Incidence de la mortalité précoce et de la morbidité néonatales après la naissance à terme et en pré-terme avancé par césarienne

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Thèse
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RESUME

Un enfant sur trois naît aujourd'hui par césarienne en Suisse. Les possibles complications néonatales liées à la césarienne élective et à l'anticipation de la naissance sont peu connues.

L'objectif de notre recherche est de déterminer le risque, stratifié par âge gestationnel dès 34 semaines, des morbidités et de la mortalité néonatales après césarienne. Morbidités et mortalité néonatales baissent avec l'âge gestationnel pour atteindre un nadir autours de 39 semaines de gestation pour tous les modes d'accouchement ; nos données confirment ainsi les recommandations de l'OMS pour l'âge idéal de naissance.

Comparé à l'intention d'un accouchement par voie basse, le risque de décès, de nécessiter une hospitalisation ou de développer une morbidité respiratoire est augmenté pour le nouveau-né après césarienne élective, ce qui n'est pas le cas pour la seule adaptation néonatale à la naissance. Nos données ajoutent une évidence épidémiologique au bénéfice pour le nouveau-né d'une naissance par voie naturelle.

INTRODUCTION

L'objet de cette thèse concerne les effets de la césarienne élective sur la mortalité et la morbidité néonatale des nouveau-nés après 34 semaines de gestation. L'intérêt que nous avons porté à cette question a été sollicité par l'observation que dans tous les pays tant industrialisés, que non-industrialisés, une augmentation importante du taux de césariennes en général est observée ; cette augmentation est souvent mise en relation avec un nombre croissant de césariennes de choix délibéré, ou sur une indication élective. La césarienne est de plus en plus souvent l'intervention de choix demandée par les parents et , pour des raisons de confort ou de pressentiment d'un risque par les équipes médicales. Des études randomisées et contrôlées justifient une césarienne élective dans un nombre limité de situations spécifiques (siège, HIV, détresse fœtale, macrosomie) en raison du risque plus élevé pour la mère ou pour l'enfant lors d'un accouchement par voie basse. Si la césarienne peut sauver la vie de la mère et de l'enfant dans certaines situations, l'absence du travail dans la césarienne élective peut avoir des conséquences défavorables sur l'adaptation du nouveau-né. Peu d'études ont investigué les possibles complications néonatales liées à cette pratique en termes de morbidité immédiate ou à long terme pour le nouveau-né. D'autre part, la relation entre âge gestationnel et certaines morbidités est bien connue pour les enfants nés avant le terme. L'importance de cette relation au delà de 34 semaines est mal documentée à ce jour. Elle devrait néanmoins permettre de déterminer le meilleur moment de la naissance.

La revue de la littérature depuis 1971 utilisant MED LINE et les mots clefs « césarienne, travail, morbidité respiratoire et syndrome de détresse respiratoire » n'a révèlé qu'un nombre restreint d'études de surcroit limitées par un faible nombre de cas chacune. En 2007, une revue systématique sur le lien entre césarienne et morbidité respiratoire a identifié huit études observationnelles dont deux seulement stratifiées par âge gestationnel. En raison de l'hétérogénéité des critères de sélection et des issues, les auteurs n'ont pas été en mesure d'élaborer des conclusions claires. En 2008, deux grandes études ont focalisé leur attention sur la mortalité et les morbidités après césarienne à terme comparées à l'accouchement par voie basse, concluant à une augmentation des problèmes respiratoires et du nombre d'hospitalisation, mais à une diminution de traumatismes obstétricaux pour le nouveau-né après césarienne élective. Ces dernières études excluaient par contre les enfants entre 34 et 37 semaines de gestation, n'étaient pas stratifiées par âge gestationnel et ne correspondaient ainsi que partiellement à la réalité clinique, où des césariennes sont effectuées même avant 37 semaines.

En conclusion, on peut retenir de la littérature actuelle que peu de données publiées permettent des conclusions solides sur les risques encourrus par le nouveau-né selon le mode d'accouchement et l'âge de gestation pour des grossesses près du terme ou à terme, laissant

un doute quant au moment optimal d'une césarienne élective. Une dernière étude (2009) apparue après acceptation de ce travail par « Pediatrics », situe ce moment à 39 semaines, pour la césarienne élective mais ne compare pas ces chiffres à la tentative préalable d'un accouchement par voie basse.

Le but de notre étude a été de fournir des données épidémiologiques aux équipes médicales en terme de risque néonatal, afin qu'elles soient en mesure d'informer objectivement les futurs parents et de planifier au mieux les ressources pédiatriques hospitalières nécessaires au moyen des 3 questions suivantes :

1. Quel est le risque concret pour l'enfant qui va naitre par césarienne comparé aux risques d'une tentative d'accouchement par voie basse ?

2. Est-ce qu'il existe un avantage de la césarienne élective, c'est-à-dire avant le travail, par rapport à une césarienne pratiquée après le début du travail ou en urgence ?

3. Quel est l'âge gestationnel idéal pour la naissance selon le mode d'accouchement ?

Pour répondre à ces questions, nous avons pu exploiter les bases de données informatisées obstétricales et néonatales des Hôpitaux Universitaires de Genève, englobant une période d'environ 20 ans et presque 60'000 naissances. La reconstitution d'une base de données materno-néonatale unique était le premier défi important. Sept différentes bases de données de

formats informatiques différents depuis janvier 1982 (5 bases obstétricales et 2 bases néonatales) ont été récupérées, uniformisées, nettoyées, et combinées pour finalement obtenir une base de données materno-néonatale complète de 1982 à 2004.

Cette nouvelle base de données apporte une double valeur :

1. Des données sur 60'000 naissances : avec la plus grande maternité suisse (3'500 naissances par année) Genève se prête bien à une étude épidémiologique d'un tel genre.

2. Le partenariat entre le service d'Obstétrique et Néonatologie des Hôpitaux Universitaires de Genève : le développement d'une base de données unique materno-néonatale a posé une base collaborative de recherche épidémiologique entre les deux services pour le travail actuel mais aussi pour des éventuels travaux ultérieurs.

En résumé, notre étude complète avec un nombre important de patients inclus et stratifiés par âge gestationnel, les données de la littérature. Elle confirme l'âge gestationnel optimal pour la naissance et démontre le risque supérieur d'une césarienne élective comparé à l'accouchement par voie basse en termes de mortalité et de morbidités néonatales cliniquement relevantes.

La thèse fait l'objet d'une publication scientifique soumise et acceptée en date du 30 janvier 2009 par « Pédiatrics », l'un des journaux les plus coté de pédiatrie.

Incidence of early neonatal mortality and morbidity after late preterm and term cesarean section

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Running head: Mortality and morbidity of cesarean section

Short title: Mortality and morbidity of cesarean section

Key Words: Cesarean section, late preterm newborn, neonates, neonatal mortality, neonatal morbidity

Abbreviations: eCS-elective Cesarean Section, emCS-emergency CS, pVD-planned vaginal delivery, GA-gestational age, RR-risk ratio, aRR-adjusted risk ratio

Abstract

Objective:

To determine the age stratified risk of intra-partum and neonatal mortality as well as morbidities of clinical relevance after elective cesarean section (eCS).

Study design:

A cohort study including 56549 prospectively recorded late preterm and term deliveries. We analyzed the effect of CS before the onset of labor on following multiple neonatal outcomes before hospital discharge, compared to planned vaginal delivery (pVD) and emergency CS (emCS): mortality, birth depression, special care admission and respiratory morbidity. We adjusted for confounders by multivariate analysis and stratified the risk by gestational age.

Results:

Mortality and morbidities had a strong gestational age related trend with the lowest incidences consistently found between 38 and 40 weeks of gestation independent of delivery mode. Compared to pVD, newborns after eCS had a significantly higher mortality (aRR 2.1), risk of special care admission (aRR 1.4) and respiratory morbidity (aRR 1.8), but not of depression at birth (aRR 1.1). Compared to emCS, newborns after eCS had less depression at birth (aRR 0.6) and admission to special care (aRR 0.8), but mortality (aRR 0.8) and respiratory morbidity (aRR 1.0) were similar.

Conclusion:

Gestational age specific risk estimates are lowest between 38 and 40 weeks and should be included in the informed consent process. The information should also be used to allow for appropriate preparation with respect to adequate staff and equipment. eCS is consistently associated with increased intra-partum and neonatal mortality, risk of admission and respiratory morbidity compared to pVD and has no advantage over emCS in terms of mortality. Neonatal morbidities are lower after eCS than emCS only at term. Our data provide evidence that eCS should not be performed before term.

Introduction

Both developed and developing countries are experiencing a tremendous increase in cesarean section (CS) deliveries; hospitals in Europe, the US, South America and eastern Asia report rates in excess of 30 to 40% (1-5). Results of randomized controlled trials justify an elective CS (eCS) in a limited number of conditions, such as a breech presentation (6) or HIV infection. However, eCS is increasingly preferred by future parents and by medical staff because the maternal risks have decreased considerably, the perceived risk for the neonate is small (7, 8) and logistic or commodity reasons make it attractive. While it is widely recognized that CS may be life-saving, neonatal mortality and morbidity of this mode of delivery are often ignored or their importance is minimized (7, 9).

The risk of respiratory morbidity beyond 34 weeks of gestation is recognized, but is underestimated by both patients and caregivers (6, 10-12). The use of the expression *'near-term'* at a gestational age between 34 and 37 weeks, falsely implying biological similarities with the full term, also leads to a more liberal attitude towards earlier elective deliveries (13). CS may increase the risk of neonatal morbidity via two mechanisms. First, CS anticipates the date of spontaneous delivery, thus increasing prematurity, and second, CS is likely to reduce the beneficial effect of labor on lung adaptation (14-16).

A limited number of studies, mostly of small size, have been carried out to compare neonatal morbidity particularly between eCS and vaginal delivery (VD) (17, 18). A recent systematic review on respiratory morbidity after eCS (19) has identified eight observational studies (12,

20-27) of which only two were stratified by GA (12, 27). Due to heterogeneous study designs, varying selection criteria and outcome definitions, no clear-cut conclusion was possible (19). Two subsequent, large population based studies confirm increased mortality (28) and morbidities (9) after CS at term with poorer outcomes for respiratory diseases, special care admission and breast-feeding, but also reduced neonatal traumatic injuries. However, these studies excluded late preterm neonates and did not stratify for GA, thus denying the clinician a parameter for decision in a gestational age frame where mortality and morbidities change abruptly.

We designed this study to compare mortality and incidence of clinically significant morbidities in the late preterm and term neonate according to delivery mode by intention-to-treat. We used 20 years of data on 59626 mother-infant pairs prospectively recorded in our database. The objective was to determine gestational age stratified intra-partum and neonatal mortality and morbidity associated with elective CS.

Methods

The current study was performed at Geneva University Hospital, a tertiary care facility, with presently about 4000 births and 100 neonates < 32 weeks of gestation yearly, serving mainly an urban Caucasian population. Clinical databases include prospectively collected data on obstetric and neonatal outcomes of all the deliveries performed between January 1982 and September 2004 (Figure 1). The current analysis included all life-born neonates at or after 34 weeks of gestation, including infants who died intra-partum or in the delivery room. The hospital ethics committee approved the study.

A single electronic database (FilemakerPro7®) was obtained by standardizing formats and merging the obstetric and neonatal databases when special care admission was required, using *surname*, *date of birth* and *birth weight* as matching criteria. 98.1% were electronically matched and 1.9% (typos, different *surname* or *birth weight*) were manually identified. Maternal data were duplicated for multiple pregnancies (2.3%) and subsequent pregnancies were treated as independent. All variables were checked for consistency manually and with computerized routines.

We defined elective CS as a CS before the onset of labor and before rupture of membranes; this is in agreement with most other authors (7, 9, 12, 19, 22, 24, 25, 27, 28). We compared the outcome of newborns after eCS, with emergency CS (emCS; i.e. after the onset of labor or rupture of membranes) and with planned VD (pVD). Following the suggestions of the

American National Institutes of Health (28-30), pVD included in addition to neonates actually born by VD, neonates born by emCS that presumably were intended as VD.

We tested the following outcomes: 1) **Mortality** including intra-partum death and death before discharge, a proxy for neonatal mortality; 2) **Depression at birth**, defined by arterial cord blood pH ≤ 7.10 and/or a venous cord blood pH ≤ 7.15 and/or Apgar score at 5 minutes < 7; 3) **Admission** to the special care unit; note that admission policy was based on clinical requirements, not on birth weight or GA, and 4) **Respiratory morbidity**, defined as any respiratory disease requiring medical support for more than 30 minutes and special care admission (recorded since 1995).

GA was calculated using the time elapsed between the first day of the last menstrual period and the day of delivery, confirmed by a first trimester ultrasound (performed routinely since 1980). We stratified GA in strata of 1 week, from 34 to 42 completed weeks and grouped into late preterm (< 37 weeks) and term neonates (≥ 37 weeks).

Differences in categorical data were tested using the Chi square test, while Students t test was used for continuous variables. To adjust for the effect of potential confounders (gender, multiple birth, malformations, IUGR, macrosomia -above 4000g- and year of birth), we performed a multivariate logistic regression analysis. All analyses were performed with SPSS® version 15.0 (SPSS Inc, Chicago, IL).

Results

We retrieved the information on 59626 mother-infant pairs between 1982 and 2004. A consecutive period of 21 months from January 1996 (n=5074) was not retrievable for informatics reasons. 1.3% of values were missing for mortality and depression at birth, 1.9% for admission and 1.1% for respiratory morbidity. 56549 neonates ≥ 34 weeks of gestation were included in the analysis (figure 1); 99.7% were inborn, 2.2% had malformations and male to female ratio was 1.1. The CS rate doubled from below 10% to over 20% during the study period (figure 2). Overall, 13.3% (n=7427) of neonates were delivered by CS of which 34.7% (n=2574) by elective, and 65.3% (n=4853) by emergency CS. 95.4% (n=53256) were planned vaginal deliveries; 86.7% (n=48403) were delivered vaginally and 8.7% (n=4853) had an emCS. Mean GA at delivery was 8 days younger after eCS than pVD (37 6/7 vs. 39 0/7; $p<0.001$).

Outcomes

Intra-partum and neonatal mortality was 0.16% (n=91); 20.3% (n=11612) had depression at birth, 7.0% (n=3936) were admitted to special care and 2.3% (575/24679; 1995-2004) had respiratory morbidities requiring special care admission. Univariate and multivariate comparison between delivery modes are given in table 1, age stratified incidences in figures 3-6.

Mortality

Mortality was higher after CS than VD (0.57% vs. 0.10%; RR 5.7; p<0.001). Adjusted mortality was also significantly higher when eCS was compared to pVD (table 1). An increased mortality after eCS compared to pVD was found in the full term (0.41% vs. 0.11%; RR 3.72; p<0.001) but not in late preterm group (1.34% vs. 0.75%; RR 1.79; p=0.223). Mortality after eCS and emCS were similar in univariate or multivariate analysis (table 1), in all strata (figure 3) or when grouped into term (0.41% vs. 0.42%; RR 0.97; p=1.0) and late preterm (1.34% vs. 1.89%; RR 0.71; p=0.605).

Depression at birth

Depression at birth was similar after eCS and pVD (table 1, figure 4). Depression was slightly less frequent after eCS than pVD in the term (18.1% vs. 20.3%; RR 0.89; p=0.01) but more frequent in the late preterm group (41.1% vs. 24.0%; RR 1.7; p<0.001).

Fewer neonates were depressed at birth after eCS compared to emCS (table 1). The difference was significant in the term (18.1% vs. 29.6%; RR 0.61; p<0.001) but not in the late preterm group (41.1% vs. 41.6%; RR 1.0; p=0.945).

Special care admission

Admissions were more frequent after eCS than pVD (table 1). The difference was significant in all strata below 39 weeks, and also more common after eCS in both the term (9.6% vs. 5.6%; RR 1.71; p=0.001), and the late preterm group (46.0% vs. 25.0%; RR 1.84; p<0.001).

The risk of admission decreased with increasing GA (figure 4). The lowest incidence of admissions after eCS (6.6%) and pVD (4.7%) occurred in the 39 week stratum.

Admission rates were lower after eCS than emCS in the multivariate but not in the univariate analysis (table 1); admissions after eCS were less common in the term (9.6% vs. 12.4%; RR 0.77; p=0.001) but similar in the late preterm group (46.0% vs. 40.3%; RR 1.14; p=0.098).

Respiratory morbidity

Respiratory morbidity was more than twice as frequent after eCS compared to pVD (table 1) and was more common in both the term (3.5% vs. 1.7%; RR 2.05; p=0.001), and the late preterm group (18.9% vs. 8.8%; RR 2.15; p<0.001). Respiratory morbidity fell with progressing GA and the lowest incidence was 1.4% in the 39 week stratum after pVD and 2.7% in the 38 week stratum after eCS (figure 5).

Neonates delivered by eCS had a similar risk of respiratory morbidity to those delivered by emCS (table 1), however, respiratory morbidity was lower in the term (3.5% vs. 5.2%; RR 0.67; p=0.013) and higher in the late preterm group (18.9% vs. 11.9%; RR 1.59; p=0.032).

Discussion

This large cohort study on neonatal morbidities by intended mode of delivery shows a consistent association between eCS and mortality as well as with clinically relevant morbidities. The well-documented GA trend is confirmed, with the lowest mortality and morbidities between 38 and 40 weeks. Compared to pVD (including emCS), eCS is associated with significantly higher mortality, admission rates and respiratory morbidity. Compared to emCS, eCS is associated with less depression, admissions and respiratory morbidity in the term, but not the preterm neonates. Mortality between eCS and emCS was similar**.**

Limitations and strengths

The general increase in CS rates (2, 4, 5, 13, 31) is often attributed to eCS (32, 33) that is not performed for dystocia or fetal distress. CS rates at our perinatal centre remained below the Swiss National figures (29.2% in 2004 (34)) as a result of a low proportion of CS performed electively over the 20 years (figure 2). This policy has limited the number of eCS in this study. Nevertheless, our findings are based on a large population in the various delivery groups.

Published data on neonatal morbidities after CS remain limited, particularly after eCS, where case control studies prevail (11, 35-42). Population based cohort studies remain rare or do not consider GA specific morbidities (10, 12, 43) and usually focus on single severe outcomes, such as mortality (28). Cohort studies sampling on delivery mode (44-46) have recruited only small numbers. A recent very large study (9), analyzed the direct effect of CS on the neonate

but limited the analysis to delivery at term. By excluding late preterm delivery important clinical information was lost on a high-risk population increasingly being delivered by eCS. We included late preterm deliveries and stratified results by GA to provide generally available clinical data that could be presented to parents before deciding on mode of delivery and inform the clinician on likely staff needs.

A policy of restricted indications for eCS, as in our centre, possibly selected pregnancies with higher neonatal risk and thus may have led to an overestimation of unfavorable outcomes. Only a randomized controlled trial comparing eCS with VD as intention-to-treat would overcome this weakness (47), but presently, no such study is available, except in specific contexts, such as in the term breech (6) or steroids at term trials (48). The outcomes reported are difficult to compare with our study, except for respiratory morbidity of 5.1% (48) and gross mortality of 0.3% (6) that are similar or lower in our cohort. Our categorization of births into eCS and pVD resembles an intention-to-treat approach employed in a randomized controlled trial and solves ethical and recruitment problems likely to be encountered in any attempt to do a truly randomized controlled trial of eCS vs. 'planned' VD.

The strength of our study lies in its large number, nearly 60000 mother-infant pairs, prospectively and electronically recorded. Presently, it is the largest GA stratified cohort on neonatal outcomes comparing eCS to pVD (10, 12, 23, 24, 44, 49, 50). To account for potential confounders commonly associated with the reported neonatal morbidities, we adjusted our results in a multivariate analysis (51-53) including year of birth, to account for

uneven variable definition over a long study period. Indeed, confounders may have been present, as adjusted estimates are different from the crude estimates.

Methodology

An effect of non-independence resulting from duplicated maternal data for twins may tend to reduce the variability of the estimates thus slightly narrowing confidence intervals without influence on trends. Its contribution in this analysis is small given the small percentage of twins.

By linking maternal and neonatal data into one single cohort, our study allowed the analysis of several outcomes, an advantage over case-control studies (11, 35-42) that usually sample on one single and severe outcome. We chose neonatal outcomes in terms of clinical relevance for the patient and the caregiver and not based on specific diagnoses. Intra-partum and neonatal mortality, depression at birth, special care admission and respiratory morbidity translate into risk management, support of parental anxiety, requirements for resuscitation facilities and hospital beds, with a direct impact on economic issues (54).

Effect of GA

Depression at birth, admission to special care and respiratory morbidity showed an expected (10, 12, 49) strong age related trend independent of delivery mode. This was particularly marked for respiratory morbidity with a more than 10-fold decrease from 34 weeks to term after pVD and eCS, and a 4-fold decrease after emCS. Clearly, late preterm infants do not behave as term infants. A CS anticipates delivery by definition. Mean GA for the neonates

after eCS was indeed significantly younger than after pVD. An excess mortality and morbidity resulting from an anticipated delivery however, would not have been fully accounted for in our GA stratification, as it compares within a stratum. In addition, by stratifying into completed weeks, we have artificially underestimated the mean gestational age of the stratum by at least 3.5 days.

To plan equipment and staffing, hospitals need be aware that in the 34th week, up to 54% of neonates after eCS (38% after pVD) are depressed at birth. Resuscitation requirements are easily underestimated as depression at birth is most often benign when appropriate care is given. Moreover, in the 34th week, special care admission is required in up to 69% of neonates after eCS (47% after pVD), leading to separation from their mother during the essential early bonding period (54).

For all neonatal outcomes tested, a nadir of morbidities was found between 38 and 40 weeks. The lowest incidence of the combined adverse outcomes (mortality, depression at birth, respiratory distress and special care admission) is indicative of the best time to be born. The lowest incidence of combined neonatal complications was in the 39 weeks stratum after pVD and eCS and 41 weeks stratum after emCS. Thereafter was an increasing trend in complications.

Effect of delivery mode

Because CS may be life-saving, it is often assumed by the public opinion that elective CS avoids neonatal risks. Rare traumatic complications are indeed reduced in the absence of labor

and VD (9). However, our data shows a significant excess mortality (aRR 2.09) after eCS compared to pVD. Although this was not statistically significant throughout all GA strata and in the late preterm group because of small numbers, it was significant in the larger term group and overall in the cohort. Admission rates and respiratory morbidities were consistently higher after eCS than pVD including all strata except at 39 and 40 weeks, making the finding very robust. The similarity in outcomes at 39 to 40 weeks is coincident with the lowest mortality and rate of individual or combined morbidities.

Neonates born by emCS are delivered due to an imminent risk and are therefore expected to have a poorer outcome. Indeed, in mature infants, depression at birth, special care admission and even respiratory morbidity were higher after emCS than eCS, but mortality was similar. In late preterm infants eCS had no better outcome than emCS and a negative association was confirmed for respiratory morbidity.

The association between eCS and respiratory morbidity compared to pVD was reported (35, 55) and we confirmed it. Although compared to emCS we did not substantiate an overall difference for respiratory morbidity, an inverse interaction between preterm (RR 1.59) and term (RR 0.67) neonates is noteworthy. Steroids before eCS at term may further improve lung condition (48), an effect attributable to enhanced maturity of surfactant production (56) and lung liquid clearance (14, 15, 57, 58).

Conclusion

Our age stratified cohort confirms that adverse neonatal outcomes decrease with increasing GA independently of delivery mode, with the lowest risk between 38 and 40 weeks. This provides epidemiological confirmation of the WHO definition of term, the age at birth supposed to have the lowest neonatal risk. We provide GA specific risk estimates that allow informed consent for the mode of delivery as well as planning for resources. Our study also shows that CS, whether before or after the onset of labor, is associated with increased mortality and clinically relevant morbidities, except at term. Elective CS carries a higher risk for the neonate than planned VD and has no advantage over emergency CS in terms of mortality, except at term, where eCS has a lower morbidity than emCS. Our data provide evidence that eCS should not be performed before term. We believe that the worldwide escalating CS rate places an urgent duty on healthcare policy makers and professionals to prospectively investigate and monitor its' medical and social outcomes.

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What's known on the subject

CS rates rise worldwide, often extending into the late preterm period.

Neonatal outcomes after CS are rarely compared to VD as intention-to-treat and adjusted for GA.

It is a public perception that CS is safer for the neonate.

What this study adds

A large cohort study (n=56549).

Neonatal mortality, depression at birth, respiratory morbidity and admissions by delivery mode and GA.

Outcomes were poorer after elective CS than planned VD.

Mortality was similar between elective and emergency CS.

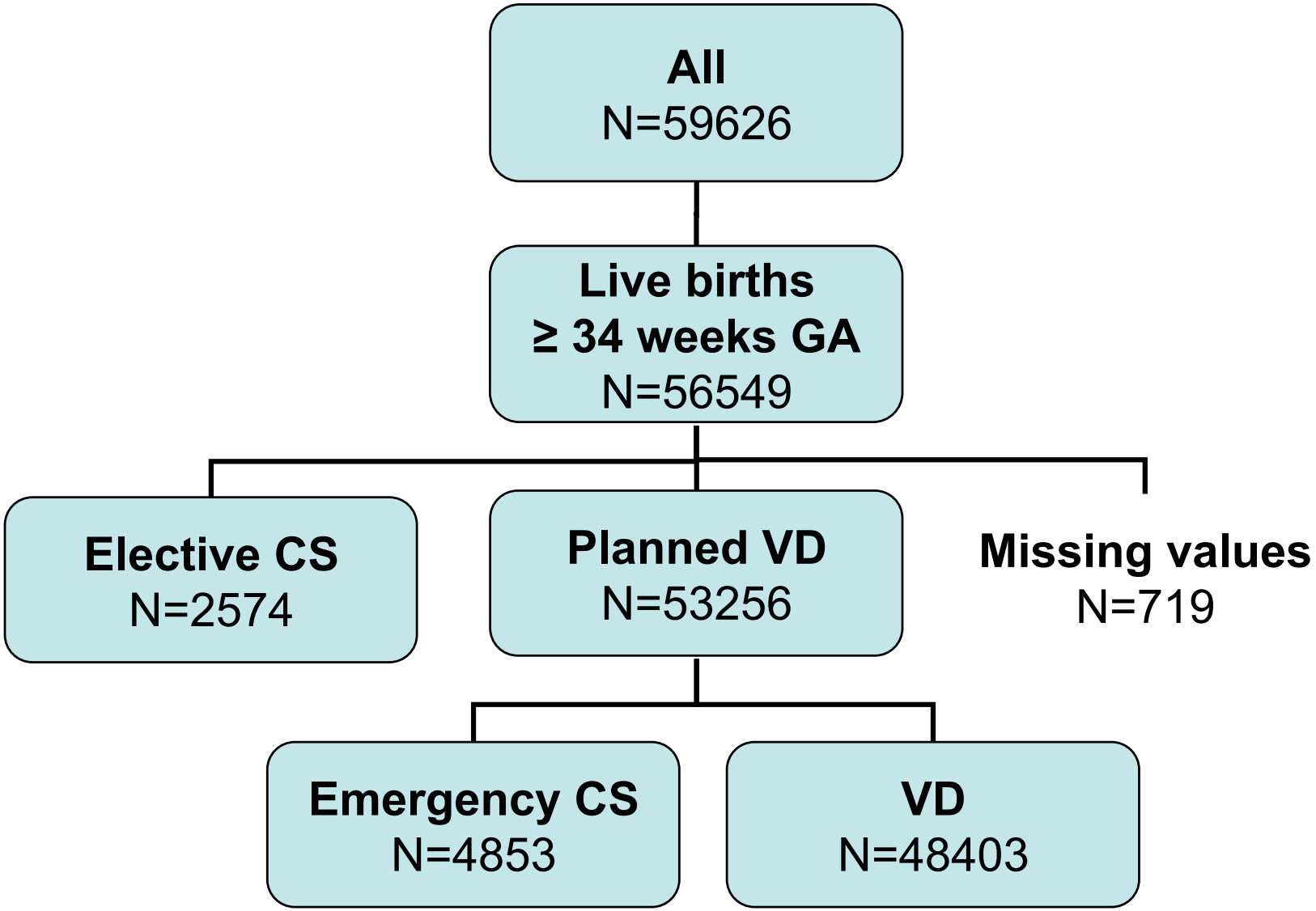
Tables

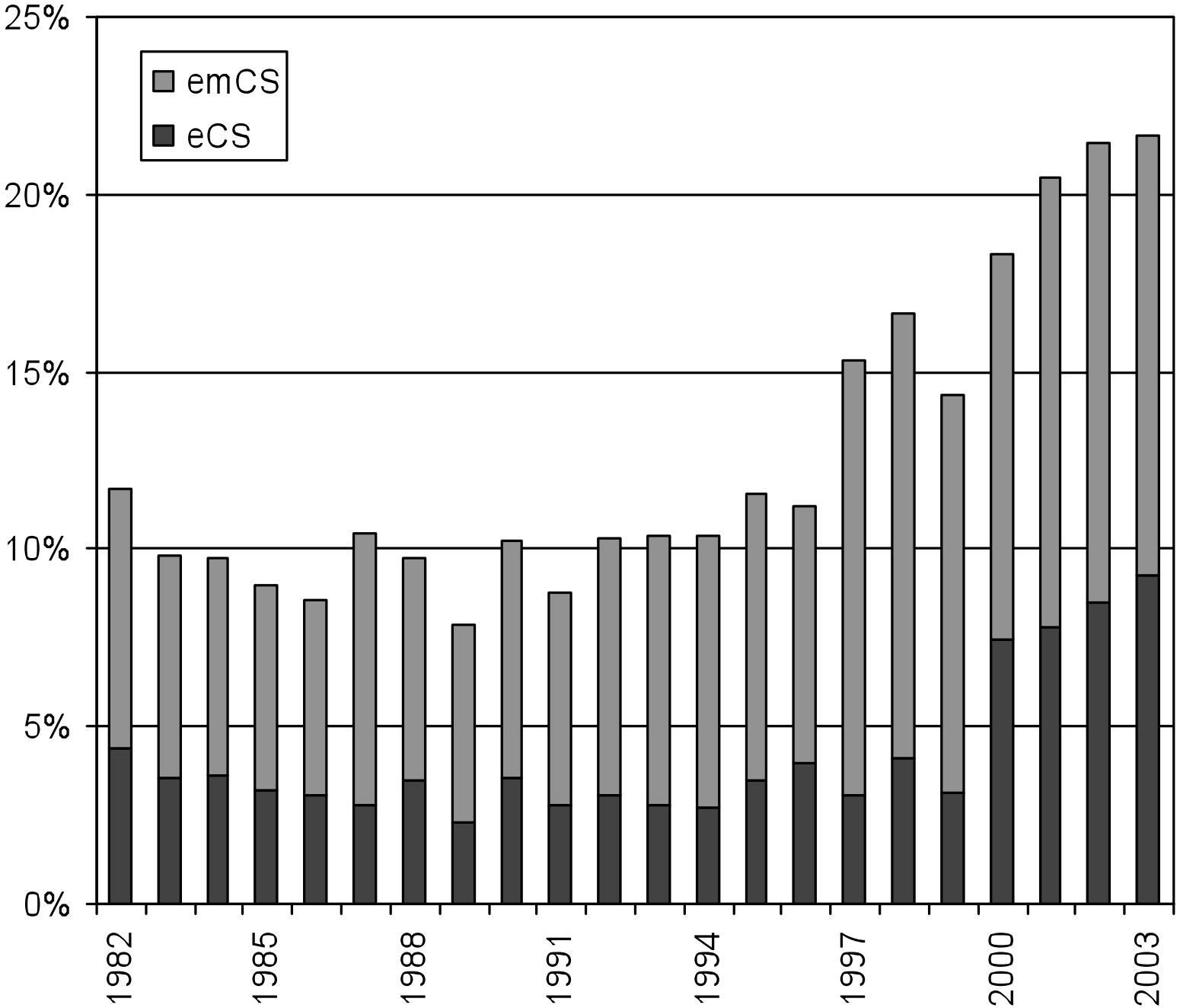
Table 1. Rate and relative risk (RR) of selected neonatal outcomes by mode of delivery

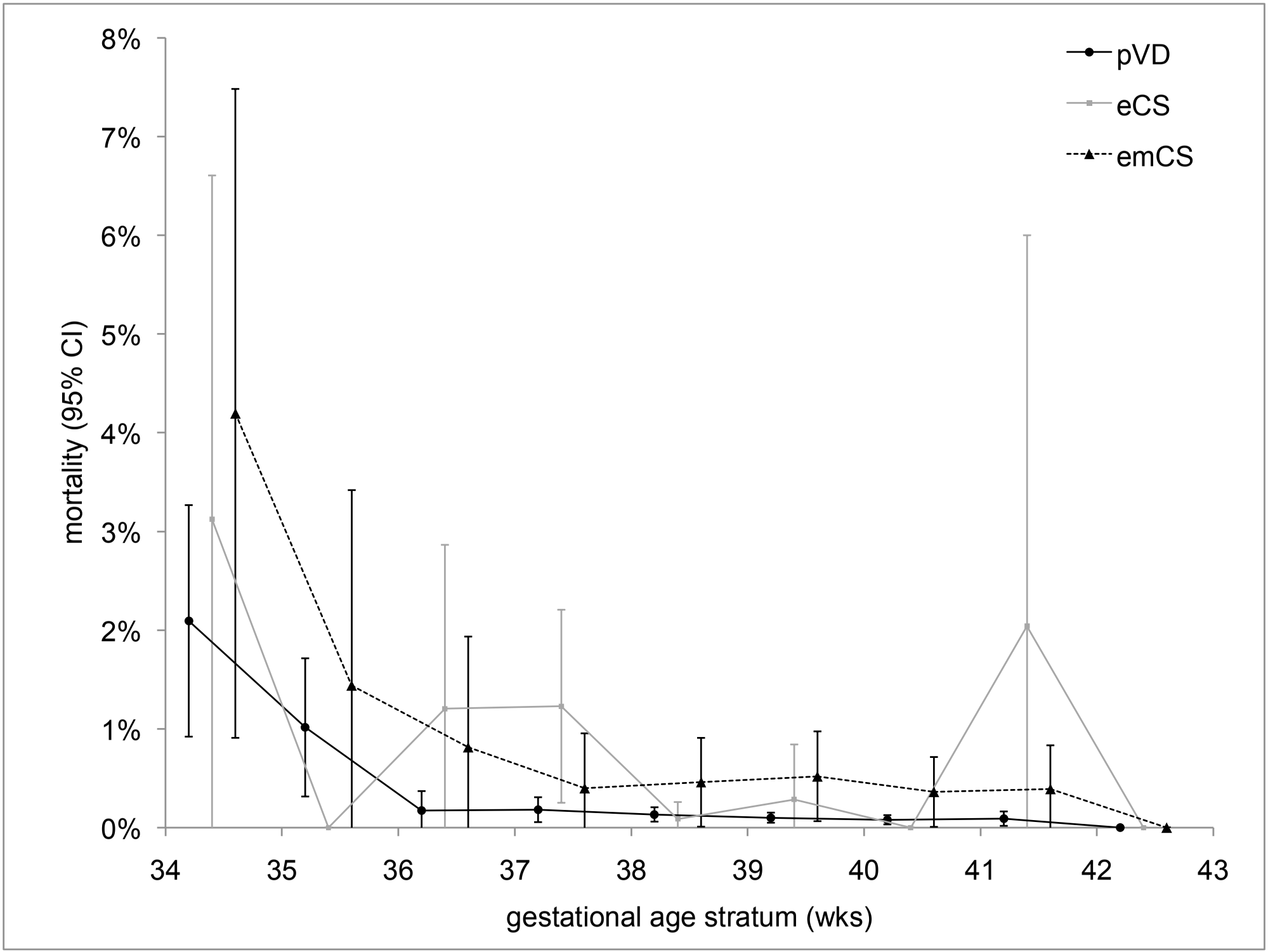
	Elective CS		Planned VD		RR	*95% CI*	p	adj. RR**	*95% CI*	p
MORTALITY*	0.54%	14/2574	0.14%	76/53256	3.83	2.16-6.78	<0.001	2.09	1.07-4.09	0.031
BIRTH DEPRESSION	21.4%	551/2574	20.5%	10926/53254	1.06	0.96-1.16	0.275	1.07	0.96-1.18	0.209
ADMISSION	14.7%	377/2558	6.7%	3529/52918	2.42	2.16-2.71	<0.001	1.41	1.23-1.60	<0.001
RESP. MORB.	5.5%	88/1593	2.1%	487/23396	2.75	2.18-3.47	<0.001	1.80	1.38-2.34	<0.001

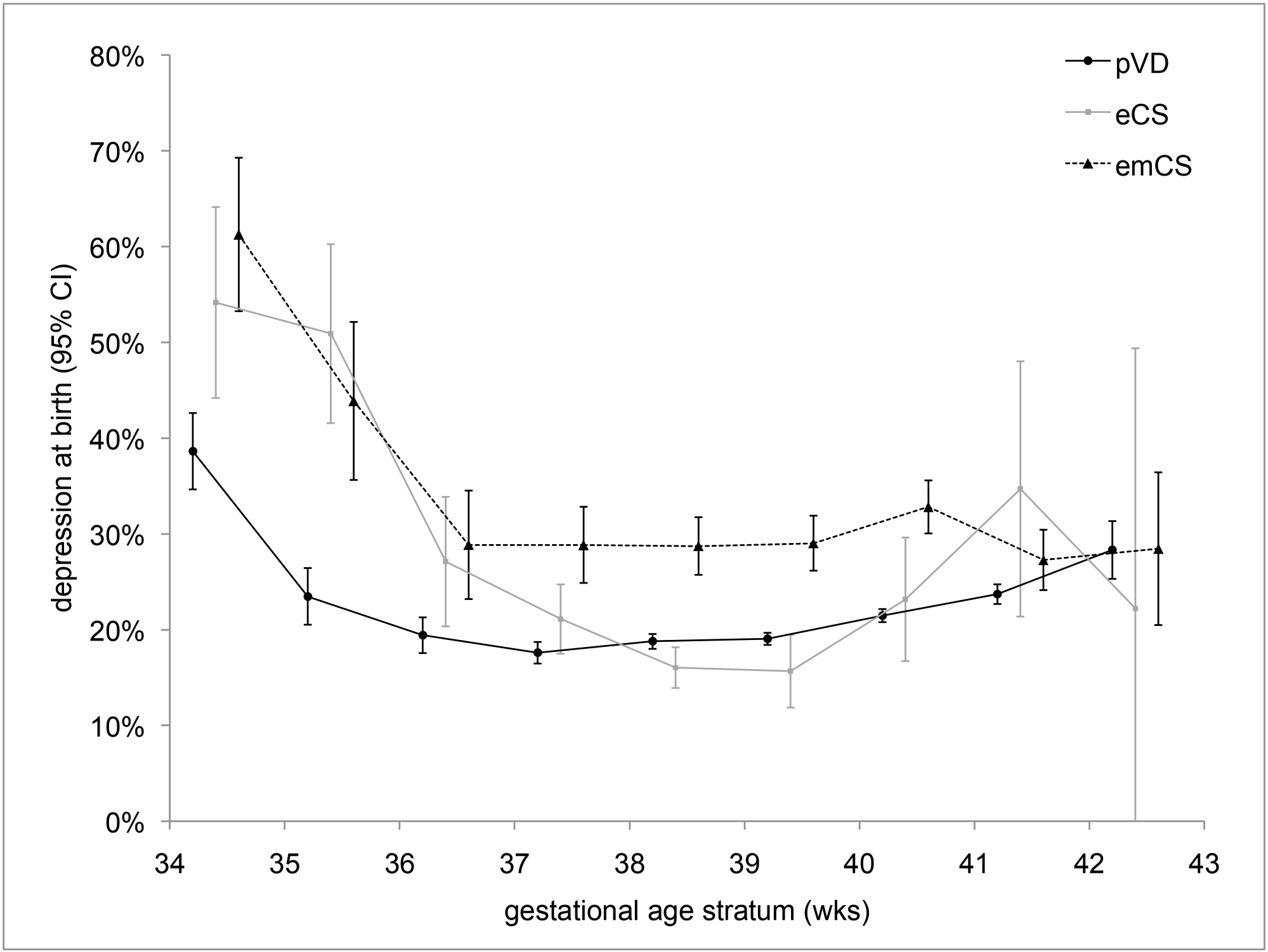
	Elective CS		Emergency CS		RR	*95% CI*	p	adj. RR**	*95% CI*	p
MORTALITY*	0.54%	14/2574	0.58%	28/4853	0.94	0.50-1.79	0.857	1.03	0.49-2.15	0.938
BIRTH DEPRESSION	21.4%	551/2574	30.9%	1499/4852	0.61	0.55-0.68	<0.001	0.60	0.52-0.68	<0.001
ADMISSION	14.7%	377/2558	15.4%	744/4829	0.95	0.83-1.09	0.446	0.77	0.65-0.90	0.002
RESP. MORB.	5.5%	88/1593	5.9%	167/2818	0.93	0.72-1.21	0.583	0.83	0.61-1.13	0.231

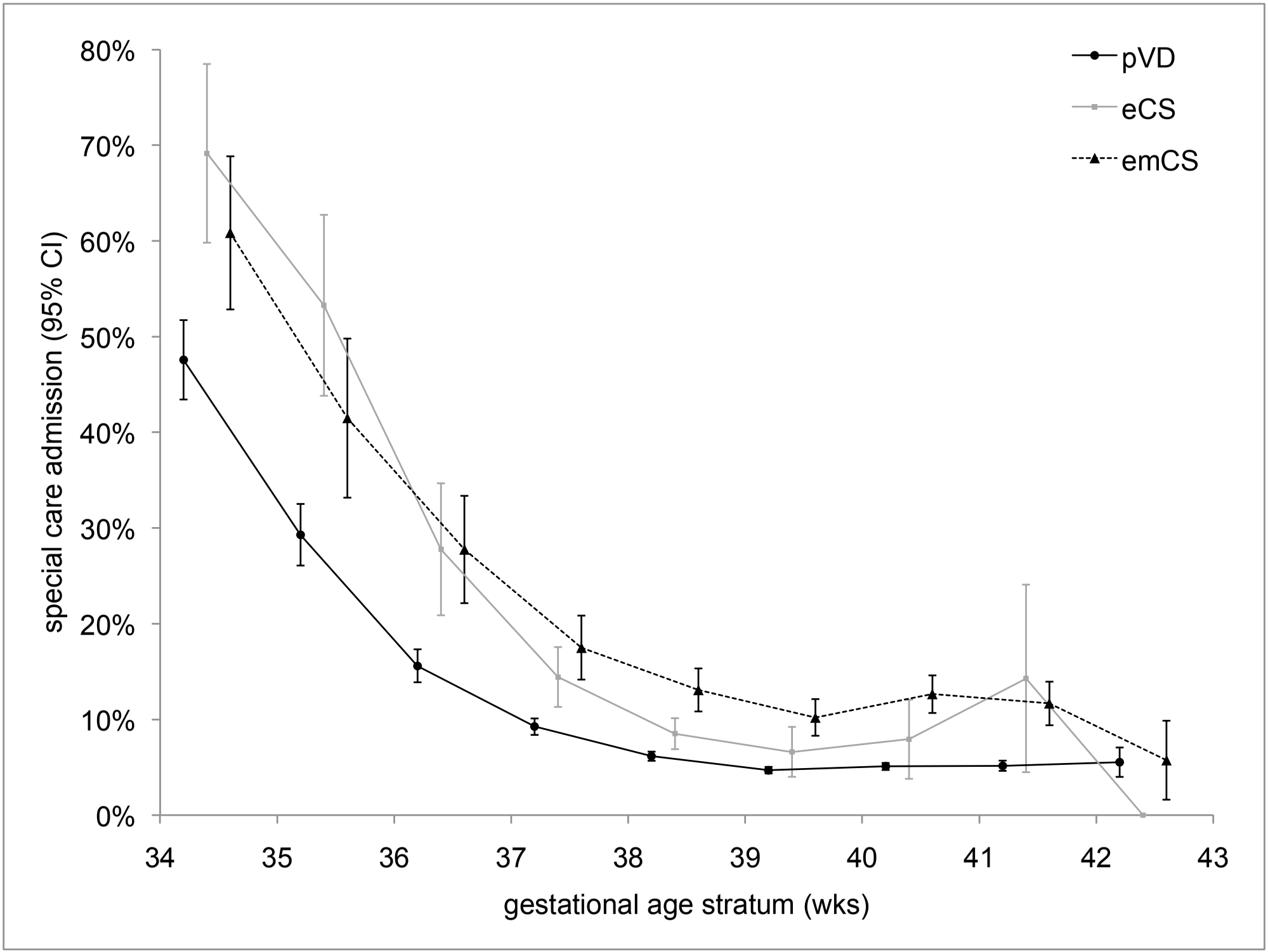
***adjusted for GA, malformations. IUGR, twin/multiple, macrosomia, gender and year of birth*
** includes intra-partum mortality and pre-discharge mortality*

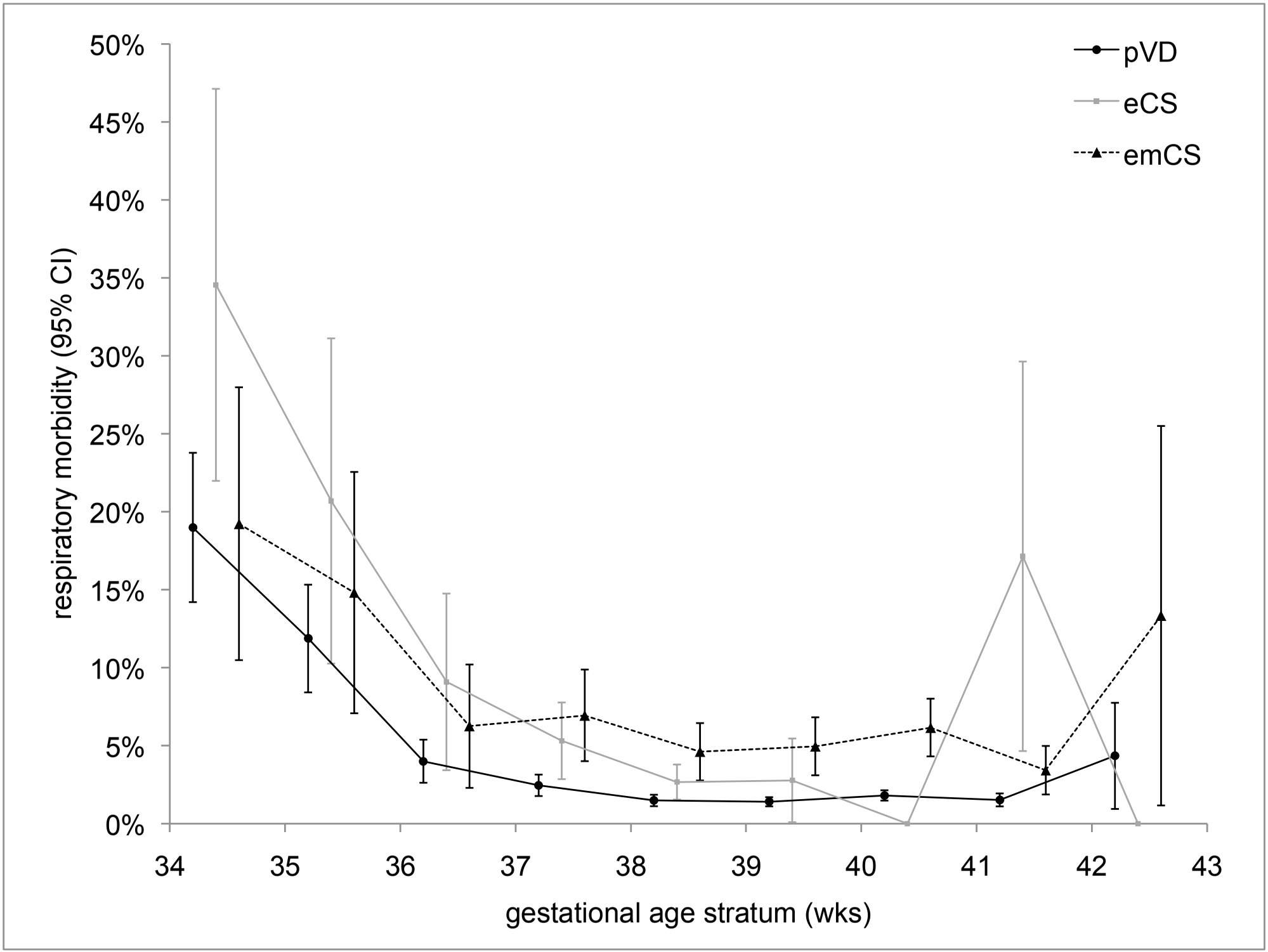

All
N=59626
Live births
≥ 34 weeks GA
N=56549
Elective CS
N=2574
Planned VD
N=53256
Missing values
N=719
Emergency CS
N=4853
VD
N=48403


25%
20%
15%
10%
5%
0%
emCS
eCS
1982
1985
1988
1991
1994
1997
2000
2003


8%
7%
6%
5%
4%
3%
2%
1%
0%
mortality (95% CI)
34
35
36
37
38
39
40
41
42
43
gestational age stratum (wks)
pVD
eCS
emCS


80%
70%
60%
50%
40%
30%
20%
10%
0%
depression at birth (95% CI)
34
35
36
37
38
39
40
41
42
43
gestational age stratum (wks)
pVD
eCS
emCS


80%
70%
60%
50%
40%
30%
20%
10%
0%
special care admission (95% CI)
34
35
36
37
38
39
40
41
42
43
gestational age stratum (wks)
pVD
eCS
emCS


50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
respiratory morbidity (95% CI)
34
35
36
37
38
39
40
41
42
43
gestational age stratum (wks)
pVD
eCS
emCS