Could the maternal ethnicity to be a determinant in the healthcare cost of assistance at birth?

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Runnig title: Cost analysis for deliveries segregated by ethnicity.

ABSTRACT

Recent policy and service provision recommends a woman-centered approach to maternity care and encourages the development of personalized models of clinical assistance. As ethnicity has been recognized as determinant in the risk calculation of some obstetric complication, our aim was to assess costs for birth assistance according to the maternal ethnicities. In a five-year period (2012-16) all women admitted for delivery at the Department of Obstetrics and Gynaecology, Fondazione Policlinico Universitario 'A. Gemelli' IRCCS, Rome, Italy were investigated. Economic evaluations were performed by using the 'diagnosis-related group' (DRG) approach. Cost analysis was completed by including maternal ethnicity, delivery mode and perinatal complications. A total of 18,093 patients were involved in the analysis. An overall care expense of €42.663.481 was calculated. Caucasian was the main ethnicity (90.7%), leaving the minority groups to 9.3%. Vaginal delivery (VD) was the most common mode of delivery in all ethnic clusters, with a global rate of 59.6%. Not including Asiatic women, increased CS rates were recorded in all minority ethnic groups (Maghreb (51.5%) and Afro-Caribbean (47.8%)). A double incidence of complicated VD was observed in the minority groups, primarily among Afro-Caribbean (69.9%), followed by Asiatic (64.1%), Maghreb (63.2%) and Latin-America (62.7%) patients. By logistic regression, Afro-Caribbean delivering women had a significant increased risk of complicated CS among all subgroups. Minority groups (Afro-Caribbean, in particular) increase the health care cost for birth assistance due to higher incidence of adverse perinatal outcomes.

INTRODUCTION

Migration flows have the ability to alter local epidemiology and require additional resources in the clinical care [1]. Recently, research on the health status of international migrants to industrialized countries, and on perinatal outcomes specifically, has assumed an interpretative model based on migration, characterized by the permanent cross-border movement from the migrant's country of birth [2]. As consequence, ethnicity-based carrier screening for obstetric disorders is an integral part of preconception and prenatal care at the present time, not only in genetic pathologies [3], but also in selective complications that can occur in pregnancy, subsequently to correction for potential confounding variables [4].

Current economic analysis on maternal health care has addressed the interest on two extreme situations, named 'too little, too late' (TLTL) and 'too much, too soon (TMTS)', respectively [5]. TLTL describes care with inadequate resources, below evidence-based standards, associated with high maternal mortality and morbidity, more in place in low-income countries [5]. In contrast, TMTS, describes the routine over-medicalization of normal pregnancy and birth in developed states, including unnecessary use of non-evidence-based interventions, as well as use of interventions that can be life saving when used appropriately, but causing increased health costs if redundant [5]. A global approach to quality and equitable maternal health might be achieved driving the clinical care in the varied scenario. Particularly, existing traditional health economic methods require including in their assessment the heterogeneous aspect of maternal origin in the planning of the assistance and management of delivery. Indeed, if a prolific medical literature has been focused the attention on the causative role of the ethnicity in selective obstetric complications [5-10], a fractional investigation addressing the economic impact segregated by ethnic groups has been conducted. Of interest, the findings in U.S. by Zang et al [11] are conclusive for higher costs in American, more likely to have a cesarean section (CS), to

stay longer in the hospital, to experience preeclampsia, placental abruption, preterm birth, small birth size for gestational age, and fetal death/stillbirth. In a different study on American population, Goodman and co-workers focused on disparities in unintended pregnancy rates between Black and White teens age 15-19 years sexually active, finding reduced absolute and relative scales, if barriers to cost, access, and knowledge were removed [12]. As consequence, ethnic disparities in adverse pregnancy outcomes represent not only potentially preventable human suffering, but also avoidable economic costs. Therefore, a significant financial return-on-investment opportunity tied to eliminating ethnic disparities in birth outcomes could be planned.

Rates of migration to Europe, and within Europe, have increased in the last decade, with considerable implications for health systems and launching the challenge on how to deliver effective and cost-effective screening and health services [13]. In particular, the main difficulties are given by the different risk profile in migrants and substandard care, which is identified more frequently in migrants, patient delays, due to a lack of knowledge about the health system in the host country, and health worker delays, often compounded by communication barriers [14].

To the best of our knowledge, no previous studies have been addressed to explore the economic impact of migration flows on birth assistance by using a categorical scheme for maternal origin in a European setting. Therefore, the objective of the present study was twice: first, to describe the linkage between baseline characteristics and all maternal ethnic groups in a border country, such as Italy; second, to accomplish the cost analysis for the local healthcare system, distinguishing mode of delivery, absence or presence of complications at birth and maternal stay duration in all ethnic groups.

MATERIALS AND METHODS

Study population

Between January 2012 to December 2016 all delivering women at the Department of Obstetrics and Gynaecology, Fondazione Policlinico Universitario 'A. Gemelli' IRCCS, Rome, Italy, were included in the cost analysis. The hospital is a tertiary referral center with an average of 3,600 deliveries per annum at the study time. Additionally, in the hospital a specific outpatient service (so-called 'Mamme del Mondo') for assistance during pregnancy for temporally present foreigners women was created. A research approval for the retrospective analysis was obtained by the local Institutional Review Board (IRB 16_10_2017). Any consent was signed by patients due to the nature (retrospective) of the study.

Collection of resource use data

From electronic data sources information on maternal characteristics, including age at delivery, socio-economic status (calculated by including level of study and occupational status), marital status (married/unmarried), were collected. All patients were categorized according to the ethnic origin (Caucasian, Latin-American, Afro-Caribbean, Asian, and Maghrebian). As well, data pertaining to obstetric history, mode of delivery (vaginal delivery (VD)/CS), developing complications, and perinatal outcomes were retrieved from local Birth Registry.

Clinical management

At delivery, all high and low-risk pregnancies were formally assessed to ensure that the correct clinical management had been followed, according to local protocols. Labour induction was defined as the use of any medication (intravaginal or intracervical prostaglandin, PGE2 gel, oxytocin). Vaginal operative delivery was accomplished only by Kiwi OmniCup ventouse, due to the impact on clinical practice of increased legal proceedings that discourage other options in Italy. Cesarean section was performed according to elective or emergent indications.

Definition of adverse maternal outcomes at birth

Women who had hospital admission for adverse maternal outcomes were defined according to International Classification of Diseases-Clinical Modification (ICD-9-CM), version 2007. Maternal complications included in the study were fever (ICD-9 codes: 659.23, 670.02, 672.04), anaesthetic complications (ICD-9 code: 668.82); uterine atony (ICD-9 code: 666.12); postpartum haemorrhage requiring blood transfusion and/or hysterectomy (ICD-9 codes: 666.22, 54.1, 68.3, 68.4); anaemia (ICD-9 code: 648.22); thrombosis (ICD-9 code: 671.12); sepsis (ICD-9 code: 670.02); dehiscence of sutures and reparation (ICD-9 code: 674.12).

Cost assessment

A descriptive cost analysis for assistance at birth was based on hospital discharge summary from hospital information system. In particular, the charges were calculated according to the health care system perspective by using the Italian fees associated to the 'diagnosis-related group' (DRG) system (version 24). The DRGs are a patient classification scheme which provides a means of relating the type of patients a hospital to the costs incurred by the hospital. DRGs are defined based on the principal diagnosis, secondary diagnoses, surgical procedures, age, sex and discharge status of the patients treated. Through DRGs, hospitals can gain an understanding of the patients being treated, the costs incurred and within reasonable limits, the services expected to be required. Prospective payment rates based on DRGs have been established as the basis of Medicare's hospital reimbursement system. In agreement with the initial motivation for developing the DRGs to create an effective framework for monitoring the quality of care and the utilization of services in a hospital setting, nowadays the DRGs form a manageable, clinically coherent set of patient classes that relate a hospital's case mix to the resource demands and associated costs experienced by the hospital.

Outcome measures

The primary outcome was to define the mode of delivery in all ethnic groups. The secondary outcomes explored the association between economic issues and an inclusive compound of complications. The list of maternal complications includes fever (at birth and/or in the postpartum period), anaesthetic complications, postpartum haemorrhage requiring blood transfusion and/or hysterectomy, anaemia, thrombosis, admission in intensive care unit, dehiscence of sutures and reparation. The compound was defined as any of the above adverse birth complications. Additionally, the stay duration was included in the evaluation, both as general information and specified according to the mode of the delivery and the presence/absence of complications.

Statistical analysis

Normal distributions were assured by the Shapiro-Wilk test. The Student's t-test for independent samples, the Mann-Whitney-U test, Pearson's chi-square or exact Fisher's tests were used to analyze collected data, as appropriate. Determinants of cost's variations were studied according to the age intervals. Results are presented in means and standard deviations (SD) or number and percentage. Logistic regression to estimate relative risk (RR) and 95% confidence intervals (CI) for the associations between ethnicity and complications in the mode of delivery.

All tests were two-sided, and *p*-values lower than 0.05 were established statistically significant. IBM SPSS 23.0 (Armonk, NY, USA) and R version 2.15.1 (The R Foundation for Statistical Computing) with package version 1.7.2 software were used for statistical analyses.

RESULTS

In the 5-year period study, 18.093 delivering women referred to the local Department of Obstetrics and Gynaecology for clinical assistance at birth were considered. All of them were categorized in agreement with the maternal ethnic origin criterion, as depicted in the flowchart (Fig. 1). Caucasian ethnicity was the most common (90.7%), leaving the minority groups to 9.3%, as described in the Fig. 2.

Demographic characteristics of the overall study population and subgroups are defined in Tab. 1. Maternal age was higher among Caucasians women than other subgroups, in contrast to Maghrebian patients. Medium SES was dominant among all ethnic groups, not including Afro-Caribbean women (low SES).

According to the primary outcome, VD was the most common mode of delivery in all maternal ethnic clusters, with a global rate of 59.6% (Fig. 3). Conversely, increased CS rates were recorded in all minority ethnic groups, excluding Asiatic women, with higher values in Maghrebian (51.5%) and Afro-Caribbean (47.8%) ethnicities.

An in-depth analysis focused on mode of delivery (VD/CS) and absence or presence of any maternal complications at delivery, minority ethnic groups showed significant lower rate of VD without complications, longer maternal stay and more expensive clinical care, if compared with Caucasian women (Tab.2). In particular, a double incidence of complicated VD was observed in the minority groups, led by the Afro-Caribbean (69.9%), followed by Asiatic (64.1%), Maghrebian (63.2%) and Latin-America (62.7%) patients. The rate of complications according to the surgical mode of delivery (elective or emergent CS) was equally greater among subgroups (+11%, as mean) in comparison with Caucasian (21.8%), led by Afro-Caribbean women (37.6%).

In Tab. 3 the association between ethnicity and complicated mode of delivery are reported. Afro-Caribbean women had a significantly higher increased risk of complicated CS among all subgroups (Fig. 4).

DISCUSSION

To the present, paucity of satisfactory data and no robust scientific evidence define the impact of rising migration flows on health care systems for obstetrics in European countries. This is the first cost-analysis study on women delivering in a border country in Mediterranean area, segregated by maternal ethnic origin and according to the mode of delivery *plus* an *ad hoc* composite of complications. By using the DRGs approach, we found that the minority groups are at increased risk of maternal adverse outcome at birth, requiring a more expensive birth assistance. Among all ethnic clusters, Afro-Caribbean women lead the health care cost due to over two-fold risk for having a complicated delivery. Additionally, the surgical approach at delivery is more frequent in Maghrebian women, and in general at increased rate of unfavorable outcome in comparison with VD for all minority groups.

The role of ethnic differences in maternal and child health outcomes was explored with interesting findings in American settings [1,2-4, 7-14]. Specifically, higher frequency of CS [15] and recognized factors influencing late (> sixth month of gestation) entry into prenatal care by ethnicity and insurance payer were scored [16]. Of interest, younger women, Asian ethnicity, <12-year education, abuse of drugs or alcohol or resided in rural counties seem more likely to enter prenatal care late [16]. Some similarities could be recognized also in Europe. Our Italian scenario highlighted the dichotomy between Caucasian and no Caucasian women at delivery time. Differences in maternal age, level of study and occupational status might reflect the set of beliefs, practices, customs and behaviors that are found to be common to everyone that is living within a certain population. The cultural environment might clearly explain the lesser age at childbearing among no Caucasian delivering patients. In minority groups, an inferior level of study reveals the overwhelming belief in religio-cultural dimension of threats. Women severally explain maternity complications as physical manifestations of spiritual attacks leading to the use

of faith healing as a health delivery option. Therefore, most pregnant women seek spiritual support from diverse sources to help address these perceived dangers [17]. Our data support the care-seeking behavior of pregnant women, largely mediated by socio-cultural influences that shape individual perceptions of threats to pregnancy, minimizing both appropriate lifestyle and medical care. At same time, we acknowledge that the lacking information on religion (not available in the electronic sources) would have been of importance to confirm our speculation.

An additional demographic aspect, such as the maternal marital status, deserves attention in the economic analysis for birth assistance. Generally, marriage is influenced by culture, tradition, and economic reality [21]. In our large study population, the vast majority of Maghrebian (68.7%), Asiatic (66.4%), and Afro-Caribbean (51.1 %) women were married. In contrast to the current evidence that consider the marriage as a protective factor in the reduction of adverse peritanatal outcomes [18-20], we recorded conflicting results with data from current literature. We could speculate that the modest proportion of interracial and inter-ethnic marriage reflects the educational gap in minority groups, more prone to conservative relationships.

Moving from causes to effects, our study has the merit to show the economical impact of multi-ethnical obstetric population at birth on the health care system. In agreement with the previous research, minority groups are at increased risk of complicated deliveries, irrespective of the mode (VD or CS). These evidence must be linked to the longer maternal stay and higher costs. A Copernican revolution with a change in the perspective is mandatory for the modern obstetrics. Efforts to encourage use of maternity care should focus on the attractiveness of facility-based care by offering important opportunities for building collaborations with care providers, in order to increase use of skilled obstetric care. Conventional antenatal care should be packaged to provide psycho-social support that helps women deal with pregnancy-related fear. The local experience (a specific outpatient service, so-called 'Mamme del Mondo') in offering an exclusive

service to temporally present foreigners women in pregnancy showed real benefits for obstetricians and patients through improvements in perinatal outcomes. Firstly, this result is of value at an individual level especially for care providers, who can refer the patients with higher risk for a more extensive assessment. Secondly, it could be the first step of the personalized approach in order to identify patients who will require a high level of care in the peripartum period and following pregnancies. Thirdly, actions addressing functional, social and economic factors are probably the most effective in reducing the hospitalization rate at delivery.

Strengths and limitations

There are a number of notable strengths of the current analysis. These include the reasonably large sample of ethnically mixed inner-city mothers, the detailed definition of complications at delivery by using DGR approach, and the statistical modeling that allowed us to use data driven methods to identify windows of vulnerability. We also acknowledge some limitations, such as the retrospective nature of the study and the absence of information on maternal complications occurring during pregnancy and adverse feto-neonatal outcomes.

Conclusions

No Caucasian ethnicities are associated with higher health care costs for medical assistance at birth, driven largely by additional complications rates, irrespective to the delivery mode. In terms of the generalisability, our research findings can be applied to settings other than in which we obtained them. The validation is conceivable because the changes in both demographics and clinical care codified by using a DRG approach have worldwide been recorded or performed in obstetric population. In a prospective view, an *ad hoc* combination of ethnicity, mode of delivery and obstetric complications should be weighed to describe an individualized risk to mitigate the clinical care charge.

CONTRIBUTION OF AUTHORSHIP: Each author listed on the manuscript saw and approved the submission of this version of the manuscript and took full responsibility for the manuscript. There is not anyone else who fulfils the criteria that has been excluded as an author. ST gave substantial contributions to the conception and design of the work. She was responsible for the analysis of data and their interpretation. She wrote the first draft of the work and approved the final revised version. FL and FP were responsible for the acquisition of data. MV and AL gave substantial contributions to the design of the work and collaborated to their interpretation. They revisited the work critically and approved the final revised version. 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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REFERENCES

1. Hernando Rovirola C, Ortiz-Barreda G, Galán Montemayor JC, Sabidó Espin M, Casabona Barbarà J. HIV and other sexually transmitted infections among migrant population in Spain: a scoping review. Rev Esp Salud Publica. 2014 Nov-Dec;88(6):763-81.

2. Urquia ML, Frank JW, Glazier RH. From places to flows. International secondary migration and birth outcomes. Soc Sci Med. 2010 Nov;71(9):1620-6.

3. King JR, Klugman S. Ethnicity-Based Carrier Screening. Obstet Gynecol Clin North Am. 2018 Mar;45(1):83-101.

4. Khalil A, Rezende J, Akolekar R, Syngelaki A, Nicolaides KH.Maternal racial origin and adverse pregnancy outcome: a cohort study. Ultrasound Obstet Gynecol. 2013 Mar;41(3):278-85

5. Miller S, Abalos E, Chamillard M, et al. Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide. Lancet. 2016 Oct 29;388(10056):2176-2192.

6. Carter MF, Fowler S, Holden A, Xenakis E, Dudley D. The late preterm birth rate and its association with comorbidities in a population-based study. Am J Perinatol 2011; 28: 703–707.

7. Cohen GR, Curet LB, Levine RJ, Ewell MG, Morris CD, Catalano PM, Clokey D, Klebanoff MA. Ethnicity, nutrition, and birth outcomes in nulliparous women. AmJObstetGynecol 2001; 185: 660–667.

8. Xu X, Grigorescu V, Siefert KA, Lori JR, Ransom SB. Cost of racial disparity in preterm birth: evidence from Michigan. J Health Care Poor Underserved 2009; 20: 729–747.

9. Alexander GR, Kogan MD, Himes JH, Mor JM, Goldenberg R. Racial differences in birthweight for gestational age and infant mortality in extremely-low-risk US populations. Paediatr Perinat Epidemiol 1999; 13: 205–217.

10. Frisbie WP, Biegler M, de Turk P, Forbes D, Pullum SG. Racial and ethnic differences in determinants of intrauterine growth retardation and other compromised birth outcomes. Am J Public Health 1997; 87: 1977–1983.

11. Zhang S, Cardarelli K, Shim R, Ye J, Booker KL, Rust G. Racial disparities in economic and clinical outcomes of pregnancy among Medicaid recipients. Matern Child Health J. 2013 Oct;17(8):1518-25.

12. Goodman M, Onwumere O, Milam L, Peipert JF. Reducing health disparities by removing cost, access, and knowledge barriers. Am J Obstet Gynecol. 2017 Apr;216(4):382.e1-382.e5.

13. Seedat F, Hargreaves S, Nellums LB, Ouyang J, Brown M, Friedland JS. How effective are approaches to migrant screening for infectious diseases in Europe? A systematic review. Lancet Infect Dis. 2018 Sep;18(9):e259-e271.

14. van den Akker T, van Roosmalen J. Maternal mortality and severe morbidity in a migration perspective. Best Pract Res Clin Obstet Gynaecol. 2016 Apr;32:26-38.

15. Baer RJ, Altman MR, Oltman SP, et al. Maternal factors influencing late entry into prenatal care: a stratified analysis by race or ethnicity and insurance status. J Matern Fetal Neonatal Med. 2018;22:1-7.

16. Yee LM, Costantine MM, Rice MM, et al. Racial and Ethnic Differences in Utilization of Labor Management Strategies Intended to Reduce Cesarean Delivery Rates. Obstet Gynecol. Dec;130(6):1285-1294.

17. Dako-Gyeke P, Aikins M, Aryeetey R, Laura Mccough et al. The influence of socio-cultural interpretations of pregnancy threats on health-seeking behavior among pregnant women in urban Accra, Ghana. BMC Pregnancy and Childbirth2013; 13:211.

18. El-Sayed AM, Tracy M, Galea S. Life course variation in the relation between maternal marital status and preterm birth. Ann Epidemiol. 2012;22(3):168-74.

19. Shapiro GD, Bushnik T, Wilkins R, Kramer MS, Kaufman JS, Sheppard AJ, Yang S. Adverse birth outcomes in relation to maternal marital and cohabitation status in Canada.Ann Epidemiol. 2018;28(8):503-509.e11

20. Frimmel W, Pruckner GJ. Birth weight and family status revisited: evidence from Austrian register data. Health Econ. 2014;23(4):426-45.

21. Fairfax CN. Social Work, Marriage, and Ethnicity: Policy and Practice. Journal of Human Behavior in the Social Environment. 2014; 24:83-91.

Tab. 1. Demographic characteristics of overall study population, expressed as mean (SD) or n (%), as appropriate.

Variables	Overall population (n=18,093)	Caucasian (n=16,420)	Asiatic (n=646)	Latin-America (n=552)	Maghrebin (n=297)	Afro-Caribbean (n=178)
Maternal age	33.5 (5.5)	33.7 (5.4)	31.1 (5.3)	32.4 (6.6)	30.8 (5.9)	31.9 (6.1)
Level of study						
- Primary	2,188 (12.1)	1,627 (9.9)	215 (33.3)	168 (30.4)	115 (38.7)	63 (35.4)
- Secondary	4,692 (25.9)	4,205 (25.6)	189 (29.3)	182 (33)	76 (25.6)	40 (22.5)
- Superior	3,503 (19.4)	3,327 (20.3)	64 (9.9)	63 (11.4)	32 (10.89)	17 (9.6)
- Not declared	7,710 (42.6)	7,261 (44.2)	178 (27.6)	139 (25.2)	74 (24.9)	58 (32.6)
Occupational status						
- Working	6,157 (34)	5,674 (34.6)	193 (29.9)	182 (33)	39 (13.1)	41 (23)
- No-working	4,089 (22.6)	3,361 820.5)	274 (42.4)	196 (35.5)	180 (60.6)	78 (43.8)
- Not declared	7,847 (43.4)	7,385 (45)	179 (27.7)	146 (26.4)	78 (26.3)	59 (33.1)
SES[1]						
- Low	2,188 (12.1)	1,627 (9.9)	215 (33.3)	168 (30.4)	115 (38.7)	63 (35,4)
- Medium	4,692 (25.9)	4,205 (25.6)	189 (29.3)	182 (33)	76 (25.6)	40 (22.5)
- High	3,503 (19.4)	3,327 (20.3)	64 (9.9)	63 (11.4)	32 (10.8)	17 (9.6)
- Not declared	7,710 (42.6)	7,261 (44.2)	178 (27.6)	139 (25.2)	74 (24.9)	58 (32.6)
Marital status						
- Married	6,883 (38)	5,931 (36.1)	429 (66.4)	228 (41.3)	204 (68.7)	91 (51.1)
- Unmarried	4,017 (22.2)	3,685 (22.4)	72 (11.1)	193 (35)	33 (11.1)	34 (19.1)
- Divorced	241 (1.3)	220 (1.3)	6 (0.9)	11 (2)	2 (0.7)	2 (1.1)
- Widow	8 (0)	5 (0)	1 (0.2)	1 (0.2)	0 (0)	1 (0.6)
- Not declared	6,356 (35.1)	5,998 (36.5)	135 (20.9)	115 (20.8)	58 (19.5)	50 (28.1)

[1]SES: Socio-economic status level, defined as 'low' in presence of the two-following combinations: no study *plus* no-working status, or primary of level of study *plus* working status; as 'medium' in presence of the two-following combinations: secondary level of study *plus* no-working status, or secondary of level of study *plus* working status; and 'high' in presence of the two-following combinations: superior level of study *plus* no-working status, or superior of level of study *plus* working status; respectively.

Tab. 2. Health care system costs analysis according to mode of delivery and complication segregated by maternal ethnic criterion, expressed as mean (SD) or n (%), as apprropriate.

Variables	Overall population (n=18,093)	Caucasian (n=16,420)	Asiatic (n=646)	Latin-America (n=552)	Maghrebin (n=297)	Afro-Caribbean (n=178)
Total VD	10,791 (59.6)	9,825 (59.2)	407 (63)	322 (58.3)	144 (48.5)	93 (52.2)
Total CS	7,302 (40.4)	6,595 (40.8)	239 (37)	230 (41.7)	153 (51.5)	85 (47.8)
VD without complications[1]	6.655 (61.7)	6.036 (61.3)	146 (35.9)	120 (37.3)	53 (36.8)	28 (30.1)
- Recovery duration (days)	4.3 (1.8)	4.3 (2.4)	4.6 (1.8)	4.4 (1.7)	4.2 (1.5)	4.8 (3.4)
- Delivery costs (€)	1.424,18 (283,78)	1.420,70 (281,43)	1.440,92 (234,80)	1.456,64 (292,98)	1.491,13 (401,25)	1.543,04 (453,78)
VD with complications	4.136 (38.3)	3.789 (38.7)	261 (64.1)	202 (62.7)	91 (63.2)	65 (69.9)
- Recovery duration (days)	4.5 (2.4)	4.4 (1.9)	4.5 (1.9)	4.8 (2.3)	5 (4.2)	5 (2.3)
- Delivery costs (€)	2.861,79 (302,23)	2.859,30 (305,50)	2.862,26 (328,77)	2.908,49 (190,58)	2.894,92 (212,95)	2.905,7 (262,8)
CS without complications	5.659 (77.5)	5.155 (78.2)	179 (66.5)	161 (70)	109 (71.2)	55 (62.4)
- Recovery duration (days)	4.8 (2.6)	4.8 (2.7)	4.7 (1.9)	4.7 (2.4)	4.6 (1.4)	5.4 (3.2)
- Delivery costs (€)	2.234,41 (333,87)	2.238,86 (341,18)	2.232,37 (207,21)	2.247,04 (293,11)	2.195,71 (161,03)	2.275,59 (340,71)
CS with complications	1.643 (22.5)	1.440 (21.8)	80 (33.5)	69 (30)	44 (28.8)	30 (37.6)
- Recovery duration (days)	7.6 (6.6)	7.6 (6.6)	7.6 (5.9)	8.2 (7.6)	8.4 (7.6)	7.1 (4.6)
- Delivery costs (€)	3.080,16 (669,89)	3.075,37 (673,3)	3.064,33 (528,78)	3.154,60 (684,16)	3.214,34 (825,07)	2.973,84 (449,69)

VD: vaginal delivery, CS: cesarean section. [1] The compound was defined as any of the following adverse maternal complications: fever (at birth and/or in the postpartum period), anaesthetic complications, postpartum haemorrhage requiring blood transfusion and/or hysterectomy, anaemia, thrombosis, admission in intensive care unit, dehiscence of sutures and reparation.

Tab. 3. Association of ethinicity and complications in mode of delivery.

	Complicated VD RR [95% CI]	P-value	Complicated CS RR [95% CI]	P-value
Caucasian	0.93 [0.83-1.03]	0.182	0.68 [0.57-0.79]	<0.001
Asiatic	0.82 [0.64-1.07]	0.143	1.67 [1.17-2.30]	0.004
Latin-America	1.06 [0.88-1.27]	0.535	1.49 [1.14-1.94]	0.003
Maghrebin	0.82 [0.64-1.07]	0.143	1.64 [1.17-2.29-]	0.004
Afro-Caribbean	1.15 [0.83-1.60]	0.389	2.17 [1.43-3.31]	<0.001

VD: vaginal delivery, CS: cesarean section, RR: relative risk, CI: confidence interval.

Fig. 1. Flowchart of the study population, segregated according to the maternal ethnic origin.

Fig. 2. Graphic representation of the study population according to the maternal ethnic origins, expressed in percentage (%).
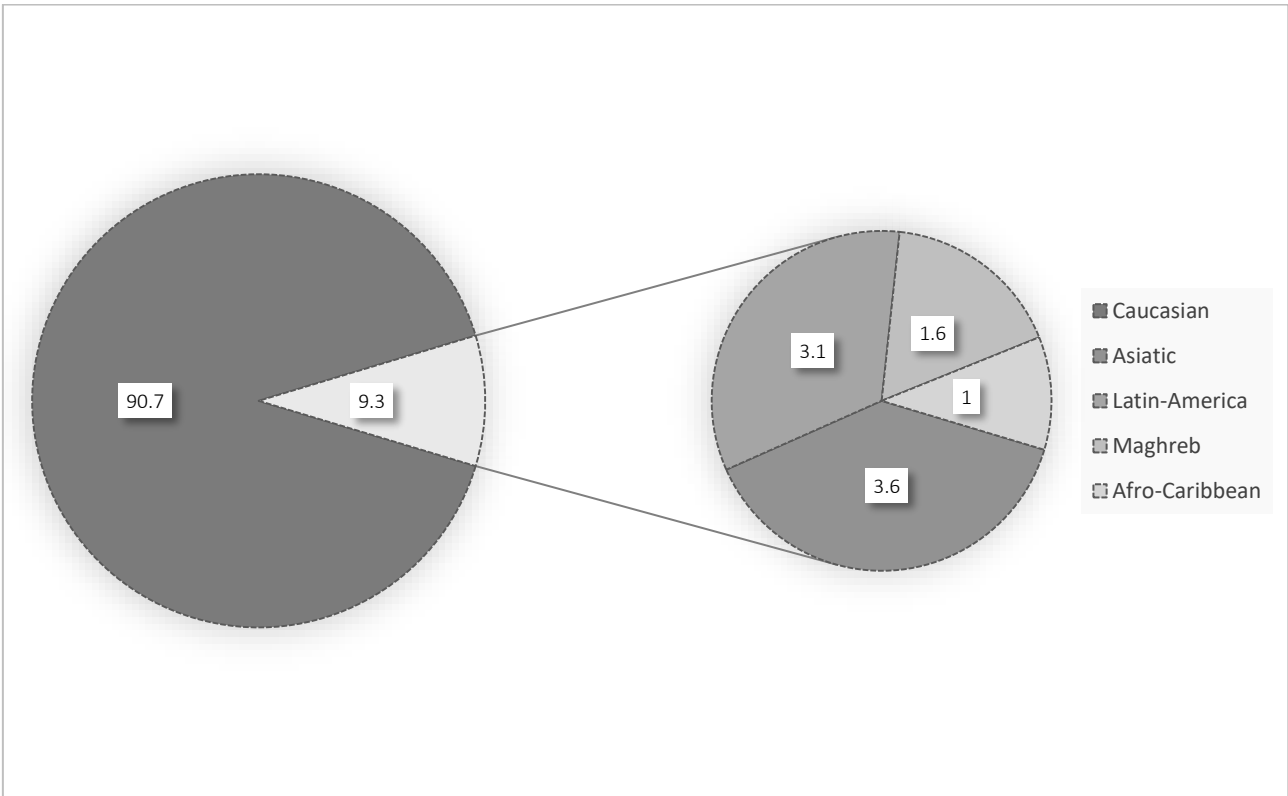
Fig. 3. Mode of delivery in the study population according to the maternal ethnic origins, expressed in percentage (%).

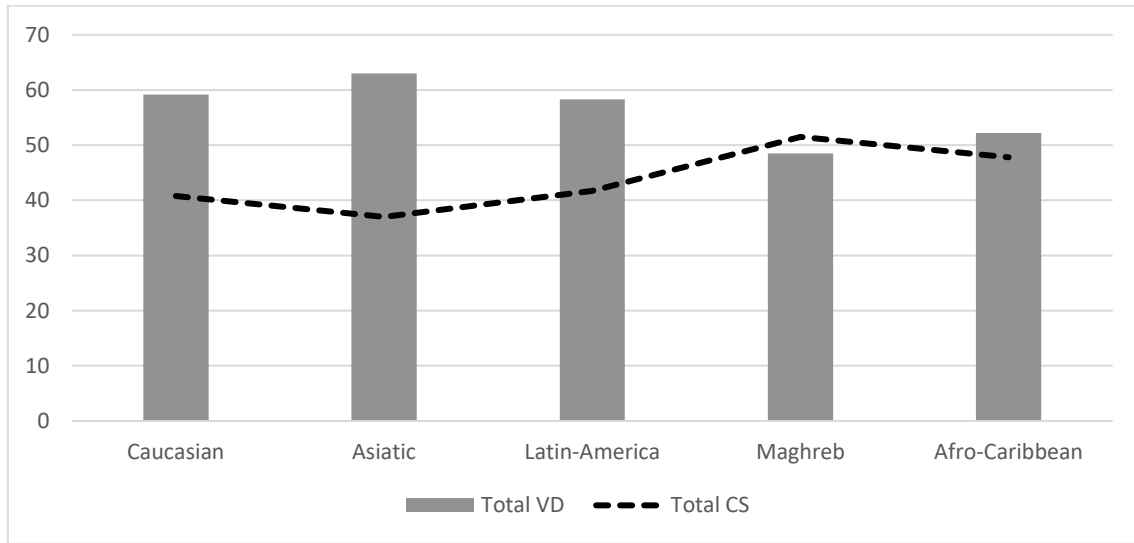**Fig. 4.** Distribution of mode of delivery according to the absence/presence of maternal complications in ethnic subgroups.