures, for instance. Women living further than 45 km from the closest maternity unit – mostly isolated rural areas in these regions (in the administrative regions of Corsica, Languedoc-Roussillon and Provence-Alpes-Côte d'Azur as well as a small number of communes spread all throughout France) – account overall for less than 1% of births in 2003 but would be heavily penalized by further reductions in maternity units. Policies aimed at concentrating births into large maternities could make exceptions for particular situations, with small maternities in the most isolated areas as is currently the case in some other European countries or regions where most deliveries take place in large facilities, such as Scotland and Finland (Wildman et al., 2003).

While closures did not affect travel time, they did affect the number of maternity units near pregnant women's homes. French government policy, like that in other European countries, advocates choice for women with respect to pregnancy care, including choice of health professional and place of delivery (Bréart, Puech, & Rozé, 2003; Smith & Smith, 2005). It is possible that the closure of units and subsequent concentration of deliveries in larger institutions reduced the choices open to women. It is also possible that the closures have had other effects on the care of pregnant women due to changes in the organization of care according to the size or the status of the maternity units and the subsequent difficulties that these units may face providing care for larger numbers of women. For instance, closures may have affected the institutions' provision of prenatal care. French professional organizations recommend that the maternity units provide at least one prenatal visit to all pregnant women before delivery. But from 1998 to 2003, the number of women without one prenatal visit with the medical team in their maternity ward increased (Blondel, Supernant, du Mazaubrun, & Bréart, 2006). This may have resulted in poorer care upon admission to the maternity for delivery. However, these effects may reflect not only changes in geographic accessibility, but also insufficient redeployment of medical personnel from maternity units that have closed to larger structures. This may be especially true in a context of increasing scarcity of obstetricians and midwives. Since there are differences in management of labour and prevention according to size and status of maternity units (Bonet, Kaminski, & Blondel, 2007; Guihard & Blondel, 2001), it is also possible that the evolution of the organization of obstetric supply affected care in other ways.

In conclusion, our study shows that increases in travel time do not necessarily accompany hospital closures. To assess the full impact of these trends on the accessibility of obstetrical services, however, more information is needed on women's satisfaction with the options available to them, the types of care provided in the maternities that were closed and those that remained open, and how networks of maternity units covering specific areas have reorganised themselves to face the declining number of institutions, with respect to policy but also personnel. A comprehensive assessment would also explore the impact on health and in particular intrapartum fetal deaths and deaths due to unexpected complications during labour, both of which have been found to be higher in smaller maternity units (Albers & Savitz, 1991; Berg et al., 1989). The impact on rates of non-planned home deliveries should also be measured, since they are associated with adverse outcomes (Northern Region Perinatal Mortality Survey Coordinating Group, 1996; Sheiner et al., 2002; Viisainen et al., 1999). As closures of maternity units are likely to continue in the future, attention to their impact on maternal and child health, geographical accessibility, user choice and the provision of health care is important to ensure effective and equitable health reform.

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