**QUEEN'S
UNIVERSITY
BELFAST**

Cerebral palsy in twins and higher multiple births: a Europe-Australia population-based study

The Surveillance Of Cerebral Palsy Europe Group And The Australian Cerebral Palsy Register Group (2021). Cerebral palsy in twins and higher multiple births: a Europe-Australia population-based study. *Developmental Medicine and Child Neurology*, 63(6), 712-720. <https://doi.org/10.1111/dmcn.14827>

Published in:
Developmental Medicine and Child Neurology

Document Version:
Peer reviewed version

Queen's University Belfast - Research Portal:
[Link to publication record in Queen's University Belfast Research Portal](#)

Publisher rights
Copyright 2021 Mac Keith Press.
This work is made available online in accordance with the publisher's policies. Please refer to any applicable terms of use of the publisher.

General rights
Copyright for the publications made accessible via the Queen's University Belfast Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
The Research Portal is Queen's institutional repository that provides access to Queen's research output. Every effort has been made to ensure that content in the Research Portal does not infringe any person's rights, or applicable UK laws. If you discover content in the Research Portal that you believe breaches copyright or violates any law, please contact openaccess@qub.ac.uk.

[Original article: 3 tables, 2 figures, 1 appendix, 2 online tables]

Cerebral palsy in twins and higher multiple births: a Europe-Australia population-based study

ELODIE SELLIER^{1,2}
SHONA GOLDSMITH³
SARAH MCINTYRE³
OLIVER PERRA⁴
GIJA RACKAUSKAITE⁵
NADIA BADAWI^{3,6}
ASMA FARES⁷
HAYLEY SMITHERS-SHEEDY³

ON BEHALF OF THE SURVEILLANCE OF CEREBRAL PALSY EUROPE GROUP AND THE AUSTRALIAN CEREBRAL PALSY REGISTER GROUP

1 Université Grenoble Alpes, CNRS, Grenoble INP, CHU Grenoble Alpes, TIMC-IMAG, Grenoble; **2** RHEOP, Grenoble, France. **3** Cerebral Palsy Alliance Research Institute, Discipline of Child and Adolescent Health, The University of Sydney, Sydney, New South Wales, Australia. **4** Queen’s University Belfast, Belfast, UK. **5** Child and Adolescent Medicine, Aarhus University Hospital, Aarhus, Denmark. **6** Grace Centre for Newborn Intensive Care, The Children’s Hospital at Westmead, Sydney, New South Wales, Australia. **7** Pôle Santé Publique, Département de l’Information Médicale CHU Grenoble Alpes, Grenoble, France.

Correspondence to Elodie Sellier, Pavillon Taillefer, CS 10217, 38043 Grenoble cedex 9, France.
E-mail: ESellier@chu-grenoble.fr

PUBLICATION DATA

Accepted for publication 00th Month 2020.
Published online 00th Month 2021.

ABBREVIATIONS

ACPR	Australian Cerebral Palsy Register
SCPE	Surveillance of Cerebral Palsy Europe

[abstract]

AIM To describe the birth prevalence, temporal trends, and clinical outcomes of twins, triplets, or quadruplets with cerebral palsy (CP).

METHOD This was a cross-sectional study using data for twins, triplets, and quadruplets with prenatally or perinatally acquired CP and pooled from the Surveillance of Cerebral Palsy in Europe network (born 1992–2009) and Australian Cerebral Palsy Register (born 1993–2009). Children were at least 4 years old at time of registration. Children born in regions with population ascertainment and available denominator data were included in prevalence calculations ($n=1033$ twins, 81 triplets, and 11 quadruplets). Clinical data from children registered in all participating registers were described, including 2163 twins (56% male), 187 triplets (59% male), and 20 quadruplets (45% male).

RESULTS The birth prevalence of CP was higher with increasing plurality (twins 6.5 per 1000 live births [95% confidence interval {CI} 6.1–6.9], triplets 17.1 [95% CI 13.6–21.2], quadruplets 50.7 [95% CI 25.6–88.9]); however, prevalence by gestational age was similar across all pluralities. Between 1992–1994 and 2007–2009, prevalence of CP among twins declined ($p=0.001$) but prevalence of CP among triplets did not change significantly over time ($p=0.55$). The distributions of Gross Motor Function Classification System, epilepsy, and impairments of intellect, vision, and hearing were similar regardless of plurality.

INTERPRETATION The data combined from two CP register networks indicated that triplets and quadruplets had increased risk of CP compared to twins. The higher prevalence of CP in triplets and quadruplets is due to their higher risk of preterm birth. Prevalence of CP among twins significantly declined in Europe and Australia. Clinical outcomes were similar for all multiple births.

[First page footer]

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

DOI: 10.1111/dmcn.xxxxx

[Left page footer]

Developmental Medicine & Child Neurology 2021, 63: 000–000

[Right page footer]

CP in Children from Multiple Births *Elodie Sellier et al.*

What this study adds

- The overall prevalence of cerebral palsy (CP) was greater in triplets and quadruplets than twins.
- The higher prevalence of CP among triplets and quadruplets was due to their higher risk of preterm birth.
- Higher-order multiples did not have more severe clinical outcomes than twins.
- The prevalence of CP among twins decreased over time.

[main text]

Cerebral palsy (CP) is the most common physical disability of childhood and is the result of a non-progressive disturbance to the developing brain.¹ Risk factors for CP before conception, throughout pregnancy, and in the perinatal period have been identified.² One major risk factor is a multiple birth.³ In Australia and Europe, infants from a multiple birth account for a small proportion of all births; however, this proportion has risen in recent decades, largely due to the availability of assisted reproductive technologies, including in vitro fertilization and ovulation induction, and older maternal age.^{4,5} Infants from a multiple birth have a higher risk of antenatal and perinatal complications, including twin-to-twin transfusion, preterm birth, and low birthweight.⁶ Twins and higher-order multiple births (triplets and higher) also have an increased risk of long-term complications, including intellectual impairment, behavioural problems, and CP.^{6–11}

Multiple births comprise 12% of all CP cases.³ Two total population studies have reported that the risk of CP increases with higher plurality. In the largest study to date from the UK (64 twins, six triplets, and no quadruplets), the prevalence of CP among singleton infant survivors was 2.3 per 1000

live births, which increased to 13.2 for twins and 44.8 for triplets.¹² The magnitude of risk was similar in a study from Western Australia.¹³ However, despite including total populations of children with CP, the number of CP cases from a higher-order multiple birth included in these studies was very small ($n=6$ triplets with CP in both studies).^{12,13} As identified by the authors, larger data sets are required to further understand the relationship between multiple births and CP, particularly in the case of higher-order multiple births. The relationship between multiple births and CP is complex. It is likely that preterm birth and low birthweight account for much of the increased risk of CP,¹⁴ but other factors may include placental issues, zygosity, loss of co-multiples, birth order, subfertility, and assisted reproductive technology.^{15–17}

To develop a larger data set to explore CP among higher-order multiples, international collaboration between total population registers is required. This was made possible through the cooperation between two large register networks in Europe and Australia. The Surveillance of Cerebral Palsy Europe (SCPE), established in 1998, is a network of CP surveys and registers in Europe, holding data from registers representing 30 geographical regions.¹⁸ The Australian Cerebral Palsy Register (ACPR) is a similar database of deidentified information about children with CP in Australia, including all eight geographical jurisdictions.^{3,19} Our study objective was to explore the prevalence and characteristics of children with CP born from a multiple birth in high-income regions, specifically: (1) to estimate the birth prevalence of CP among twins and higher-order multiples, overall and stratified by birthweight and gestational age; (2) to describe temporal trends in the prevalence of CP by plurality (birth years 1992–2009), overall and stratified by birthweight and gestational age; and (3) to compare the clinical profile of CP in children born from twin births and from higher-order multiple births.

METHOD

Study design

Case data, void of personal identifiers, were pooled from the population-based European (SCPE) and Australian (ACPR) register networks for this cross-sectional study. Descriptions of the SCPE and

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

ACPR have been published elsewhere.^{3,18,20,21} The register networks use the same definition of CP²⁰ and their minimum data sets can be harmonized.^{22,23}

Participants

Individual children with prenatally or perinatally acquired CP born from a multiple birth between 1992 (SCPE) or 1993 (ACPR) and 2009, registered in any SCPE register (*n*=26 regions) or any Australian register (*n*=8 regions) were included. These birth years were common to both SCPE and ACPR and were the most contemporary data available. To estimate prevalence, children born in SCPE regions with available denominator data were included (*n*=5 regions) along with children born in ACPR regions with total population ascertainment (*n*=3 regions). Denominator data for live births and neonatal survivors and/or neonatal deaths were provided by SCPE registers where available and sourced from the National Perinatal Epidemiology and Statistics Unit (Australia). For live births, the denominators consisted of the total number of individual children born alive from a twin, triplet, or quadruplet birth. For neonatal survivors, the denominators consisted of the total number of individual children born alive from a twin, triplet, or quadruplet birth and still alive at the age of 28 days after birth.

Study variables

Variables were identified from the minimum data sets from the SCPE and ACPR, with collapsing of variables where required to allow harmonization between regions. Gestational age was classified by weeks as: <28, 28 to 31, 32 to 36, and ≥37. Birthweight was classified by grams as: <1000, 1000 to 1499, 1500 to 2499, and ≥2500. Motor subtype was classified by unilateral spasticity, bilateral spasticity, dyskinesia, ataxia, or other/unknown. Motor function was classified by a simplification of the Gross Motor Function Classification System (GMFCS):²⁴ levels I and II (ambulatory); level III (uses mobility device); and levels IV and V (uses wheelchair for mobility). Intellectual impairment was classified as none (IQ ≥70), mild (IQ 50–69), or moderate to profound (IQ <50) and impairments of vision, hearing, and speech as: none, some, and severe impairment.

Statistical analysis

To estimate the overall birth prevalence of CP among higher-order multiples, prevalence estimates (95% confidence intervals [CIs]) were calculated from pooled Australian and European data per 1000 live births and 1000 neonatal survivors. Available data were provided by the ACPR in 3-year epochs, in line with the available denominator data. Thus, analysis of prevalence were performed for six epochs (from 1992–1994 to 2007–2009). Prevalence estimates were stratified by birthweight in grams (<1000, 1000–1499, 1500–2499, $\geq$ 2500) and gestational age groups in weeks (<28, 28–31, 32–36, $\geq$ 37). Given the small number of triplets, birthweight and gestational age were dichotomized for the analysis of temporal trends (birthweight <1500g, $\geq$ 1500g; gestational age <32 weeks, $\geq$ 32 weeks). Relative risk (95% CI) was calculated for each birthweight and gestational age group to compare prevalence estimates by live births between twins and triplets. We analysed trends over time using Poisson regression models adjusted for network (SCPE or ACPR) and respective offset terms to account for differences in the number of live births between networks and time epochs. To analyse whether there was a significant difference in the trend between the two networks, we added an interaction term between the network and birth year. Likelihood ratio χ^2 tests were used to compare the two nested models. The threshold for significance was $p < 0.05$. Descriptive analysis of clinical outcomes (sex, motor subtypes, GMFCS levels, and presence of associated impairments) were conducted, along with polytomous regression adjusting for gestational age and register network. Maternal age was analysed using linear regression with adjustment for gestational age and register network. All analyses were conducted in Stata v15 (StataCorp LLC, College Station, TX, USA).

Ethical approval

Member registers of the ACPR and SCPE have ethical approval to operate in accordance with the legislation of their geographical region. This study was granted a waiver of ethical approval (no. 2016-02-01) by the Cerebral Palsy Alliance Human Research Ethics Committee (EC00402). Additionally, where required, individual registers received ethical approval before their participation in the current study.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

RESULTS

A total of 1125 children with CP were included as numerators in the calculation of birth prevalence estimates (Table 1). A total of 158 843 infants born from a twin birth, 4748 infants born from a triplet birth, and 217 infants born from a quadruplet birth were included as denominators in the prevalence estimates. For children born from a twin birth ($n=1033$), the birth prevalence of CP was 6.5 per 1000 live births (95% CI 6.1–6.9) (Table 2). The prevalence of CP was more than doubled for children born from a triplet birth ($n=81$ children with CP) at 17.1 per 1000 live births (95% CI 13.6–21.2) (Table 2) and increased again to 50.7 per 1000 live births (95% CI 25.6–88.9) in children born from a quadruplet birth ($n=11$ children with CP). There were no cases of CP with plurality higher than quadruplets. Using neonatal survivors as the denominator, the prevalence by plurality followed a similar pattern (Table 2): twins, 6.6 per 1000 live births (95% CI 6.2–7.0); triplets, 18.0 per 1000 live births (95% CI 14.3–22.3); and quadruplets, 55.3 per 1000 live births (95% CI 27.9–96.8).

Across all pluralities, birth prevalence estimates of CP per 1000 live births or neonatal survivors increased with decreasing gestational age and birthweight. A greater proportion of triplets were born <1500g and/or before 32 weeks’ gestation compared to twins. Prevalence estimates were similar within each birthweight or gestational age stratum for all pluralities (Table 2 and Fig. 1). Given the small number of quadruplets with CP ($n=11$), that is, less than one per birth year across Australia and Europe, stratification by birthweight or gestational age is not reported. However, all quadruplets with CP were born before 32 weeks’ gestation and all but one had a birthweight <1500g.

Over time, the birth prevalence of CP in twins ($n=1033$) decreased from 8.2 per 1000 live births (95% CI 6.6–10.1) in 1992 to 1994 to 5.5 (95% CI 4.7–6.4) in 2007 to 2009 ($p=0.001$) (Fig. 2a). For triplets ($n=81$), prevalence was consistently higher but fluctuated over time with no clear pattern ($p=0.55$) (Fig. 2a).

The prevalence of CP per 1000 live births for twins decreased over time in the four birthweight categories. The decline was significant for the 1000 to 1499g and ≥ 2500 g categories (Fig. 2b and Table S1). There was no discernible temporal trend in the prevalence for triplets <1500g or ≥ 1500 g (Fig. 2c and Table S2). When analysing prevalence estimates stratified by gestational age groups, similar patterns were observed. The decline was significant in twins born at 28 to 31 weeks and ≥ 37

weeks. The decline did not reach statistical significance for those born at <28 weeks and was not significant for infants born moderately preterm (32–36wks) (Fig. 2d and Table S1). In triplets, no significant change in prevalence was observed in either gestational age subgroup (Fig. 2e and Table S2). Similar results were observed in the prevalence estimates per 1000 neonatal survivors (Tables S1 and S2), except that the decline reached significance for twins born <1000g and <28 weeks.

Clinical outcomes are described for 2163 twins (56% males), 187 triplets (59% males), and 20 quadruplets (45% males) (Table 3). Distributions of GMFCS, epilepsy, and impairments of intellect, vision, and hearing were similar regardless of plurality. Distribution of motor subtype differed by plurality ($p=0.04$) with the unilateral spastic subtype more often observed in twins than triplets or quadruplets; however, the difference was not statistically significant after adjustment for gestational age and network.

DISCUSSION

While the increased risk of CP for twins compared to singletons has been well described,^{2,12,13} the literature is scarce regarding the prevalence of CP among higher-order multiples. To investigate this further, we describe a collaboration between CP register networks from high-income regions (Europe and Australia). Using data exclusively from multiple births, we identified that the overall birth prevalence of CP is increased in higher-order multiple births compared to twins. However, within each gestational age or birthweight stratum, prevalence was similar regardless of plurality. There were no discernible differences in clinical outcomes between twins and triplets after adjustment for preterm birth. The increased risk of CP in higher-order multiples and differences in motor subtype can be attributed to their inherent increased risk of preterm birth. In investigating temporal trends in the prevalence of CP, we observed a decline in the prevalence of CP for children born from a twin pregnancy from the mid-1990s to the late 2000s. When stratified, the prevalence of CP for these children declined over time for those with a low birthweight and short gestation, whereas for the smaller group of children with CP born from a triplet pregnancy there was no consistent trend in prevalence over time.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

As described previously, to date there have been two population-based CP register studies describing the risk of CP for higher-order multiples. These single-region studies included births in the 1980s and only a small number of triplet cases. In comparison, our larger data set was drawn from multiple regions and included almost two decades of more recent births. While acknowledging that our denominator was neonatal survivors rather than infant survivors, our prevalence of CP sat within the CIs of previous studies at 18.0 (95% CI 14.3–22.3). Given our narrow CI, this is a more precise estimate of the prevalence of CP for children born from a triplet pregnancy. While prevalence of CP was highest among children born from a quadruplet pregnancy, the number of quadruplet births was very low despite including eight regions across Europe and Australia. Nevertheless, to the best of our knowledge, this study provides the first population prevalence estimate of CP for quadruplets.

In recent years, the declining birth prevalence of CP has been described in the literature,^{19,25–27} including a decline in prevalence for twins.³ General trends in multiple births versus singletons have been reported recently and the results are consistent with those reported in this study.²⁸ In our study, we indeed reported a similar decline overall for twins using a pooled data set from Europe and Australia, probably accounted for by a decline in prevalence for very-low-birthweight and infants born preterm. It has been postulated that declining prevalence of CP in these most vulnerable infants is likely due to multifactorial improvements in maternal and neonatal care, such as increased use of antenatal monitoring, earlier detection of high-risk pregnancies, magnesium sulphate for neuroprotection, and antenatal steroids before preterm birth.^{19,26,29} There is a paucity of literature regarding temporal trends in CP prevalence for higher-order multiples. Despite our large data set, the total number of higher-order multiples with CP was small, leading to volatility in the prevalence estimates over time.

A previous European study of the impact of plurality in CP reported a significant effect of birth order, with a higher proportion of second-born twins with CP (56% second-born vs 44% first-born).⁷ In contrast, we found similar proportions of each birth order among twins and triplets. Clinical outcomes in this study, including gross motor severity and associated impairments, were similar between twins and triplets. This mirrors other research reporting no difference in the severity of CP, intellectual impairment,¹³ or motor impairment²⁸ by plurality.

While our study included data from a large international collaboration, only registers with total population ascertainment and available denominator data were included in the prevalence analyses. This limited the number of cases available (less than half of the total number of cases registered in the SCPE and ACPR), which probably contributed to fluctuation in temporal trends for triplets and inhibited the analysis for quadruplets. The study was also limited by the variables available from the register networks. By their nature, CP registers include a relatively small minimum data set to make total population ascertainment and timely reporting feasible. As such, data on some factors associated with increased risk of CP including zygosity, co-multiple deaths, and use of assisted reproductive technology were not collected or not available from participating regions. Such variables are important because the use of assisted reproductive technology has steadily increased since its introduction in the late 1970s. While in vitro fertilization is associated with an increased risk of CP,^{16,30} primarily due to multiple and preterm birth, this association will likely change with the shift towards single-embryo transfer. This study intentionally pooled data between regions to maximize sample size allowing analyses in higher-order multiples. While beyond our objectives, future studies should consider whether differences between regions exist, potentially associated with variation in clinical practices. For example, in Australia and Norway, regions with a high uptake of single-embryo transfer, the rates of multiple births after assisted conception have declined.^{4,31,32} Finally, since epidemiology of CP is known to differ in low-to-middle income regions, future studies should consider these populations.

In this large population-based study from high-income regions, we found that the overall birth prevalence of CP was increased in higher-order multiple births compared with twins due to their higher proportions of preterm births. Clinical outcomes were similar for all multiple births. In an era of increasing use of assisted reproductive technology and variation in clinical practice around the world, CP registers have a vital role to play in monitoring rates of CP by plurality over time.

ACKNOWLEDGEMENTS

The members of the SCPE study group are as follows: A Ego, C Tronc, C Arnaud, M Delobel, V Mc Manus, A Lyons, O Perra, K McConnel, K Himmelmann, M Pahlman, O Hensey, V Dowding, J

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Kurinczuk, G Rackauskaite, B Laursen, MG Torrioli, M Marcelli, GL Andersen, S Julsen Hollung, M Bottos, G Gaffney, J de la Cruz, C Pallas, D Neubauer, A Radsel, D Virella, T Folha, A Greitane, K Hollody, G Csabi, I Dakovic, S Sigurðardóttir, I Einarsson, E Haberlandt, E Ortibus, I Franki, V Mejaski-Bosnjak, C Kuenzle, A Tscherter, S Attard, A Papavasilou, K Horridge, MJ Platt, I Krägeloh-Mann, and V Horber.

The members of the ACPR study group are as follows: M Auld, N Badawi, E Blair, L Diviney, C Gibson, N Gibson, S Goldsmith, D Gration, J Hernandez, K Langdon, S Love, E Maloney, T Martin, S McIntyre, F Kay, G O’Grady, D Reddihough, S Reid, H Scott, H Smithers-Sheedy, and L Watson.

We gratefully acknowledge the families and individuals whose clinical data is included in the CP registers across Australia and Europe. We thank all the registers (Appendix S1, online supporting information) that participated in this study and their staff.

The ACPR and the New South Wales/Australian Capital Territory CP registers are funded by the Cerebral Palsy Alliance Research Foundation. The Victorian Cerebral Palsy Register receives funding from the Victorian Department of Health and Human Services and the Royal Children’s Hospital Foundation. The Western Australian Register of Developmental Anomalies-Cerebral Palsy is funded as a statutory data collection of the Department of Health, Western Australia. SG, SM, HSS, and NB received salary support from the Cerebral Palsy Alliance Research Foundation. HSS received salary support through a National Health and Medical Research Council of Australia Early Career Fellowship (no. 1144566) and Australasian Cerebral Palsy Clinical Trials Network. SM received salary support through a National Health and Medical Research Council of Australia Early Career Fellowship (no. 1111270).

Supporting information

The following additional material may be found online:

- Table S1:** Trends in prevalence of CP for children born from a twin birth
- Table S2:** Trends in prevalence of CP for children born from a triplet birth
- Appendix S1:** Study registers

REFERENCES

1. Rosenbaum P, Paneth N, Leviton A, et al. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol* 2007; **109**: 8–14.
2. Korzeniewski SJ, Slaughter J, Lenski M, Haak P, Paneth N. The complex aetiology of cerebral palsy. *Nat Rev Neurol* 2018; **14**: 528–43.
3. Australian Cerebral Palsy Register. Report of the Australian Cerebral Palsy Register, birth years 1995–2012 [Internet]. Allambie Heights, NSW, Australia: ACPR, 2018. Available at: <https://cpregister.com/publications-and-other-resources/> (accessed 21 December 2020).
4. Umstad MP, Hale L, Wang YA, Sullivan EA. Multiple deliveries: the reduced impact of in vitro fertilisation in Australia. *Aust N Z J Obstet Gynaecol* 2013; **53**: 158–64.
5. Heino A, Gissler M, Hindori-Mohangoo AD, et al. Variations in multiple birth rates and impact on perinatal outcomes in Europe. *PLoS One* 2016; **11**: e0149252.
6. Doyle P. The outcome of multiple pregnancy. *Hum Reprod* 1996; **11**(Suppl. 4): 110–7.
7. Topp M, Drasbek Huusom L, Langhoff-Roos J, Delhumeau C, Hutton JL, Dolk H, SCPE Collaborative Group. Multiple birth and cerebral palsy in Europe: a multicenter study. *Acta Obstet Gynecol Scand* 2004; **83**: 548–53.
8. Sutcliffe AG, Derom C. Follow-up of twins: health, behaviour, speech, language outcomes and implications for parents. *Early Hum Dev* 2006; **82**: 379–86.
9. Yokoyama Y, Shimizu T, Hayakawa K. Prevalence of cerebral palsy in twins, triplets and quadruplets. *Int J Epidemiol* 1995; **24**: 943–8.
10. Scher AI, Petterson B, Blair E, et al. The risk of mortality or cerebral palsy in twins: a collaborative population-based study. *Pediatr Res* 2002; **52**: 671–81.
11. Skrablin S, Kuvacić I, Simunić V, Bosnjak-Nadj K, Kalafatić D, Banović V. Long-term neurodevelopmental outcome of triplets. *Eur J Obstet Gynecol Reprod Biol* 2007; **132**: 76–82.
12. Pharoah PO, Cooke T. Cerebral palsy and multiple births. *Arch Dis Child Fetal Neonatal Ed* 1996; **75**: F174–F177.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

13. Petterson B, Nelson KB, Watson L, Stanley F. Twins, triplets, and cerebral palsy in births in Western Australia in the 1980s. *BMJ* 1993; **307**: 1239–43.

14. Hansen M, Colvin L, Petterson B, Kurinczuk JJ, de Klerk N, Bower C. Twins born following assisted reproductive technology: perinatal outcome and admission to hospital. *Hum Reprod* 2009; **24**: 2321–31.

15. Hack KE, Koopman-Esseboom C, Derks JB, et al. Long-term neurodevelopmental outcome of monochorionic and matched dichorionic twins. *PLoS One* 2009; **4**: e6815.

16. Goldsmith S, McIntyre S, Badawi N, Hansen M. Cerebral palsy after assisted reproductive technology: a cohort study. *Dev Med Child Neurol* 2018; **60**: 73–80.

17. Zhu JL, Hvidtjørn D, Basso O, et al. Parental infertility and cerebral palsy in children. *Hum Reprod* 2010; **25**: 3142–5.

18. Surveillance of Cerebral Palsy in Europe. Surveillance of Cerebral Palsy in Europe (SCPE) scientific report 1998–2018 [Internet]. 2018. Available at: <https://eu-rd-platform.jrc.ec.europa.eu/sites/default/files/SCPE%20Scientific%20report%201998-2018.pdf>.

19. Galea C, McIntyre S, Smithers-Sheedy H, et al. Cerebral palsy trends in Australia (1995–2009): a population-based observational study. *Dev Med Child Neurol* 2019; **61**: 186–93.

20. Surveillance of Cerebral Palsy in Europe. Surveillance of cerebral palsy in Europe: a collaboration of cerebral palsy surveys and registers. Surveillance of Cerebral Palsy in Europe (SCPE). *Dev Med Child Neurol* 2000; **42**: 816–24.

21. Smithers-Sheedy H, McIntyre S, Gibson C, et al. A special supplement: findings from the Australian Cerebral Palsy Register, birth years 1993 to 2006. *Dev Med Child Neurol* 2016; **58**: 5–10.

22. Goldsmith S, Garcia Jalon G, Badawi N, et al. Comprehensive investigation of congenital anomalies in cerebral palsy: protocol for a European-Australian population-based data linkage study (The Comprehensive CA-CP Study). *BMJ Open* 2018; **8**: e022190.

23. Sellier E, McIntyre S, Smithers-Sheedy H, Platt MJ, SCPE and ACPR Groups. European and Australian cerebral palsy surveillance networks working together for collaborative research. *Neuropediatrics* 2020; **51**: 105–12.

- 1
2
3
4
5
6
7
8
9 24. Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and
10 reliability of a system to classify gross motor function in children with cerebral palsy. *Dev Med*
11 *Child Neurol* 1997; **39**: 214–23.
12
13 25. Sellier E, Platt MJ, Andersen GL, et al. Decreasing prevalence in cerebral palsy: a multi-site
14 European population-based study, 1980 to 2003. *Dev Med Child Neurol* 2016; **58**: 85–92.
15
16 26. Reid SM, Meehan E, McIntyre S, et al. Temporal trends in cerebral palsy by impairment
17 severity and birth gestation. *Dev Med Child Neurol* 2016; **58**: 25–35.
18
19 27. Touyama M, Touyama J, Toyokawa S, Kobayashi Y. Trends in the prevalence of cerebral palsy
20 in children born between 1988 and 2007 in Okinawa, Japan. *Brain Dev* 2016; **38**: 792–9.
21
22 28. Perra O, Rankin J, Platt MJ, et al. Decreasing cerebral palsy prevalence in multiple births in the
23 modern era: a population cohort study of European data. *Arch Dis Child Fetal Neonatal Ed*
24 2020. DOI: 10.1136/archdischild-2020-318950 (Online ahead of print).
25
26 29. Shepherd E, Salam RA, Middleton P, et al. Antenatal and intrapartum interventions for
27 preventing cerebral palsy: an overview of Cochrane systematic reviews. *Cochrane Database*
28 *Syst Rev* 2017; **8**: CD012077.
29
30 30. Hvidtjørn D, Grove J, Schendel D, et al. Multiplicity and early gestational age contribute to an
31 increased risk of cerebral palsy from assisted conception: a population-based cohort study. *Hum*
32 *Reprod* 2010; **25**: 2115–23.
33
34 31. Kushnir VA, Barad DH, Albertini DF, Darmon SK, Gleicher N. Systematic review of
35 worldwide trends in assisted reproductive technology 2004–2013. *Reprod Biol Endocrinol*
36 2017; **15**: 6.
37
38 32. Hollung SJ, Vik T, Lydersen S, Bakken IJ, Andersen GL. Decreasing prevalence and severity of
39 cerebral palsy in Norway among children born 1999 to 2010 concomitant with improvements in
40 perinatal health. *Eur J Paediatr Neurol* 2018; **22**: 814–21.
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 1: Study participants for the prevalence and clinical outcomes analyses

	Location of register	Birth years included	Children with CP born from a twin birth	Children with CP born from a triplet birth	Children with CP born from a quadruplet birth
Prevalence analyses	SCPE registers with stratified denominators by plurality and birthweight available	1992–2009	646	50	9
	Western Sweden	1992–2009	83	6	2
	Denmark	1992–2009	224	17	1
	Norway	1997–2009	169	8	2
	Slovenia	1999–2008	50	2	0
	Portugal	2001–2009	120	17	4
	ACPR registers (population registers):				
	South Australia, Victoria, Western Australia	1993–2009	387	31	2
	Total <i>n</i> for prevalence analyses	1992–2009	1033	81	11
Clinical outcomes analyses	SCPE registers (with or without denominators)	1990–2009	1459	123	13
	ACPR registers (population and non-population registers)	1993–2009	704	64	7
	Total <i>n</i> for clinical outcomes analyses	1990–2009	2163	187	20

SCPE and ACPR registers contributing to this study are listed in Appendix S1 (online supporting information). CP, cerebral palsy; SCPE, Surveillance of Cerebral Palsy Europe; ACPR, Australian Cerebral Palsy Register.

Table 2: Prevalence of cerebral palsy by plurality, birthweight, and gestational age per 1000 live births and neonatal survivors

Plurality	Children born from a twin birth					Children born from a triplet birth					Triplets/twins RR (95% CI) (live births)	
	CP, <i>n</i> (%)	Live births	Prevalence per 1000 live births (95% CI)	NNS	Prevalence per 1000 NNS (95% CI)	CP, <i>n</i> (%)	Live births	Prevalence per 1000 live births (95% CI)	NNS	Prevalence per 1000 NNS (95% CI)		
Overall	1033	158 843	6.5 (6.1–6.9)	155 850	6.6 (6.2–7.0)	81	4748	17.1 (13.6–21.2)	4495	18.0 (14.3–22.3)	2.62 (2.1–3.3)	
Birthweight (g)			Commented [SC21]: Typesetter: Please insert a thin space									
<1000	222 (22)	4666	47.6 (41.6–54.1)	3004	73.9 (64.6–83.8)	27 (35)	554	48.7 (32.4–70.1)	361	74.8 (49.9–107.0)	1.02 (0.7–1.5)	.
1000–1499	274 (27)	7991	34.3 (30.4–38.5)	7650	35.8 (31.8–40.2)	30 (39)	986	30.4 (20.6–43.2)	968	31.0 (21.0–43.9)	0.89 (0.6–1.3)	.
1500–2499	371 (36)	64 734	5.7 (5.2–6.3)	64 121	5.8 (5.2–6.4)	19 (25)	2855	6.7 (4.0–10.4)	2829	6.7 (4.0–10.5)	1.16 (0.7–1.8)	.
≥2500	152 (15)	81 281	1.9 (1.6–2.2)	80 907	1.9 (1.6–2.2)	1 (1)	350	2.9 (0.1–15.8)	336	3.0 (0.1–16.5)	1.53 (0.0–8.6)	.
Unknown	14	171		168		4	3		1			.
Gestational age (wks)												.
≤28	233 (23)	4328	53.8 (47.3–61.0)	2743	84.9 (74.8–96.0)	26 (33)	429	60.6 (40.0–87.5)	255	102.0 (67.7–145.8)	1.13 (0.72–1.69)	.
28–31	319 (32)	9435	33.8 (30.3–37.7)	9000	35.4 (31.7–39.4)	36 (46)	1129	31.9 (22.4–43.9)	1118	32.2 (22.7–44.3)	0.94 (0.65–1.33)	.
32–36	297 (30)	65 168	4.6 (4.1–5.1)	64 594	4.6 (4.1–5.2)	17 (22)	2970	5.7 (3.3–9.1)	2912	5.8 (3.4–9.3)	1.26 (0.72–2.05)	.
≥37	154 (15)	79 801	1.9 (1.6–2.3)	79 543	1.9 (1.6–2.3)	0	271		200		N/A N/A	.
Unknown												.

^a38% born during the week 37, 40% week 38, 12% week 39, 8% week 40, and 2% week 41. Includes SCPE regions with available denominators and ACPR population registers only. Proportions exclude unknown data. For live births, the denominators consisted of the total number of individual children born alive from a twin, triplet, or quadruplet birth. For NNS, the denominators consisted of the total number of individual children born alive from a twin, triplet, or quadruplet birth and still alive at the age of 28 days after birth. RR, relative risk; CI, confidence interval; CP, cerebral palsy; NNS, neonatal survivors; N/A, not applicable; SCPE, Surveillance of Cerebral Palsy Europe; ACPR, Australian Cerebral Palsy Register.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 3: Characteristics and clinical outcomes for children with cerebral palsy by plurality

	Twins (<i>n</i> =2163)	Triplets (<i>n</i> =187)	Quadruplets (<i>n</i> =20)	<i>p</i> (univariate)	<i>p</i> (adjusted) ^a
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)		
Sex				0.44	0.37
Male	1205 (56)	110 (59)	9 (45)		
Female	958 (44)	77 (41)	11 (55)		
Unknown	0	0	0		
Birth order				N/A	N/A
First	1008 (52)	58 (31)	5 (29)		
Second	948 (48)	55 (29)	4 (24)		
Third	0	53 (28)	6 (35)		
Fourth	0	0	2 (12)		
Unknown	207	21 (11)	3		
Maternal age, mean (SD) y:mo	30:5 (5:2)	31:2 (5:4)	30:8 (4:0)	0.16	0.14
Motor subtype				0.04	0.13
Unilateral spastic	621 (30)	37 (21)	4 (21)		
Bilateral spastic	1311 (63)	126 (72)	13 (68)		
Dyskinetic	100 (5)	9 (5)	0		
Ataxic	48 (2)	3 (2)	2 (11)		
Unknown/other	83	12	1		
GMFCS level				0.13	0.05
I and II	1226 (59)	101 (57)	8 (42)		
III	279 (13)	28 (16)	7 (37)		
IV and V	586 (28)	48 (27)	4 (21)		
Unknown	72	10	1		
Intellectual impairment				0.44	0.39
None (IQ ≥70)	1097 (58)	106 (64)	8 (47)		
Some (IQ 50–69)	354 (19)	27 (16)	3 (18)		
Moderate-profound (IQ <50)	427 (23)	32 (19)	6 (35)		
Unknown	285	22	3		
Vision impairment				0.24	0.21
None	1211 (62)	103 (63)	8 (44)		
Some	606 (31)	44 (27)	9 (50)		
Severe	150 (8)	17 (10)	1 (6)		
Unknown	196	23	2		
Hearing impairment				0.89	0.98
None	1601 (90)	143 (92)	16 (94)		
Some	98 (6)	8 (5)	1 (6)		
Severe	74 (4)	5 (3)	0 (0)		
Unknown	390	31	3		
Epilepsy				0.08	0.14
No	1523 (75)	142 (81)	12 (63)		
Yes	514 (25)	33 (19)	7 (37)		
Unknown	126	12	1		

The proportions exclude unknown data. ^aAdjusted for gestational age and register network using polytomous logistic regression for all

clinical characteristics, except for maternal age where linear regression was used. GMFCS, Gross Motor Function Classification System.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Figure legends

Figure 1: Prevalence of cerebral palsy by plurality and gestational age per 1000 live births neonatal survivors.

Figure 2: (a) Temporal trends in the prevalence of cerebral palsy (CP) per 1000 live births by plurality. (b) Temporal trends in the prevalence of CP per 1000 live births for twins (birthweight in four categories). (c) Temporal trends in the prevalence of CP per 1000 live births for twins and triplets (birthweight in two categories). (d) Temporal trends in the prevalence of CP per 1000 live births for twins (gestational age in four categories). (e) Temporal trends in the prevalence of CP per 1000 live births for twins and triplets (gestational age in two categories).

Prevalence of cerebral palsy per 1000
live births

M
a
c

K
e
i
t
h

P
r
e
s
s

Figure 2a. Temporal trends in prevalence of cerebral palsy per 1000 live births by plurality

Temporal trends in prevalence of cerebral palsy per 1000 live births for:

2b. Twins (birthweight in four categories)

2c. Twins and triplets (birthweight in two categories)

2d. Twins (gestational age in four categories)

2e. Twins and triplets (gestational age in two categories)

Supplementary Table 1. Trends in prevalence of CP for children born from a twin birth.

Twins	Prevalence per 1000 live births							Prevalence per 1000 neonatal survivors						
	1992-1994	1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	P *	1992-1994	1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	p
<1000g	63.8 (39.9, 95.9)	53.3 (35.4, 76.5)	46.8 (32.4, 65.1)	56.6 (43.5, 72.3)	38.2 (27.9, 51.0)	40.5 (28.7, 55.4)	0.07	121 (76.7, 179.6)	89.4 (59.7, 127.4)	70.4 (48.9, 97.4)	89.8 (69.2, 114.1)	56.6 (41.4, 75.2)	60.3 (42.8, 82.1)	0.01
1000-1499g	40.3 (24.8, 61.6)	47.4 (33.6, 64.8)	43.7 (33.1, 56.4)	34.6 (26.6, 44.1)	30.1 (22.9, 38.9)	24.3 (17.6, 32.6)	< 0.001	44.6 (27.5, 68.1)	48.9 (34.7, 66.8)	45.6 (34.5, 58.9)	36.2 (27.9, 46.2)	31.1 (23.6, 40.1)	25.4 (18.5, 34.1)	<0.001
1500-2500g	6.5 (4.3, 9.6)	6.2 (4.4, 8.4)	5.5 (4.1, 7.2)	6.1 (4.9, 7.4)	6.0 (4.9, 7.4)	4.8 (3.8, 6.1)	0.10	6.9 (4.5, 10.1)	6.2 (4.4, 8.4)	5.5 (4.1, 7.2)	6.1 (4.9, 7.5)	6.0 (4.9, 7.4)	4.9 (3.8, 6.2)	0.09
≥2500g	3.4 (2.0, 5.2)	2.6 (1.7, 3.8)	2.2 (1.5, 3.1)	1.0 (0.6, 1.6)	2.2 (1.6, 3.0)	1.1 (0.6, 1.7)	0.001	3.5 (2.1, 5.4)	2.6 (1.7, 3.8)	2.2 (1.5, 3.1)	1.0 (0.6, 1.6)	2.2 (1.6, 3.0)	1.1 (0.6, 1.7)	0.001
< 28 weeks	74.0 (48.4, 107.3)	52.6 (34.3, 76.7)	60.1 (43.3, 80.9)	57.1 (43.5, 73.3)	45.7 (33.9, 60.2)	47.5 (33.8, 64.6)	0.08	131.6 (87.0, 188.1)	91.2 (59.9, 131.7)	88.5 (64.0, 118.6)	90.3 (69.1, 115.5)	71.0 (52.8, 93.0)	73.1 (52.2, 98.3)	0.03
28-31 weeks	40.9 (26.4, 60.2)	50.8 (37.8, 66.6)	35.0 (26.2, 45.6)	37.7 (29.8, 47.0)	28.6 (22.1, 36.3)	25.1 (18.9, 32.7)	<0.001	45.2 (29.2, 66.5)	52.1 (38.8, 68.3)	36.2 (27.1, 47.2)	39.0 (30.8, 48.5)	29.8 (23.1, 37.9)	27.0 (20.3, 35.2)	<0.001
32-36 weeks	4.7 (2.8, 7.4)	4.6 (3.1, 6.5)	4.7 (3.5, 6.3)	4.6 (3.6, 5.9)	4.8 (3.8, 6.0)	4.1 (3.1, 5.3)	0.47	4.9 (2.9, 7.8)	4.6 (3.1, 6.6)	4.7 (3.5, 6.3)	4.7 (3.6, 5.9)	4.8 (3.8, 6.0)	4.2 (3.2, 5.3)	0.44
≥ 37 weeks	3.3 (2.0, 5.2)	2.6 (1.7, 3.8)	2.0 (1.3, 2.8)	1.3 (0.9, 2.0)	2.3 (1.6, 3.1)	1.2 (0.7, 2.0)	0.008	3.5 (2.1, 5.5)	2.6 (1.7, 3.9)	2.0 (1.3, 2.9)	1.3 (0.9, 2.0)	2.3 (1.6, 3.1)	1.2 (0.7, 19.6)	0.006

* p-value compares prevalence between earliest (1992-1994) and most recent (2007-2009) birth year epochs; trend adjusted for network.

** Analysis of the interaction term between networks (ACPR and SCPE) and birth year suggested that the trends identified for twins were similar within all gestational age and birthweight groups (i.e. the model with the interaction term was not significantly better than the model without the interaction term). The only exceptions to this were for: i) the decline in prevalence of CP for twins born ≥ 37 weeks for live births and neonatal survivors only reached significance for the ACPR and ii) the decline in prevalence of CP for twins born 28-31 weeks per neonatal survivors only reached significance for SCPE (data not shown).

Supplementary Table 2. Trends in prevalence of CP for children born from a triplet birth.

Triplets	Prevalence per 1000 live births							Prevalence per 1000 neonatal survivors						
	1992-1994	1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	p	1992-1994	1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	p
<1500g	51.5 (20.9, 103.2)	36.9 (16.0, 71.3)	42.4 (22.1, 72.9)	35.8 (18.6, 61.7)	24.0 (10.4, 46.8)	42.4 (20.5, 76.5)	0.38	61.4 (25.0, 122.4)	45.5 (19.8, 87.6)	48.6 (25.4, 83.3)	41.1 (21.4, 70.7)	28.1 (12.2, 54.6)	46.5 (22.5, 83.9)	0.30
≥1500g	7.3 (0.9, 26.1)	6.5 (1.3, 18.8)	5.0 (1.0, 14.5)	8.5 (3.1, 18.4)	2.2 (0.1, 11.9)	2.2 (0.1, 11.9)	0.64	7.8 (0.9, 27.7)	6.5 (1.3, 18.8)	5.0 (1.0, 14.6)	8.5 (3.1, 18.5)	7.3 (2.4, 17.0)	2.2 (0.1, 12.1)	0.63
< 32 weeks	50.7 (20.6, 101.7)	34.5 (15.0, 66.8)	38.7 (20.2, 66.6)	41.8 (22.4, 70.4)	28.3 (13.7, 51.5)	56.1 (29.3, 95.9)	0.48	59.8 (24.4, 119.4)	41.9 (18.3, 80.9)	43.6 (22.7, 75.0)	46.9 (25.2, 78.9)	33.3 (16.1, 60.4)	56.3 (29.4, 96.3)	0.86
≥ 32weeks	7.4 (0.9, 2.7)	6.7 (1.4, 19.5)	3.5 (0.4, 12.5)	8.2 (3.0, 17.8)	4.4 (0.9, 12.9)	2.1 (0.1, 11.4)	0.10	7.9 (1.0, 28.2)	6.7 (1.4, 19.6)	3.5 (0.4, 12.7)	8.4 (3.1, 18.2)	4.5 (0.9, 13.0)	2.2 (0.1; 12.0)	0.34

* Analysis of the interaction term between networks (ACPR and SCPE) and birth year suggested that the trends identified for triplets were similar within all gestational age and birthweight groups (i.e. the model with the interaction term was not significantly better than the model without the interaction term).

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 26
- 27
- 28
- 29
- 30
- 31
- 32
- 33
- 34
- 35
- 36
- 37
- 38
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60

Appendix S1: Study registers

From Europe, we thank the Joint Research Centre, Registre des Handicaps de l'Enfant et Observatoire Périnatal, France; Registre des Handicaps de l'Enfant en Haute-Garonne, France; Cork and Kerry counties, Ireland; Northern Ireland Cerebral Palsy Register, UK; Cerebral Palsy Register of Western Sweden, Sweden; Eastern Ireland Cerebral Palsy Register, Ireland; 4Child, Oxford, UK; Danish Cerebral Palsy Register, Denmark; Cerebral Palsy Register of Central Italy-Viterbo, Italy; Cerebral Palsy Register of Norway, Norway; Bologna Cerebral Palsy Register, Italy; Galway Cerebral Palsy Register, Ireland; Madrid Cerebral Palsy Register, Spain; Slovenian Register of Cerebral Palsy, Slovenia; Programa Vigilancia Nacional da Paralisia Cerebral aos 5 anos de Idade, Portugal; Cerebral Palsy Database of Riga, Latvia; Cerebral Palsy Register of South-West Hungary, Hungary; Nicosia, Cyprus; Icelandic Cerebral Palsy Register, Iceland; Cerebral Palsy Register of Innsbruck, Austria; Belgian Cerebral Palsy Registry, Belgium; Register of Cerebral Palsy of Croatia, Croatia; Cerebral Palsy Register of St Gallen, Switzerland; Cerebral Palsy Register of Malta, Malta; Cerebral Palsy Register of Attica, Greece; North of England Register, UK.

From Australia, we thank the Australian Capital Territory and New South Wales Cerebral Palsy Register; Northern Territory Cerebral Palsy Register; Queensland Cerebral Palsy Register; South Australian Cerebral Palsy Register; Tasmanian Cerebral Palsy Register; Victorian Cerebral Palsy Register; and Western Australian Register of Developmental Anomalies (Cerebral Palsy).