National Congenital Anomaly and Rare Disease Registration Service

Congenital Anomaly Official Statistics 2020: Technical details

Contents

About the NDRS

The National Disease Registration Service (NDRS) is part of NHS Digital (NHSD). Its purpose is to collect, curate, quality assure and analyse data on patients with cancer, congenital anomalies, and rare diseases for the population of England. It provides robust surveillance to monitor and detect changes in health and disease in the population. NDRS is a vital resource that helps researchers, healthcare professionals and policy makers make decisions about NHS services and the treatments people receive.

The NDRS includes:

- the National Congenital Anomaly and Rare Disease Registration Service (NCARDRS)
- the National Cancer Registration and Analysis Service (NCRAS) and

Healthcare professionals, researchers and policy makers use data to better understand population health and disease. The data is provided by patients and collected by the NHS as part of their care and support. The NDRS uses the data to help:

- understand cancer, rare diseases, and congenital anomalies
- improve diagnosis
- plan NHS services
- improve treatment
- evaluate policy
- improve genetic counselling

NDRS
NATIONAL DISEASE REGISTRATION SERVICE

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1. Incidence and birth prevalence

Incidence is the total number of new cases of disease occurring in a population in a specified time period, whereas prevalence is the total number of all cases in a population at one point in time. Conventionally, as in this report, congenital anomaly registers report birth prevalence estimates. This is because a proportion of pregnancies affected with an anomaly will miscarry spontaneously before being identified. It is also not possible to provide a population estimate of the total number of pregnancies at risk of a congenital anomaly: there is no reliable estimate of the total number of pregnancies given some result in miscarriages, sometimes before a pregnancy is identified, and some result in terminations. Prevalence estimates are reported per 10,000 total births (live births and stillbirths); these are referred to as birth prevalence estimates even though the pregnancy may not result in a registered birth because of late miscarriage or termination.

Confidence intervals

Confidence intervals (CIs) are computed around a point estimate (e.g., prevalence and proportions) to quantify the imprecision that results from natural variation in the estimate of the value and find the range of values within which the true population value is likely to fall (Eayres, 2008). In this report, CIs are based on a 95% confidence level, hence these are expected to contain the true population values with 95% certainty. Comparing CIs across groups allows to assess whether differences in the estimates are likely to be true or due to natural variation. A wider confidence interval shows that the indicator value presented is likely to be a less precise estimate of the true underlying value. Comparisons are often made between 2 or more estimates. In this report, examples include comparisons of estimated birth prevalence across different regions of registration, maternal age category and type of congenital anomaly. Basic statistical testing is undertaken by comparing the confidence intervals of estimated birth prevalence to see if they overlap - with differences across non-overlapping confidence intervals being considered as statistically significant.

The confidence intervals used in this report for rates and counts are calculated using the Poisson distribution (Bégaud et al, 2005).

$$\text{Birth prevalence} = \frac{\text{Number of cases (live births + stillbirths + late miscarriages + TOPFAs)}}{\text{Number of births (live births+stillbirths)}} \text{ x } 10{,}000$$

$$\text{Lower 95\% confidence limit} = \frac{\left(\frac{1.96}{2} - \sqrt{\text{number of cases} + 0.02}\right)^2}{\text{number of births}} \text{ x } 10{,}000$$

$$\text{Upper 95\% confidence limit} = \frac{\left(\frac{1.96}{2} + \sqrt{\text{number of cases} + 0.96}\right)^2}{\text{number of births}} \text{ x } 10{,}000$$

The confidence intervals used for proportions are calculated using the Binomial distribution and the Wilson's method (Agresti et al, 1998). For instance, for total birth prevalence the formula is:

Lower 95% confidence limit = $$\frac{p+\frac{1.96^2}{2a}-1.96\sqrt{\frac{p(1-p)}{a}+\frac{1.96^2}{4a^2}}}{1+\frac{1.96^2}{a}}$$

Upper 95% confidence limit = $$\frac{p+\frac{1.96^2}{2a}+1.96\sqrt{\frac{p(1-p)}{a}+\frac{1.96^2}{4a^2}}}{1+\frac{1.96^2}{a}}$$

Where *a* = all cases (livebirths + fetal deaths + TOPFA), and *p* = estimated proportion in the observed sample.

More information about the use of confidence intervals is explained in the Public Health England (PHE) Technical Guide.

Denominators

The number of total births (live births and stillbirths) in England reported by the Office of National Statistics (ONS) is used to calculate total and live birth prevalence of congenital anomalies. These are obtained from the PHE Data Lake which is a SQL table updated each year with the birth data from ONS. We also obtain the number of births from each of the UK Crown Dependencies, Isle of Man, Jersey and Guernsey. These are added to the total births for the respective regions (North West and Wessex) and also to the overall total births for England.

2. Congenital anomaly groupings

Congenital anomaly subgroups

Congenital anomalies are aggregated into subgroups for much of the analysis in the report. These are based on a selection of the major European Surveillance of Congenital Anomalies (EUROCAT) subgroups as described in EUROCAT Guide 1.5.

In the present report for 2020, three EUROCAT subgroups were excluded from the analyses by subgroups:

- “Eye”, due to ascertainment issues at the national level
- “Ear, face and neck”, due to ascertainment issues at the national level
- “Other anomalies/syndromes”, due to the heterogenous nature of all the congenital anomalies included in this group.

These three subgroups and related selected conditions are represented in Data table 1 of the NCARDRS Congenital Anomaly Official Statistics 2020: Data tables document (please, see spreadsheet in attachment to the report), however these are not accounted for in the remaining analyses whenever subgroups are presented.

Severe cardiac subgroup

Severe cardiac anomalies are a subgroup comprised of the following congenital heart anomalies:

- common arterial trunk
- transposition of great vessels
- single ventricle
- atrioventricular septal defect
- tetralogy of Fallot
- tricuspid atresia and stenosis
- Ebstein's anomaly
- pulmonary valve atresia
- aortic valve atresia/stenosis
- hypoplastic left heart
- hypoplastic right heart
- coarctation of aorta
- total anomalous pulmonary venous return

Genetic and non-genetic congenital anomalies

Genetic anomalies are those included in the binary code al105_geneticsyndromes, from version 1.5 of EUROCAT subgroups.

3. Timing of detection and confirmation

Anomalies are registered according to varying degrees of certainty depending on the clinical evidence available: confirmed, probable or suspected. Anomalies remain at the level of suspected until the evidence supporting the diagnosis of the anomaly attains agreed confirmation criteria. Only confirmed or probable anomalies are included in annual reporting. Timing of the identification of an anomaly (antenatal/postnatal) is represented by timing of detection and timing of confirmation. Timing of detection is defined as the point at which an anomaly is first suspected clinically, and timing of confirmation is defined as the point at which the anomaly is confirmed by a diagnostic test; confirmation is reported only in relation to Trisomy 13, Trisomy 18 and Trisomy 21 and relies on a diagnostic genetic test.

Timing of the first detection of a baby with a congenital anomaly

This relates to the first anomaly identified in a baby and so is designated at a case-level. Other anomalies in a baby may be identified at a later stage, and where there are multiple anomalies, the timing of detection of all these subsequently identified anomalies will be when the baby was first suspected as having a congenital anomaly. For example, in a baby with a congenital heart anomaly that was detected antenatally and a digestive anomaly detected postnatally, the timing of detection for the baby (and for both conditions) would be antenatal.

Timing of the first detection of each congenital anomaly group

If there are multiple anomalies within a subgroup then any which are antenatally diagnosed will count as an overall antenatal diagnosis for the subgroup. For example, if a baby has two heart anomalies, one antenatally diagnosed and one postnatally diagnosed, this will count as an antenatal diagnosis for the congenital heart subgroup.

Timing of confirmation (Trisomy 13, Trisomy 18 and Trisomy 21)

Confirmation is based on a definitive diagnosis of a trisomy from genetic test. Where a baby has had both a prenatal and a postnatal diagnostic test, the earlier diagnosis is taken as the point of ascertainment. If the presence of a trisomy had been clinically suspected due to a structural anomaly seen on ultrasound scan, for example a heart anomaly, the presence of the trisomy might not be confirmed until after the baby was delivered.

4. Important public health indicators

Maternal age

The denominators used for maternal age in the analyses presented in this NCARDRS report for data from year 2020 in England are below. They are obtained from the ONS.

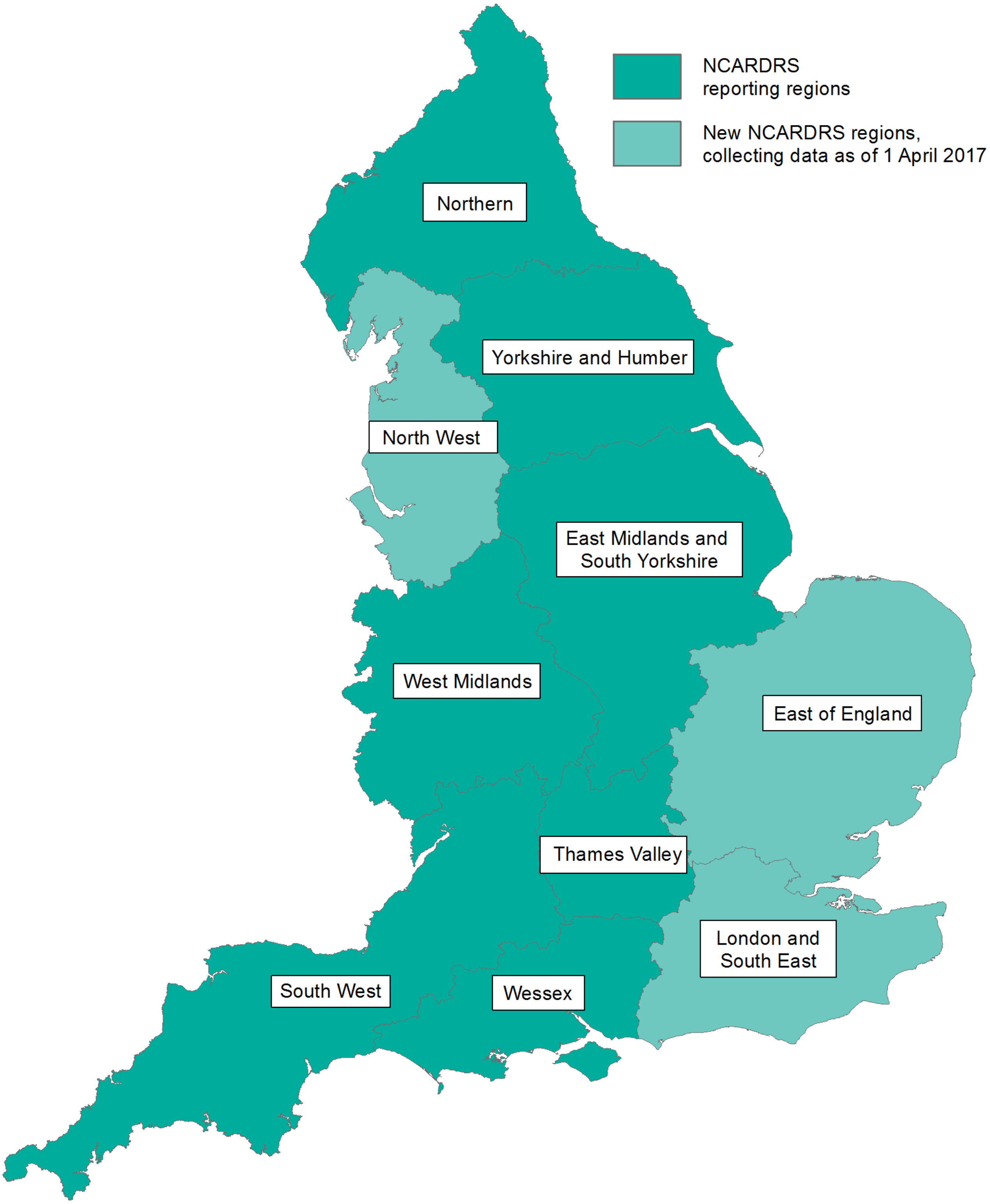
Table 1. Total birth denominators by maternal age for England, 2020

Congenital anomaly	Age group	Population	Number of anomalies
All anomalies	All ages	587,931	13,064
All anomalies	Under 20	15,079	357
All anomalies	20 to 24	75,350	1,599
All anomalies	25 to 29	156,994	3,183
All anomalies	30 to 34	197,559	3,890
All anomalies	35 to 39	114,349	2,889
All anomalies	40 and over	28,600	1,146

5. Geographical coverage of the NCARDRS regions

NCARDRS is made up of 10 reporting regions in England (Figure 1). The regional boundaries used in this report are the EUROCAT reporting regions for England. To preserve the longitudinal trend, they are consistent with the legacy registers for the regions that were collecting data prior to the establishment of NCARDRS in 2015 (East Midlands and South Yorkshire, Northern, South West, Thames Valley and Wessex). Table 2 in Appendix 1 lists the local authorities that are included in each region.

Figure 1: Map of NCARDRS reporting regions England, 2020



6. Data collection

Congenital anomalies are defined as being present at delivery, originating before birth, and include structural and genetic anomalies. Screening during pregnancy can detect some congenital anomalies, while some are found at birth. Others are detected as a baby grows older.

Congenital anomaly data are collected from several different sources including:

- maternity units
- neonatal units
- diagnostic departments (paediatric, neonatal, clinical genetics, antenatal ultrasound, fetal medicine, pathology)
- genetic laboratories
- National health service (NHS) trust IT departments
- local audit schemes
- disease-specific registers
- neighbouring national registers

This multiple- source reporting enables NCARDRS to achieve the highest possible ascertainment of congenital anomalies in the population. Much of the focus to date has been on ensuring high ascertainment and completeness of cases nationally and ensuring consistency and standardisation across the country.

Data in electronic form are regularly sent to NCARDRS by every NHS cytogenetic laboratory in England, giving complete national ascertainment from this data feed. Laboratories follow a specific case definition, to ensure national consistency and data quality. Data are supplied for antenatal and postnatal testing (the latter category including fetal losses as well as livebirths), and for all test methods used in cytogenetics laboratories.

Data is collected on all suspected and confirmed congenital anomalies identified in utero, at birth or at any point in childhood. In addition to babies that are liveborn or stillborn that have congenital anomalies, information about termination at any gestation and miscarriages where an anomaly is present is also collected. NCARDRS only report anomalies that are recorded in pregnancies that end in a late miscarriage (20 to 23 completed weeks gestation) as ascertainment of all miscarriages with congenital anomalies is not possible.

Data is input onto a single data management system and registered by a team of dedicated registration officers and analysts. NCARDRS currently takes electronic data from over 500 NHS providers across the country.

NCARDRS collects information about the mother and child, including postcode of residence, mother's age, pregnancy length, pregnancy outcome, when and how the anomaly was identified and the details of each anomaly. Some identifiable information is collected on the mother and child but only enough information to avoid duplicate registrations and for the validation of cases, ensuring accurate matching between antenatally diagnosed anomalies and postnatal notifications.

7. Data quality

All 10 reporting regions have submitted data to the EUROCAT since the 2018 birth year cohort and followed their data quality procedures, ensuring collection of a number of harmonised core variables. More information can be found in the EUROCAT Guidelines for data registration. In addition, there is an established national process and system for data collection, processing and quality assurance, adopting internationally approved methods of coding, recording and analysis.

Inclusion criteria

All livebirths, fetal deaths with gestational age greater than or equal to 20 weeks and termination (at any gestational age) with at least one registered anomaly delivered in England are included for reporting.

Information on babies is included if they have:

- A postcode at delivery, to establish residency in England
- A date of birth within the report year
- At least one confirmed or probable anomaly

All babies with Down’s syndrome, Edwards’ syndrome or Patau’s syndrome delivered in 2020 according to the case definition previously described with a confirmed cytogenetic laboratory diagnosis provided as part of care from NHS and private providers who submit data to NCARDRS are included within this report. This includes results obtained from conventional karyotyping (full or targeted), rapid aneuploidy testing (usually by quantitative fluorescence polymerase chain reaction or fluorescence in situ hybridization), or microarray analysis. All specimen types are included, including prenatal (amniocentesis, chorionic villus sampling, fetal blood), postnatal (blood, buccal swab) and post-mortem (solid tissue). Babies with a high chance non-invasive prenatal testing (NIPT) and a clinical suspicion of Down’s syndrome, Edwards’ syndrome or Patau’s syndrome based on postnatal phenotype, but with no further testing, are also included in this report.

Coding and reporting

NCARDRS codes congenital anomalies according to the paediatric adaptation of ICD-10 produced by the British Paediatric Association (BPA). The BPA classification specifies more clinical terms than ICD-10 and provides greater granularity for analytical purposes using 5th character extensions to many ICD-10 codes. NCARDRS uses a modified version of the EUROCAT congenital anomaly subgroup categories for reporting (see above Congenital anomaly groupings section). These subgroups use ICD10 codes with the BPA extension to group together conditions by body system and anomaly type.

8. References

Agresti A, Coull BA. Approximate is Better than “Exact” for Interval Estimation of Binomial Proportions. *The American Statistician*, 1998: volume 52(2), pages 119-126

Bégaud B, Martin K, Abouelfath A, Tubert-Bitter P, Moore N, Moride Y. ‘An easy to use method to approximate Poisson confidence limits.’ *European Journal of Epidemiology,* 2005: volume 20, pages 213-216

Eayres D. Technical Briefing 3: Commonly used public health statistics and their confidence intervals. APHO; 2008. Available at https://fingertips.phe.org.uk/documents/APHO Tech Briefing 3 Common PH Stats and CIs.pdf

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9. Appendix: geographical coverage of the NCARDRS regions in this report

Table 2. Geographical coverage of the NCARDRS regions in this report

NCARDRS region	**Local authorities**	
East of England	Peterborough Luton Southend-on-Sea Thurrock Bedford Central Bedfordshire Cambridge East Cambridgeshire Fenland Huntingdonshire South Cambridgeshire Basildon Braintree Brentwood Castle Point Chelmsford Colchester Epping Forest Harlow Maldon Rochford Tendring Uttlesford	Broxbourne Dacorum Hertsmere North Hertfordshire Three Rivers Watford Breckland Broadland Great Yarmouth King’s Lynn and West Norfolk North Norfolk Norwich South Norfolk Babergh Ipswich Mid Suffolk St Albans Welwyn Hatfield East Hertfordshire Stevenage West Suffolk East Suffolk
East Midlands and South Yorkshire	Amber Valley Ashfield Barnsley Bassetlaw Balby Bolsover Boston Broxtowe Charnwood Chesterfield Corby Daventry Derby Derbyshire Dales Doncaster	Leicester Lincoln Mansfield Melton Newark and Sherwood North East Derbyshire North East Lincolnshire North Kesteven North Lincolnshire North West Leicestershire Northampton Nottingham Oadby and Wigston Rotherham Rushcliffe

NCARDRS region	Local authorities	
	East Lindsey East Northamptonshire Erewash Gedling Harborough High Peak Hinckley and Bosworth Kettering	Rutland Sheffield South Derbyshire South Holland South Kesteven South Northamptonshire Wellingborough West Lindsey

NCARDRS region	Local authorities	
London and South East	Medway Brighton and Hove Eastbourne Hastings Lewes Rother Wealden Ashford Canterbury Dartford Dover Gravesham Maidstone Sevenoaks Shepway Swale Thanet Tonbridge and Malling Tunbridge Wells Elmbridge Epsom and Ewell Guildford Mole Valley Reigate and Banstead Runnymeade Spelthorne Surrey Heath Tandridge Waverley Woking Adur Arun Chichester Crawley Horsham	Mid Sussex Worthing City of London Barking and Dagenham Barnet Bexley Brent Bromley Camden Croyden Ealing Enfield Greenwich Hackney Hammersmith and Fulham Haringey Harrow Havering Hillingdon Hounslow Islington Kensington and Chelsea Kingston upon Thames Lambeth Lewisham Merton Newham Redbridge Richmond upon Thames Southwark Sutton Tower Hamlets Waltham Forest Wandsworth Westminster
Northern	Allerdale Carlisle Copeland County Durham Darlington Eden Gateshead	Middlesbrough Newcastle upon Tyne North Tyneside Northumberland Redcar and Cleveland South Tyneside Stockton-On-Tees

NCARDRS region	Local authorities	
	Hartlepool	Sunderland
North West	Halton Warrington Blackburn with Darwen Blackpool Cheshire East Cheshire West and Chester Barrow-in-Furness South Lakeland Burnley Chorley Fylde Hyndburn Lancaster Pendle Preston Ribble Valley Rossendale South Ribble	West Lancashire Wyre Bolton Bury Manchester Oldham Rochdale Salford Stockport Tameside Trafford Wigan Knowsley Liverpool St.Helens Sefton Wirral
South West	Bath and North East Somerset Bristol, City of Cheltenham Cornwall Cotswold East Devon Exeter Forest of Dean Gloucester Isles of Scilly Mendip Mid Devon North Devon North Somerset	Plymouth Sedgemoor South Gloucestershire South Hams South Somerset Stroud Swindon Taunton Deane Teignbridge Tewkesbury Torbay Torridge West Devon West Somerset Wiltshire (excluding Salisbury)
Thames Valley	Aylesbury Vale Bracknell Forest Cherwell Chiltern Milton Keynes Oxford Reading Slough	South Bucks South Oxfordshire Vale of White Horse West Berkshire Windsor and Maidenhead Wokingham Wycombe

NCARDRS region	Local authorities	
Wessex	Basingstoke and Deane Bournemouth Christchurch East Dorset East Hampshire Eastleigh Fareham Gosport Hart Havant Isle of Wight New Forest	North Dorset Poole Portsmouth Purbeck Rushmoor Southampton Test Valley West Dorset Weymouth and Portland Wiltshire (Salisbury only) Winchester
West Midlands	Birmingham Bromsgrove Cannock Chase Coventry Dudley East Staffordshire Herefordshire, County of Lichfield Malvern Hills Newcastle-under-Lyme North Warwickshire Nuneaton and Bedworth Redditch Rugby Sandwell	Shropshire Solihull South Staffordshire Stafford Stoke-on-Trent Stratford-on-Avon Tamworth Telford and Wrekin Walsall Warwick Wolverhampton Worcester Wychavon Wyre Forest
Yorkshire and Humber	Bradford Calderdale Craven East Riding of Yorkshire Hambleton Harrogate Kingston upon Hull, City of Kirkless	Leeds Richmondshire Ryedale Scarborough Selby Wakefield York