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Structured abstract

Introduction: We aimed to assess the association between a patient's social status and the cost of stay for a single uncomplicated vaginal delivery.

Currently, few data have been reported.

Material and methods: We conducted an observational study with data retrieved from the medical and administrative databases of a university hospital in North-West France. We included all patients admitted in 2014 and classified in either Diagnosis-Related Group (DRG) « Single uncomplicated vaginal deliveries in a primiparous patient » or DRG « Single uncomplicated vaginal deliveries in a multiparous patient ». Criteria defining poor social status were: a specific healthcare benefit in relation to low income or for foreign undocumented patients, and/or a consultation with a social worker during the hospital stay except if no social problem was diagnosed. We compared the cost of stay between patients with poor social status and patients with good social status using a multivariate median regression stratified on parity, and adjusted for age, gestational age and neonatal hospitalization.

Results: Among 686 primiparous patients, 21% had poor social status, which was associated with an increase in the median cost of stay (+€475; 95% CI [+334 to +616]), mostly explained by a 1-day increase in the median length of stay.

Among 899 multiparous patients, 29% had poor social status, which was not associated with the cost of stay.

Discussion: Social status had an impact on the cost of vaginal deliveries in primiparous patients. Our findings suggest a need to redefine the DRG classification according to patients' social status.

Keywords: Obstetrics; Health care costs; Length of stay; Diagnosis-related groups; Payment system design; Social inequality.

Abbreviations

AME: a specific healthcare benefit for foreign undocumented patients; CMUc: a specific healthcare benefit in relation to a low income; DRG: Diagnosis-Related Group; HAS: French National Authority for Health; LOS: Length Of Stay; OECD: Organisation of Economic Cooperation and Development; WA: Weeks of Amenorrhea.

Introduction

Social determinants not only affect people's health [1], but also increase hospital costs and length of stay (LOS) especially in patients with poor social status [2–7]. The usual assumption in these surveys is that the increase in the LOS is explained by the extra time required to find a suitable place to discharge patients [5].

As in other member countries of the Organisation of Economic Cooperation and Development (OECD), hospitals in France are funded by a prospective payment system using a Diagnosis-Related Group (DRG) classification [8]. The goal of a DRG prospective payment model is for hospitals to achieve efficient functioning by defining a price for each DRG equal to the average cost in all other hospitals nation-wide [9]. In this model, the poor social status of a patient may result in an increase in hospital costs independently of the DRG and ultimately to a loss of revenue. According to some sparse and rather old studies, there is a 9 to 12% prevalence of patients with poor social status (described as “precarious patients”) among inpatients in France [3,4,7].

Accordingly, there might be an interest to redefine the DRG system especially for hospitals which provide care to patients with poor social status.

In 2014, there were 252,477 and 174,055 single uncomplicated vaginal deliveries in multiparous patients (DRG 14Z14A) and primiparous patients (DRG 14Z13A) respectively, in public and private non-profit hospitals in France [10]. These two DRGs represent the second and the third most common admissions to hospital in France, excluding day hospitalizations [10]. In a recent French study based on the PreCARE cohort, Gonthier et al. [11]

estimated that 18.2 % of women with singleton pregnancies delivered after 21 completed weeks of gestation, had at least one deprivation criteria (among: social isolation, poor or insecure housing conditions, non work-related household income and no permanent health care insurance) and 7.5% had three of four criteria. Previous published studies suggested poor social status could have an impact on the risk of adverse maternal and perinatal outcomes [11–13]. However, the effect of the poor social status of a patient on the cost of delivery remains unclear. Two American and one Australian study found that low education level, or low socioeconomic status, was associated with shorter stay [14–16]. These contrasting results may be due to differences in the organization of healthcare systems including the lack of universal healthcare cover in the United States or health insurance that does not cover all hospitals in Australia [17]. In these countries, the purchase of costly private insurance is necessary for full reimbursement of hospital stay [17]. Other studies found no association between social status, hospital costs and LOS [3,18,19]. Only Coevoet et al. [20] found an association between unemployment rate (assessed at an area-based level) and increased LOS. However, a preferential insurance scheme, i.e. a specific healthcare benefit for foreign undocumented patients (AME) or a specific healthcare benefit in relation to a low income (CMUc), was not associated with the LOS [20]. Analyses performed in these studies were not stratified on parity, although we can assume that the effect of social status on hospital costs may vary according to parity status. The aim of our study was to analyze the association between an inpatient's poor social status and the cost of single uncomplicated vaginal deliveries in a tertiary care university hospital in France, using stratified analyses on parity status.

Material and methods

Design

We conducted a single center observational study. All data were retrieved from the medical, administrative and social databases of our university hospital in the North-West of France.

This study has been approved by Rouen University Hospital's institutional review board.

Subjects and data collected

All patients admitted to our university hospital in 2014 and classified in either DRG 14Z13A « Single uncomplicated vaginal deliveries in a primiparous patient » or DRG 14Z14A « Single uncomplicated vaginal deliveries in a multiparous patient » were identified through the hospital medical and administrative databases and included in the present study. In France, primiparous and multiparous patients admitted for a single uncomplicated vaginal premature delivery between 32 and 37 weeks of amenorrhea (WA) are classified in another DRG. Thus, no patient included in our study, had a delivery before 37 WA.

The following data were collected: age, gestational age, neonatal hospitalization and preferential insurance scheme, i.e. a specific healthcare benefit for foreign undocumented patients (AME) or a specific healthcare benefit in relation to a low income (CMUc).

The first time a patient presents to our university hospital, he/she is given a unique patient identification number. All subsequent stays and consultations of the same patient, within our university hospital, can be linked using this unique patient identification number. Data regarding a consultation with a social worker during the hospital stay were collected through the Social Services database. This documents the date and reason for all consultations with a social worker at our university hospital, as well as the unique patient identification number. Each consultation with a social worker can be linked to a hospital stay *via* the date of the consultation and the unique patient identification number. Poor social status was defined as satisfying at least one criterion among: receiving AME, CMUc benefits, a consultation with a social worker during the hospital stay except if no social problem was diagnosed.

Cost of stay

Length of stay (LOS) was calculated for all admissions. Costs were estimated from a hospital perspective. We considered daily-specific costs, i.e. the costs attributable to a day of hospitalization in a specific department. Daily-specific costs included mean cost of daily staff, mean cost of prescribed drugs and devices, mean cost of hospital bed, food and laundry, and financial mean costs. We also considered inpatient-specific costs, i.e. the medical and technical costs attributable to each specific hospital admission. Inpatient-specific costs included cost of laboratory tests, medical imaging tests and surgery. The cost of stay for a given admission was equal to the sum of daily-specific costs multiplied by the patient's LOS, plus inpatient-specific costs attributed to

that admission. The cost of newborn hospitalization in a neonatal facility was not included in the cost of the mother's stay.

Statistical analysis

Statistical analysis was performed separately in the primiparous patients' group and the multiparous patients' group (corresponding to two different DRGs).

Patients' age was categorized according to a previous study [17]: < 25 years, 25 – 34 years and \geq 35 years. Patients' gestational age was categorized according to the usual thresholds defining prematurity and term delivery: 37 – 41 WA and \geq 41 WA. Neonatal hospitalization was considered as a binary variable (yes/no) and the type of neonatal facility as three categories (continuous care unit, intensive care unit, resuscitation care unit).

In each group, patients were compared according to their social status using the Wilcoxon test for quantitative variables and the Fisher exact test for categorical variables. The 95% confidence intervals of medians were based on a method that is distribution-free, previously described by Hahn and Meeker [21]. Then, the impact of the patient's poor social status on LOS, and on the cost of stay, was analyzed using a multivariate median regression given the presence of outliers, as recommended by Lee et al. [22]. The regression was adjusted for age, gestational age, neonatal hospitalization, and social status. The 95% confidence intervals of coefficients were calculated by resampling according to the MCMB (Markov Chain Marginal Bootstrap) method [23]. All analyses were performed with SAS (version 9.3, SAS Institute, Cary, NC).

Patient involvement

No patients were involved in setting the research question or the outcome measures, nor were they involved in developing plans for design or implementation of the study. No patients were asked to advise on interpretation or writing up of results. There are no plans to disseminate the results of the research to study participants or the relevant patient community.

Results

Patients' characteristics are displayed in tables 1 and 2. In total, 1,585 inpatients comprising 686 primiparous women and 899 multiparous women were included. There were no missing data. Among primiparous and multiparous patients respectively, 21% (141/686) and 29% (263/899) had poor social status (tables 1 and 2).

In the group of primiparous patients, 5% (31/686) of newborns were hospitalized, including 68% (21/31) in a continuous care unit, 26% (8/31) in an intensive care unit and 6% (2/31) in a resuscitation care unit.

In the group of multiparous patients, 6% (50/899) of newborns were hospitalized, including 54% (27/50) in a continuous care unit, 28% (14/50) in an intensive care unit and 18% (9/50) in a resuscitation care unit.

The results of univariate comparison according to social status are displayed in table 2. Primiparous patients with poor social status had a longer median LOS than primiparous patients with good social status (table 2), associated with an increase in the cost of stay (table 2, figure 1). This result was confirmed after adjustment for age, gestational age and neonatal hospitalization. A 1-day

increase in the median length of stay was associated with a €475 increase in the median cost of stay (table 3). Conversely, for multiparous patients, no association was found between the patient's social status and hospital costs (table 4).

Also, there was a significant increase in the median cost of stay among primiparous patients who delivered after 41 weeks of amenorrhea (+ €475), compared to patients who delivered between 37 and 41 weeks of amenorrhea (table 3).

Finally, there was a significant increase in the median cost of stay among primiparous (+ €1038) and multiparous (+€1073) patients whose newborn was hospitalized (tables 3 and 4).

Discussion

Statement of principal findings

Our findings show a 1-day increase in the median LOS, and a corresponding increase in the median cost of stay for primiparous patients with poor social status, admitted for a single uncomplicated vaginal delivery, independent of age, gestational age and neonatal hospitalization. We did not observe this effect in multiparous patients.

Strengths and weaknesses

Our study has several strengths. Of note, we performed an easily reproducible study based on medical and administrative databases. In addition, our study was exhaustive on all admitted inpatients. There were no missing data.

In France, DRG are especially defined according to specific comorbidities and/or complications. Stratification based on DRG allowed us to avoid some confounders, such as the comorbidities and/or complications considered in the DRG classification. However, since we did not consult medical records, it is possible that there are still confounders related to comorbidities and/or complications not considered in the DRG classification.

Otherwise, the average LOS of single uncomplicated vaginal deliveries is stable, especially since 2010 [10,24] and standardized in France [25] and finally, cost distribution is particularly homogenous [26]. In March, 2014, the French National Authority for Health (HAS) defined a standard LOS between 72 and 96 hours [25]. The typology of the admissions used in our survey therefore lowers the risk of confounders when comparing patients with poor social status and those with good social status.

One weakness of our study might be the method for calculating the cost of stay, which might have led to an information bias. Such bias is inherent to the hospital information system, especially concerning cost allocation to the different functional units within the hospital cost accounting system.

Nevertheless, this potential bias concerns all patients regardless of social status, so it cannot explain our results.

Second, our survey was performed in a large tertiary care hospital where costs could be different to those in smaller hospitals or private-for-profit hospitals.

However, our costs were similar to those calculated in the French National Common Survey of Costs conducted in 2013 [27].

Third, there might have been patients in a difficult social situation who did not benefit from a preferential insurance scheme or a consultation with a social worker.

Strengths and weaknesses in comparison with other studies

Previous studies reported inconsistent results regarding the effect of social status on LOS in maternity patients. We suggest that these results might be explained by the absence of stratified analyses on parity status. However, our study, with an analysis stratified on parity status, found a relation between social status and LOS for delivery. The heterogeneity of methods used in previous studies for identifying inpatients with poor social status may have had an effect on the inconsistency of their results. The definition of poor social status that we used, had the advantage of including two categories of patients: patients already identified by the French social protection system as living in poor social conditions and patients not yet identified, or slightly above the eligibility threshold for benefits but requiring the assistance of a social worker. This definition offers another advantage in that it is not affected by the reporting bias that may arise in questionnaire surveys.

Meaning of the study, unanswered questions and future research

We analyzed two DRGs including single uncomplicated vaginal deliveries which are very common admissions [10]. Our findings support the fact that primiparous patients with poor social status had a 1-day increase in median LOS. This result may be explained by the fact that hospitals could be the main care providers for this population of patients with poor social status who often lack social support in the community, as suggested by Kangovi et al. [28] and cited by McCarthy [29]. We suggest that this result be taken into account by

policymakers to adapt the prospective payment system, especially by redefining DRG classification.

Our study design does not allow us to explain the difference we found between primiparous and multiparous patients especially since it is the first time to our knowledge that such a difference has been reported. A hypothesis may nevertheless be suggested. The birth of a child comes as a turning point in the lives of primiparous patients. For primiparous patients with poor social status, social workers and caregivers may need extra time to organize the patient's discharge to allow them to look after their child in adequate conditions. This may be less necessary in multiparous patients.

As expected, there was a significant increase in the median cost of stay among patients whose newborn was hospitalized. This result is consistent with previously published studies suggesting an association between neonatal outcomes and the LOS after delivery [17,30].

Our study provides useful information regarding hospital funding targeted to the care of patients with poor social status. Our study suggests a probable interest in redefining the Diagnosis-Related Group classification to include single uncomplicated vaginal deliveries in primiparous patients with poor social status. Flexible funding adapted to inpatients' social conditions seems necessary for hospitals to provide proper support and especially to extend length of stay when required for the health and well-being of mother and child. Further studies are needed for a clearer definition of patients' social status to improve cost allocation for single uncomplicated vaginal deliveries in hospitals.

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Ethics approval

This study has been approved by Rouen University Hospital's institutional review board (ID of the approval: E2016-66).

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations of interest: none

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Authors' contributions

-*Study concepts and design*: TV, ML, LF, VJ, PC, EV and VM.

-*Data acquisition*: TV and ML.

-*Quality control of data*: TV.

-*Statistical analysis*: TV.

-*Data analysis and interpretation*: TV, ML, LF, VJ and VM.

-*Manuscript preparation*: TV and VM.

-*Manuscript review*: ML, LF, VJ, PC and EV.

- All authors read and approved the final manuscript.

- All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Table 1: Number of stays according to poor social status criteria in primiparous and multiparous patients.

Social status	Primiparous patients (n=686)	Multiparous patients (n=899)
Non poor social status	545 (79)	636 (71)
Consultation with a social worker only	28 (4)	24 (3)
CMUc + Consultation with a social worker	6 (1)	15 (2)
CMUc only	88 (13)	210 (23)
AME + Consultation with a social worker	3 (0)	4 (0)
AME only	16 (2)	10 (1)

AME: a specific healthcare benefit for foreign undocumented patients, CMUc: a specific healthcare benefit in relation to a low income.

Table 2: Comparison according to social status, of primiparous and multiparous patients.

Variables	Primiparous patients (n=686)			Multiparous patients (n=899)		
	Poor social status		p ^a	Poor social status		p ^a
	no n = 545	yes n = 141		no n=636	yes n = 263	
Age (years), n (%)			<0.001			< 0.001
< 25	159 (29)	92 (65)		60 (9)	65 (25)	
25-34	354 (65)	43 (30)		416 (65)	152 (58)	
≥ 35	32 (6)	6 (4)		160 (25)	46 (17)	
Gestational age (WA), n (%)			0.259			0.192
37 – 41	427 (78)	104 (74)		507 (80)	220 (84)	
≥ 41	118 (22)	37 (26)		129 (20)	43 (16)	
Neonatal hospitalization			0.820			0.874
No	521 (96)	134 (95)		601 (94)	248 (94)	
Yes	24 (4)	7 (5)		35 (6)	15 (6)	
Length of stay (days), median (95% CI)	4 (4 to 5)	5 (5 to 5)	0.002	4 (4 to 4)	4 (4 to 4)	0.307
Cost of stay (€), median (95% CI)	2223 (2185 to 2660)	2673 (2660 to 2698)	0.002	2137 (2128 to 2140)	2140 (2128 to 2150)	0.222

^a Wilcoxon or Fisher exact test according to the type of variable.

WA: weeks of amenorrhea, CI: confidence interval, €: euros.

Table 3: Determinants of the LOS and cost of stay in primiparous patients.

Independent variables	Length of stay		Cost of stay	
	coefficient (95% CI) ^a (days)	p	coefficient (95% CI) ^a (€)	p
Age (years)				
< 25	0.00 (-0.02 to +0.02)	1.000	0 (-53 to +53)	1.000
25-34	ref.	ref.	ref.	ref.
≥ 35	0.00 (-0.00 to +0.00)	1.000	+9 (-273 to +291)	0.950
Gestational age (WA)				
37-41	ref.	ref.	ref.	ref.
≥ 41	+1.00 (+0.99 to +1.01)	<0.001	+475 (+368 to +582)	<0.001
Neonatal hospitalization				
No	ref.		ref.	
Yes	+2.00 (+1.75 to +2.25)	<0.001	+ 1038 (+429 to +1647)	0.001
Poor social status				
no	ref.	ref.	ref.	ref.
yes	+1.00 (+0.85 to +1.15)	<0.001	+475 (+334 to +616)	<0.001

^a Multivariate median regression adjusted on age, gestational age, neonatal hospitalization and social status.

LOS: length of stay, CI: confidence interval, WA: weeks of amenorrhea, €: euros.

Interpretation: There was a significant increase (+ €475) in the median cost of stay of patients with poor social status compared to patients with good social status after adjustment for age, gestational age and neonatal hospitalization ($p < 0.001$).

Table 4: Determinants of the LOS and cost of stay in multiparous patients.

Independent variables	Length of stay		Cost of stay	
	coefficient (95% CI) ^a (days)	p	coefficient (95% CI) ^a (€)	p
Age (years)				
< 25	0.00 (-0.00 to +0.00)	1.000	+0 (-17 to +17)	1.000
25-34	ref.	ref.	ref.	ref.
≥ 35	0.00 (-0.00 to +0.00)	1.000	+9 (-3 to +21)	0.139
Gestational age (WA)				
37-41	ref.	ref.	ref.	ref.
≥ 41	0.00 (-0.00 to +0.00)	1.000	+20 (+2 to +38)	0.026
Neonatal hospitalization				
No	ref.	ref.	ref.	ref.
Yes	+2.00 (+2.00 to +2.00)	<0.001	+1073 (+761 to +1385)	<0.001
Poor social status				
no	ref.	ref.	ref.	ref.
yes	0.00 (-0.00 to +0.00)	1.000	+7 (-3 to +17)	0.155

^aMultivariate median regression adjusted on age, gestational age, neonatal hospitalization and social status.

LOS: length of stay, CI: confidence interval, WA: weeks of amenorrhea, €: euros.

Interpretation: There was not a significant increase (+ €7) in the median cost of stay of patients with poor social status compared to patients with good social status after adjustment for age, gestational age and neonatal hospitalization ($p=.155$).

Figure legends

Figure 1: Distribution of the cost of stay in primiparous patients admitted for a single uncomplicated vaginal delivery.

Abbreviations: €, euros.

Color should be used for this figure.

