Department for Communities and Local Government

The English Indices of Deprivation 2015

Technical report

September 2015
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Department for Communities and Local Government

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Preface

The English Indices of Deprivation are an important tool for identifying the most deprived areas in England. Local policy makers and communities can also use this tool for the effective targeting of resources.

The English Indices of Deprivation 2015 is the fifth release in a series of statistics produced to measure multiple forms of deprivation at the small spatial scale. Following engagement with users and a significant programme of work by the research team, the Indices of Deprivation 2015 retain broadly the same methodology, domains and indicators as the earlier Indices of Deprivation 2010, 2007, 2004 and 2000.

This report outlines the theory underpinning the model of multiple deprivation, the methods that were used, and describes the domains and indicators that make up the Indices of Deprivation 2015. A small number of changes to the indicators have been made, for example due to better availability of data, which are described in this report.

In addition to the technical details presented in this report, the Statistical Release produced by the Department of Communities and Local Government (DCLG) contains information on how to use and interpret the Indices, and there is further detail in the Research Report. DCLG has also produced short, accessible guidance and responses to frequently asked questions.

All of the supporting documents and datasets for the Indices of Deprivation 2015 are available from:
www.gov.uk/government/statistics/english-indices-of-deprivation-2015

The data has also been loaded into the DCLG's Open Data Communities platform[1] and made available on the Neighbourhood Statistics website[2].

[1] UK Department for Communities and Local Government's official Linked Open Data website http://opendatacommunities.org/
[2] ONS Neighbourhood Statistics http://www.neighbourhood.statistics.gov.uk/dissemination/

Acknowledgements

The English Indices of Deprivation 2015 were constructed by Oxford Consultants for Social Inclusion (OCSI). The research team comprised: Tom Smith, Michael Noble, Stefan Noble, Gemma Wright, David McLennan and Emma Plunkett.

In addition, some indicators from the Health Deprivation and Disability Domain were constructed by Karen Bloor, Nils Gutacker and Richard Cookson at the University of York; the air quality indicator by Jon Fairburn at Staffordshire University; the housing affordability indicator by Glen Bramley at Heriot-Watt University; and the housing condition indicator by the Building Research Establishment.

Chris Dibben at the University of Edinburgh acted as statistics and methodology advisor, external quality assurance was carried out by Alex Sutherland at Cambridge University, and geographic information system work was undertaken by David Avenell. Julia Griggs and Kirby Swales at the National Centre for Social Research carried out the user survey and engagement. Additional support at Oxford Consultants for Social Inclusion was provided by Sophie Hale, Dan Kidby and Paul Shanks.

The research team would also like to thank the Strategic Statistics Division and the Project Board within the Department for Communities and Local Government, the project Advisory Group, and all the suppliers of data.

We would like to thank all those who assisted in the production of the Indices of Deprivation 2015, in particular all those who responded to the survey of users, the consultation and/or attended user events.

Chapter 1. Introduction

1.1 Introduction

1.1.1 The Department for Communities and Local Government commissioned Oxford Consultants for Social Inclusion (OCSI) to review and update the English Indices of Deprivation 2010. The project remit was to:

- review the indicators included in the Indices of Deprivation 2010 to determine if they remain fit for purpose, and where there is a clear rationale for doing so, identify potential changes to the basket of indicators in each domain;
- assess the current data landscape, identify changes to (or outdatedness of) previously used sources, as well as any new sources;
- review whether the statistical methods used in the production of the Indices of Deprivation 2010 are still justified and assess if alternative methods are available and the strengths and weaknesses of any such alternatives;
- produce the updated Indices of Deprivation 2015.

1.1.2 Following engagement with users and a significant programme of work by the research team, the Indices of Deprivation 2015 have been produced using the same approach, structure and methodology used to create the previous Indices of Deprivation 2010. Changes to existing domains and sub-domains were outside the scope of the update, although there have been a modest number of changes to the basket of indicators used in the domains.

1.1.3 Feedback from users was supportive of the decision not to make major changes to the Indices. Maintaining comparability with previous versions of the Indices is important to them. The updated Indices continue to be based on the Lower-layer Super Output Area geography, although the updated Indices use the new 2011 version of the Lower-layer Super Output Area geography.

1.2 Overview of the Indices of Deprivation 2015

1.2.1 The Indices of Deprivation 2015 provide a set of relative measures of deprivation for small areas (Lower-layer Super Output Areas) across England, based on seven different domains of deprivation:

- Income Deprivation
- Employment Deprivation
- Education, Skills and Training Deprivation
- Health Deprivation and Disability
- Crime
- Barriers to Housing and Services
- Living Environment Deprivation

1.2.2 Each of these domains is based on a basket of indicators. As far as is possible, each indicator is based on data from the most recent time point available; in practice most indicators in the Indices of Deprivation 2015 relate to the tax year 2012/13.

1.2.3 The Index of Multiple Deprivation 2015 combines information from the seven domains to produce an overall relative measure of deprivation. The domains are

combined according to their respective weights as described in section 3.7. In addition, there are seven domain-level indices, and two supplementary indices: the Income Deprivation Affecting Children Index and the Income Deprivation Affecting Older People Index.

1.2.4 A range of summary measures are available for higher-level geographies including local authority districts and upper tier local authorities, local enterprise partnerships, and clinical commissioning groups. These summary measures are produced for the overall Index of Multiple Deprivation, each of the seven domains and the supplementary indices.

1.2.5 The Index of Multiple Deprivation 2015, domain indices and the supplementary indices, together with the higher area summaries, are collectively referred to as the Indices of Deprivation 2015.

1.3 Research leading up to publication of the Indices of Deprivation 2015

1.3.1 The development of the Indices of Deprivation follows extensive exploration of data sources, review of methodology and testing and quality assurance of data sources and indicators. The development also takes into account the range of views gathered prior to and during the earlier phases of this project, including:

- feedback from users gathered during a session on the Indices at the DCLG Statistics User Engagement Day in November 2013
- the views of the Government Statistical Service Methodology Advisory Committee on a paper on methodology and indicators presented in November 2013[3]
- responses from almost 250 users to a survey which took place in July 2014
- the views of the department's Project Board and its Advisory Group, comprising representatives from central and local government and other interest groups, including the voluntary and community sector
- feedback from users on dissemination and outputs gathered during three user events held in November 2014
- 100 responses to the consultation which took place in November and December 2014.

1.4 About this Technical Report

1.4.1 This report presents the conceptual framework of the Indices of Deprivation 2015; the methodology for creating the domains and the overall Index of Multiple Deprivation; the component indicators and domains and the quality assurance carried out to ensure reliability of the data outputs.

1.4.2 The main findings from the Indices of Deprivation are presented in the DCLG Statistical Release[4], and an accompanying research report[5] gives a fuller account with examples of how to use the Indices.

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[3] Government Statistical Service Methodology Advisory Committee 26 minutes and papers: http://www.ons.gov.uk/ons/guide-method/method-quality/advisory-committee/26th-meeting/index.html

1.4.3 Improvements to the reports have been made in response to demand from users. The majority of users reported finding the Indices easy to use and interpret in the user survey. But there was demand for short and clearer guidance on how to use the Indices and for support in communicating this to others, particularly non-specialists.

1.4.4 All project outputs are available to download from www.gov.uk/government/statistics/english-indices-of-deprivation-2015

[4] Department of Communities and Local Government (2015). The English Indices of Deprivation 2015, Statistical Release.
[5] Department of Communities and Local Government (2015). The Indices of Deprivation 2015. Research Report.

Chapter 2. Measuring deprivation at the small area level: The conceptual framework

2.1 Overview

2.1.1 The Index of Multiple Deprivation 2015 is a measure of multiple deprivation at the small area level. The model of multiple deprivation which underpins the Index is the same as that which underpinned its predecessors[6] and is based on the idea of distinct dimensions of deprivation which can be recognised and measured separately.

2.1.2 These dimensions (or domains) of deprivation are experienced by individuals living in an area. The overall Index of Multiple Deprivation is a measure of multiple deprivation based on combining together these specific dimensions of deprivation.

2.2 Poverty, deprivation and multiple deprivation

2.2.1 In his 1979 account of *Poverty in the United Kingdom* Townsend sets out the case for defining poverty in relative terms: 'Individuals, families and groups can be said to be in poverty if they lack the resources to obtain the types of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged or approved in the societies to which they belong'[7]. Townsend further argues that 'people can be said to be *deprived* if they lack the types of diet, clothing, housing, household facilities and fuel and environmental, educational, working and social conditions, activities and facilities which are customary …'[8]

2.2.2 Though 'poverty' and 'deprivation' have often been used interchangeably, many have argued that a clear distinction should be made between them[9]. People are in *poverty* if they lack the financial resources to meet their needs, whereas people can be regarded as *deprived* due to a lack of resources of all kinds, not just income. The Index of Multiple Deprivation framework follows Townsend, in defining

[6] The previous versions of the Index of Multiple Deprivation 2015 which broadly follow the same framework and methodology for measuring multiple deprivation are the Index of Multiple Deprivation 2010, 2007, 2004 and 2000. See McLennan et al. (2011) https://www.gov.uk/government/statistics/english-indices-of-deprivation-2010; Noble et al. (2008) http://webarchive.nationalarchives.gov.uk/+/http:/www.communities.gov.uk/communities/neighbourhoodrenewal/deprivation/deprivation07/; Noble et al. (2004) http://webarchive.nationalarchives.gov.uk/20100410180038/http://www.communities.gov.uk/archived/general-content/communities/indicesofdeprivation/216309/ and Noble et al (2000) http://webarchive.nationalarchives.gov.uk/20100410180038/http:/www.communities.gov.uk/archived/general-content/communities/indicesofdeprivation/indicesofdeprivation/.

[7] Townsend (1979), *Poverty in the United Kingdom*, p.31.

[8] Townsend (1987), *Deprivation*, p.125-126, our italics.

[9] See for example the discussion in Nolan and Whelan (1996).

deprivation in a broad way to encompass a wide range of aspects of an individual's living conditions.

2.2.3 Townsend also lays down the foundation for articulating multiple deprivation as an accumulation of several types of deprivation. This formulation of multiple deprivation is the starting point for the model of small area deprivation which is presented here.

2.3 Dimensions of deprivation

2.3.1 The approach allows the separate measurement of different dimensions of deprivation. Seven main types of deprivation are considered in the Index of Multiple Deprivation 2015 – income, employment, education, health, crime, access to housing and services, and living environment – and these are combined to form the overall measure of multiple deprivation.

2.3.2 There is a question as to whether low income or the lack of socially perceived necessities (for example adequate diet, consumer durables, ability to afford social activities etc) should be one of the dimensions[10]. To follow Townsend, within a multiple deprivation measure only the types of deprivation resulting from a low income would be included. So low income itself would not be a component, but lack of socially perceived necessities would. However, there is no readily available small area data on the lack of socially perceived necessities, and therefore low income is an important proxy for these aspects of material deprivation.

2.3.3 Despite recognising income deprivation in its own right, it should not be the only measure of area deprivation. Other dimensions of deprivation contribute crucial further information about an area. However, low income remains a central component of the definition of multiple deprivation used here. As Townsend writes 'while people experiencing some forms of deprivation may not all have low income, people experiencing multiple or single but very severe forms of deprivation are in almost every instance likely to have very little income and little or no other resources'[11].

2.4 Combining dimensions of deprivation into a multiple deprivation measure

2.4.1 Measuring different aspects of deprivation and combining these into an overall multiple deprivation measure raises a number of questions. Perhaps the most important one is the extent to which area deprivation in one dimension can be *cancelled* out by lack of deprivation in another dimension. Thus if an area is found to have high levels of income deprivation but relatively low levels of education deprivation, should the latter cancel out the former and if so to what extent? The Index of Multiple Deprivation 2015 is essentially based on a weighted cumulative

[10] Gordon et al. (2000).
[11] Townsend (1987), *Deprivation*, p.131.

model and the methodology is designed to ensure that cancellation effects are minimised[12].

2.4.2 Another question concerns the extent to which the same people or households are represented in more than one of the dimensions of deprivation. The position taken in the Index of Multiple Deprivation 2015 is that if an individual, family or area experiences more than one form of deprivation this is 'worse' than experiencing only one form of deprivation. The aim is not to eliminate double counting *between* domains – indeed it is desirable and appropriate to measure situations where deprivation occurs on more than one dimension.

2.4.3 On the other hand, it is desirable to eliminate double counting of people or households *within* domains. So for example, the Income Deprivation and Employment Deprivation domains, and the Adult Skills sub-domain, are constructed from non-overlapping counts of people experiencing such deprivation. However in practice, it is not always possible to avoid double counting in the indicators within domains.

2.5 An area-based model of multiple deprivation

2.5.1 The model of multiple deprivation is based on the idea of separate dimensions of deprivation which can be recognised and measured separately. These are experienced by individuals living in an area, and an area-level measure of deprivation for each of the dimensions (or domains) can in principle be measured.

2.5.2 An area can be characterised as deprived *relative to other areas* on a particular dimension of deprivation, on the basis that a higher proportion of people in the area are experiencing the type of deprivation in question. In other words, the experience of the people in an area gives the area its deprivation characteristics.

2.5.3 The area itself is not deprived, though the presence of a concentration of people experiencing deprivation in an area may give rise to a compounding deprivation effect, but this is still measured by reference to those individuals. Having attributed the aggregate of individual experience of deprivation to the area, it is possible to say that an area is deprived in that particular dimension.

2.5.4 Having measured specific dimensions of deprivation, these can be understood as separate domains of multiple deprivation. The overall Index of Multiple Deprivation is constructed by combining together these specific dimensions to produce an area-level measure of multiple deprivation. As with the individual dimensions of deprivation, an area can be characterised as deprived relative to other areas, but is not in itself deprived.

2.5.5 The following chapters outline how the Indices of Deprivation 2015 and Index of Multiple Deprivation 2015 have been designed and developed based on the conceptual model of multiple deprivation outlined in this chapter.

[12] See Appendix F for details of how the Indices of Deprivation 2015 methodology minimises cancellation effects across the domains.

Chapter 3. Methods

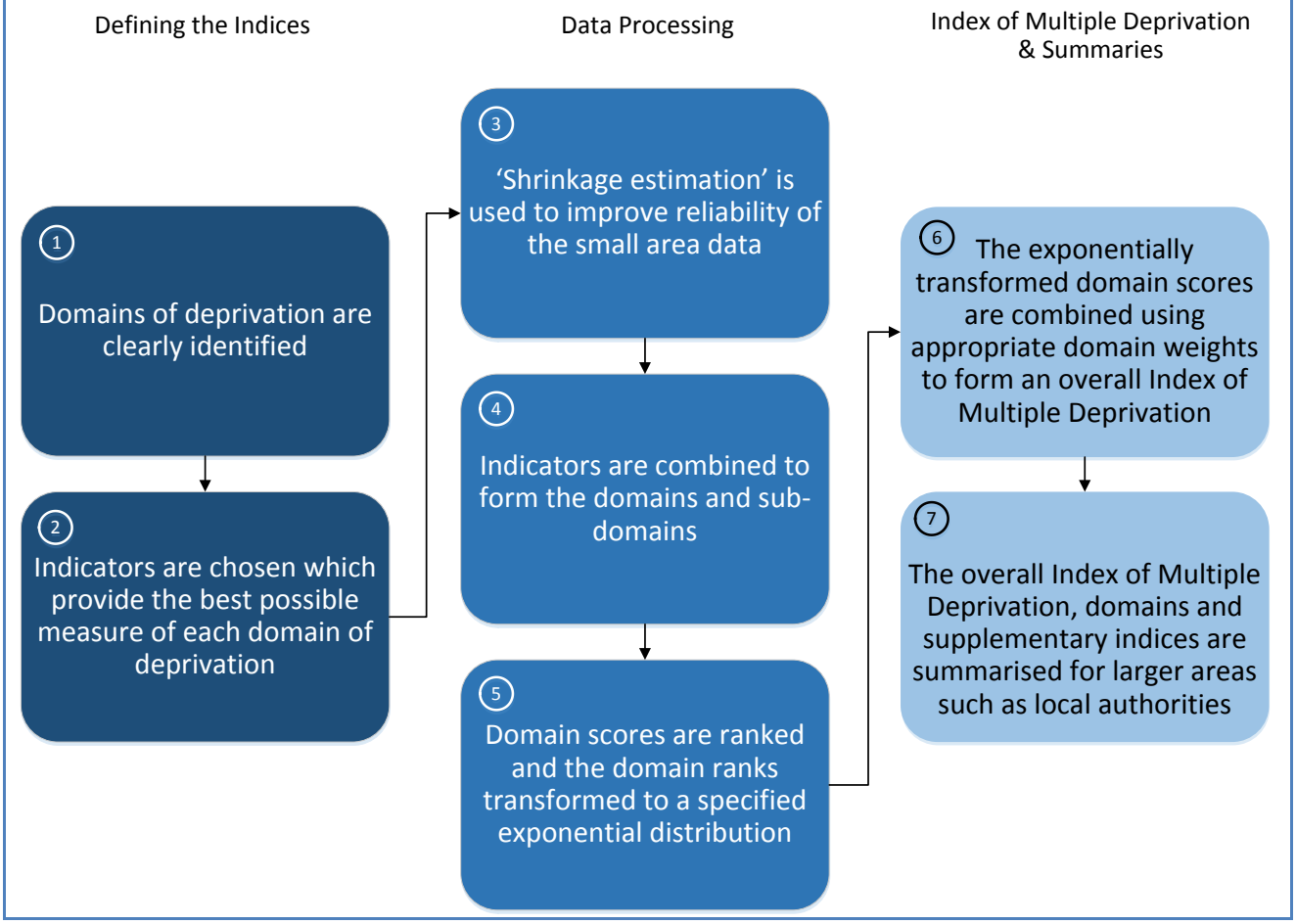
3.1 Overview of the methodology used to construct the Indices of Deprivation 2015

3.1.1 The construction of the Indices of Deprivation 2015[13], including the Index of Multiple Deprivation broadly consists of the following seven stages. As shown in Figure 3.1, these stages fulfil the purposes of defining the Indices, data processing, and producing the Index of Multiple Deprivation and summary measures. Each stage is described in the following sections. Figure 3.3 summarises how these stages are applied in producing each of the domain indices and the Index of Multiple Deprivation.

1. Dimensions (referred to as domains) of deprivation are clearly identified.
2. Indicators are chosen which provide the best possible measure of each domain of deprivation.
3. 'Shrinkage estimation' is used to improve reliability of the small area data[14].
4. Indicators are combined to form the domains, generating separate domain scores. These can be regarded as indices in their own right – the domain indices[15].
5. Domain scores are ranked and the domain ranks are transformed to a specified exponential distribution[16].
6. The exponentially transformed domain scores are combined using appropriate domain weights to form an overall Index of Multiple Deprivation at small area level[17]. This stage completes the construction of the Indices of Deprivation 2015 at Lower-layer Super Output Area level.
7. The overall Index of Multiple Deprivation, the domains and the supplementary indices are summarised for higher level geographical areas such as local authority districts.

[13] The Index of Multiple Deprivation 2015, domain indices and the supplementary indices, together with the higher area summaries, are collectively referred to as the Indices of Deprivation 2015.
[14] See Section 3.4 and Appendix D for description of the shrinkage technique.
[15] In domains where there are sub-domains, this stage involves first combining the indicators into a sub-domain score. The sub-domain scores are then ranked and transformed to an exponential distribution before being combined into their respective domain scores. The supplementary indices are also created at this stage as a subset of Income Domain scores.
[16] See Section 3.6 and Appendix F for description of the exponential transformation.
[17] See Section 3.7 and Appendix G for description of the domain weights.

Figure 3.1. Overview of the methodology used to construct the Indices of Deprivation 2015



Robustness of the methods and datasets

3.1.2 The methods used to construct the Indices of Deprivation 2015 have been carefully designed to ensure the robustness and reliability of the output datasets. Chapter 5 describes how the design of the Indices contributes to this, along with many other quality management actions and quality assurance checks.

3.1.3 As will be reiterated when considering the selection of indicators, the robustness of the index methodology is reinforced by the fact that a consistent and uniform methodology is applied across the country. The indices are a *relative* measure of multiple deprivation. The national comparisons that such a relative measure enables are only possible if the same methodology is consistently applied irrespective of local conditions or the local availability of data.

Changes since the Indices of Deprivation 2010

3.1.4 Maintaining comparability with previous versions of the Indices is important to users. Scoping work undertaken for this project did not identify ways to improve the methodology, and feedback from users during the consultation stages of this project was supportive of the decision not to make major changes to the Indices. For these reasons, the methods used in developing the Indices of Deprivation 2015 update have remained consistent with those used in 2010.

3.1.5 Changes since the Indices of Deprivation 2010 are therefore mainly confined to updates to the data used to create the indicators, and a small number of new, modified and dropped indicators. These are outlined in Stage 2 below, and discussed in more detail in Chapter 4 and Appendix C under the appropriate domains.

3.2 Stage 1: Domains of deprivation are clearly identified

3.2.1 The central idea of the Index of Multiple Deprivation is that deprivation is multi-dimensional and can be experienced in relation to a number of distinct domains. Multiple deprivation is measured at an area level by combining these domains. It is therefore important that each dimension of deprivation is clearly identified and reflects a particular aspect of deprivation.

3.2.2 The Indices of Deprivation 2015 are based on the same seven domains used in the previous 2010 and 2007 Indices:

- Income Deprivation
- Employment Deprivation
- Education, Skills and Training Deprivation
- Health Deprivation and Disability
- Crime
- Barriers to Housing and Services
- Living Environment Deprivation.

3.2.3 Appendix N on the history of the indices gives a high level account of the changes to domains and component indicators since the inception of the indices in their current form with the Indices of Deprivation 2000.

3.3 Stage 2: Indicators are chosen which provide the best possible measure of each domain of deprivation

Indicator criteria

3.3.1 For each of the seven domains of deprivation, an assessment has been made about whether the indicators in the Indices of Deprivation 2010:

- are still appropriate measures of deprivation for that domain
- can be updated
- can be strengthened, for example due to better available data.

3.3.2 In addition, the research team has conducted considerable work to explore whether there are possible new indicators which would improve the measure of deprivation captured by each domain. Appendix M contains information on indicators explored which were for the reasons indicated not considered suitable for inclusion in the current indices.

3.3.3 To be considered for inclusion, any new or modified indicators had to meet the same criteria as for the Indices of Deprivation 2010 and its predecessors. Indicators should:

- be ‘domain specific’ and appropriate for the purpose (as far as possible, being direct measures of that form of deprivation)

- measure major features of that deprivation (not conditions just experienced by a small number of people or areas)
- be up-to-date and (as far as possible) updateable[18]
- be statistically robust at the small area level
- be available for the whole of England at a small area level in a consistent form
- In addition, to be considered for inclusion in the Indices of Deprivation 2015, indicators had to have sufficiently robust data that was readily available to use in updating the Indices without significant extra work.

3.3.4 The aim for each domain was to include a parsimonious selection of indicators that comprehensively captured the deprivation for each domain, within the constraints of data availability and the criteria listed above.

Indicators used in the Indices of Deprivation 2015

3.3.5 There are 37 indicators in total in the Indices of Deprivation 2015. Almost all of the indicators in the Indices of Deprivation 2010 have been updated with little or, at most, minor changes. In addition, there are a small number of new, modified or dropped indicators:

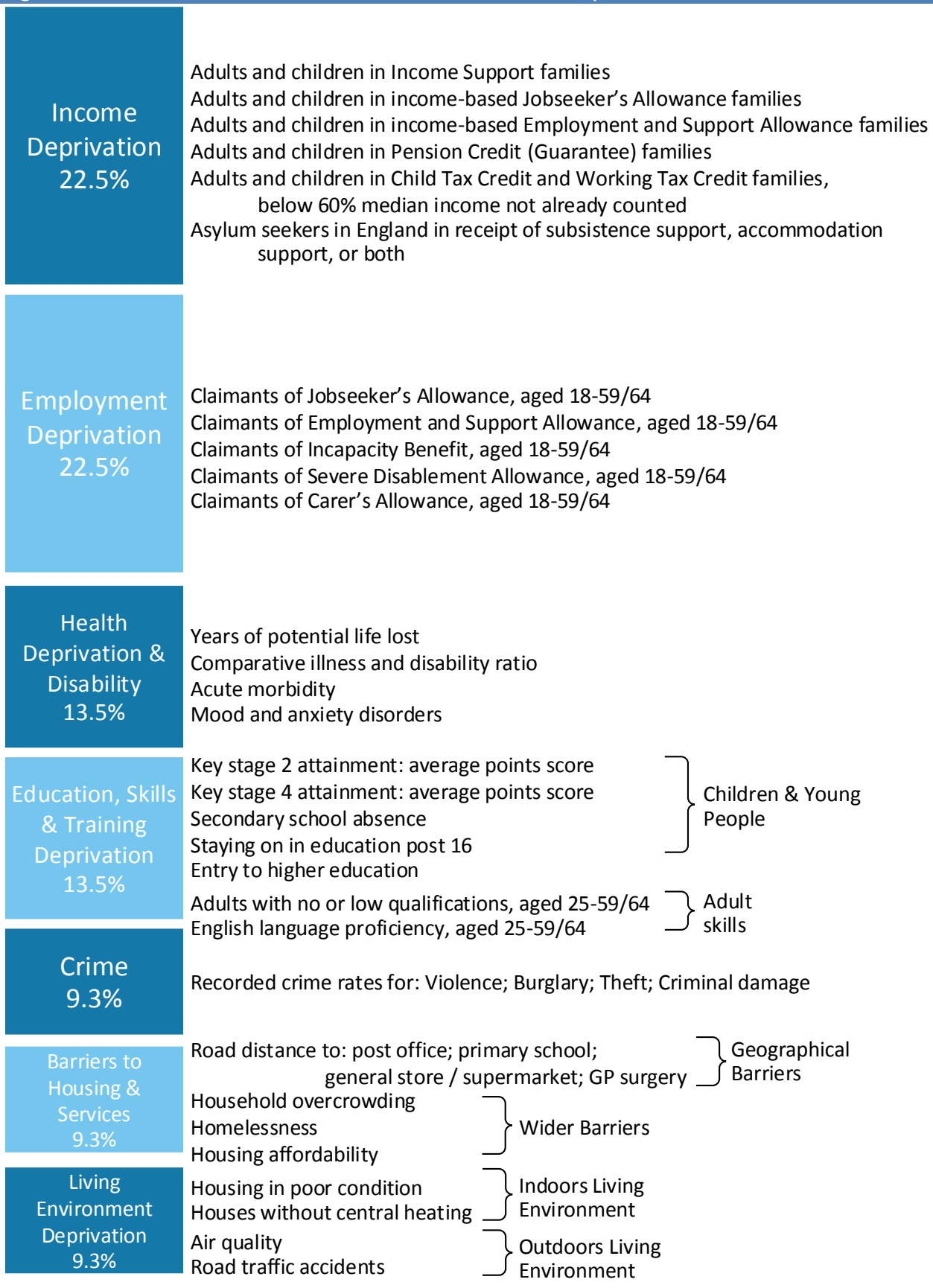
- two new indicators have been included, based on improved availability of robust data
- four indicators have been modified, due to improved data or estimation methods
- four indicators have been dropped, as these are no longer available or appropriate to include.

3.3.6 Appendix C provides details of the changes to the indicators the Indices of Deprivation 2010 occasioned by this update. This includes minor changes made to indicators, for example due to changes in available data.

3.3.7 Figure 3.2 summarises the updated, new and modified indicators for each of the domains. Details are given in the appropriate place in Chapter 4.

[18] Wherever possible, indicators are used that can be regularly updated. However not all indicators can be regularly updated, for example those based on Census 2011. Census data is used only when alternative data from administrative sources is not available

Figure 3.2. Domains and indicators for the Indices of Deprivation 2015



The percentages reported in each domain box show the weight the domain receives in the Index of Multiple Deprivation 2015. See Section 3.7 and Appendix G for a description of the domain weights.

Data time point

3.3.8 As far as is possible, each indicator was based on data from the most recent time point available. Using the latest available data in this way means that there is not a single consistent time point for all indicators. However in practice most indicators in the Indices of Deprivation 2015 relate to 2012/13[19]. For example, the most recent finalised tax credit data available from HMRC at the time of construction of the Indices of Deprivation 2015 was for the 2012/13 tax year.

3.3.9 As with previous Indices, the Indices of Deprivation 2015 use Census data only when alternative data from administrative sources was not available. Four such indicators were derived from the 2011 Census: adult skill levels and English language proficiency in the Education, Skills and Training Deprivation Domain; household overcrowding in the Barriers to Housing and Services Domain; and houses without central heating in the Living Environment Deprivation Domain.

3.3.10 As a result of the time points for which data was available, the indicators do not take into account changes to policy since the time point of the data used. For example, the 2012/13 benefits data used do not include the impact of Universal Credit, which only began replacing certain income related benefits from April 2013.

Geography and spatial scale

3.3.11 The Indices of Deprivation 2015 have been produced at Lower-layer Super Output Area level, using the current (2011) Lower-layer Super Output Areas[20].

3.3.12 Guidance is provided in the research report Appendix A on how to aggregate the Lower-layer Super Output Area data to other geographies such as wards or bespoke local areas, as requested by a number of users.

3.3.13 Summary measures for the Index of Multiple Deprivation, domains and supplementary Indices have been produced for the following higher-level geographies: local authority districts, upper tier local authorities, Local Enterprise Partnerships and Clinical Commissioning Groups.

Denominators

3.3.14 Denominators are an integral and important component of almost all indicators included in the Indices of Deprivation. For each indicator, the denominator seeks to measure the number of people (or households etc.) that are ‘at-risk’ of being defined as deprived, in other words that are at-risk of being included in the numerator. The denominator for each indicator is expressed on the same geographical scale as the numerator (for example Lower-layer Super Output Areas or local authority districts) and is usually measured for the same year as the numerator.

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[19] The previous Indices of Deprivation 2010 were based mainly on data from 2008/9.

[20] Lower-layer Super Output Areas are homogenous small areas of relatively even size containing approximately 1,500 people. The Indices of Deprivation 2010 and earlier versions used the 2001 Lower-layer Super Output Area geography. However the Office for National Statistics has produced an updated version of the Lower-layer Super Output Area geography using population data from the 2011 Census. The changes made between the 2001 and 2011 versions were minimal: 96.4 per cent of the 32,844 Lower-layer Super Output Areas in 2011 remain the same as the 2001 version used in the Indices of Deprivation 2010.

3.3.15 The majority of the indicators in the Indices of Deprivation are measured as proportions or rates of the population that are deprived, and therefore use denominators based on population. To give a more accurate measure of the population 'at-risk' of being defined as deprived, these population-based denominators are calculated by taking the small area mid-year population estimates from the Office for National Statistics, and removing prison populations (as provided by the Ministry of Justice). This step is undertaken because prisoners are typically not at-risk of being included in the numerator counts for the indicators. For example, individuals who are in prison are not eligible to claim means-tested out-of-work benefits.

3.3.16 Some of the indicators use denominators other than the resident population. For example, some indicators draw denominators from within the same dataset as the numerator (such as pupil attainment datasets); some are expressed as the proportion of households rather than people; and some incorporate special adjustments to better reflect the population at risk.

3.3.17 Details of the exact denominators that are used for each numerator are discussed in the indicator descriptions in Chapter 4, and a full list given in Appendix A. A more detailed explanation of the denominators used can be found in Appendix B.

3.3.18 Population-based denominators as referred to in paragraph 3.3.15 are also published, as they were for the Indices of Deprivation 2010. Denominators are unrounded except for those which include prison populations which have been rounded to the nearest three.

3.4 Stage 3: 'Shrinkage estimation' is used to improve reliability of the small area data

3.4.1 Where a rate or other measure of deprivation for a small area is based on small numbers, the resulting estimate may be unreliable, with an unacceptably high standard error. The technique of shrinkage estimation is used to 'borrow strength' from larger areas to avoid creating unreliable small area data; the impact of shrinkage may be to move a Lower-layer Super Output Area's score towards more deprivation or towards less deprivation.

3.4.2 Without shrinkage, some Lower-layer Super Output Areas would have scores which do not reliably describe the deprivation in the area due to chance fluctuations from year to year. Such scores occur most commonly where numbers are small at Lower-layer Super Output Area level and the event is thus relatively rare. This may be the case for the indicator as a whole or only for particular Lower-layer Super Output Areas. In shrinkage estimation the score for a small area is estimated as a weighted combination of that small area's score and the mean value for a larger area from which the smaller areas within the larger area borrow strength.

3.4.3 As with previous Indices, the larger areas used for shrinkage in the Indices of Deprivation 2015 are local authority districts. The Lower-layer Super Output Areas within a single district share issues relating to local governance and possibly to economic sub-climates. To a certain extent, they may also share issues relating to labour market sub-climates. During the development of the indices, the possibility of using other large areas as the areas from which to borrow strength was explored. Appendix D provides a summary of this exploration and the conclusion

was to continue to use local authority districts as the larger areas for the shrinkage process.

3.4.4 In the Indices of Deprivation 2015 the shrinkage technique is applied to the majority of indicators. Those which are not subjected to shrinkage include the modelled indicators, the road distance indicators and the indicators supplied at local authority district level. Specific information about the indicators to which shrinkage is applied is given in the indicator descriptions in Chapter 4. Further details about the shrinkage technique, including examples of the impact of shrinkage and work undertaken to explore alternatives to using local authority districts as the areas from which to 'borrow strength', are given in Appendix D.

3.5 Stage 4: Indicators are combined to form the domains, generating separate domain scores

3.5.1 For each domain of deprivation the aim is to obtain a single measure which is straightforward to interpret in that it is, if possible, expressed in meaningful units (for example the proportion of people or of households experiencing that form of deprivation). This was achieved in the Income and Employment Domains, but was not possible in the other five domains.

3.5.2 The Income Deprivation Domain and Employment Deprivation Domain are constructed as simple rates of the population at-risk. Separate indicators in these domains are constructed as non-overlapping counts, and are simply summed together to identify the total at-risk population for the domain.

3.5.3 In the other domains the indicators are on different metrics and therefore it is not possible to calculate a simple rate. The indicators are therefore standardised by ranking and transforming to a standard normal distribution based on their ranks, before combining with selected weights to form the domain score:

- Maximum Likelihood factor analysis is used to determine what weight to give each of these indicators when combining them. It does this by testing the extent to which each of the indicators measure the underlying aspect of deprivation[21]. In three domains – the Children and Young People sub-domain of the Education, Skills and Training Deprivation Domain, the Health Deprivation and Disability Domain, and the Crime Domain – factor analysis is used to generate appropriate weights for combining the standardised indicators into a single score per domain, or sub-domain. Factor analysis is described in Appendix E.
- In the remaining domains, equal weights or weights based on a theoretical premise have been applied.
- In domains where there are sub-domains, this stage involves first combining the indicators into sub-domain scores. The sub-domain scores are then ranked and transformed to an exponential distribution for the reasons given in Section 3.6 before being combined into their respective domain scores.

[21] The method of factor analysis used in the 2015 Indices and earlier versions is the Maximum Likelihood method. Unlike Principal Components Analysis, which is the main alternative, the Maximum Likelihood method does not require the assumptions that all indicators are perfectly reliable and measured without error. For further details about the factor analysis technique, please see Appendix E.

3.5.4 Details of the specific steps taken to arrive at the domain scores are given in the appropriate places in Chapter 4. This approach to combining the indicators into the domains replicates that taken in the Indices of Deprivation 2010 and earlier Indices.

3.5.5 The domain scores and ranked indices that are generated as a result of this stage, and the sub-domain scores *before* ranking and transforming to an exponential distribution, are published outputs (see Appendix O for details of the published data and spreadsheets). These domain indices can be used in the own right by users interested in particular dimensions of deprivation rather than the overall Index of Multiple Deprivation.

3.6 Stage 5: Domain scores are ranked and the domain ranks transformed to a specified exponential distribution

3.6.1 When combining the domains to form an overall index, it is important that the scores of each domain are comparable and that the weighting of domains is not distorted by the fact that the domains may have very different distributions. It is also important to select a method of combination that does not result in deprivation on one domain being cancelled out by lack of deprivation on another domain. It is fundamental to the model of deprivation employed in the Indices that deprivations are cumulative.

3.6.2 In order to combine the domains, a number of steps are necessary. First the domain scores must be standardised, that is converted in such a way that they are measured on the same metric. Second, the standardised domain scores must be transformed to the same distribution. The different distributions would otherwise distort the impact of the explicit weights used in the final stage to combine the domains into the overall Index of Multiple Deprivation.

3.6.3 There are a number of different statistical techniques that can be employed to standardise and transform the domain scores to prepare them for combination. The method which has been employed since the Indices of Deprivation 2000 – exponential transformation of the ranked domain score – was explicitly designed to reduce ‘cancellation effects’. So, for example, high levels of deprivation in one domain are not completely cancelled out by low levels of deprivation in a different domain. Also the exponential transformation applied puts more emphasis on the deprived end of the distribution and so facilitates identification of the most deprived areas.

3.6.4 The property of the exponential distribution which effectively emphasises the most deprived part of the distribution means that the Indices are specifically constructed to identify deprivation and *not* affluence. Put another way, the Indices discriminate well between deprived neighbourhoods but not between those in the less deprived part of the distribution.

3.6.5 The Indices of Deprivation 2015 uses exponential transformation of the ranks, as in the previous Indices. A more extensive account of the exponential transformation procedure is given in Appendix F.

3.6.6 In order to allow users to combine domains using alternative weights for specific purposes, the exponentially transformed scores are made available in file 9 (see Appendix O for details of the published data and spreadsheets).

3.7 Stage 6: The exponentially transformed domain scores are combined using appropriate domain weights to form an overall Index of Multiple Deprivation

3.7.1 Combining the different domains into an overall index always involves weighting the domains, whether the weights are set explicitly or not. Greater weight on a specific domain gives greater importance to that domain in the overall index. Weights may be set explicitly, as they were in the Indices of Deprivation 2000 and subsequent updates. If domain scores were simply added together (after standardisation), this explicitly gives each domain an equal weight. Conversely, if domains are not standardised to lie on the same scale or distribution, then weights are set implicitly by the domain distributions.

3.7.2 The weights used for the Indices of Deprivation 2000 were derived from consideration of the academic literature on poverty and deprivation, as well as consideration of the levels of robustness of the indicators. This resulted in a decision to give the greatest weight to the Income Deprivation Domain and Employment Deprivation Domain. A fuller account of this is given in Appendix G.

3.7.3 The weights employed in the construction of the Index of Multiple Deprivation 2015 are shown in the table below. These weights are unchanged since the construction of the Index of Multiple Deprivation 2004 when the Crime Domain was introduced and the seven current domains established.

Table 3.1. Domain weights used to construct the Index of Multiple Deprivation 2015

Domain	Domain weight (%)
Income Deprivation Domain	22.5
Employment Deprivation Domain	22.5
Health Deprivation and Disability Domain	13.5
Education, Skills and Training Deprivation Domain	13.5
Barriers to Housing and Services Domain	9.3
Crime Domain	9.3
Living Environment Deprivation Domain	9.3

3.7.4 While applying different weights would affect the Index of Multiple Deprivation, the impact may not be large. Research into the issue of weighting was carried out by the University of St Andrews (Dibben et al., 2007)[22]. Sensitivity testing on three different approaches to weighting showed that although a small adjustment could be made to the weights (in effect swapping the weights for the Employment

[22] Dibben, C., Atherton, I., Cox, M., Watson, V., Ryan, M. and Sutton, M. (2007) Investigating the Impact of Changing the Weights that Underpin the Index of Multiple Deprivation 2004, http://webarchive.nationalarchives.gov.uk/20100410180038/http://www.communities.gov.uk/publications/communities/investigatingimpact.

Deprivation Domain and the Health Deprivation and Disability Domain) it did not have a large impact on the final Index of Multiple Deprivation ranks. This work is described in greater detail in Appendix G.

3.7.5 With reference to these research findings, the use of these weights was revisited in the most recent consultations preceding the release of the Indices of Deprivation 2007[23] and Indices of Deprivation 2010[24]. Both consultations found 89 per cent of respondents were in favour of keeping the weights the same. Furthermore, the survey of users in July 2014 did not reveal significant support for moving to new weights. In light of the very high level of user support, the weights used in the Indices of Deprivation 2015 remain as used in the Indices of Deprivation 2010.

3.7.6 Based on these weights, the Index of Multiple Deprivation will suit the purposes of most users. But it is recognised that some users may wish to analyse deprivation using only a subset of the deprivation domains or to apply different weights. For example, analysts working in public health may wish to create a combined index that excludes the Health Deprivation and Disability Domain, allowing them to explore other forms of deprivation as a determinant of health outcomes. To facilitate users in applying alternative weights, the exponentially transformed domain scores (from stage 5) are published along with the appropriate population sizes; guidance on how to combine the domains together using different weights is provided in Appendix B of the Research Report.

3.8 Stage 7: The overall Index of Multiple Deprivation and domains are summarised for larger areas such as local authority districts

3.8.1 The previous stages produce the small area (Lower-layer Super Output Area) data for the Indices of Deprivation 2015. In this final stage, the small area statistics are summarised for larger areas such as local authority districts.

3.8.2 For larger areas, a single deprivation score (or rank) may not be adequate to accurately describe levels of deprivation across the area. Local authority districts can vary enormously in both geographic and population size, and may have very different patterns of deprivation. Some areas are deprived but contain relatively little variation in deprivation across their neighbourhoods; in other places deprivation may be concentrated in pockets of severe deprivation rather than being more evenly spread.

3.8.3 To summarise the level of deprivation in larger areas, a range of summary measures of the Index of Multiple Deprivation 2015, the domains and the two supplementary indices (Income Deprivation Affecting Children Index and Income

[23] Department for Communities and Local Government (2007) Updating the English Indices of Deprivation 2004: Stage Two 'Blueprint' Consultation Report – Summary of Responses. http://webarchive.nationalarchives.gov.uk/20120919132719/http://www.communities.gov.uk/publications/communities/indicesdeprivationresponses

[24] Department for Communities and Local Government (2011) English Indices of Deprivation consultation: summary of responses. https://www.gov.uk/government/consultations/english-indices-of-deprivation.

Deprivation Affecting Older People Index) have been created [25], see table below. No single summary measure is the 'best' measure. Each highlights different aspects of deprivation, and comparison of the different measures is needed to give a fuller description of deprivation in a large area. In addition, it is important to remember that the higher-area measures are *summaries*; the Lower-layer Super Output Area level data provides more detail than is available through the summaries.

[25] For the Indices of Deprivation 2010 and previous versions, the majority of summary measures published were for the Index of Multiple Deprivation only. In response to demand from users, additional summary measures for the domains and supplementary indices have been published here.

Table 3.2. The higher-area summary measures

Summary measure	Description
Average rank	The average rank measure summarises the average level of deprivation across the higher-level area, based on the ranks of the Lower-layer Super Output Areas in the area. As all Lower-layer Super Output Areas in the higher-level area are used to create the average rank, this gives a measure of the whole area covering both deprived and non-deprived areas. The measure is population-weighted, to take account of the fact that Lower-layer Super Output Area population sizes can vary
Average score	The average score measure summarises the average level of deprivation across the higher-level area, based on the scores of the Lower-layer Super Output Areas in the area. As all Lower-layer Super Output Areas in the higher-level area are used to create the average score, this gives a measure of the whole area covering both deprived and non-deprived areas. The measure is population-weighted, to take account of the fact that Lower-layer Super Output Area population sizes can vary
Proportion of Lower-layer Super Output Areas in most deprived 10 per cent nationally	The proportion of Lower-layer Super Output Areas that are in the most deprived 10 per cent nationally.
Extent	The extent measure is a summary of the proportion of the local population that live in areas classified as among the most deprived in the country. The extent measure uses a weighted measure of the population in the most deprived 30 per cent of all areas: • The population living in the most deprived 10 per cent of Lower-layer Super Output Areas in England receive a 'weight' of 1.0; • The population living in the most deprived 11 to 30 per cent of Lower-layer Super Output Areas receive a sliding weight, ranging from 0.95 for those in the most deprived eleventh percentile, to 0.05 for those in the most deprived thirtieth percentile.
Local concentration	The local concentration measure is a summary of how the most deprived Lower-layer Super Output Areas in the higher-level area compare to those in other areas across the country. This measures the population-weighted average rank for the Lower-layer Super Output Areas that are ranked as most deprived in the higher-area, and that contain exactly 10 per cent of the higher-area population.
Income scale and employment scale (two measures)	The two scale measures summarise the number of people in the higher-level area who are income deprived (the income scale) or employment deprived (the employment scale).

3.8.4 In response to feedback from users, clearer guidance is provided on how to use and interpret these measures in the research report Section 3.3.

3.8.5 The table below sets out which summary measures have been published for the Index of Multiple Deprivation, the domains and supplementary indices.

Table 3.3. The summary measures published for the Index of Multiple Deprivation, the domains and supplementary indices

	Average rank	Average score	Proportion of Lower-layer Super Output Areas in most deprived 10 per cent nationally	Extent	Local concentration	Scale
Index of Multiple Deprivation	x	x	x	x	x	
Income	x	x	x			x
Employment	x	x	x			x
Education	x	x	x			
Health	x	x	x			
Crime	x	x	x			
Living	x	x	x			
Barriers	x	x	x			
IDACI	x	x	x			
IDAOPI	x	x	x			

3.8.6 The higher-level geographical areas at which the Indices have been summarised are as follows: local authority districts, upper tier local authorities, local enterprise partnerships and clinical commissioning groups. These are published in files 10 - 13 (see Appendix O for details of the data and spreadsheets that have been published).

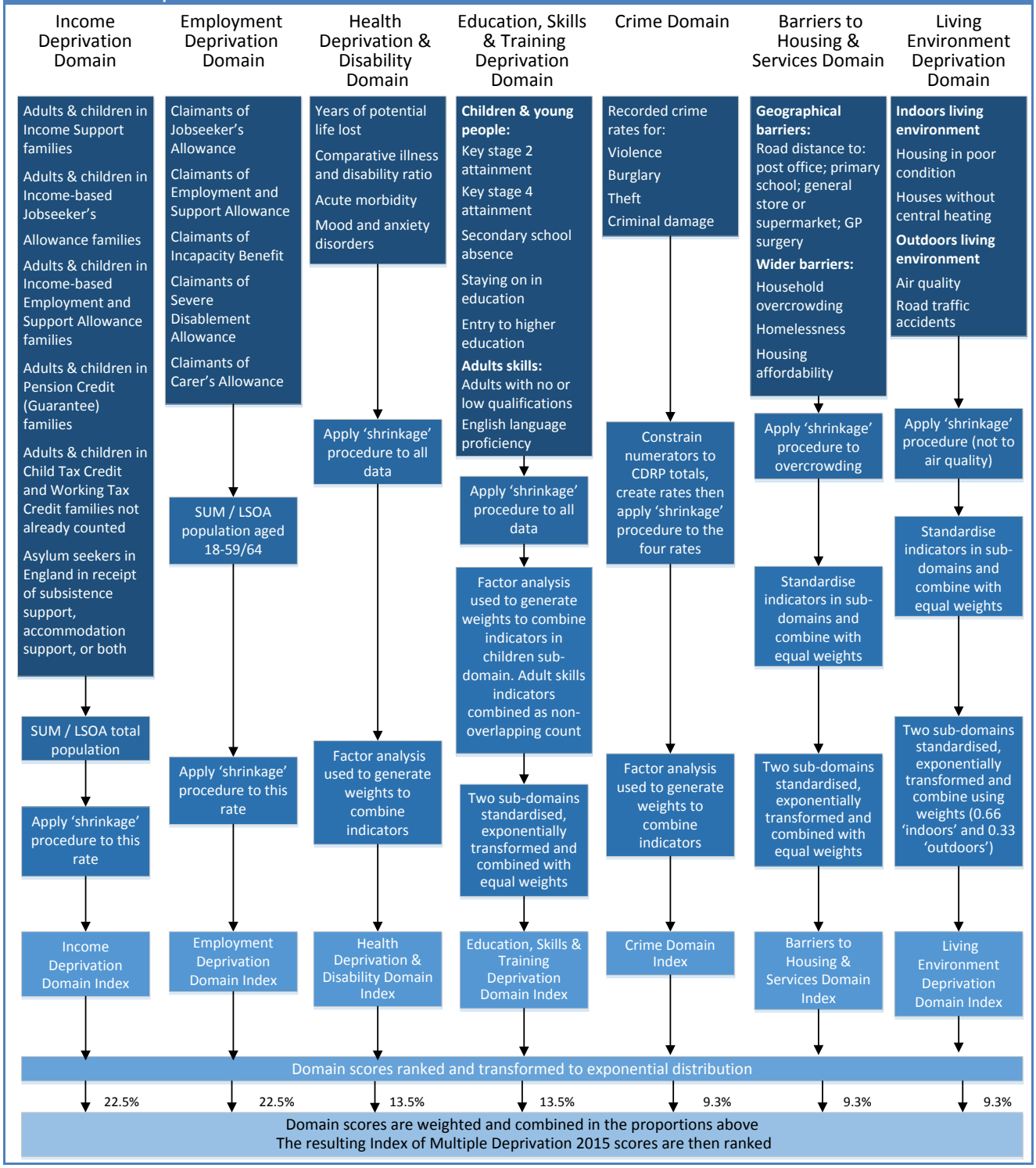
3.8.7 The population denominators used for the construction of the higher level geographies for the Index of Multiple Deprivation and all domains other than the Employment Deprivation domain are the mid-2012 Lower-layer Super Output Area population estimates, minus any prison populations. For the Employment Deprivation domain the working-age population aged 18 to 59/64 for mid-2012 and mid-2013 was used, minus any prison populations for that age group. For the supplementary indices the appropriate age group population estimate for mid-2012 was used, minus any prison populations for those age groups. These are published in file 6; see Appendix O for details of the published data and spreadsheets.

3.8.8 In order to construct these high-level geographical summaries, look-up tables were constructed to indicate which Lower-layer Super Output Areas nest within each of the high-level geographies. This nesting was precise except in the case of the Local Enterprise Partnerships, where a "best fit" Lower-layer Super Output Area lookup was provided by the Office for National Statistics.

3.9 Summary of the domains, indicators and methods used to construct the Indices of Deprivation 2015

3.9.1 Figure 3.3 summarises the domains, indicators and methods used to construct the Lower-layer Super Output Area level Indices of Deprivation 2015.

Figure 3.3. Summary of the domains, indicators and statistical methods used to create the Indices of Deprivation 2015



Chapter 4. The domains and indicators

4.1 Introduction

4.1.1 This chapter describes the 37 component indicators in the Indices of Deprivation 2015 and how these were combined to create each domain. Appendix A lists the data sources used for each indicator and Appendix B describes how denominators for indicators were selected.

4.1.2 In this chapter, a section at the end of each domain summarises changes made to indicators since the Indices of Deprivation 2010. This summary covers new or dropped indicators and briefly describes modifications to indicators; more detail is presented in Appendix C which contains a full description of the changes. Where benefits have been replaced or there have been eligibility changes since the Indices of Deprivation 2010, this is discussed in the main text.

4.2 Domains

4.2.1 The Indices of Deprivation 2015 are a relative measure of deprivation for small areas (Lower-layer Super Output Areas) across England. The overall Index of Multiple Deprivation 2015 combines together indicators under seven different domains of deprivation, detailed in the following sections:

- Income Deprivation
- Employment Deprivation
- Education, Skills and Training Deprivation
- Health Deprivation and Disability
- Crime
- Barriers to Housing and Services
- Living Environment Deprivation.

4.2.2 In addition there are two supplementary indices: the Income Deprivation Affecting Children Index and the Income Deprivation Affecting Older People Index. These are described under the Income Deprivation Domain, since they are subsets of this domain.

4.3 Income Deprivation Domain

4.3.1 The Income Deprivation Domain measures the proportion of the population in an area experiencing deprivation relating to low income. The definition of low income used includes both those people that are out-of-work, and those that are in work but who have low earnings (and who satisfy the respective means tests).

The indicators

- Adults and children in Income Support families[26]
- Adults and children in income-based Jobseeker's Allowance families

[26] The word 'family' is used to designate a 'benefit unit', that is the claimant, any partner and any dependent children (those for whom Child Benefit is received).

- Adults and children in income-based Employment and Support Allowance families
- Adults and children in Pension Credit (Guarantee) families
- Adults and children in Working Tax Credit and Child Tax Credit families not already counted, that is those who are not in receipt of Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee) and whose equivalised income (excluding housing benefit) is below 60 per cent of the median before housing costs
- Asylum seekers in England in receipt of subsistence support, accommodation support, or both

Indicator details

Adults and children in Income Support families

Adults and children in income-based Jobseeker's Allowance families

Adults and children in income-based Employment and Support Allowance families

Adults and children in Pension Credit (Guarantee) families

4.3.2 These four indicators comprise a non-overlapping count of the number of adults and children in a Lower-layer Super Output Area living in families claiming Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee). Data for August 2012 was sourced from databases held by the Department for Work and Pensions and HM Revenue & Customs.

4.3.3 Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance and Pension Credit (Guarantee) are means-tested social security benefits. The benefits are mutually exclusive so there is no double counting involved. To be eligible for these benefits, claimants must be able to demonstrate that their income and savings are below specified thresholds.

4.3.4 Income-based Employment and Support Allowance replaced Income Support paid because of an illness or disability for new claims (from October 2008). To account for this, adults and children in income-based Employment and Support Allowance families were included in the domain in addition to adults and children in Income Support families.

4.3.5 The Lower-layer Super Output Area level count was constructed by selecting relevant claimants from the Department for Work and Pensions' Unified Publication Database, matching in information on dependent partners (conducted within the Department for Work and Pensions) and dependent children (conducted within HM Revenue & Customs), then aggregating to Lower-layer Super Output Area level. The administrative records used to construct the indicators are the same as those used to produce published National Statistics.

Adults and children in Working Tax Credit and Child Tax Credit families

Child Tax Credit component

4.3.6 The Child Tax Credit component of this indicator was constructed as the number of adults and children in a Lower-layer Super Output Area living in Child Tax Credit families, who are not claiming Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee), and whose equivalised income[27] (excluding housing benefits) is below 60 per cent of the national median before housing costs[28]. Data for August 2012 was sourced from a database held by HM Revenue & Customs.

4.3.7 Child Tax Credit is payable to families with children who are either:

- Claiming out-of-work benefits
- In work and claiming Working Tax Credit
- Claiming neither out-of-work benefits nor Working Tax Credit but whose household income does not exceed the Child Tax Credit income threshold.

Working Tax Credit component

4.3.8 The Working Tax Credit component of this indicator was constructed as the number of adults in a Lower-layer Super Output Area in receipt of Working Tax Credit (who are not claiming Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee) and are not counted already under the Child Tax Credit component above) and whose equivalised income (excluding housing benefits) is below 60 per cent of the national median before housing costs. Data for August 2012 was sourced from a database held by HM Revenue & Customs.

4.3.9 Working Tax Credit is payable to people who:

- are aged from 16 to 24 and have a child or a qualifying disability, or are aged 25 or over (with or without children); and
- work at least the specified number of hours; and
- have an income below the means tested level.

Asylum seekers in England in receipt of subsistence support, accommodation support, or both

4.3.10 The indicator is the number of asylum seekers (adults and children) in a Lower-layer Super Output Area who were in receipt of subsistence support, accommodation support or both. Data for August 2012 was supplied by the Home Office.

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[27] Income equivalisation is a way of taking into account variations in household size and/or composition when making income comparisons between households. The Organisation for Economic Co-operation and Development's modified equivalence scale is used to equivalise household income in this indicator.

[28] The official low income threshold is 60 per cent of median household equivalised income. The Department for Work and Pensions' Households Below Average Income team provided a special version of the 60 per cent of median threshold which is at assessment unit level (claimant, partner and dependent children) and which takes into account only income that is required for the Working Tax Credit/Child Tax Credit calculation. This methodology is also used for the annual estimate of child poverty undertaken by the Child Poverty Unit in accordance with its mandate contained in the Child Poverty Act 2010.

4.3.11 Asylum is protection given to someone fleeing persecution in their own country under the 1951 United Nations Convention Relating to the Status of Refugees. In the UK, asylum seekers who are homeless or without money to buy food and other essentials ('destitute') can apply for subsistence and accommodation support while their application is being considered[29].

Combining the indicators to create the domain

4.3.12 The counts for each of these indicators at Lower-layer Super Output Area level were summed to produce a non-overlapping overall count of income deprived individuals. This overall count was then expressed as a proportion of the total population of the Lower-layer Super Output Area for mid-2012 (from the Office for National Statistics) less the prison population (from the Ministry of Justice). Shrinkage was applied to construct the overall domain score[30].

Changes since the Indices of Deprivation 2010

4.3.13 The indicators in the domain remain the same as in the Indices of Deprivation 2010, except for an enhancement to the Working Tax Credit and Child Tax Credit indicator, to include all people receiving tax credits who are below the income threshold. Where benefits have been replaced or there have been eligibility changes since the Indices of Deprivation 2010, this has been described above. Further details of all these changes are given in Appendix C.

4.3.14 New sanctions regulations were introduced in 2012 for claimants of certain benefits. As explained in Appendix M, those affected by sanctions could not be included in the domain due to a lack of suitable data.

4.3.15 The data on claimants of income-based Employment Support Allowance (which replaced Incapacity Benefit and Income Support paid because of an illness or disability for new claimants from 2008) has now been incorporated into this indicator. Work Capability Assessments for Employment Support Allowance were introduced in 2008, reducing the number of people eligible for income related support because of an illness or disability.

Supplementary indices

4.3.16 In addition, two supplementary indices were created, which are subsets of the Income Deprivation Domain. These are the Income Deprivation Affecting Children Index and the Income Deprivation Affecting Older People Index:

The Income Deprivation Affecting Children Index is the proportion of all children aged 0 to 15 living in income deprived families. Income deprived families are defined as families that either receive Income Support or income-based Jobseekers Allowance or income-based Employment and Support Allowance or Pension Credit (Guarantee) or families not in receipt of these benefits but in receipt of Working Tax Credit or Child Tax Credit with an equivalised income (excluding

[29] See www.gov.uk/browse/visas-immigration/asylum for further details on asylum support in the UK.
[30] Shrinkage is a statistical method used to 'borrow strength' from larger areas (the local authority district) to reduce the impact of unreliable small area data. This is described in Section 3.4 and Appendix D.

housing benefit) below 60 per cent of the national median before housing costs. Shrinkage was applied to construct the Income Deprivation Affecting Children Index score.

The Income Deprivation Affecting Older People Index is the proportion of all those aged 60 or over who experience income deprivation. This includes adults aged 60 or over receiving Income Support or income-based Jobseekers Allowance or income-based Employment and Support Allowance or Pension Credit (Guarantee). Shrinkage was applied to construct the Income Deprivation Affecting Older People Index score.

4.4 Employment Deprivation Domain

4.4.1 The Employment Deprivation Domain measures the proportion of the working-age population in an area involuntarily excluded from the labour market. This includes people who would like to work but are unable to do so due to unemployment, sickness or disability, or caring responsibilities.

The indicators

- Claimants of Jobseeker's Allowance (both contribution-based and income-based), women aged 18 to 59 and men aged 18 to 64
- Claimants of Employment and Support Allowance (both contribution-based and income-based) , women aged 18 to 59 and men aged 18 to 64
- Claimants of Incapacity Benefit, women aged 18 to 59 and men aged 18 to 64
- Claimants of Severe Disablement Allowance, women aged 18 to 59 and men aged 18 to 64
- Claimants of Carer's Allowance, women aged 18 to 59 and men aged 18 to 64.

Indicator details

4.4.2 Data for the five indicators was provided by the Department for Work and Pensions, constructed from administrative records of benefit claimants in such a way to create a non-overlapping count of claimants. To account for seasonal variations in employment deprivation, four quarterly cuts were taken for each indicator and the average number of claimants across the four quarterly cuts calculated for each of the five indicators.

Claimants of Jobseeker's Allowance

4.4.3 Jobseeker's Allowance is paid to individuals who are out of work, available for work and actively seeking work. It is the primary measure of unemployment levels for small areas.

4.4.4 New Deal and Flexible New Deal have been replaced by the Work Programme, so the three New Deal indicators included in the Indices of Deprivation 2010 have been removed from the domain. Participants in the Work Programme are still in receipt of Jobseeker's Allowance, so are included in the domain through this indicator.

4.4.5 From May 2012, any lone parents whose youngest child is aged 5 or over are no longer eligible for Income Support and are now eligible for Jobseeker's Allowance.

Accordingly this group were counted in this domain if they received Jobseeker's Allowance.

Claimants of Employment and Support Allowance

Claimants of Incapacity Benefit

Claimants of Severe Disablement Allowance

4.4.6 Employment and Support Allowance, Incapacity Benefit and Severe Disablement Allowance are paid to individuals who are unable to work due to limiting illness or disability. Incapacity Benefit and Severe Disablement Allowance are no longer available for new claimants: Incapacity Benefit replaced Severe Disablement Allowance for new claimants in April 2001 and Employment and Support Allowance replaced Incapacity Benefit and Income Support paid because of an illness or disability for new claimants from October 2008. However, there still are a number of long-term sickness benefit claimants receiving Severe Disablement Allowance and Incapacity Benefit[31].

Claimants of Carer's Allowance

4.4.7 The new Carers Allowance indicator measures those adults who are involuntarily excluded from the labour market due to caring responsibilities. Carer's Allowance is payable to people aged 16 or over who provide unpaid care for at least 35 hours a week to someone who is in receipt of disability or social care benefits, who are not in full-time education or studying, and earn less than £102 a week[32].

Combining the indicators to create the domain

4.4.8 A non-overlapping count of claimants of each of the benefits was created for the following four time points to account for seasonal variations in employment deprivation: May 2012, August 2012, November 2012 and February 2013 [33]. The counts of Jobseeker's Allowance, Employment and Support Allowance, Incapacity Benefit and Severe Disablement Allowance are non-overlapping because the benefits system does not permit an individual to claim more than one of these benefits at the same time. To account for the new Claimants of Carer's Allowance indicator, a count of such claimants *not* receiving Jobseeker's Allowance, Employment and Support Allowance, Incapacity Benefit and Severe Disablement Allowance was added to the domain numerator to provide a non-overlapping count.

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[31] As of February 2013 there were approximately 170,000 Severe Disablement Allowance claimants across England as a whole (an average of just over 5 claimants per Lower-layer Super Output Area) and 582,000 Incapacity Benefit claimants (just under 18 claimants per Lower-layer Super Output Area).

[32] The eligible disability or social care benefits are: Personal Independence Payment daily living component, Disability Living Allowance middle or highest care rate, Attendance Allowance, Constant Attendance Allowance at or above the normal maximum rate with an Industrial Injuries Disablement Benefit, or basic (full day) rate with a War Disablement Pension or Armed Forces Independence Payment. Full-time studying is more than 21 hours per week. The earnings threshold is after the deduction of taxes, care costs while at work and 50 per cent of pension contributions.

[33] These time points are consistent with the Income Deprivation Domain. Also, using later time points would mean that a subset of claimants would have migrated on to Universal Credit, which has different eligibility criteria to the existing Employment Deprivation Domain benefits.

This was achieved by the Department for Work and Pensions through the use of a unique person identifier.

4.4.9 A quarterly averaged count of claimants/participants was calculated for each of the indicators to create the Employment Deprivation Domain numerator, calculated as the seasonally-adjusted count of employment deprived people per Lower-layer Super Output Area.

4.4.10 The denominator was the working-age population (women aged 18 to 59 and men aged 18 to 64), derived from mid-year population estimates (from the Office for National Statistics), with the prison population (from the Ministry of Justice) subtracted. In order to provide a time point which closely matches the numerator, 2012 and 2013 mid-year population estimates were used, with a weight of 0.75 applied to the 2012 count and a weight of 0.25 applied to the 2013 count[34].

4.4.11 The Employment Deprivation Domain numerator was expressed as a proportion of the Employment Deprivation Domain denominator to form the Employment Deprivation Domain score. The score represents the proportion of the working-age population experiencing employment deprivation. Shrinkage was applied to construct the final domain score.

Changes since the Indices of Deprivation 2010

4.4.12 The indicators in the domain remain the same as in the Indices of Deprivation 2010, except for the new indicator on claimants of Carer's Allowance. As the New Deal ceased after the Indices of Deprivation 2010, the indicators based on New Deal claimants were removed.

4.4.13 Where benefits have been replaced or there have been eligibility changes since the Indices of Deprivation 2010, this has been described above. Further details on all these changes are given in Appendix C.

4.4.14 New sanctions regulations were introduced in 2012 for claimants of certain benefits. As explained in Appendix M, those affected by sanctions could not be included in the domain due to a lack of suitable data.

4.4.15 The data on claimants of contribution-based Employment Support Allowance (which replaced Incapacity Benefit and Income Support paid because of an illness or disability for new claimants from 2008) was incorporated into this indicator in the Indices of Deprivation 2010. Claimants of income-based Employment and Support Allowance are now also included together with the contribution-based claimants. Work Capability Assessments for Employment Support Allowance were introduced in 2008, affecting the number of people eligible for these benefits.

4.5 Education, Skills and Training Deprivation Domain

4.5.1 The Education, Skills and Training Domain measures the lack of attainment and skills in the local population. The indicators fall into two sub-domains: one relating to children and young people and one relating to adult skills. These two sub-domains are designed to reflect the 'flow' and 'stock' of educational disadvantage

[34] A ratio of 3:1 between 2012 and 2013 has been adopted for the denominator to match the numerator which uses three time points from 2012 and one from 2013.

within an area respectively. That is, the 'children and young people' sub-domain measures the attainment of qualifications and associated measures ('flow'), while the 'skills' sub-domain measures the lack of qualifications in the resident working-age adult population ('stock').

The indicators

Children and Young People sub-domain

- Key Stage 2 attainment: The average points score of pupils taking reading, writing and mathematics Key Stage 2 exams
- Key Stage 4 attainment: The average capped points score of pupils taking Key Stage 4
- Secondary school absence: The proportion of authorised and unauthorised absences from secondary school
- Staying on in education post 16: The proportion of young people not staying on in school or non-advanced education above age 16
- Entry to higher education: A measure of young people aged under 21 not entering higher education

Adult Skills sub-domain

- Adult skills: The proportion of working-age adults with no or low qualifications, women aged 25 to 59 and men aged 25 to 64
- English language proficiency: The proportion of working-age adults who cannot speak English or cannot speak English well, women aged 25 to 59 and men aged 25 to 64

Indicator details

Key Stage 2 attainment

4.5.2 The indicator is the average points score for pupils at Key Stage 2. The numerator is the total score of pupils taking English and mathematics in 2010/11 and 2011/12, and reading, writing and mathematics in 2012/13[35], in a Lower-layer Super Output Area. The denominator is the total number of subjects (exams) taken by pupils for the same years as the numerator.

4.5.3 The data is for pupils in state-funded schools[36] and was supplied by the Department for Education from the National Pupil Database, based on the Lower-layer Super Output Area of pupil residence. Three years of data were used to reduce issues due to fluctuations between year-groups.

4.5.4 During the 2010/11 to 2012/13 period for which data was used, changes to the grading scheme and teacher assessments resulted in changes to the way that the

[35] In 2012/13 the reading and writing components of English were assessed separately. Previously, the reading and writing components were assessed jointly.

[36] The state-funded schools comprise: academies, free schools and City Technology Colleges, and schools maintained by a local authority (Community, Foundation, Voluntary Aided, Voluntary Controlled, Community Special and Foundation Special).

average points scores are constructed[37]. Therefore, standardisation and shrinkage were applied separately to each year of data before combining into a single indicator using factor analysis.

Key Stage 4 attainment

4.5.5 The indicator is the average capped points score for pupils at Key Stage 4 (GCSE or equivalent)[38]. The numerator is the total capped score of pupils taking Key Stage 4 in 2010/11, 2011/12 and 2012/13 in a Lower-layer Super Output Area. The denominator is the total number of pupils in the area who took Key Stage 4 exams, for the same years as the numerator.

4.5.6 The data is for pupils in state-funded schools and was supplied by the Department for Education from the National Pupil Database, based on the Lower-layer Super Output Area of pupil residence. Three years of data were used to reduce issues due to fluctuations between year-groups. As each year's results are separately moderated (and thus score thresholds change), standardisation and shrinkage were applied separately to each year of data before combining into a single indicator using factor analysis.

Secondary school absence

4.5.7 The indicator is the proportion of authorised and unauthorised absences from secondary school. The numerator is the number of half days missed by pupils living in a Lower-layer Super Output Area due to authorised and unauthorised absences for 2010/11, 2011/12 and 2012/13. The denominator is the total number of possible half-day sessions for 2010/11, 2011/12 and 2012/13.

4.5.8 The data is for pupils in state-funded schools and was supplied by the Department for Education from the National Pupil Database, based on the Lower-layer Super Output Area of pupil residence. Three years of data were used to reduce issues due to fluctuations between year-groups. Shrinkage was applied to the indicator.

Staying on in education post 16

4.5.9 The indicator measures the proportion of young people not staying on in school or non-advanced education above age 16, based on receipt of Child Benefit. Child Benefit is a tax-free payment that most parents can claim for their child(ren).

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[37] In 2010/11, students sat separate English and maths National Curriculum Tests, with the average points score calculated from these two tests and with level 5 (point score 33) being the maximum achievable grade. In 2011/12, the writing element of the English exam was changed to be based on teacher assessment of a mixture of tests and coursework, with only partial external moderation. The reading element was still assessed externally with a National Curriculum Test, and in addition, a new level 6 test was introduced with a point score of 39 (the previous maximum point score was 33). In 2012/13, there were separate point scores for reading and writing, rather than a combined score. The writing element was entirely based on the teacher's internal assessment of work for the year. See http://www.education.gov.uk/schools/performance/2011/primary_11/PointsScoreAllocation2011.pdf p1, http://dera.ioe.ac.uk/12366/1/assessment%20and%20reporting%20arrangements%20-%20key%20stage%202.pdf p.5 and 6, http://www.naldic.org.uk/Resources/NALDIC/Teaching%20and%20Learning/ARA2013.pdf p.6.

[38] The average capped points score caps the total number of courses that can be included at the equivalent of eight full GCSEs. This places higher weight on the grades within the core of eight subjects than on the quantity of courses taken.

Children aged under 16 are eligible. Those aged between 16 and 19 are only eligible if they are in relevant education or training, or registered for work, education or training with an approved body.

4.5.10 The numerator for the indicator is the number of people aged 17 receiving Child Benefit (who are only eligible if they are in relevant education or training), at Lower-layer Super Output Area level for the period 2010 to 2012. The denominator is the number of people in the area aged 15 receiving Child Benefit in the period 2008 to 2010.

4.5.11 The indicator definition is based on the assumption that the group of young people aged 17 in a Lower-layer Super Output Area in a given year is comparable to the group aged 15 two years previously. For indicator reliability, the value of deriving the numerator and the denominator from the same (Child Benefit) source is seen to outweigh the impact of in-migration and out-migration of young people in this age cohort between the two time points.

4.5.12 The data was supplied by HM Revenue & Customs. The indicator was calculated in a positive form as the proportion of children staying on in school or non-advanced education. This figure was subtracted from 1 to produce the proportion *not* staying on in education after the age of 16. Shrinkage was applied to the indicator.

Entry to higher education

4.5.13 The indicator is a measure of young people aged under 21 not entering higher education. The numerator is the number of successful entrants aged under 21 to higher education in a Lower-layer Super Output Area. Data from the Higher Education Statistics Agency was used for the numerator, with four years of data – 2009/10 to 2012/13 – used to reduce the problems of small numbers and year-on-year fluctuation. The denominator was the population aged 14-17 in the Lower-layer Super Output Area for the four years, 2009 to 2012 less the prison population.

4.5.14 The indicator includes those aged under 21 who successfully applied from a domestic postcode in England to a higher education institution anywhere in the UK[39]. The data was restricted to first degree, first year, full-time students, and age was as at 31 August each year.

4.5.15 As detailed above, the numerator and denominator for this indicator were constructed from four years of data, now possible due to the availability of annually updated data. The indicator was calculated in a positive form as a measure of those aged 21 entering higher education. This figure was subtracted from 1 to produce the measure of young people *not* entering higher education. Shrinkage was applied to the indicator.

[39] For the purpose of the Higher Education Statistics Agency's data collection, 'higher education' refers to courses for which the level of instruction is above that of level 3 of the Qualifications and Curriculum Authority National Qualifications Framework (for example courses at the level of Certificate of Higher Education and above).

Adult skills

English language proficiency

4.5.16 The adult skills indicator is the proportion of working-age adults (women aged 25 to 59 and men aged 25 to 64) with no or low qualifications.

4.5.17 The English language proficiency indicator is the proportion of the working-age population (women aged 25 to 59 and men aged 25 to 64) who cannot speak English or cannot speak English 'well'. This new indicator was included in the Adult Skills sub-domain to include those adults who experience barriers to learning and disadvantage in the labour market as a result of lack of proficiency in English.

4.5.18 A non-overlapping count of those adults with no or low qualifications, and/ or who cannot speak English or cannot speak English 'well' was provided by the Office for National Statistics from Census 2011 data. The denominator was the number of working-age adults (women aged 25 to 59 and men aged 25 to 64) in the same area, again taken from the 2011 Census. Shrinkage was applied to the indicator.

Combining the indicators to create the domain

4.5.19 The indicators within the Children and Young People sub-domain were standardised by ranking and transforming to a normal distribution. The maximum likelihood factor analysis technique was used to generate the weights to combine the indicators into the sub-domain score see Table 4.1.

Table 4.1. Indicator weights generated by factor analysis for the Children and Young People sub-domain

Indicator	Indicator weight
Key Stage 2 attainment	0.210
Key Stage 4 attainment	0.232
Secondary school absence	0.224
Staying on in education post 16	0.130
Entry to higher education	0.204

4.5.20 The indicators within the Adult Skills sub-domain were the proportion of adults with no or low qualifications and/ or lack of English language proficiency. As these were already combined into a non-overlapping indicator, no further combination was needed within the sub-domain.

4.5.21 The two sub-domains were standardised by ranking and transforming to an exponential distribution and combined with equal weights to create the overall domain score.

Changes since the Indices of Deprivation 2010

4.5.22 The indicators in the domain remain the same as in the Indices of Deprivation 2010, except for the removal of the Key Stage 3 attainment indicator (Key Stage 3 assessments became teacher assessment only from 2008/9), the addition of the indicator on English language proficiency, and the change in the upper age band of the adult skills indicator from 54 in the Indices of Deprivation 2010 to 59 for women and 64 for men. Appendix C gives more details and describes other minor changes

to indicators in this domain, for example due to changes in available data, and changes to definitions.

4.6 Health Deprivation and Disability Domain

4.6.1 The Health Deprivation and Disability Domain measures the risk of premature death and the impairment of quality of life through poor physical or mental health. The domain measures morbidity, disability and premature mortality but not aspects of behaviour or environment that may be predictive of future health deprivation.

The indicators

- Years of potential life lost: An age and sex standardised measure of premature death
- Comparative illness and disability ratio: An age and sex standardised morbidity/disability ratio
- Acute morbidity: An age and sex standardised rate of emergency admission to hospital
- Mood and anxiety disorders: A composite based on the rate of adults suffering from mood and anxiety disorders, hospital episodes data, suicide mortality data and health benefits data.

Indicator details

Years of potential life lost

4.6.2 The years of potential life lost indicator measures 'premature death', defined as death before the age of 75 from any cause (the commonly used measure of premature death). This includes death due to disease as well as external causes such as accidents, unlawful killing and deaths in combat.

4.6.3 The indicator was based on mortality data covering the period 2008 to 2012, provided by the Office for National Statistics. The denominator was the 2008 to 2012 mid-year population estimates (minus the prison population) in five-year age-sex bands. The level of unexpected mortality was weighted by the age of the individual who has died. The unexpected death of a younger person therefore has a greater impact on the overall score than someone who is older, even if their death is also unexpected.

4.6.4 The indicator was directly age and sex standardised in five-year age-sex bands: comparing the actual number of deaths in an area to what would be expected given the area's age and sex structure. Shrinkage was applied to the indicator.

Comparative illness and disability ratio

4.6.5 The comparative illness and disability ratio is an indicator of work limiting morbidity and disability, based on those receiving benefits due to inability to work through ill health.

4.6.6 The benefits paid to people who are unable to work due to ill health are Disability Living Allowance, Employment and Support Allowance, Attendance Allowance, the disability premium of Income Support, Incapacity Benefit, and Severe Disablement Allowance (these last two benefits are not available for new claimants, but there are groups still receiving them). Individuals cannot receive more than one of these

benefits at the same time, so the numbers of people receiving them can be straightforwardly summed to produce an indicator.

4.6.7 The indicator was based on data from 2013 provided by the Department of Work and Pensions. The denominator was the 2013 mid-year population estimate (minus the prison population) in five-year age-sex bands. The indicator was directly age and sex standardised in five-year age-sex bands; comparing the actual number of benefit recipients in an area to what would be expected given the area's age and sex structure. Shrinkage was applied to the indicator.

Acute morbidity

4.6.8 The acute morbidity indicator measures the level of emergency admissions to hospital, based on administrative records of inpatient admissions.

4.6.9 Emergency admissions are defined as cases where 'admission is unpredictable and at short notice because of clinical need'. This includes admission via the Accident and Emergency department, admission directly onto a ward or into theatre and the emergency transfer of patients between hospitals. All emergency admissions greater than one day in length (where discharge is not on the same date as admission) are included as an indication of acute health problems. Only admissions to NHS hospitals are included in the data.

4.6.10 The numerator used the number of hospital spells starting with admission in an emergency and lasting more than one calendar day, and was based on data from the period 2011/12 to 2012/13 provided by the Health and Social Care Information Centre from the Hospital Episode Statistics database. The denominator was the 2011 and 2012 mid-year population estimates (minus the prison population) in five-year age-sex bands.

4.6.11 Two years of data were used to reduce the problems of small numbers. The indicator was directly age and sex standardised in five-year age-sex bands, and shrinkage applied.

Mood and anxiety disorders

4.6.12 The mood and anxiety disorders indicator is a broad measure of levels of mental ill health in the local population. The definition used for this indicator includes mood (affective), neurotic, stress-related and somatoform disorders.

4.6.13 The indicator is a modelled estimate based on four separate sources outlined in the sections below: prescribing data; hospital episodes data; suicide mortality data; and health benefits data. Although none of the four sources on their own provide a comprehensive measure of mood and anxiety disorders, used in combination they represent a large proportion of all those suffering mental ill health.

Prescribing data

4.6.14 The number of patients within a particular GP practice with mental health problems was estimated using information on the conditions for which particular drugs are

prescribed and their typical dosages[40]. Prescription data is published at GP practice level[41], and a two-stage process used to estimate area rates.

1. The number of people was estimated based on the assumption that those with mental ill health take the national 'average daily quantity' of a specific drug on every day of the year[42]. Two years of prescription data (for 2012 and 2013) were used to reduce problems of small numbers.
2. The estimate for each GP practice was then distributed indirectly to Lower-layer Super Output Area level using data on GP practice patients place of residence by Lower-layer Super Output Area level[43].

4.6.15 The denominator for the indicator was based on the same practice population distribution used to distribute the GP Practice estimates to local areas.

Hospital episode data

4.6.16 Hospital episode data made available by the Health and Social Care Information Centre was used to estimate the proportion of the population suffering severe mental health problems relating to depression and anxiety, based on all those who have had an inpatient spell for reason of mental ill health.

4.6.17 The indicator is an annual count of those suffering at least one severe mental health inpatient spell during the year, an 'annual incidence of hospitalisation'. A count was made of all those who have had at least one inpatient spell in any one year coded within International Classification of Diseases 10 chapter 'F' (the coding for mental ill health)[44]. Two years of data (for 2012 and 2013) were used to reduce problems of small numbers.

4.6.18 The denominator was the 2012 and 2013 mid-year population estimates (minus the prison population). A simple (not standardised) rate was calculated, and shrinkage applied.

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[40] Based on prescription medication use for anxiolytics (British National Formulary Section 4.1.2) and anti-depressants (British National Formulary Section 4.3). http://www.hscic.gov.uk/catalogue/PUB06624/nati-deme-anti-pres-audi-summ-rep-apx4.pdf.

[41] GP practice level prescription data was sourced from the Health and Social Care Information Centre (HSCIC) at http://www.hscic.gov.uk/gpprescribingdata and http://www.hscic.gov.uk/searchcatalogue?q=title%3A%22presentation+level+data%22&area=&size=10&sort=Relevance.

[42] While this assumption may not fit very well in individual cases, it is more likely to hold across the 'average' for the practice population. For information on average daily quantities, see the Prescribing Support Unit information at www.hscic.gov.uk/prescribing. The average daily quantities were used to produce an estimate of the numbers of patients required to account for the GP Practice level prescription volumes for the different prescription drugs based on 'typical' dosages.

[43] The GP Attribution Dataset contains information about populations registered with GP practices, and is maintained by the Health and Social Care Information Centre. From 2013, data is published for individual GP practice patients at Lower layer Super Output Area level, for example http://www.hscic.gov.uk/article/2021/Website-Search?productid=16172. For earlier time points, data was made available by the Health and Social Care Information Centre.

[44] The International Classification of Diseases 10 mental health codes used were: F30-F39 (Mood (affective) disorders) and F40-F48 (Neurotic, stress-related and somatoform disorders).

Suicide mortality data

4.6.19 Although suicide is not a direct measure of mental ill health, it is highly associated with depression where it is implicated in a majority of cases[45]. The actual measure used was deaths that occurred between 2008 and 2012 which had International Classification of Diseases 10 codes X60-X84 and Y10-Y34 excluding Y33.9 where the coroner's verdict was pending. Five years of data were used to reduce problems of small numbers.

4.6.20 The denominator was the 2008 to 2012 mid-year population estimates (minus the prison population). A simple (not standardised) rate was calculated, and shrinkage applied.

Health benefits data

4.6.21 The rate of long-term sickness and disability in an area, including for mental health reasons, can be measured using information on receipt of particular benefits. Incapacity Benefit, Severe Disablement Allowance and Employment and Support Allowance benefits are paid to individuals of working-age who are unable to work because of ill health. These datasets are coded for medical conditions, and the codes were converted to an International Classification of Diseases 10 coding. A count of individuals with a condition within chapter 'F' was used as the numerator for the indicator[46].

4.6.22 The numerator was based on data from 2013 provided by the Department of Work and Pensions. The denominator was the 2013 mid-year population estimate (minus the prison population). A simple (not standardised) rate was calculated, and shrinkage applied.

Combining the components to create a composite indicator

4.6.23 The four independent administrative data sources were combined to reduce the influence of under- or over-recording on any one source using weights generated by factor analysis, see Table 4.1.

Table 4.2. Indicator weights generated by factor analysis for the mood and anxiety disorders indicator

Indicator	Indicator weight
Prescribing data	0.224
Hospital episode data	0.419
Suicide mortality data	0.086
Health benefits data	0.270

4.6.24 Using the four components minimises the impact of any variation in the organisation and practice of local services, where individuals with identical mental health needs may receive different types of treatment; the combined indicator

[45] See for example Inskip, H., Harris, E. and Barraclough, B. (1998), Lifetime risk of suicide for affective disorder, alcoholism and schizophrenia, The British Journal of Psychiatry, 172, p.35-37. http://bjp.rcpsych.org/content/172/1/35.abstract

[46] The precise International Classification of Diseases 10 codes were as for the hospital data used in the acute morbidity indicator above: F30-F39 (Mood (affective) disorders) and F40-F48 (Neurotic, stress-related and somatoform disorders).

should therefore be a more precise measure of the underlying 'true' rate of mental health than any single indicator on its own.

4.6.25 Unlike the other indicators in this domain, the mood and anxiety disorders indicator is not age and sex standardised. Although there are particular ages when a person is at higher risk of suffering from these mental health disorders, and females are at greater risk than males, the distribution of mood and anxiety disorders does not follow a clear distribution over the lifespan so age and sex have not been controlled for.

Combining the indicators to create the domain

4.6.26 The indicators within the domain were standardised by ranking and transforming to a normal distribution. Factor analysis was used to generate the weights to combine the indicators into the final domain score, see Table 4.3.

Table 4.3. Indicator weights generated by factor analysis for the Health Deprivation and Disability Domain

Indicator	Indicator weight
Years of potential life lost	0.244
Comparative illness and disability ratio	0.287
Acute morbidity	0.254
Mood and anxiety disorders	0.216

Changes since the Indices of Deprivation 2010

4.6.27 The indicators in the domain remain the same as in the Indices of Deprivation 2010. Where benefits have been replaced or there have been eligibility changes since the Indices of Deprivation 2010, this has been described above. Further details of these changes are given in Appendix C.

4.6.28 The data on claimants of Employment Support Allowance (which replaced Incapacity Benefit and Income Support paid because of an illness or disability for new claimants from 2008) was incorporated into this indicator since Indices of Deprivation 2010. Work Capability Assessments for incapacity benefits were also introduced in 2008, further affecting the number of people eligible for these benefits.

4.7 Crime Domain

4.7.1 Crime is an important feature of deprivation that has major effects on individuals and communities. The Crime Domain measures the risk of personal and material victimisation at local level.

The indicators

- Violence: The rate of violence per 1,000 at-risk population
- Burglary: The rate of burglary per 1,000 at-risk properties
- Theft: The rate of theft per 1,000 at-risk population
- Criminal Damage: The rate of criminal damage per 1,000 at-risk population.

Indicator details

Violence: The rate of violence per 1,000 at-risk population

Burglary: The rate of burglary per 1,000 at-risk properties

Theft: The rate of theft per 1,000 at-risk population

Criminal Damage: The rate of criminal damage per 1,000 at-risk population

4.7.2 Recorded crime data for 2013/14 was made available via the Association of Chief Police Officers and the Home Office. The Appendix on quality assurance outlines the work done to check the input data and data processing involved (Appendix J).

4.7.3 The methodology used in the Indices of Deprivation 2015 is identical to that developed for and used in the Indices of Deprivation 2010, 2007 and 2004:

1. A list of notifiable offence codes that were active during the 2013/14 year was identified, which best replicated the definitions of the four Crime Domain indicators 'violence', 'burglary', 'theft' and 'criminal damage'. See Appendix H for this list of offences by indicator.
2. Individual level geocoded crime records for this list of notifiable offences were extracted from the recorded crime data made available, and assigned to one of the four indicators.
3. Lower-layer Super Output Area level counts were constructed for each indicator by aggregating the individual event-level geocoded crime data using a bespoke mapping application. Where an incident occurred within 100 metres of a Lower-layer Super Output Area boundary, the incident was apportioned equally to the areas either side of the boundary. A series of rules were imposed to maximise data quality, such as ensuring that crimes that were geocoded to locations well outside of the respective force boundary were not mapped at this stage.

4.7.4 The Lower-layer Super Output Area level counts for each indicator were constrained to aggregate counts of crime (for an equivalent set of notifiable offence categories) published at Community Safety Partnership level which are available as open data[47]. All recorded crimes are allocated a Community Safety Partnership identifier code, whilst a minority of recorded crimes are not allocated a detailed geocode. Any discrepancies between the Community Safety Partnership level data and the aggregated geocoded data are therefore dealt with in this constraining step, so that the constrained Lower-layer Super Output Area level aggregations from geocoded data sum up to match the Community Safety Partnership level open data exactly.

4.7.5 For the violence, theft and criminal damage indicators, the constrained Lower-layer Super Output Area counts for 2013/14 were expressed as crime rates per 1,000 'at-risk' population, using a special population-based denominator. This denominator consisted of the total Lower-layer Super Output Area mid-year 2013

[47] Although the Community Safety Partnership level open data statistics do relate to the same underlying occurrence of crime, they are semi-independent of the geocoded crime data because the Community Safety Partnership identifier in the crime record is not dependent upon the detailed geocode variable(s) (i.e. the grid reference or postcode).

population estimate (minus the prison population) plus the non-resident workplace population from the 2011 Census.

4.7.6 For the burglary indicator, counts for Lower-layer Super Output Areas for 2013/14 were expressed as a crime rate per 1,000 'at-risk' properties, using a special property-based denominator. This denominator consisted of residential dwellings at Lower-layer Super Output Area level from the 2011 Census plus non-domestic properties at the same level from Ordnance Survey's Address Base.

4.7.7 Finally, shrinkage was applied to the Lower-layer Super Output Area level rates for each indicator, to produce the four indicator scores.

Combining the indicators to create the domain

4.7.8 The four composite shrunk indicators were standardised by ranking and transforming to a normal distribution. Factor analysis was used to generate the weights to combine the indicators into the domain score, see Table 4.4.

Table 4.4. Indicator weights generated by factor analysis for the Crime Domain

Indicator	Indicator weight
Violence	0.324
Burglary	0.189
Theft	0.222
Criminal Damage	0.265

Changes since the Indices of Deprivation 2010

4.7.9 The indicators in the domain remain the same as in the Indices of Deprivation 2010. Minor changes made to accommodate updated Home Office counting rules are described in Appendix C.

4.8 Barriers to Housing and Services Domain

4.8.1 The Barriers to Housing and Services Domain measures the physical and financial accessibility of housing and local services. The indicators fall into two sub-domains: 'geographical barriers', which relate to the physical proximity of local services, and 'wider barriers' which includes issues relating to access to housing such as affordability.

The indicators

Geographical Barriers sub-domain

- Road distance to a post office: A measure of the mean distance to the closest post office for people living in the Lower-layer Super Output Area
- Road distance to a primary school: A measure of the mean distance to the closest primary school for people living in the Lower-layer Super Output Area
- Road distance to a general store or supermarket: A measure of the mean distance to the closest supermarket or general store for people living in the Lower-layer Super Output Area
- Road distance to a GP surgery: A measure of the mean distance to the closest GP surgery for people living in the Lower-layer Super Output Area

Wider Barriers sub-domain

- Household overcrowding: The proportion of all households in a Lower-layer Super Output Area which are judged to have insufficient space to meet the household's needs
- Homelessness: Local authority district level rate of acceptances for housing assistance under the homelessness provisions of the 1996 Housing Act, assigned to the constituent Lower-layer Super Output Areas
- Housing affordability: Difficulty of access to owner-occupation or the private rental market, expressed as the inability to afford to enter owner-occupation or the private rental market.

Indicator details

Road distance to a post office

Road distance to a primary school

Road distance to a general stores or supermarket

Road distance to a GP surgery

4.8.2 The four road distance indicators were chosen for the Indices of Deprivation 2000 and retained in each subsequent update as they relate to key services that are important for people's day-to-day life and to which people need to have good geographical access. All road distance indicators are constructed in the same way.

4.8.3 The indicators are defined as an average road distance measured in kilometres and calculated initially at Output Area level[48].

4.8.4 The grid referenced locations of Post Offices were supplied by Post Office Ltd (for March 2014). All Post Office branches were included.

4.8.5 The postcoded locations of primary schools were obtained from the Department for Education's Edubase system (July 2014). These postcodes were then geocoded using Code-Point Open (May 2014 version) and the ONS Postcode Directory (May 2014 version). All schools classified as 'open' or 'open but proposed to close' that are also 'primary' or 'all through' were included. In terms of the type of establishment, schools were included that are classified as local authority maintained schools, academies or free schools.

4.8.6 The grid referenced locations of food shops were obtained from the Ordnance Survey Points of Interest dataset (for March 2014). The definition of food shop includes supermarket chains, convenience stores and independent supermarkets. This includes concessions such as food shops within petrol stations, but administrative offices are removed.

4.8.7 The postcodes of GP premises were obtained from the Health and Social Care Information Centre (May 2014 release). These postcodes were geocoded using

[48] For more information about Output Areas see: www.neighbourhood.statistics.gov.uk/dissemination/Info.do?page=nessgeography/neighbourhoodstatisticsgeographyglossary/neighbourhood-statistics-geography-glossary.htm#O

Code-Point Open (May 2014 version), the ONS Postcode Directory (May 2014 version) and a small number of manual assignments. The dataset of GPs used to construct the indicator is a list of all active medical practices and prescribing cost centres (numbering approximately 8,200). It does not capture the size of a practice, which varies from that of a single practitioner to a large surgery with many GPs and additional health care professionals.

4.8.8 Because healthcare and education are a responsibility for the devolved administrations, only GPs and primary schools located in England have been taken into account when constructing the English Indices of Deprivation. However, food shops and post offices in mainland UK were included, so that account can be taken of services just within the Scottish or Welsh borders.

4.8.9 A bespoke geographic information system application was used to calculate the road distance to the closest service from the population weighted centroid of each Output Area. To create an average road distance for the Lower-layer Super Output Area, a population-weighted mean of the Output Area road distances was used. Each Output Area score was weighted according to the proportion of the Lower-layer Super Output Area population that is within the Output Area, and the weighted scores summed. The Output Area level population estimates used for population-weighting were obtained from the 2011 Census[49].

Household overcrowding

4.8.10 The indicator is the proportion of households in a Lower-layer Super Output Area that are classed as overcrowded according to the definition below. The numerator is the number of overcrowded households in the Lower-layer Super Output Area, while the denominator is the number of households in the same area. Both were taken from the 2011 Census. Shrinkage was applied to the indicator.

4.8.11 The Census 2011 'occupancy rating' provides a measure of whether a household's accommodation is overcrowded or under-occupied. There are two measures of occupancy rating, one based on the total number of rooms in a household's accommodation, and one based only on the number of bedrooms. As for the Indices of Deprivation 2010, the household overcrowding indicator uses the occupancy rating based on rooms. This relates the actual number of rooms in a dwelling to the number of rooms required by the household, taking account of the ages of, and relationships between, household members.

4.8.12 The room requirement[50] used in the occupancy rating states that every household needs a minimum of two common rooms, excluding bathrooms, with bedroom requirements that reflect the composition of the household. The occupancy rating of a dwelling is expressed as a positive or negative figure, reflecting the number of rooms in a dwelling that exceed the household's requirements, or by which the home falls short of its occupants' needs.

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[49] Each road distance indicator uses the total population for population-weighting, with the exception of the road distance to a primary school where the population of children aged 4 to 11 was used.

[50] For worked examples of how the room requirement is calculated, see: http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-notes-and-clarifications/index.html

4.8.13 All statistics derived from the 2011 Census and published by the Office for National Statistics are classified as National Statistics and comply fully with the National Statistics Code of Practice.

Homelessness

4.8.14 This local authority district level indicator is expressed as the rate of acceptances for housing assistance under the homelessness provisions of housing legislation (as defined below). Although the Indices of Deprivation 2010 indicator used data for a single year, the updated indicator was constructed from the average of data for three years (2011/12, 2012/13 and 2013/14) in order to increase the robustness of the indicator. The homelessness data used in the numerator is published by the Department for Communities and Local Government. The denominator is the local authority district count of households from the 2011 Census, which is the latest date for which this data is available.

4.8.15 Homelessness is defined as applications made to local housing authorities under the homelessness provisions of housing legislation where a decision was made and the applicant was found to be eligible for assistance (acceptances). It therefore excludes any households found to be ineligible.

4.8.16 The raw data used to construct the indicator was the same as those used to produce published National Statistics. Local authority district rates were assigned to the constituent Lower-layer Super Output Areas, with each such area in a district given the same rate. As this data is available at local authority district level, shrinkage was not applied to this indicator.

Housing affordability

4.8.1 The housing affordability indicator is a measure of the inability to afford to enter owner-occupation or the private rental market. The indicator is made up of two components relating to housing affordability: one component which measures difficulty of access to owner-occupation, and one component which measures difficulty of access to the private rental market. The private rental component considers whether people can afford to rent in the market without assistance from Housing Benefit. The two components were constructed separately.

4.8.2 The indicator is a modelled estimate based on house prices and rents in the relevant Housing Market Area[51] and modelled incomes at Lower-layer Super Output Area level with a 2012 time point. The main data sources are the Family Resources Survey for household incomes and composition, the Regulated Mortgage Survey (Council for Mortgage Lenders) and Land Registry for house prices, and the Valuation Office Agency for market rents. Other sources include a range of Census and other published data at Lower-layer Super Output Area level, and indicators at local authority district level including the Annual Population Survey and the Annual Survey of Hours and Earnings.

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[51] Jones, Coombes and Wong (2010) The Geography of Housing Market Areas in England, undertaken for the former National Housing and Planning Advice Unit and published by the Department for Local Government and Communities www.gov.uk/government/publications/housing-market-areas. For further details see www.ncl.ac.uk/curds/research/defining/NHPAU.htm. The geography of HMAs is described in Appendix I.

4.8.3 The target group is households where the head is aged under 40[52]. This aims to capture the cohort of households entering the housing market based on the recognition that most first time buyers and renters are in the younger adult age group. To increase the robustness of the indicator, the age cut-off has changed since the Indices of Deprivation 2010, from 35 to 40, resulting in a larger number of cases in the relevant surveys with which to produce modelled estimates.

4.8.4 Households (that is the first benefit units in the household) are assigned to dwelling size groups based on their bedroom requirements as under the standard UK 'bedroom standard'[53]. Affordability criteria are broadly the same as for the Indices of Deprivation 2010. The threshold house prices and rents were based on the lower quartile of all sale prices/rents within size groups (0, 1, 2, 3 and 4 or more bedrooms) at Housing Market Area level.[54] The lower tier of Housing Market Areas was used, with Lower-layer Super Output Area level price and local authority level rent data apportioned to Housing Market Areas (lower-tier Housing Market Areas are described in Jones et al (2010), see footnote 51, and Appendix I).

4.8.5 Income is defined as the income of the 'first benefit unit' in the household, excluding income from means-tested benefits.[55] Income levels were estimated in stages, following similar lines to a study by Bramley and Watkins[56] for the Improvement Service for Scottish local government, which estimated income and poverty measures for Scottish Datazones. Individual-level predictive regression models were developed based on income levels for individuals and households in the Family Resources Survey, applied to small areas using equivalent variables from Census and other sources at Lower-layer Super Output Area level; and constrained using the Office for National Statistics' 'groups' of similar Lower-layer Super Output Areas in stronger or weaker housing markets[57].

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[52] Technically, the head of household is known as the "Household Reference Person", defined as the highest income householder without regard to gender.

[53] The standard is defined in the Housing (Overcrowding) Bill 2003 and in summary allocates a bedroom for each couple and for each additional adult, and for each child or pair of children, provided that children over 10 do not have to share with the opposite sex. For the renting component, a single person household aged under 35 is deemed to need only a bedroom in a shared dwelling (using threshold rents available for a '0-bedroom' unit).

[54] The primary criterion for buying is based on lending multipliers, assuming a 95% mortgage and ignoring deposit constraints. For renting, the primary criterion is a ratio of rent to gross income of 25%, The secondary criterion for both buying and renting is that net income after housing cost should exceed 1.2 times the Housing Benefit Applicable Amount (HBAA) for the relevant household unit (DWP *Housing Benefit and Council Tax Benefit Circular HB/CTB A1/2012*, Appendix A, Annexe 2).

[55] The first benefit unit is defined as the main householder and any partner and dependent children, where the household reference person is aged under 40. Other adults present in any 'complex' households are separate benefit units, and their income is not included because these would not be considered reckonable income for the purposes of obtaining a mortgage and because it is assumed that it is the core benefit unit that would be seeking to buy or rent an appropriate housing unit. For the same reason, the room requirements of other adults in a 'complex' household are not included when constructing the indicator.

[56] Bramley, G. and Watkins, D. (2013) Local Incomes and Poverty in Scotland: developing local and small area estimates and exploring patterns of income distribution, poverty and deprivation, Report of Research for the Improvement Service on behalf of four Local Authorities (Edinburgh, Falkirk, Fife and Highland) and the Scottish Government. http://www.improvementservice.org.uk/library/download-document/3838-local-incomes-and-poverty-in-scotland/.

[57] Lower-layer Super Output Areas were classified according to whether the Housing Market Area to which they belong has relatively lower or higher house prices. This classification was then combined with the Office

4.8.6 In order to combine the two components into a single indicator of housing affordability, each component was standardised by ranking and transforming to a normal distribution. The two components were then combined with equal weights to create the housing affordability indicator.

Combining the indicators to create the domain

4.8.7 The relevant indicators within each of the sub-domains were then standardised by ranking and transforming to a normal distribution, and combined using equal weights. The sub-domains were then standardised by ranking and transforming to an exponential distribution and combined with equal weights to create the overall domain score.

Changes since the Indices of Deprivation 2010

4.8.8 The indicators in the domain remain the same as in the Indices of Deprivation 2010, apart from changes to the housing affordability indicator including:

- broadening the measure to include affordability of the private rental market;
- improving the income estimation methodology, and producing the indicator at Lower-layer Super Output Area level, rather than local authority districts; and
- using local Housing Market Areas as the reference area.

4.8.9 Other minor changes to this domain, for example due to changes in available data, have been explained above. Further details of all these changes are given in Appendix C.

4.9 Living Environment Deprivation Domain

4.9.1 The Living Environment Deprivation Domain measures the quality of the local environment. The indicators fall into two sub-domains. The 'indoors' living environment measures the quality of housing; while the 'outdoors' living environment contains measures of air quality and road traffic accidents.

The indicators

Indoors sub-domain

- Houses without central heating: The proportion of houses that do not have central heating
- Housing in poor condition: The proportion of social and private homes that fail to meet the Decent Homes standard.

Outdoors sub-domain

- Air quality: A measure of air quality based on emissions rates for four pollutants
- Road traffic accidents involving injury to pedestrians and cyclists.

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for National Statistics Census 2001-based classification of Lower-layer Super Output Areas at 'Group' level to produce the groups of similar Lower-layer Super Output Areas in stronger or weaker markets.

Indicator details

Houses without central heating

4.9.2 The houses without central heating indicator is used as a measure of housing which is expensive to heat. The numerator is the number of houses without central heating in the Lower-layer Super Output Area while the denominator is the number of households in the area.

4.9.3 Data was taken from the Census 2011 (the previous indicator was based on Census 2001 data), and identifies the proportion of houses in each Lower-layer Super Output Area that do not have central heating in any room[58]. Shrinkage was applied to the indicator.

Housing in poor condition

4.9.4 The housing in poor condition indicator is a modelled estimate of the proportion of social and private homes that fail to meet the Decent Homes standard.

4.9.5 A property fails the Decent Homes Standard if it fails to meet any one of the four separate components shown in the table below [59]. Each of these components was modelled separately, using data from the 2011 English Housing Survey at national level, in combination with a commercial dataset that provides information on the age, type, tenure and occupant characteristics of the housing stock at individual dwelling level. Failure likelihood factors for individual dwellings were generated by segmentation analysis and logistic regression models, and aggregated to Lower-layer Super Output Area.

[58] The Census 2011 definition of central heating used includes gas, oil or solid fuel central heating, night storage heaters, warm air heating and underfloor heating.
[59] See 'A Decent Home: Definition and guidance for implementation' published in June 2006 for details of the Decent Homes standard. https://www.gov.uk/government/publications/a-decent-home-definition-and-guidance

Table 4.5. The four components of the Decent Homes Standard	
Component	Description
Housing Health and Safety Rating System	Dwellings which fail to meet this criterion are those containing one or more hazards assessed as serious ('Category 1'). The system includes 29 hazards in the home categorised into Category 1 (serious) or Category 2 (other).
Disrepair	A dwelling is said to be in disrepair if: at least one of the key building components is old and needs replacing or major repair due to its condition; or more than one of the other building components are old and need replacing or major repair due to their condition.
Modernisation	A dwelling is said to fail this criterion if it lacks three or more of the following: a reasonably modern kitchen (20 years old or less); a kitchen with adequate space and layout; a reasonably modern bathroom (30 years old or less); an appropriately located bathroom and WC; adequate insulation against external noise (where such noise is a problem); or adequate size and layout of common areas for blocks of flats.
Thermal comfort	A dwelling fails this criterion if it does not have effective insulation and efficient heating.

Air quality

4.9.6 The indicator is an estimate of the concentration of the four pollutants nitrogen dioxide, benzene, sulphur dioxide and particulates. Indicators for each of the pollutants were based on 2012 air quality data published by the UK Air Information Resource for 1km grid-squares[60], which was modelled to Lower-layer Super Output Area level using the point-in-polygon method. For Lower-layer Super Output Areas that did not have grid points falling within them, data from the nearest point of the air quality grid was assigned.

4.9.7 For each pollutant the atmospheric concentration was compared to a national standard value[61], with the concentrations in each Lower-layer Super Output Area divided by the appropriate national standard, before summing to produce a single indicator.

4.9.8 In theory, values for the combined indicator range from zero to infinity. However in practice values are unlikely to exceed 4, the equivalent of a site where concentrations of all four pollutants are at their respective thresholds.

4.9.9 Due to changes in the national targets[62], the particulate matter component of the air quality indicator were based on particles less than 2.5 micrometres in diameter, rather than the 10 micrometres previously used. Additional pollutants (arsenic, cadmium, nickel and benzoapyrene) are also the subject of a new air quality

[60] UK-AIR: Air Information Resource http://uk-air.defra.gov.uk/
[61] The annual mean standards of nitrogen dioxide, benzene and particulates are defined by the UK's National Air Quality Strategy while the safe guideline for sulphur dioxide is set by the World Health Organisation.
[62] UK and EU Air Quality Policy Context http://uk-air.defra.gov.uk/air-pollution/uk-eu-policy-context

directive[63]. However the overwhelming majority of areas in the country have better-than-target values for these pollutants so they have not been included in the measure.

Road traffic accidents involving injury to pedestrians and cyclists

4.9.10 The indicator is based on reported accidents that involve death or personal injury to a pedestrian or cyclist[64]. The indicator uses data for 2011 to 2013 published by the Department for Transport, with three years of data used to reduce the problem of small numbers.

4.9.11 The numerator for this indicator is the number of reported accidents (weighted for severity) in a Lower-layer Super Output Area that involve death or personal injury to a pedestrian or cyclist, averaged across the three years 2011 to 2013. To take into account the number of people in the local area during the day, the denominator uses the non-resident workplace population (from Census 2011) as well as the average of the mid-year population estimates for 2011 to 2013 (from the Office for National Statistics) with the prison population (from the Ministry of Justice) subtracted.

4.9.12 Weights were applied to the total counts of the three severity types: a weight of 1 was applied for slight severity, 2 for serious and 3 for fatal. Each incident was plotted according to its grid reference, which gives its location accurate to 10 metres. Where an incident occurred within 100 metres of a Lower-layer Super Output Area boundary, the incident was apportioned equally to the areas either side of the boundary. Shrinkage was applied to the indicator.

Combining the indicators to create the domain

4.9.13 The indicators within each of the sub-domains was standardised by ranking and transforming to a normal distribution, and combined using equal weights to create the sub-domains. The sub-domains were standardised by ranking and transforming to an exponential distribution.

4.9.14 The domain was created by summing the two sub-domains, weighted according to patterns of 'indoors' and 'outdoors' time use[65]. As done in the Indices of Deprivation 2010, the Indoors Living Environment sub-domain was given two thirds of the domain's weight, and the Outdoors Living Environment sub-domain, one-third.

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[63] See Air Quality Standards Regulations 2010, http://www.legislation.gov.uk/uksi/2010/1001/pdfs/uksi_20101001_en.pdf

[64] Only accidents that involve at least one 'mechanically propelled' vehicle are included in the dataset. Accidents involving personal injury are counted, including deliberate acts of violence but not confirmed cases of suicide. Accidents involving pedal cycles are included. Where many casualties were associated with one accident, all pedestrian and cyclist casualties were counted. Injuries sustained on private roads and in car parks are not included. See www.gov.uk/government/collections/road-accidents-and-safety-statistics for details.

[65] UK 2000 Time Use Survey, http://discover.ukdataservice.ac.uk/catalogue?sn=4504

Changes since the Indices of Deprivation 2010

The indicators in the domain remain the same as in the Indices of Deprivation 2010, apart from changes to the housing in poor condition indicator which include an improved modelling methodology. Other minor changes to this domain, for example due to changes in available data, are described above. Further details of all these changes are given in Appendix C.

Chapter 5. Ensuring reliability of the Indices of Deprivation

5.1 Overview of quality assurance

5.1.1 The Indices of Deprivation 2015 have been carefully designed and developed to ensure the robustness and reliability of the output datasets and reports. The quality assurance process for the methods, input data sources, data processing steps and outputs builds on the research team's experience of previous developments of the Indices of Deprivation since 2000, and involves a number of different processes outlined in this section.

5.1.2 The quality assurance process also draws on the quality assurance and audit arrangements practice models developed by the UK Statistics Authority to ensure that the assessment of data sources and methodology carried out is proportionate to both the level of public interest in the Indices, and the scale of risk over the quality of the data[66].

5.1.3 Further detail on the quality assurance is provided in Appendices J, K and L, including our assessment against the UK Statistics Authority criteria for National Statistics status and additional validation carried out for the Crime domains and modelled indicators (Appendix J), an overview of the quality assurance process provided to data suppliers (Appendix K), and quality assurance documents for the input data sources (Appendix L).

Our assessment of the quality of the Indices of Deprivation

5.1.4 Based on the design and development of the Indices of Deprivation, and the quality assurance processes and actions, we have assessed that the Indices of Deprivation outputs are fit for purpose. This is based on our assessment of the level of risk of quality concerns and public interest in the Indices, which use the risk and profile matrix set out in the UK Statistics Authority toolkit.

5.1.5 In the following sections we outline how our quality management meets the criteria required for the basic and enhanced levels of assurance. Our quality assurance draws on the four practice areas associated with data quality set out by the UK Statistics Authority toolkit: operational context and data collection; communication with data suppliers; quality assurance principles, standards and checks; and quality assurance investigations carried out for enhanced assurance.

5.2 Designing the Indices to ensure quality

5.2.1 The starting point for the quality assurance work is that the Indices themselves have been designed to ensure the high quality of the output data. The design of the Indices of Deprivation 2015 is based on a set of principles and practices that help

[66] UK Statistics Authority (2015) Administrative Data Quality Assurance Toolkit. http://www.statisticsauthority.gov.uk/assessment/monitoring/administrative-data-and-official-statistics/quality-assurance-toolkit.pdf

to ensure data quality (more detail on the methods, domains and indicators is given in Chapters 3 and 4):

- The domains and Index of Multiple Deprivation bring together 37 indicators of deprivation, from a wide range of data sources. This sheer diversity of inputs also leads to more reliable overall data outputs; to be highly deprived on the Index of Multiple Deprivation, an area is likely to be highly deprived on many of the domains[67]. Due to the variety of data inputs, there is little chance that an area is identified as highly deprived due to a bias in one of the component indicators; the use of multiple independent indicators increases robustness of the final outputs.
- Shrinkage estimation is used to improve reliability of the small area data, by 'borrowing strength' from larger local authority districts. This tends to result in unreliable values (those having larger standard errors) being shifted or 'shrunk' towards the average of the larger area. During the development of the Indices (see below), all indicators were compared before- and after-shrinking, to examine the extent of movement of unreliable scores.
- The different domain scores are standardised (in order to combine them into the overall Index of Multiple Deprivation) by ranking across all areas. This has the effect of pulling-in any extreme area scores that lie at the top or bottom of the distribution. Exponential transformation is then used to ensure that deprivation on one domain is not completely cancelled out by lack of deprivation on another domain.
- The domains are weighted before combining into the overall Index of Multiple Deprivation. The smallest weights are given to the two domains containing modelled indicators (Barriers to Housing and Services, and Living Environment), which therefore have a relatively small impact on the overall Index of Multiple Deprivation.

5.3 How we have ensured quality of the Indices

Appropriate and robust indicators, based on well understood data sources

5.3.1 As outlined in Chapter 3, the development of the Indices of Deprivation 2015 identified a set of 37 indicators that can be used to measure relative deprivation within each of the domains. These indicators are based on data sources that can be used to derive appropriate measures covering England at small area level. Chapter 4 sets out the sources used for each of the indicators. The data sources used as inputs to the Indices of Deprivation 2015 can be grouped into three types as shown in the table below.

5.3.2 For each of the input data sources used, the research team assessed and documented its quality. Appendix L lists the quality documents for each data source. Close communication with the data suppliers ensured that the strengths and weaknesses of the underlying sources and indicators were well understood. In

[67] To a lesser extent, this also applies to individual domains of deprivation; to be highly deprived on a domain, an area is likely to be highly deprived on the individual indicators from which the domain is constructed.

some cases, this led to potential indicators being rejected as not sufficiently robust to use in the Indices of Deprivation 2015 (see Appendix M).

Table 5.1. Types of data sources used as inputs to the Indices of Deprivation 2015

Data source	Notes	Documentation assessed
Published i.e. open data	The preference was to directly use, wherever possible, existing high quality open data sources that have themselves been validated as being of National Statistics quality. In some cases, small variations on open data sources were obtained from the same source through special request; for example Census 2011 data on qualifications and English language proficiency was obtained from the Office for National Statistics.	Quality assurance report(s) supplied with the open data
Administrative data sources made available to the research team	In the absence of appropriate published open data sources, the second preference was for the Indices of Deprivation 2015 to derive indicators from established and well-understood administrative data sources. These data sources, or indicators derived from them, were made available to the research team by data suppliers. In many cases, these data sources are also used by data suppliers to derive published statistical data outputs; for example the Income Deprivation and Employment Deprivation domains are in-part derived from the DWP Unified Publication Database, which is a source for DWP Official Statistics (many of which have themselves been assessed as being of National Statistics quality). In practice, the majority of indicators in the Indices were built directly from well-understood administrative sources in this way.	Quality assurance report(s) on the underlying administrative data sources
Modelled estimates derived for the Indices of Deprivation 2015	In the small number of cases where there was an absence of appropriate open data or established and well-understood administrative data sources, the Indices of Deprivation 2015 used specially modelled estimates for the deprivation indicator at hand. In practice, this was the case for only three indicators: housing affordability, housing in poor condition and air quality. These were developed and quality assured by leading experts in the appropriate fields (see Chapter 4 for further details on these indicators).	Quality assurance report(s) on any underlying data sources, and technical summaries of the methodology used to construct the indicator

5.3.3 In practice, the majority of the datasets used in the Indices of Deprivation 2015 were derived from administrative records, which have close to 100 per cent coverage and are not subject to sampling error. In many instances the raw administrative records are the same as those used to produce published National Statistics.

5.3.4 The research team conducted additional exploration of issues that could affect the quality of the sources, such as the impact of any changes since the Indices of Deprivation 2010, and considered actions to minimise risks to quality. These are set out in Appendices J and M. As an example, the team explored the impact on benefits data of people affected by sanctions, and the potential to adjust the relevant indicators in the Income Deprivation and Employment Deprivation domains. Because data is only available on sanctions decisions taken during a particular month, and not on the total number of people subject to sanctions at a particular time point, the team were not able make adjustment for those subject to sanctions.

5.3.5 The following sections outline the quality assurance steps undertaken during the development of the data outputs. Appendix J provides further detail of the quality assurance process, under the framework outlined by the UK Statistics Authority.

Minimise the impact of potential bias and error in the input data sources

5.3.6 As set out in Section 5.2, the Indices of Deprivation have been carefully designed to minimise the impact of possible bias and error in the input data sources. The different processing stages, and range of different indicators used, mean that the resulting output datasets provide a robust identification of deprived areas.

5.3.7 An example of this comes from the Mood and anxiety disorders indicator of the Health and Disability Deprivation Domain. This indicator is constructed from four independent administrative data sources (see Section 4.6). Although none of the four sources on their own provide a comprehensive measure of mood and anxiety disorders, used in combination they represent a large proportion of all those suffering mental ill health. In addition, using the four component indicators in this way reduces the influence of under- or over-recording from any one source, and minimises the impact of any variation in the organisation and practice of local services, where individuals with identical mental health needs may receive different types of treatment. The combined indicator should therefore be a more precise measure of the underlying ‘true’ rate of mental health than any single indicator on its own.

Views of data users

5.3.8 This update of the Indices of Deprivation has involved close engagement with users to gather views on potential indicators and data sources, and to ensure that the outputs are of high quality and meet user needs. Their views were sought in the survey carried out in July 2014, the consultation in November 2014, and workshops in November and December 2014. There was considerable support for the methodology, including the new and enhanced indicators.

5.3.9 The Department for Communities and Local Government Project Board and its Advisory Group have also provided feedback on the methodology, data sources and quality assurance process.

Audited, replicable and validated processing steps are used to construct the indicators, domains and Index of Multiple Deprivation 2015

5.3.10 All processing of the data was carried out using syntax, providing a complete audit of the processing steps from input data sources through to data outputs[68]. Using syntax avoids the risks associated with carrying out calculations and processing using spreadsheets.

5.3.11 The syntax also enabled clearer validation and audit of the work done, both internally within the teams responsible for the domains and other members of the research team, and externally by the independent assessor (see paragraph 5.3.19). The checks included external replication and validation of the complete set of processing steps. The syntax was checked to confirm the processing steps were being implemented accurately, and produced data outputs as expected.

Real world validation of the data inputs and outputs

5.3.12 An important part of the checking process was to compare the Indices of Deprivation 2015 data against the data used to construct the previous Indices (the Indices of Deprivation 2010) at all stages in the process. A range of methods were used, including plotting histograms and box plots to examine the range and distribution of data, and scatter plots and correlations to determine the overall association of data between years. The final domains and Index of Multiple Deprivation were tabulated for the 2015 and 2010 versions, and areas that had changed significantly between the versions were examined.

5.3.13 The administrative datasets used in the Indices of Deprivation are liable to change between years as eligibility criteria, definitions and methodology are modified over time. To ensure that reliable data was used, the input data sources were compared thoroughly with the sources used in producing the previous Indices where available. This quality check was carried out before any data processing, in order to check for large differences that might indicate a methodological change in the administrative datasets being used.

5.3.14 Examining the input data sources also helped contextualise differences seen at a later stage of data processing. For example, trends in benefit claimant numbers, or road traffic accidents, were used in the quality checks once data processing had been carried out, helping judge whether any change between years identified by the Indices data is realistic.

5.3.15 Where possible, the Indices of Deprivation 2015 data was compared to equivalent published data to check that they were broadly similar. Small differences between the Indices of Deprivation 2015 data and published data are inevitable due to methodological differences, but significant differences could indicate a processing error. Published data was not always available at Lower-layer Super Output Area level so comparisons were made at a spatial scale that was possible, most commonly at local authority district level. Ideally this validation would have used data from independent sources to those used in constructing the Indices, however in practice this was not always possible as no such separate source existed.

[68] All processing was carried out using Stata 13 statistical software.

5.3.16 The deprivation deciles of each indicator, sub-domain and domain were mapped and the geographical pattern of deprivation examined. Checks of the overall distribution of deprivation across England were accompanied by more detailed checks of small areas known to the research team.

5.3.17 In addition, 'reality checks' were undertaken to consider whether the Indices of Deprivation 2015 data corresponded with the expected pattern of deprivation. For example, overcrowding is expected to be more severe in urban areas than rural locations because cities are more densely populated. Reality checking provides an additional check that the data processing has been correctly carried out, and that the indicators, domains and overall Index of Multiple Deprivation have been correctly ranked.

Internal and external quality assurance checks

5.3.18 *Internal audit*. The data processing steps and data outputs were subject to a series of internal quality assurance checks by the project team. Indicators and domains were reviewed by the team responsible for constructing the domain, and internally audited by a team member who was not involved in constructing the domain. The Index of Multiple Deprivation and higher-level summaries were reviewed and audited by three team members.

5.3.19 *External scrutiny of the complete process*. On completion of the Indices, an external independent assessor carried out external validation and assurance of the data processing steps for construction of the indicators, domains and Index of Multiple Deprivation from start to finish. This external scrutiny included assessment of the data processing methods and syntax, and real-world analysis of the Indices of Deprivation 2015 output datasets against the Indices 2010 data outputs and comparable open data sources.

Additional enhanced assurance of specific data sources

5.3.20 A small number of data sources were identified as requiring additional quality assurance. These were related to indicators in the Crime Domain, the acute morbidity indicator in the Health Deprivation and Disability Domain, and the modelled indicators of housing affordability and housing condition. The additional assurance work for these indicators is outlined in Appendix J.

Roles and responsibilities of the research team and data suppliers

5.3.21 The development and construction of the Indices of Deprivation was a complex project, involving multiple data suppliers and processing steps carried out by the research team. The composition of the research team carrying out the update of the Indices of Deprivation has been carefully considered to ensure quality of the data outputs.

5.3.22 In addition, clear communication and coordination between the different teams involved was an important part of ensuring the quality of the final outputs. Regular contact with each of the data suppliers helped understand the strengths and weaknesses of the different input data sources and modelling techniques used.

Appendix A. Indicator details and data sources

A.1.1. This Appendix provides numerator and denominator details for each of the 37 indicators included in the Indices of Deprivation 2015.

A.1.2. As far as is possible, each indicator has been based on data from the most recent time point available. Using the latest available data in this way means that there is not a single consistent time point for all indicators, however in practice most indicators in the Indices of Deprivation 2015 relate to the tax year 2012/13.

A.1.3. Where the denominator is detailed as residential population, this includes the communal establishment population, but excludes any prison population.

A.2. Income Deprivation Domain

- **Adults and children in Income Support families**
  Numerator: As described, 2012 (Department for Work and Pensions)
  Denominator (for summed Income Domain indicators): Total resident population mid-2012 (Office for National Statistics) less the prison population (Ministry of Justice).
- **Adults and children in income-based Jobseeker's Allowance families**
  Numerator: As described, 2012 (Department for Work and Pensions)
  Denominator (for summed Income Domain indicators): Total resident population mid-2012 (Office for National Statistics) less the prison population (Ministry of Justice).
- **Adults and children in income-based Employment and Support Allowance families**
  Numerator: As described, 2012 (Department for Work and Pensions)
  Denominator (for summed Income Domain indicators): Total resident population mid-2012 (Office for National Statistics) less the prison population (Ministry of Justice).
- **Adults and children in Pension Credit (Guarantee) families**
  Numerator: As described, 2012 (Department for Work and Pensions)
  Denominator (for summed Income Domain indicators): Total resident population mid-2012 (Office for National Statistics) less the prison population (Ministry of Justice).
- **Adults and children in Working Tax Credit and Child Tax Credit families not already counted, that is those who are not in receipt of Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee) and whose equivalised income (excluding housing benefit) is below 60 per cent of the median before housing costs**
  Numerator: As described, 2012 (HM Revenue and Customs)
  Denominator (for summed Income Domain indicators): Total resident population mid-2012 (Office for National Statistics) less the prison population (Ministry of Justice).
- **Asylum seekers in England in receipt of subsistence support, accommodation support, or both**

Numerator: As described, 2012 (Home Office)
Denominator (for summed Income Domain indicators): Total resident population mid-2012 (Office for National Statistics) less the prison population (Ministry of Justice).

A.3. Employment Deprivation Domain

- **Claimants of Jobseeker's Allowance (both contribution-based and income-based), women aged 18-59 and men aged 18-64**
  Numerator: As described, four quarters from May 2012 to February 2013 (Department for Work and Pensions)
  Denominator (for summed Employment Domain indicators): Working-age population, women aged 18 to 59 and men aged 18 to 64 (Office for National Statistics population estimates 2012 and 2013) less the prison population (Ministry of Justice). .
- **Claimants of Employment and Support Allowance (both contribution-based and income-based), women aged 18-59 and men aged 18-64**
  Numerator: As described, four quarters from May 2012 to February 2013 (Department for Work and Pensions)
  Denominator (for summed Employment Domain indicators): Working-age population, women aged 18 to 59 and men aged 18 to 64 (Office for National Statistics population estimates 2012 and 2013) less the prison population (Ministry of Justice).
- **Claimants of Incapacity Benefit, women aged 18-59 and men aged 18-64**
  Numerator: As described, four quarters from May 2012 to February 2013 (Department for Work and Pensions)
  Denominator (for summed Employment Domain indicators): Working-age population, women aged 18 to 59 and men aged 18 to 64 (Office for National Statistics population estimates 2012 and 2013) less the prison population (Ministry of Justice).
- **Claimants of Severe Disablement Allowance, women aged 18-59 and men aged 18-64**
  Numerator: As described, four quarters from May 2012 to February 2013 (Department for Work and Pensions)
  Denominator (for summed Employment Domain indicators): Working-age population, women aged 18 to 59 and men aged 18 to 64 (Office for National Statistics population estimates 2012 and 2013) less the prison population (Ministry of Justice).
- **Claimants of Carer's Allowance, women aged 18-59 and men aged 18-64**
  Numerator: As described, four quarters from May 2012 to February 2013 (Department for Work and Pensions)
  Denominator (for summed Employment Domain indicators): Working-age population, women aged 18 to 59 and men aged 18 to 64 (Office for National Statistics population estimates 2012 and 2013) less the prison population (Ministry of Justice).

A.4. Education Skills and Training Deprivation Domain

- **Key Stage 2 attainment**

Numerator: Total score of pupils taking reading, writing and mathematics Key Stage 2 exams in maintained schools, 2010/11, 2011/12 and 2012/13 (Department for Education)
Denominator: Total number of Key Stage 2 subjects taken by pupils in maintained schools, 2010/11, 2011/12 and 2012/13 (Department for Education).

- **Key Stage 4 attainment**
  Numerator: Total capped (best 8) score of pupils taking Key Stage 4 in maintained schools, 2010/11, 2011/12 and 2012/13 (Department for Education)
  Denominator: All pupils in maintained schools who took Key Stage 4 exams, 2010/11, 2011/12 and 2012/13 (Department for Education).
- **Secondary school absence**
  Numerator: Number of authorised and unauthorised absences from secondary school, 2010/11, 2011/12 and 2012/13 (Department for Education)
  Denominator: Total number of possible sessions for 2010/11, 2011/12 and 2012/13 (Department for Education).
- **Staying on in education post 16**
  Numerator: Young people not staying on in school or non-advanced education above age 16, 2010, 2011 and 2012 (HM Revenue and Customs)
  Denominator: Young people aged 15 receiving Child Benefit in 2008, 2009 and 2010 (HM Revenue and Customs).
- **Entry to higher education**
  Numerator: Young people aged under 21 not entering higher education, 2009/10, 2010/11, 2011/12 and 2012/13 (Higher Education Statistics Agency)
  Denominator: Population aged 14-17, 2009, 2010, 2011 and 2012 (Office for National Statistics population estimates) less the prison population (Ministry of Justice).
- **Adult skills**
  Numerator: Working-age adults with no or low qualifications, non-overlapping count with English language proficiency indicator, women aged 25 to 59 and men aged 25 to 64, 2011 (Office for National Statistics, from Census 2011)
  Denominator: Working-age adults, women aged 25 to 59 and men aged 25 to 64, 2011 (Census).
- **English language proficiency**
  Numerator: Working-age adults who cannot speak English or cannot speak English well, non-overlapping count with Adult skills indicator, women aged 25 to 59 and men aged 25 to 64, 2011 (Office for National Statistics, from Census 2011)
  Denominator: Working-age adults, women aged 25 to 59 and men aged 25 to 64, 2011 (Census).

A.5. Health Deprivation and Disability Domain

- **Years of potential life lost**
  Numerator: Mortality data in five-year age-sex bands, for 2008, 2009, 2010, 2011 and 2012 (Office for National Statistics)
  Denominator: Total resident population in five-year age-sex bands, for 2008, 2009, 2010, 2011 and 2012 (Office for National Statistics population estimates) less the prison population (Ministry of Justice).
- **Comparative illness and disability ratio**
  Numerator: Non-overlapping counts of people in receipt of Income Support,

Disability Premium, Attendance Allowance, Disability Living Allowance, Severe Disablement Allowance, Incapacity Benefit in five-year age-sex bands, 2013 (Department for Work and Pensions)
Denominator: Total resident population in five-year age-sex bands, 2013 (Office for National Statistics population estimates) less the prison population (Ministry of Justice).

- **Acute morbidity**
  Numerator: Hospital spells starting with admission in an emergency in five-year age-sex bands, 2011/12 and 2012/13 (Health and Social Care Information Centre, Hospital Episode Statistics)
  Denominator: Total resident population in five-year age-sex bands, 2011/12 and 2012/13 (Office for National Statistics population estimates) less the prison population (Ministry of Justice).
- **Mood and anxiety disorders**
  A composite based on the rate of adults suffering from mood and anxiety disorders (source: Health and Social Care Information Centre, 2013), hospital episodes data (source: Health and Social Care Information Centre, Hospital Episode Statistics, 2011/12 and 2012/13), suicide mortality data (source: Office of National Statistics, 2008, 2009, 2010, 2011 and 2012) and health benefits data (source: Department for Work and Pensions, 2013).

A.6. Crime Domain

- **Violence**
  Numerator: 18 recorded crime offence types, 2013/14 (Association of Chief Police Officers, provided by the Home Office)
  Denominator: Total resident population, 2013 (Office for National Statistics) less the prison population (Ministry of Justice) plus the non-resident workplace population, 2011 (Census).
- **Burglary**
  Numerator: 4 recorded crime offence types, 2013/14 (Association of Chief Police Officers, provided by the Home Office)
  Denominator: Total residential dwellings, 2011 (Census), plus non-domestic addresses (Ordnance Survey's Address Base).
- **Theft**
  Numerator: 5 recorded crime offence types, 2013/14 (Association of Chief Police Officers, provided by the Home Office)
  Denominator: Total resident population, 2013 (Office for National Statistics) less the prison population (Ministry of Justice) plus the non-resident workplace population, 2011 (Census).
- **Criminal damage**
  Numerator: 8 recorded crime offence types, 2013/14 (Association of Chief Police Officers, provided by the Home Office)
  Denominator: Total resident population, 2013 (Office for National Statistics) less the prison population (Ministry of Justice) plus the non-resident workplace population, 2011 (Census).

A.7. Barriers to Housing and Services Domain

- **Road distance to a post office**

Population weighted mean of Output Area road distance score (the road distance from the populated weighted Output Area centroid to nearest Post Office), 2014 (Post Office Ltd).

- **Road distance to a primary school**
  Population weighted mean of Output Area road distance score (the road distance from the populated weighted Output Area centroid to nearest primary school), 2014 (Department for Education Edubase).
- **Road distance to general store or supermarket**
  Population weighted mean of Output Area road distance score (the road distance from the populated weighted Output Area centroid to general store or supermarket), 2014 (Ordnance Survey).
- **Road distance to a GP surgery**
  Population weighted mean of Output Area road distance score (the road distance from the population weighted Output Area centroid to nearest GP premises), 2014 (Health and Social Care Information Centre).
- **Household overcrowding**
  Numerator: Overcrowded households, 2011 (Census)
  Denominator: Total number of households, 2011 (Census).
- **Homelessness**
  Numerator: Number of accepted decisions for assistance under the homelessness provisions of housing legislation, average of 2011/12, 2012/13 and 2013/14 (Department for Communities and Local Government)
  Denominator: Total number of households, 2011 (Census).
- **Housing affordability**
  Modelled estimate of households unable to afford to enter owner-occupation or the private rental market on the basis of their income, estimated primarily from the Family Resources Survey, Regulated Mortgage Survey, Land Registry house prices, and Valuation Office Agency market rents, 2012.

A.8. Living Environment Deprivation Domain

- **Housing in poor condition**
  Modelled estimate of the probability that any given dwelling in the Output Area (aggregated to Lower-layer Super Output Area level) fails to meet the Decent Homes standard, estimated from the English Housing Survey, 2011.
- **Houses without central heating**
  Numerator: As described, 2011 (Census)
  Denominator: Total number of households, 2011 (Census).
- **Air quality**
  Modelled estimates of air quality based on the concentration of four pollutants (nitrogen dioxide, benzene, sulphur dioxide and particulates), estimated from UK Air Information Resource air quality, 2012.
- **Road traffic accidents**
  Numerator: Injuries to pedestrians and cyclists caused by road traffic accidents, 2011, 2012 and 2013 (Department for Transport)
  Denominator: Total resident population, averaged over 2011 to 2013 (Office for National Statistics) less the prison population (Ministry of Justice) plus non-resident workplace population, 2011 (Census)

Appendix B. Denominators

B.1.1. The majority of the 37 indicators used in the Indices of Deprivation 2015 are expressed as rates or proportions, and thus require a numerator (for example the number of people experiencing a particular form of deprivation in an area) and a suitable denominator (for example the total number of people 'at-risk' of the deprivation in the same area). This Appendix details the issues involved and the data and methodology employed in the construction of estimates of the at-risk population for the various indicators.

B.2. Choosing suitable denominators

B.2.1. A denominator should represent the population at-risk of experiencing a given type of deprivation and therefore it is important to choose a denominator that relates to the numerator with which it will be combined. Certain indicators use numerators and denominators derived from the same data source, while other indicators require their numerators and denominators to be constructed from different sources. Whichever is required, it is important to try to ensure that each denominator includes only those individuals (or households, properties etc.) that are at-risk of experiencing the particular form of deprivation being measured by that indicator.

B.2.2. So, for example, in the Education, Skills and Training Deprivation Domain, the Key Stage 2 attainment indicator is constructed by deriving both the numerator (the sum of points achieved in reading, writing and mathematics by pupils living in a Lower-layer Super Output Area) and the denominator (the sum of the number of subjects taken by pupils living in a Lower-layer Super Output Area) from the National Pupil Database dataset. Similarly, for the indicators where numerators were derived from the 2011 Census, the denominators were also drawn from the Census. Deriving both numerator and denominator using a single data source rules out any systematic error that arises from datasets of different coverage or representativeness.

B.2.3. For a considerable number of indicators, however, estimates of the at-risk population need to be constructed using external data sources. This is discussed below.

B.3. Data for the denominators

B.3.1. 'Mid-year' population estimates at Lower-layer Super Output Area level are published by the Office for National Statistics' Population Estimation Unit. These are a single year of age and sex mid-year estimates that are published in the years between censuses. These estimates are derived by 'aging' the previous Census estimates by adding in births, subtracting deaths and adjusting for migration. The

most recent mid-year estimates were published in October 2014[69], and relate to the mid-point of 2013.

B.3.2. Output Area level population denominators were used to create the four road distance indicators in the Barriers to Housing and Services Domain. These denominators use Census 2011 data, the latest year for which Output Area level data is available.

B.3.3. Data was also obtained from the Home Office on the number of prisoners per single year of age and sex for each Lower-layer Super Output Area containing a prison.

B.4. Defining the at-risk population

B.4.1. The population estimates used as denominators for many of the indicators included resident population and communal establishment population, but excluded prison population. Prisoners were not included as they are not at-risk of many forms of deprivation captured in the Indices of Deprivation. Other types of communal establishment population (for example students; persons in care establishments; children in local authority homes) *are* at-risk of experiencing these forms of deprivation (age/sex restrictions allowing), and so were included in the denominator. This is the same definition of at-risk populations that was adopted for previous Indices.

B.5. Age and sex profile

B.5.1. Some indicators required estimates of the total population for the denominator while others required estimates of the population of a specific age and sex. Population estimates by five-year age band and sex, and by non-standard age/sex groupings as required by particular indicators, were created by the research team from the population estimates published by the Office for National Statistics. For example, the Employment Deprivation Domain required a denominator of males aged 18 to 64 and females aged 18 to 59, while the standardised health indicators required a population denominator for each five-year age-band and sex group.

[69] This update takes account of a correction to these estimates, published in January 2015, to correctly treat foreign armed forces, see http://www.ons.gov.uk/ons/about-ons/get-involved/consultations-and-user-surveys/satisfaction-surveys/population-estimates-for-uk--england-wales-correction/index.html.

Appendix C. Changes since the Indices of Deprivation 2010

C.1. Changes to the Lower-layer Super Output Area geography

C.1.1. The Indices of Deprivation 2010, 2007 and 2004 used the 2001 Lower-layer Super Output Area geography, developed for the 2001 Census.

C.1.2. The Office for National Statistics has since updated Lower-layer Super Output Area geography using population data from the 2011 Census. Only a small number of changes were made between the 2001 and 2011 versions, with modifications to the boundaries of approximately 2.5 per cent of the 2001 Lower-layer Super Output Areas.

C.1.3. The Indices of Deprivation 2015 have been produced using this 2011 version of the Lower-layer Super Output Area geography.

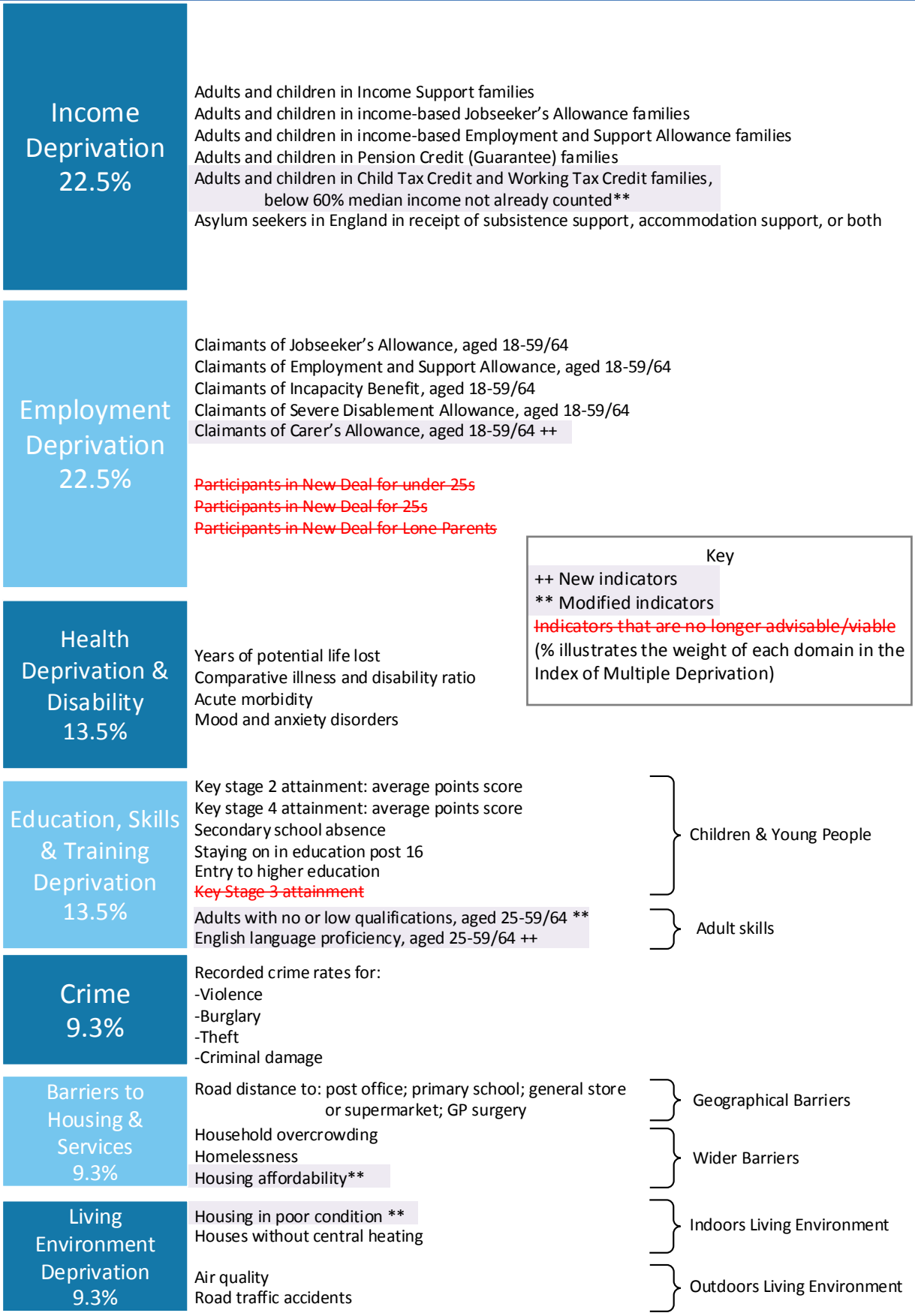
C.2. Domains and indicators

C.2.1. It has been possible to update almost all of the indicators in the Indices of Deprivation 2010 with little or, at most, minor changes. Figure C.1 summarises the updated, new and modified indicators for each of the domains:

- two new indicators are proposed, based on improved availability of robust data
- four modifications to indicators, due to improved data or estimation methods
- four indicators will be dropped, as these are no longer available or appropriate to include.

C.2.2. Minor changes to indicators, for example due to changes in available data, and changes to definitions are described in the text in the following sections.

Figure C.1.Domains and indicators for the Indices of Deprivation 2015, showing changes since the Indices of Deprivation 2010



Changes to the Income Deprivation Domain

Modified indicator	**Adults and children in Working Tax Credit and Child Tax Credit families not already counted** Cases of Working Tax Credit where no Child Tax Credit is in payment (for single people and childless couples) are included, in addition to cases where there is also Child Tax Credit in payment. As with Child Tax Credit, 'Working Tax Credit only' cases are included up to the income threshold - that is those whose equivalised income (excluding housing benefits) is below 60 per cent of the median before housing costs. The change to this indicator means that the Income Deprivation Domain now includes all people receiving tax credits who are below the income threshold.
Changes to data and definitions[70]	Income-based Employment and Support Allowance replaced Income Support paid because of an illness or disability for new claims (from October 2008). To account for this, adults and children in income-based Employment and Support Allowance families have been included in the domain in addition to adults and children in Income Support families.

Changes to the Employment Deprivation Domain

New indicator	**Claimants of Carer's Allowance** This indicator captures adults who are involuntarily excluded from the labour market due to caring responsibilities. The indicator is a non-overlapping count of Carers Allowance claimants of working-age excluding those who receive Jobseeker's Allowance, Employment and Support Allowance, Incapacity Benefit or Severe Disablement Allowance[71]. Carers Allowance is payable to people aged 16 or over who provide unpaid care for at least 35 hours a week to someone who is in receipt of disability or social care benefits[72] and who are a) not in full-time education or studying for more than 21 hours a week and b) earn less than £102 a week[73].
Changes to data and definitions	New Deal and Flexible New Deal have been replaced by the Work Programme, so the three New Deal indicators included in the Indices of Deprivation 2010[74] have been removed from the domain. Participants in the Work Programme are still in receipt of

[70] Universal Credit is replacing certain income related benefits. This will not affect the updated Indices since this change was introduced after the time point of the data used.
[71] Note, not all claimants of Incapacity Benefit, Severe Disablement Allowance, contribution-based Employment and Support Allowance and contribution-based Jobseeker's Allowance are eligible for Carer's Allowance but it is payable to claimants of income-based Jobseeker's Allowance and income-based Employment and Support Allowance.
[72] The social care benefits comprise: Personal Independence Payment daily living component, Disability Living Allowance - the middle or highest care rate, Attendance Allowance, Constant Attendance Allowance at or above the normal maximum rate with an Industrial Injuries Disablement Benefit, or basic (full day) rate with a War Disablement Pension or Armed Forces Independence Payment.
[73] These are earnings after the deduction of taxes, care costs while at work and 50 per cent of pension contributions.
[74] As shown in Figure C.1.

	Jobseeker's Allowance so do not need to be included separately in the domain. There has been progressive replacement of Incapacity Benefit and Severe Disablement Allowance by contribution-based Employment and Support Allowance and income-based Employment and Support Allowance. This change has been reflected by including claimants of income-based Employment and Support Allowance as well as the contributory claimants. In addition, four quarters of data have been used rather than the previous single quarter, to be consistent with the other indicators in the domain. From May 2012, any lone parents whose youngest child is aged 5 or over are no longer eligible for Income Support and are now eligible for Jobseeker's Allowance. Accordingly this group is now counted in this domain if they receive Jobseeker's Allowance.

Changes to the Education, Skills and Training Deprivation Domain

New indicator	**English language proficiency** This indicator captures those adults who experience barriers to learning and disadvantage in the labour market because of lack of proficiency in English. Based on Census 2011 data, this indicator measures the proportion of the working-age population who cannot speak English, or cannot speak English 'well', and has been combined with the adults skills indicator to provide a non-overlapping count of adults with no or low qualifications and/or lack of English language proficiency.
Modified indicator	**Adult skills** The upper age threshold has been increased, from 54 in the Indices of Deprivation 2010, to 59 for women and 64 for men. This reflects that the majority of people aged 55 to retirement age are economically active. The upper age limit is now consistent with indicators in the Employment Deprivation Domain.
Changes to data and definitions	The Key Stage 3 attainment indicator included in the Indices of Deprivation 2010 has been removed from the Children and Young People sub-domain. This is because statutory tests were abolished and Key Stage 3 assessments became teacher assessment only from 2008/9. In order to strengthen the indicators on Key Stage 2 attainment, Key Stage 4 attainment, secondary school absence and staying on in education post 16, the average of three years' worth of data has been used (rather than the two years used previously). The numerator for the entry to higher education indicator is based on four years of data. The denominator for this indicator has also been constructed from four years of data, now possible due to the availability of annually updated data (a single year was used previously).

	The average points score for the Key Stage 2 attainment indicator no longer contains a science element, and there have been changes to the way the English element of Key Stage 2 has been assessed and graded.

Changes to the Health Deprivation and Disability Domain

Changes to data and definitions	Data on claimants of Employment Support Allowance (which replaced Incapacity Benefit and Income Support paid because of an illness or disability for new claimants from 2008) has been incorporated into the comparative illness and disability ratio indicator and the health benefits component of the mood and anxiety disorders indicator. Work Capability Assessments for Employment Support Allowance were introduced in 2008, reducing the number of people eligible for incapacity benefits.

Changes to the Crime Domain

Changes to data and definitions	The Home Office periodically updates the counting rules that define what constitutes crime and the specific type of crime. Some minor updates have been made to the rules since the Indices of Deprivation 2010, but it has still been possible to replicate the indicators using the same definitions for 'violence', 'burglary', 'theft' and 'criminal damage'. The number of offence categories used for each crime indicator were revised for the Indices of Deprivation 2015, in order to maximise comparability with the Indices of Deprivation 2010: • Violence - 18 notifiable offence categories (previously 21) • Burglary – 4 notifiable offence categories. • Theft – 5 notifiable offence categories • Criminal damage – 8 notifiable offence categories (previously 11) See Appendix H for details of the notifiable offence categories used in the Indices of Deprivation 2015.

Changes to the Barriers to Housing and Services Domain

Modified indicator	**Housing affordability** The following changes were made to this indicator: • broadening the measure to include inability to afford to enter the private rental market, in addition to the owner-occupied sector; • producing the indicator at Lower-layer Super Output Area level, rather than at local authority level as was produced for the Indices of Deprivation 2010; • using local Housing Market Areas as the reference areas (see

	Appendix I for information on Housing Market Areas), to reflect commuting and migration patterns, rather than the local authorities which were the reference areas for the Indices of Deprivation 2010; • improving the income estimation methodology • improving the indicator reliability, by increasing the upper age cut-off from age 35 to age 40 to increase the sample size available for the statistical modelling. The resulting indicator combines with equal weight the two underlying components: affordability of owner-occupation and affordability of private rented accommodation.
Change to data and definitions	In order to strengthen the homelessness indicator, the average of three years' worth of data is used (instead of one year used previously).

Changes to the Living Environment Domain

Modified indicator	**Housing in poor condition** The following changes were made to this indicator: • the four components of the Decent Homes standard were modelled separately to improve accuracy; • the statistical model was created at dwelling-level, rather than the Output Area level measure created previously; • to reflect policy changes since the indicator was last produced, the Housing Health and Safety Rating System was used instead of the previous fitness standard.
Change to data and definitions	Changes to national targets on air quality mean that the particulate matter component of the air quality indicator will now be based on particles less than 2.5 micrometres in diameter (10 micrometres was used previously)

Appendix D. The shrinkage technique

D.1. Improving the reliability of small area data values using shrinkage estimation

D.1.1. The shrinkage technique is designed to deal with the problems associated with small numbers in a Lower-layer Super Output Area. In some areas – particularly where the at-risk population is small – data may be 'unreliable', that is more likely to be affected by sampling and other sources of error.

D.1.2. The technique of shrinkage estimation (in other words empirical Bayesian estimation) is used to 'borrow strength' from larger areas to avoid creating unreliable small area data. Shrinkage estimation involves moving Lower-layer Super Output Area scores towards another more robust score, often relating to a higher geographical level. All Lower-layer Super Output Area scores will move somewhat through shrinkage, but those with large standard errors (in other words the most 'unreliable' scores) will tend to move the most. The Lower-layer Super Output Area score may be moved towards a 'more deprived' or 'less deprived' score through shrinkage estimation. Without shrinkage, some Lower-layer Super Output Areas would have scores which do not reliably describe the deprivation in the area due to chance fluctuations from year to year.

D.1.3. It could be argued that shrinkage estimation is inappropriate for administrative data which are, in effect, a census. This is not correct. The problem exists not only where data are derived from samples but also where scans of administrative data effectively mean that an entire census of a particular group is being considered. This is because such censuses can be regarded as samples from 'super-populations', which one could consider to be samples in time. All the data from administrative sources and the 2011 Census are treated as samples from a super-population in this way, and the shrinkage technique was applied to indicators which use this data. The exceptions are the modelled indicators, road distance indicators and indicators supplied at local authority district level.

Selecting the larger areas from which unreliable small area data can borrow strength

D.1.4. The principle for selecting the larger area should be that the Lower-layer Super Output Areas within them share characteristics. In the current shrinkage methodology, local authority districts are used. The Lower-layer Super Output Areas within a single district share issues relating to local governance and possibly to economic sub-climates. To a certain extent, they may also share issues relating to labour market sub-climates.

D.1.5. There are various other contenders for larger areas from which unreliable small area data can borrow strength. The Government Statistical Service Methodology Advisory Committee suggested alternatives to the current local authority district geography that could be explored. Following discussion with the project Advisory Group, the Office for National Statistics Super Output Area Classification was investigated as a potential 'larger area' from which small area data could 'borrow strength'.

D.1.6. The impact of using clusters defined by the Super Output Area Classification as the larger areas to which Lower-layer Super Output Areas are 'shrunk' was investigated and compared with the impact of shrinkage to local authority districts[75]. The analysis was undertaken using the Indices of Deprivation 2010, examining the impact of shrinkage using different larger areas on Lower-layer Super Output Area ranks in the Income Deprivation Domain, the Employment Deprivation Domain, and on the Key Stage 4 indicator in the Education, Skills and Training Deprivation Domain.

D.1.7. It was found that when estimates for Lower-layer Super Output Areas were shrunk to the mean score of their cluster (as defined by the Super Output Area Classification), a greater number of Lower-layer Super Output Areas changed rank than if they were shrunk to the mean score of the local authority district. Shrinkage to the mean score for their cluster also results in more Lower-layer Super Output Areas moving from 'more deprived' to 'less deprived' than in the other direction (in comparison with shrinkage to local authority districts).

D.1.8. Whichever larger area was selected, the overwhelming majority of Lower-layer Super Output Areas remained within the same decile of deprivation after shrinkage. So, for example, taking the most deprived decile of the Income Deprivation Domain, out of 3,248 Lower-layer Super Output Areas[76], 3,243 of them remained in the same decile after shrinkage to the district mean and 5 moved to the adjacent, less deprived decile. If shrinkage was applied to the mean of the Super Output Area Classification cluster, then 3,236 remained in the most deprived decile while 12 moved to the adjacent decile. More Lower-layer Super Output Areas moved out of the most deprived decile into a less deprived decile when shrinkage was to the mean for the Super Output Area Classification cluster than when it was to the district mean.

D.1.9. Other factors were considered in addition to the above assessment of the two options for shrinkage. The main consideration was whether Lower-layer Super Output Areas have more in common (in terms of the underlying drivers of deprivation) with other such areas in the same cluster elsewhere in England than they do with those in their own local authority district. Other considerations were that the approach used should be transparent, and whether there is a perceived advantage to containing the impact of shrinkage within a local authority district, as occurs when shrinking to the district mean.

D.1.10. Having considered the results of the investigation there was no clear evidence that shrinkage to Super Output Area Classification clusters would be preferable, and the conclusion was to continue with the approach of shrinking to local authority districts.

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[75] In the Super Output Area Classification in use at the time of the 2010 Indices (based on 2001 Lower-Layer Super Output Areas), there is a hierarchy of 52 cluster subgroups nested within 20 groups and 7 supergroups. For this exploration, the clusters used for shrinkage were the 52 subgroups. The descriptions of Super Output Area Classification groups and supergroups did not sufficiently differentiate between Layer Super Output Areas according to shared characteristics to be an appropriate higher level geography to which to shrink.

[76] There were fewer Lower-layer Super Output Areas at the time of the construction of the Indices of Deprivation 2010 than is the case since the 2011 Census.

D.2. The shrinkage calculation

D.2.1. The actual mechanism of the shrinkage procedure is to estimate deprivation in a particular Lower-layer Super Output Area using a weighted combination of (a) data from the Lower-layer Super Output Area, and (b) data from another more robust score (in the case of the Indices, this is the local authority district score). The weight attempts to increase the efficiency of the estimation, while not increasing its bias. For example, if the Lower-layer Super Output Area score has a large standard error and the score is out of line with other Lower-layer Super Output Area scores in the local authority then the Lower-layer Super Output Area score moves towards the district score. The amount of movement depends on both the size of the standard error and the amount of heterogeneity amongst the Lower-layer Super Output Areas in a local authority district.

D.2.2. The 'shrunk' estimate of a Lower-layer Super Output Area level proportion (or ratio) is a weighted average of the two 'raw' proportions for the Lower-layer Super Output Area and for the corresponding District. The weights used are determined by the relative magnitudes of within-Lower-layer Super Output Area and between-Lower-layer Super Output Area variability.

If the rate for a particular indicator in Lower-layer Super Output Area j is r_j events out of a population of n_j, the empirical logit for each Lower-layer Super Output Area is:

$$m_j = \log\left[\frac{(r_j + 0.5)}{(n_j - r_j + 0.5)}\right]$$

whose estimated standard error s_j is the square root of:

$$s_j^2 = \frac{(n_j + 1)(n_j + 2)}{n_j(r_j + 1)(n_j - r_j + 1)}$$

The corresponding counts r out of n for the district in which Lower-layer Super Output Area j lies gives the district-level logit:

$$M = \log\left[\frac{(r + 0.5)}{(n - r + 0.5)}\right]$$

The 'shrunk' Lower-layer Super Output Area level logit is then the weighted average:

$$m_j^* = w_j m_j + (1 - w_j)M$$

where w_j is the weight given to the 'raw' Lower-layer Super Output Area-j data and $(1-w_j)$ the weight given to the overall rate for the district. The formula used to determine w_j is:

$$w_j = \frac{1/s_j^2}{1/s_j^2 + 1/t^2}$$

where t^2 is the inter-Lower-layer Super Output Area variance for the k Lower-layer Super Output Areas in the district, calculated as:

$$t^2 = \frac{1}{k-1}\sum_{j=1}^{k}\left(m_j - M\right)^2$$

D.2.3. Thus large Lower-layer Super Output Areas, where precision $1/s_2^j$ is relatively large, have weight w_j close to 1 and so shrinkage has little effect. The shrinkage effect is greatest for small Lower-layer Super Output Areas in relatively homogeneous districts.

The final step is to back-transform the shrunk logit m_j^* using the 'anti-logit', to obtain the shrunk Lower-layer Super Output Area level proportion for each Lower-layer Super Output Area:

$$z_j = \frac{\exp\left(m_j^*\right)}{1+\exp\left(m_j^*\right)}$$

Appendix E. Factor analysis

E.1. Combining different types of indicator using factor analysis

E.1.1. In a number of the domains, factor analysis is used as a method for combining indicators, by finding appropriate weights for combining indicators into a single score based on the inter-correlations between all the indicators[77].

E.1.2. Factor analysis is only used in domains where 'latent variables' are hypothesised to exist and where the indicator variables are 'effect indicators', i.e. indicators that are influenced by the latent variable. In practice, the technique is applied to three domains: the Children and Young People sub-domain of the Education, Skills and Training Deprivation Domain, the Health Deprivation and Disability Domain, and the Crime Domain.

E.1.3. There are many candidates in terms of types of factor analysis. Two of the main contenders are maximum likelihood factor analysis (as used in the current and previous versions of the Indices of Deprivation) and Principal Components Analysis. The distinction between maximum likelihood factor analysis and Principal Components Analysis is a technical one. In brief, the assumptions underpinning Principal Components Analysis are that the indicators going into the analysis are perfectly reliable and measured without error. Maximum likelihood factor analysis requires no such assumption.

E.1.4. It is not the aim of this analysis to reduce a large number of variables into a number of theoretically significant factors as is usual in much social science use of factor analysis. The indicators within a domain have been chosen because they are held to measure a single area-deprivation factor. The analysis therefore involves exploring a one-common factor model against the possibility of there being more than one meaningful factor. If a meaningful second common factor is found it would suggest the need for a new domain or the removal of variables. This possibility can be examined through standard tests and criteria, such as examination of Eigen values. No meaningful second factors (in other words second factors that measured deprivation) emerged in any of the domains.

E.2. The process for combining indicators using factor analysis

E.2.1. The process of combining indicators using factor analysis comprised three stages:

1. All indicators were converted to the standard normal distribution (following shrinkage, where appropriate).
2. The standardised scores were factor analysed (using the Maximum Likelihood method), deriving a set of weights.
3. The indicators were then combined using these weights.

[77] See Noble et al. 2004 Annex F for a full account of the Factor Analysis technique applied.

Appendix F. Exponential transformation

F.1. Using exponential transformation to prepare the domains for combination

F.1.1. In order to combine the domains into an overall Index of Multiple Deprivation, the domain scores first need to be standardised. Any standardisation and transformation should meet the following criteria:

- *Standard distribution*. It must ensure that each domain has a common distribution, so that domains can be combined, without one domain dominating due to a much larger distribution.
- *Cancellation*. It must have an appropriate degree of 'cancellation' built into it (discussed below)
- *Identify deprived areas*. It must facilitate the easy identification of the most deprived Lower-layer Super Output Areas.
- *Scale independent*. It must not be scale dependent (in other words confuse population size with level of deprivation).

F.1.2. The standardisation and transformation used in the Indices of Deprivation 2015 involves each of the domain scores being ranked, and then the ranks are transformed to an exponential distribution. The exponential distribution has a number of properties that satisfy the criteria above, most importantly that it enables control over cancellation and it helps identify the most deprived Lower-layer Super Output Areas.

Standard distribution

F.1.3. The exponential distribution transforms each domain so that they each have a common distribution, the same range and identical maximum / minimum values. The process starts by ranking the scores in each domain to standardise the domain scores (from 1 for the least deprived, to 32,844 for the most deprived), before applying the exponential transformation procedure to create a standardised domain score ranging from 0 (least deprived) to 100 (most deprived).

Cancellation

F.1.4. The exponential transformation procedure gives control over the extent to which lack of deprivation in one domain cancels or compensates for deprivation in another domain. It allows precise regulation, although not elimination, of these cancellation effects. The scaling constant (23) used produces roughly 10 per cent cancellation. This means that in the extreme case, a Lower-layer Super Output Area which was ranked most deprived on one domain but least deprived on another would overall be ranked at the 90th percentile in terms of deprivation (if the two domains were equally weighted). This compares to the 50th percentile if the untransformed ranks or a normal distribution had been used instead. For example a Lower-layer Super Output Area that ranked most deprived in terms of the Income Deprivation Domain but was ranked least deprived on the Barriers to Services Domain would still be at the 90th percentile (top 10 per cent) if these two domains were combined with equal weights.

Identify deprived areas

F.1.5. The exponential transformation effectively spreads out that part of the distribution in which there is most interest - that is the 'tail' which contains the most deprived Lower-layer Super Output Areas in each domain. The scaling constant ensures that the most deprived 10 per cent of Lower-layer Super Output Areas cover 50 per cent of the distribution of scores (in other words, scores between 50 and 100 after exponential transformation).

Scale independent

F.1.6. The transformation is not affected by the size of the Lower-layer Super Output Area's population.

F.2. The exponential transformation calculation

F.2.1. The transformation used is as follows:

For any Lower-layer Super Output Area, denote its rank on the domain R, scaled to the range [0,1]. R=1/N for the least deprived and R=N/N (in other words R=1) for the most deprived, where N=the number of Lower-layer Super Output Areas in England.

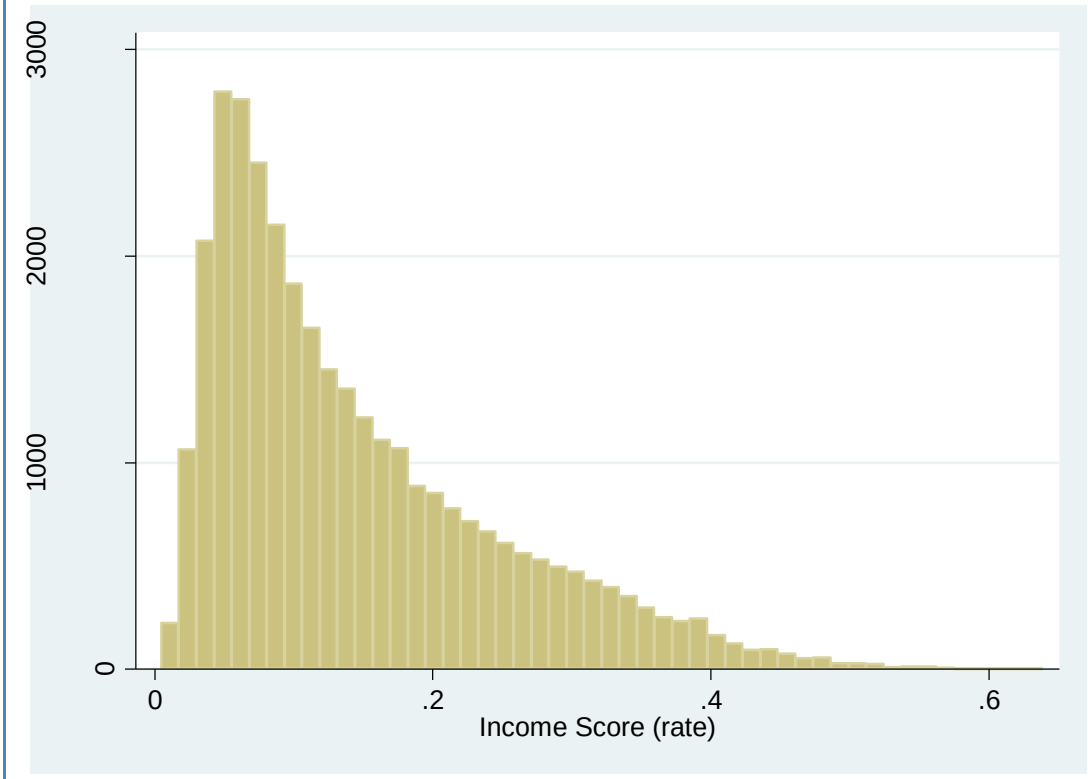
The transformed domain score X is given by:

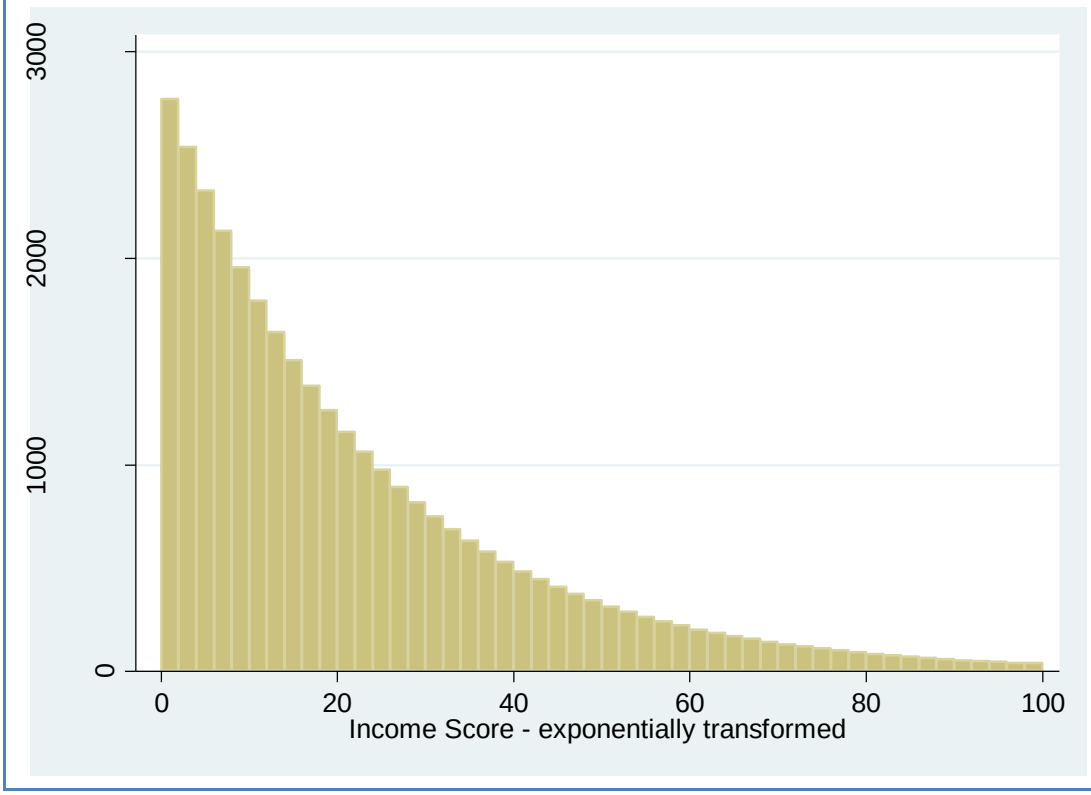
$$X = -23 \ln\left(1 - R\left(1 - \exp^{-100/23}\right)\right)$$

where 'ln' denotes natural logarithm and 'exp' the exponential or antilog transformation

F.2.2. Figure F.1 illustrates the effect of the exponential distribution using the Income Deprivation Domain as an example. The first figure shows the distribution of the Income Deprivation scores, in other words the percentage of income-deprived people in each area. The second figure shows the exponentially transformed domain scores, which range from 0 to 100. The 10 per cent most deprived Lower-layer Super Output Areas (numbering 3,248) have an exponentially transformed score between 50 and 100. The remaining 90 per cent have an exponentially transformed domain score between 0 and 50.

Figure F.1. Distribution of Indices of Deprivation 2015 Income deprivation domain, before and after exponential transformation has been applied





Appendix G. Weighting the domains

G.1. Weighting the domains to create an overall Index of Multiple Deprivation

G.1.1. Combining the different domains into an overall index always involves weighting the domains, whether the weights are set explicitly or not. Greater weight on a specific domain gives greater importance to that domain in the overall index. Weights may be set explicitly, as they were in the Indices of Deprivation 2000 and subsequent updates. If domain scores were simply added together (after standardisation), this explicitly gives each domain an equal weight. Conversely, if domains are not standardised to lie on the same scale or distribution, then weights are set implicitly by the domain distributions.

G.1.2. In the final analysis there is no ultimate method by which to measure multiple deprivation, as it is a combination of individual deprivations measured in the component domains. However, the choice of weights is not arbitrary; for the Indices of Deprivation 2000 and subsequent updates, the aim was that the weights should be explicit and based on clear criteria:

- Income and Employment Domains should carry more weight than the other domains. This is supported by research and the wider academic literature, for example the work of Townsend. Accordingly, the Income and Employment Domains have been given the highest weights, accounting for 45 per cent between them of the final domain weights in Indices of Deprivation 2015.
- Domains with the most robust indicators should be given the greater weights. Only those indicators which are sufficiently robust are included within the Indices. In addition, all the indicators meet specific criteria for being included: they are 'domain specific' and measure major features of deprivation in that domain, are up-to-date, are capable of being updated on a regular basis, and are available across England at a small area level. The relative robustness of the indicators was gauged by extensive and detailed quality assurance testing of the data which also drew on extensive experience of working with such data.

G.1.3. During the consultation for the Indices of Deprivation 2000 and each of the subsequent English Indices of Deprivation, there has been a great deal of support for the weights chosen. Subsequent assessment of potential weights based on empirical methodologies (see below) also supports the weights used for Indices of Deprivation 2010.

G.1.4. Assessment of potential weights based on empirical methods showed consistent results. Analysis commissioned from Dibben et al[78] explored three alternative empirical methods for setting domain weights, rather than the theoretical basis outlined above:

[78] Dibben, C., Atherton, I., Cox, M., Watson, V., Ryan, M. and Sutton, M. (2007) Investigating the Impact of Changing the Weights that Underpin the Index of Multiple Deprivation 2004, London: Communities and Local Government.

- Survey approach – How does living in the conditions measured by each domain affect an individual's chance of being socially excluded? This used data from the Millennium Poverty and Social Exclusion Survey to examine the contributions of different domains to a social well-being measure closely related to social exclusion.
- Revealed preference approach – How does the state divide up the 'public purse' between different policies aimed at reducing the proportion of the population affected by each of the domains of deprivation? This analysis allocated departmental and local government spend between each of the domains
- Discrete Choice Experiment – Given a choice between individuals living in these different conditions, who is felt to be most in need of support from the government? The experiment surveyed 1,000 households, asking respondents to choose between supporting individuals with different types of deprivation; these responses were used to derive empirical weights for the domains.

G.1.5. There was close overall agreement between the three empirical methods for deriving domain weights, and the actual domain weights, with the research recommending a single change to the weights – switching the weights of the Employment Domain (from 22.5 per cent to 13.5 per cent) and Health and Disability Deprivation Domain (from 13.5 per cent to 22.5 per cent) domains. This change makes little difference to the overall Index distribution, with a very high correlation between the original and revised indices.

G.1.6. With reference to these research findings, the use of these weights was revisited in the most recent consultations preceding the release of the Indices of Deprivation 2007[79] and Indices of Deprivation 2010[80]. Both consultations found 89 per cent of respondents were in favour of keeping the weights the same. Furthermore, the survey of users in July 2014 did not reveal significant support for moving to new weights. In light of the very high level of user support, the weights used in the Indices of Deprivation 2015 remain as used in the Indices of Deprivation 2010.

[79] Department for Communities and Local Government (2007) Updating the English Indices of Deprivation 2004: Stage Two 'Blueprint' Consultation Report – Summary of Responses. http://webarchive.nationalarchives.gov.uk/20120919132719/http://www.communities.gov.uk/publications/communities/indicesdeprivationresponses

[80] Department for Communities and Local Government (2011) English Indices of Deprivation consultation: summary of responses. https://www.gov.uk/government/consultations/english-indices-of-deprivation.

Appendix H. Categories of recorded crime

H.1.1. This Appendix sets out the categories of recorded crime used for the Crime Domain indicators. See Chapter 4 for details of the domain and indicators.

Violence

Table H.1. Home Office offence codes used for the violence indicator

Offence code	Offence name
1	Murder
4.1	Manslaughter
4.2	Infanticide
2	Attempted murder
37/1	Causing Death by Aggravated Vehicle Taking
5D	Assault with intent to cause serious harm
5E	Endangering Life
8N	Assault with injury
8P	Racially or Religiously Aggravated Assault with Injury
8L	Harassment
8M	Racially or Religiously Aggravated Harassment
9A	Public Fear Alarm or Distress
9B	Racially or Religiously Aggravated Public Fear, Alarm or Distress
105A	Assault without Injury
105B	Racially or religiously Aggravated Assault without Injury
34A	Robbery of Business Property
34B	Robbery of Personal Property
62A	Violent disorder

Burglary

Table H.2. Home Office offence codes used for the burglary indicator

Offence code	Offence name
28A/B/C/D	Burglary in a dwelling
29	Aggravated Burglary in a dwelling
30A/B	Burglary in a building other than a dwelling
31	Aggravated Burglary in a building other than a dwelling

Theft

Table H.3. Home Office offence codes used for the theft indicator	
Offence code	Offence name
37/2	Aggravated Vehicle Taking
39	Theft from the Person
45	Theft from a Motor Vehicle
48	Theft or Unauthorised Taking of Motor Vehicle
126	Interfering with a motor vehicle

Criminal damage

Table H.4. Home Office offence codes used for the criminal damage indicator	
Offence code	Offence name
56A	Arson endangering life
56B	Arson not endangering life
58A	Criminal Damage to a dwelling
58B	Criminal Damage to a building other than a dwelling
58C	Criminal Damage to a vehicle
58D	Other Criminal Damage
58J	Racially or Religiously Aggravated Criminal Damage
59	Threat or possession with intent to commit Criminal Damage

Appendix I. Housing Market Area geography

I.1.1. Figure I.1 shows the Housing Market Area geography across Great Britain. Lower-tier Housing Market Areas, shown with black boundaries, have been used in producing the indicator of housing affordability. The resulting indicator is produced at Lower-layer Super Output Area level.

I.1.2. Work to determine a geography for Housing Market Areas was carried out by Heriot-Watt University and the Universities of Manchester, Newcastle and Sheffield. The research was published by the Department of Communities and Local Government in November 2010[81]. The research sought to identify the optimal areas within which planning for housing should be carried out, since housing market dynamics and population changes do not respect administrative boundaries such as for local authorities.

I.1.3. The resulting Housing Market Area geography took into account commuting and migration patterns using 2001 Census data, and the extent to which areas were 'self-contained'[82]:

- Upper-tier Housing Market Areas, defined by a high level of commuting self-containment.
- Lower-tier Housing Market Areas (277 areas in England). The upper-tier Housing Market Areas were further subdivided, with larger and more urban upper-tier areas with more localised housing market conditions divided according to migration patterns.

[81] Department for Communities and Local Government research and analysis on housing market areas www.gov.uk/government/publications/housing-market-areas with additional details from the Centre for Urban and Regional Development Studies (CURDS) at www.ncl.ac.uk/curds/research/defining/NHPAU.htm.

[82] That is, the extent to which people live and work in the same area, or the extent to which people move house within the same area

Figure I.1. The upper and lower-tier Housing Market Area geography

Upper-tier - purple boundaries
Lower-tier - black boundaries nested within purple boundaries

Reproduced from the Geography of housing market areas: Executive summary, Department for Communities and Local Government, November 2010, p9
www.gov.uk/government/publications/housingmarket-areas

Appendix J. Quality assurance of the Indices of Deprivation 2015

J.1. Level of assurance

J.1.1. The quality assurance of the Indices of Deprivation 2015 used the risk and profile matrix set out in the UK Statistics Authority Administrative Data Quality Assurance Toolkit[83], summarised in the table below.

Table J.1. Risk and profile matrix for administrative data quality assurance

Level of risk of quality concerns	Public interest profile		
	Lower	Medium	Higher
Low	Statistics of lower quality concern and lower public interest [A1]	Statistics of low quality concern and medium public interest [A1/A2]	Statistics of low quality concern and higher public interest [A1/A2]
Medium	Statistics of medium quality concern and lower public interest [A1/A2]	Statistics of medium quality concern and medium public interest [A2]	Statistics of medium quality concern and higher public interest [A2/A3]
High	Statistics of higher quality concern and lower public interest [A1/A2/A3]	Statistics of higher quality concern and medium public interest [A3]	Statistics of higher quality concern and higher public interest [A3]

Level of risk of quality concerns

J.1.2. Our assessment for each indicator, domain and the overall Index of Multiple Deprivation is based on the criteria set out in the table below.

Table J.2. Our criteria for assessing the level of risk of quality

Summary	• What weight does this indicator contribute to the overall Index of Multiple Deprivation? • Our assessment of level of risk of quality concerns: Low; Medium; High.
Operational context and data collection	• Is the indicator published (i.e. open data), in a form that could be used to create the indicator relatively straightforwardly? • If published as open data, is the indicator National Statistics? (i.e. of recognised quality, and with appropriate quality assurance documentation) • If the indicator is not published as open data, is it based on underlying datasets that are themselves used to generate National Statistics?

[83] UK Statistics Authority (2015) Administrative Data Quality Assurance Toolkit. http://www.statisticsauthority.gov.uk/assessment/monitoring/administrative-data-and-official-statistics/quality-assurance-toolkit.pdf.

	• Is the underlying data used for payments (e.g. benefit systems)? (i.e. likely to high quality and regularly audited) • Is the underlying data used for performance targets (e.g. crime data)? (i.e. risk of performance pressure) • Is the underlying source data collated from separate sources? (i.e. risk of inconsistent processes across the difference sources) • Have any statistical disclosure control methods been applied to the data before being provided to us?
Communication with data suppliers	• Is there a single point of contact with the data supplier? • Have the data supplier and project team established appropriate contact points to discuss data supply and quality assurance? • Has sufficient quality assurance documentation been provided by the data supplier?
Quality assurance principles, standards and checks	• Have concerns been raised by suppliers, users or reviewers over the quality of the indicator or underlying data sources? • If any such concerns have been raised, have these been responded to in the Indices methodology and/ or documentation? • Do good proxy datasets exist for validating the indicator against real-world data sources? E.g. if the underlying datasets are not published, are any derivatives from the datasets available for our quality assurance validation such as data at local authority district level?

J.1.3. Based on our assessment of the Indices inputs and outputs, we have identified:

- The domains and overall Indices of Multiple Deprivation have a *low* Level of risk of quality concerns. These datasets might be seen to have a *high* risk of quality concerns due to the number of different data collection bodies, and complex data collection processes. However these risks are mitigated by the design, data processing, and multiple independent indicators used, in developing the domains and the Index of Multiple Deprivation.
- The input indicators have a mixture of *low* and *medium* concerns over data quality. For each of the data sources used for the indicators, Appendix L sets out the main quality assurance documents available.

Public interest profile

J.1.4. Based on our assessment of the Indices inputs and outputs, we have identified the public interest in the Indices:

- *Medium* public interest in the overall Index of Multiple Deprivation and higher level summary measures;
- *Lower / medium* public interest for the domains;
- *Lower* public interest for the underlying indicators used in the Indices.

Overall level of assurance

J.1.5. Based on our assessment of the Indices inputs and outputs, we have determined the level of assurance required to be as follows:

- *Enhanced assurance* is appropriate for the overall Index of Multiple Deprivation and higher level summary measures, and a small number of specific datasets: the Crime Domain indicators, the acute morbidity indicator in the Health

Deprivation and Disability Domain, and the housing affordability and housing condition modelled indicators. Additional assurance work for these indicators is outlined in Appendix J.3 below.

- *Basic assurance* is appropriate for the remaining indicators and domains.

J.2. Quality management actions

J.2.1. The work to produce the Indices of Deprivation has incorporated a number of actions to ensure quality, which are set out in Chapter 5. The table below lists the primary actions against the quality management actions framework set out in the UK Statistics Authority toolkit[84].

Table J.3. Quality management actions undertaken for quality assurance of the Indices of Deprivation

Quality management area	Actions
Manage	• Design of the Indices, including quality of the input data sources; statistical techniques to improve the reliability of small area data; and communication with data suppliers and users. • Clear roles and responsibilities across the research team and data suppliers, and separate internal and external quality assurance checks.
Communicate	• Review of potential data sources with data suppliers, to identify strengths and weaknesses of the data sources and data processing considered for inclusion in the Indices. • Regular dialogue with data suppliers and the research team. • Documenting quality guidelines and quality assurance for all input data sources used in the Indices (see Appendix L) • Description of the indicators used in the Indices, including biases and assumptions. • Engagement with users of the Indices of Deprivation outputs, including 250 responses to the survey on the draft proposals, 100 responses to the final consultation and over 125 attendees at workshops.
Investigate	• Quality assurance of all data sources used as inputs in the Indices, including review of quality processes for administrative and survey data, and modelling methodologies used to develop specific indicators. • Quality assurance of the processing steps used to construct all indicators, sub-domains, domains, the overall Index of Multiple Deprivation, and the higher area level summaries. • Real world validation of the outputs against data from the previous Indices of Deprivation 2010, as well as appropriate open data sources. This included sense checking of geographic

[84] UK Statistics Authority (2015) Administrative Data Quality Assurance Toolkit. http://www.statisticsauthority.gov.uk/assessment/monitoring/administrative-data-and-official-statistics/quality-assurance-toolkit.pdf.

Table J.3. Quality management actions undertaken for quality assurance of the Indices of Deprivation	
Quality management area	Actions
	patterns and time series trends. Ideally this validation would have used data from independent sources to those used in constructing the Indices; however in practice this was not always possible as no such separate source existed. • In addition to the quality assurance carried out when constructing the domains, internal audit and external scrutiny are carried out on the complete process. These include scrutiny of the methods, processing syntax, and the constructed datasets. The internal audit was carried out on a domain-by-domain basis by a team member not involved in the construction of the domain. The external scrutiny was carried out by an external academic, to provide independent verification.

J.3. Enhanced assurance

J.3.1. A small number of specific datasets were identified as requiring additional quality assurance: the Crime Domain indicators, the acute morbidity indicator in the Health Deprivation and Disability Domain, and the housing affordability and housing condition modelled indicators. The additional assurance work for these indicators is outlined below.

Crime Domain

J.3.2. The Crime Domain has been included since the 2004 Indices, based on indicators that use police recorded crime datasets. These datasets are currently under scrutiny in efforts to improve their quality. The Public Administration Select Committee[85] and Her Majesty's Inspectorate of Constabulary[86] have identified concerns with crimes being under-recorded and/or miscategorised. The UK Statistics Authority removed the National Statistics designation from statistics based on recorded crime data in January 2014 [87].

J.3.3. In its final report[88], Her Majesty's Inspectorate of Constabulary concluded that up to 20 percent of crimes may be going unrecorded. The report acknowledges that there appears to be some variation in the level of under-recording between police forces, but it is not possible to give a reliable statistical measure of this variation between forces. Neither is it possible to infer how this variation applies at lower geographical levels or between more or less deprived neighbourhoods. Therefore

[85] Commons Select Committee, Crime statistics inquiry http://www.parliament.uk/business/committees/committees-a-z/commons-select/public-administration-select-committee/inquiries/parliament-2010/crime-statistics/

[86] Her Majesty's Inspectorate of Constabulary (HMIC) crime data integrity information https://www.justiceinspectorates.gov.uk/hmic/our-work/crime-data-integrity/

[87] UK Statistics Authority register of de-designations http://www.statisticsauthority.gov.uk/assessment/assessment/register-of-de-designations/index.html

[88] Her Majesty's Inspectorate of Constabulary (2014), Crime-recording: making the victim count, https://www.justiceinspectorates.gov.uk/hmic/publication/crime-recording-making-the-victim-count/.

geographical adjustments cannot be made to the police recorded crime data used in the Indices to take under-recording into account.

J.3.4. However, the Indices themselves are designed to help ensure the quality of the output datasets by minimising the impact of bias and error in the input data sources:

- The Crime Domain is based on a combination of multiple crime types, which have different geographical distributions, and potentially different under-recording distributions, and which are then used to rank areas. The distribution of the Crime Domain ranks is therefore likely to be more reliable than the distribution of any one of the underlying offences.
- As the Crime Domain uses a large set of crime categories (see Appendix H), miscategorisation of crimes will often not affect the Domain. For example, 'Assault with intent to cause serious harm', 'Assault with injury' and 'Assault without Injury' are each included under the violence indicator; a miscategorisation between these offences will therefore have no impact on the indicator.
- The overall Index of Multiple Deprivation 2015 brings together 37 indicators of deprivation, from a wide range of data sources. As discussed in Chapter 5, due to the variety of data inputs there is little chance that an area is identified as highly deprived due to a bias in one of the component indicators; the use of multiple independent indicators increases robustness of the final outputs.
- In addition, the team has carried out enhanced quality assurance checks and processes to ensure the quality of the crime data outputs, which are described in the section below.

J.3.5. Taking into account the findings of the final report from Her Majesty's Inspectorate of Constabulary, the data exploration undertaken by the research team, and the support from users, the Indices of Deprivation 2015 continues to use police recorded crime data for the Crime Domain as the best available source of information on crime levels at small area level.

Additional quality checks and processes carried out on the police recorded crime datasets

J.3.6. The individual-level geocoded recorded crime data used to construct the Crime Domain of the Indices of Deprivation 2015 was drawn primarily from the routine monthly data extracts provided by the 39 regional police forces in England to the Home Office for the purpose of administering the police.uk website. The Association of Chief Police Officers granted members of the Indices of Deprivation 2015 research team access to the raw (i.e. non-anonymised) police data within a secure police setting for the purposes of updating the Indices.

J.3.7. In addition to the quality assurance checks already performed by the Association of Chief Police Officers and the Home Office in producing the police.uk open data source, the research team performed an extensive series of checks on the geocoded police data to ensure the appropriate levels of accuracy and completeness prior to incorporation into the Crime Domain. As well as the quality checks carried out, various techniques were used to maximise the quality of the aggregate crime counts constructed from the raw geocoded crime data.

J.3.8. The most important checking process carried out was to compare the Indices of Deprivation 2015 crime counts generated from the raw individual-level geocoded data, against aggregate crime counts at the Police Force-level and Community Safety Partnership-level that are supplied separately by each police force to the Home Office and which are available as open data. These checks of geocoded data against the open data, aggregate statistics were performed at the end of each major data processing phase of the Crime Domain. Primarily, these checks enabled assessment of:

- the degree to which the raw geocoded data contained the correct number of crime records (per crime type, time period and Police Force) prior to any mapping being undertaken; and
- the degree to which the geocoded data could be successfully mapped to appropriate Lower-layer Super Output Areas using the grid reference and/or postcode of offence location.

J.3.9. Where checks revealed discrepancies between the geocoded data and the open data, an enquiry was submitted to the relevant police force. Where necessary, a follow-up data request was submitted to the police force for a bespoke extract of geocoded data for the purpose of the Crime Domain. These bespoke data extracts were then incorporated into the processing phases of the Crime Domain, and the checks against open data performed again.

J.3.10. The extensive checks performed on the final geocoded data demonstrated a high level of correspondence with the publicly available open data at Police Force-level and Community Safety Partnership-level.

J.3.11. We have concluded that this data provides the best measure of crime levels at Lower-layer Super Output Area level, and is fit for purpose to use as an input data source for the Indices of Deprivation 2015.

Acute morbidity indicator in the Health Deprivation and Disability Domain

J.3.12. The acute morbidity indicator in the Health Deprivation and Disability Domain is an age and sex standardised rate of emergency admission to hospital, based on Hospital Episode Statistics provided by the Health and Social Care Information Centre. Emergency admissions are defined as cases where ‘admission is unpredictable and at short notice because of clinical need’, and all emergency admissions greater than one day in length (where discharge is not on the same date as admission) are included.

J.3.13. Some concerns by users and researchers have been raised over the possibility of practices by particular hospital trusts affecting the robustness of this indicator. As stated earlier, the use of multiple independent indicators is one means of minimising the impact of bias and error in input data sources on the Indices of Deprivation. But to further explore the possibility of bias in this input data source, we have carried out additional validation of the indicator as outlined below:

- Quality assurance material from the supplier was reviewed to identify whether there was specific coverage of this issue.
- Correlation and funnel-plot analysis at Lower-layer Super Output Area level showed that the distribution of short stay emergency admissions (of 1 day or less) is consistent with stays of all lengths. This suggests that there are no

large-scale systematic differences between hospital trusts in the way that short-stay and longer-stay emergency admissions are treated.

- Strong correlations were found between the indicator and the overall Health Deprivation and Disability Domain, and between the indicator and the corresponding indicator in the Indices of Deprivation 2010. In addition, analysis of local authority data showed no surprising patterns of change between data from the Indices of Deprivation 2015 and Indices 2010.

J.3.14. Without reviewing the underlying primary data sources used to create the Hospital Episodes Statistics data, it is not possible to categorically conclude that the data accurately records the underlying level of acute morbidity need[89]. However, based on our additional checks set out above, we have concluded that the indicator is the best available measure of acute morbidity, and is fit for purpose as an input indicator into the Indices of Deprivation 2015.

Housing affordability and housing condition modelled indicators

J.3.15. Where possible the Indices of Deprivation uses indicators based on data that provides a *direct measure* of the particular form of deprivation relevant to the indicator. In a small number of cases, no robust data is available to provide a direct measure, and in these cases a modelled estimate is used.

J.3.16. For two indicators, housing affordability and housing condition, synthetic estimation techniques are used to model the indicator to Lower-layer Super Output Area level. For these indicators, the data suppliers have carried out and documented additional work to quality assure the indicators:

- Each of the data sources used in the models was reviewed;
- The predictive strengths of the models were checked;
- The modelled datasets were verified at higher level against independently published sources where available;
- The predicted values were matched to larger area survey values, to ensure consistency of the modelled indicators against other available data.

J.3.17. Additional quality assurance was carried out for the housing affordability indicator:

- The methodology was based on peer reviewed methodology used to develop small area income estimates and poverty measures in Scotland[90].
- Two versions of the modelling were carried out and compared. A version of the indicator was constructed using the Understanding Society survey, and compared with the actual indicator which uses the Family Resources Survey.

J.3.18. Additional quality assurance was carried out for the housing condition indicator:

- Assessment of the input data sources, including measures of accuracy.
- Description and checks on the processing steps, including process maps / flow-charts showing the development of the indicator.

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[89] This approach has been taken by Her Majesty's Inspectorate of Constabulary in their review of crime statistics discussed earlier in this section.

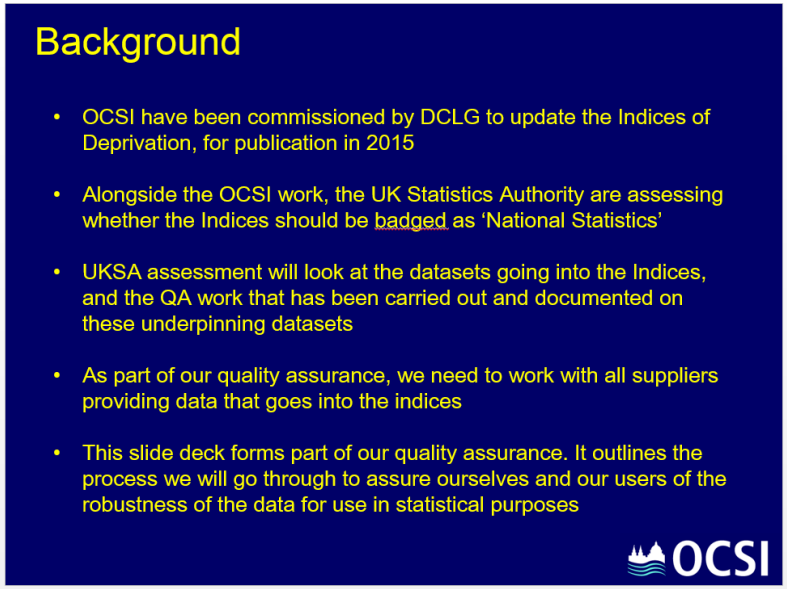
[90] Bramley and Watkins (2013). Local Incomes and Poverty in Scotland: Developing Local and Small Area Estimates and Exploring Patterns of Income Distribution, Poverty and Deprivation http://www.improvementservice.org.uk/assets/local-incomes-poverty-scotland.pdf

- Accuracies of the statistical models were estimated.
- Comparison of the Indices of Deprivation 2015 housing condition indicator methodology against the methodology used in previous versions of the indicator.
- Comparison against related data sources, including local stock condition surveys carried out by local authorities.
- Validations and peer reviews carried out by the data supplier and other users of the data.

J.3.19. Based on this additional quality assurance, we have concluded that these indicators provide the best measures of housing affordability and housing condition at Lower-layer Super Output Area level, and are fit for purpose to use as indicators in the Indices of Deprivation 2015.

Appendix K. Quality Assurance overview for data suppliers

K.1.1. This appendix sets out the overview presentation for data suppliers, used to explain the quality assurance model used for the Indices of Deprivation 2015. The overview also describes the information required from data suppliers.



Additional administrative data context

- The Indices of Deprivation use many different data sources, including administrative sources
- Administrative data provides a readily available, rich source of information but, like other data types, is susceptible to quality issues
- The concern is that the data has not usually been collected with statistical purposes in mind. With all administrative data there is a risk of variation in recording practices between suppliers, cases of incomplete data, incorrect data format and mis-typed data. There have even been cases of intentional misreporting, a particular concern where data is used to monitor performance.
- Principle 4 of the Code of Good Practice requires that we "adopt quality assurance procedures, including the consideration of each statistical product against users' requirements, and of their coherence with other statistical products."

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What we need to do – high level

Make a critical judgement about the robustness of the data for use in producing statistics

Inform users about the quality of our statistical outputs, including estimates of the main sources of bias and other errors

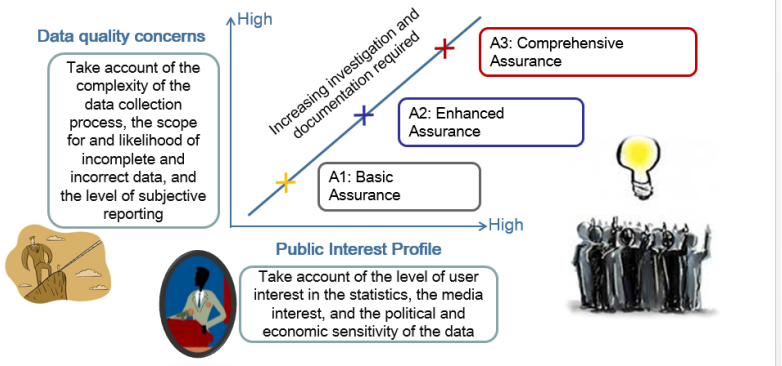
To meet requirements, provide assurance under 4 practice areas

Understand and report the operational context.	During the assessment, raise any concerns regarding the quality of the data, and, where possible, develop mitigation strategies.
Establish and maintain cooperative relationships with data suppliers.	Understand why and how the data is recorded and collected. Identify the scope for error or misreporting in the collection and recording of the data.
Investigate suppliers' QA principles, standards, quality checks and audits.	Establish a common understanding about the origin of the data, its suitability for use within the statistics and the quality standards and data format expected for the statistics.
Conduct our own quality assurance.	Quality assure the data with validation checks and by calibrating it against other sources. Review external audits and regulations.

Quality management actions should be **continuous and iterative** reflecting the ongoing use of the data and the dynamic nature of operational environments. Repeated evaluation allows for ongoing monitoring of data quality and understanding of changes which may impact the data.

Public interest and data quality concerns

- The Indices use ~40 different data indicators sourced from multiple suppliers
- Depending on the nature of the data & source, different levels of assurance will be appropriate
- We have assessed the 'maturity level' (A1 - A3) for each data indicator and, where necessary, each practice area.
- Our assessment is that the ID2015 inputs and outputs are a mix of A1 and A2
- Our reasoning behind each maturity classification will be set-out in our final report(s).



Our assessment of the underlying data sources

Based on the UKSA exposure draft, we apply this checklist to each indicator:

- Is the indicator published (ie open data)?
- If published as open data, is the indicator National Statistics?
- If not published data, are we using underlying datasets that are used to generate National Statistics?
- Is the underlying data used for payments (eg benefit systems) – i.e. likely to be higher quality
- Is the underlying data used for performance targets (eg crime data) – i.e. risk of performance pressure
- Is the underlying source data collated from separate sources, or single source? (ie risk of inconsistent processes across suppliers)
- If not published, are the underlying datasets (or derivatives of them eg LAD aggregates of LSOA data) available for our QA process?
- Have concerns been raised by users or reviewers over the quality of the indicator or underlying data sources? Have these been responded to in our QA?

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What we need from you the data supplier

- Details of the indicator development, including
  - input data sources
  - technical methodology
  - processing steps (ideally process map).
- Details of your QA, including (as appropriate)
  - assessment of data inputs
  - models goodness-of-fit
  - comparison against related data sources
  - validation and/or peer review
  - any known data quality concerns identified by you or users.
- Input datasets and syntax (as appropriate)
  - for our internal review & validation processes.

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Key reading

- UKSA Quality Assurance of Administrative Data Toolkit http://www.statisticsauthority.gov.uk/assessment/monitoring/administrative-data-and-official-statistics
- Types of official statistics www.statisticsauthority.gov.uk/national-statistician/types-of-official-statistics
- Code of Practice for Official Statistics www.statisticsauthority.gov.uk/assessment/code-of-practice
- Exposure draft of UKSA Admin data assurance www.statisticsauthority.gov.uk/assessment/monitoring/administrative-data-and-official-statistics/quality-assurance-and-audit-arrangements-for-administrative-data.html

OCSI

Quality Assurance for the Indices of Deprivation

Overview for data suppliers

Version 1.0

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Appendix L. Quality assurance documents for input data sources

L.1.1. This Appendix lists the main quality assurance documents available for the input data sources used in the Indices of Deprivation, with web links where available[91]. Table L.2 provides a look-up between the indicator identification code used in the table, and the proper name of the indicator.

Table L.1. Quality assurance documents available for the input data sources

Indicator codes(s)	Document / resource name	Web link (if available)
ID1, ID2, ID3, ID4, ID5, ID7, ID8, ID9, ID10, ID11, ID19, ID24	DWP Statistics Quality Guidelines Statement	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/203643/dwp-statistics-Quality_Guidelines_statement_final.pdf
ID1, ID2, ID3, ID4, ID5, ID7, ID8, ID9, ID10, ID11, ID19, ID24	Statement of the administrative sources of DWP statistics	https://www.gov.uk/government/statistics/statement-of-the-administrative-sources-of-dwp-statistics
ID1, ID2, ID3, ID4, ID5, ID7, ID8, ID9, ID10, ID11, ID19, ID24	Confidentiality and access policy for DWP statistics	https://www.gov.uk/government/statistics/confidentiality-and-access-policy-for-dwp-statistics
ID1, ID2, ID3, ID4, ID5, ID7, ID8, ID9, ID10, ID11, ID19, ID24	Policies and statements related to DWP statistical summaries (including Quality statement and Methodology statement)	https://www.gov.uk/government/statistics/dwp-statistical-summary-policies-and-statements
ID1, ID2, ID3, ID4, ID5, ID7, ID8, ID9, ID10, ID11, ID19, ID24	Policies and statements related to DWP abstract of statistics	https://www.gov.uk/government/statistics/dwp-abstract-of-statistics-policies-and-statements
ID1, ID2, ID3, ID4, ID5, ID7, ID8, ID9, ID10, ID11, ID19, ID24	Fraud and error in benefits recent guidelines/QA/Tech annexe	https://www.gov.uk/government/publications/fraud-and-error-in-the-benefit-system-supporting-documents-for-statistical-reports
ID 6	Home Office statistics statement of compliance with code of practice for official	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/341674/ho-compliance-state-aug14.pdf

[91] All web references were downloaded 18th August 2015.

Table L.1. Quality assurance documents available for the input data sources		
Indicator codes(s)	Document / resource name	Web link (if available)
	statistics	
ID 6	Home Office statement of compliance – release practices	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/309011/ho-release-comp-state-14.pdf
ID 6	Home Office use of administrative sources for statistical purposes	https://www.gov.uk/government/publications/home-office-use-of-administrative-sources-for-statistical-purposes
ID1, ID2, ID3, ID4, ID5, ID15	Quality reports for HMRC statistics	https://www.gov.uk/government/collections/hmrc-quality-reports-statistics
ID1, ID2, ID3, ID4, ID5, ID15	HMRC statement of administrative sources	https://www.gov.uk/government/statistics/hmrc-statistics-statement-of-administrative-sources
ID1, ID2, ID3, ID4, ID5, ID15	HMRC policy on revisions	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/251990/cop-revisions.pdf
Denominators	Census quality assurance of 2011 population estimates	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-assurance/index.html
ID16	Higher Education Statistics Agency (HESA) statement of administrative sources and quality assurance	https://www.hesa.ac.uk/sads
ID17, ID18, ID23, ID25, ID34, ID37	Census quality assurance by Local Authority	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-assurance/local-authority-quality-assurance/index.html
ID17, ID18, ID23, ID25, ID34, ID37	Census response and imputation rates	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-measures/response-and-imputation-rates/index.html
ID17, ID18, ID23, ID25, ID34, ID37	Census assessing accuracy of responses	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-measures/assessing-accuracy-of-answers/index.html
ID17, ID18, ID23, ID25, ID34, ID37	Census data capture and cleaning	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-measures/data-capture--coding-and-cleaning/index.html
ID17, ID18, ID23, ID25, ID34, ID37	Census confidence intervals	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-

Table L.1. Quality assurance documents available for the input data sources		
Indicator codes(s)	Document / resource name	Web link (if available)
		measures/confidence-intervals/index.html
ID17, ID18, ID23, ID25, ID34, ID37	Census quality notes and clarifications	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/quality/quality-notes-and-clarifications/index.html
Denominators	Quality and methodology information for population indicators	http://www.ons.gov.uk/ons/guide-method/method-quality/quality/quality-information/population/index.html
Denominators	Quality measures for population estimates and uncertainty project for Local Authority Mid-year Population Estimates	http://www.ons.gov.uk/ons/guide-method/method-quality/imps/latest-news/uncertainty-in-la-mypes/index.html
ID17, ID18, ID23, ID25, ID34, ID37	2011 census issues and corrections	http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/census-products--issues-and-corrections/index.html
ID17, ID18, ID23, ID25, ID34, ID37	Census independent review of coverage assessment and quality assurance	http://www.ons.gov.uk/ons/guide-method/census/2011/how-our-census-works/how-we-planned-the-2011-census/independent-assessments/independent-review-of-coverage-assessment--adjustment-and-quality-assurance/index.html
ID20, ID21, ID22, ID33	The HES processing cycle and data quality	http://www.hscic.gov.uk/media/1366/The-HES-processing-cycle-and-HES-data-quality/pdf/
ID20, ID21, ID22, ID33	Data quality and checks performed on SUS and HES data	http://www.hscic.gov.uk/media/13655/Data-quality-checks-performed-on-SUS-and-HES-data/pdf/Data_quality_checks_performed_on_SUS_and_HES_data.pdf
ID20, ID21, ID22, ID33	HSCIC data quality	http://www.hscic.gov.uk/dq
ID20, ID21, ID22, ID33	HSCIC 2014 data quality report	http://www.hscic.gov.uk/catalogue/PUB15783
ID20, ID21, ID22, ID33	HSCIC 2013 second annual data quality report	http://www.hscic.gov.uk/catalogue/PUB11530
ID20, ID21, ID22, ID33	HSCIC 2012 first annual data quality report	http://www.hscic.gov.uk/catalogue/PUB08687
ID20, ID21, ID22, ID33	HSCIC Secondary Use Services (SUS) data quality dashboards	http://www.hscic.gov.uk/article/1923/SUS-Data-Quality-Dashboards

Table L.1. Quality assurance documents available for the input data sources		
Indicator codes(s)	Document / resource name	Web link (if available)
ID21	2011 GP attribution data quality	http://www.hscic.gov.uk/catalogue/PUB05054/attr-data-gp-reg-pop-ons-esti-2011-qual.pdf
ID12, ID13, ID14, ID32	Standards for official statistics published by DfE	https://www.gov.uk/government/publications/standards-for-official-statistics-published-by-the-department-for-education
ID26, ID27, ID28, ID29	UK Statistics Authority 2014 report on assessment of compliance to code of practice for crime statistics	http://www.ons.gov.uk/ons/rel/crime-stats/crime-statistics/period-ending-september-2013/sty-uksa-assessment.html
ID26, ID27, ID28, ID29	UK Statistics Authority crime statistics assessment reports (links to 2014 and 2011 reports)	http://www.statisticsauthority.gov.uk/assessment/assessment/assessment-reports/
ID26, ID27, ID28, ID29	Action plans to address requirements made by UK Statistics Authority on crime statistics	http://www.ons.gov.uk/ons/guide-method/method-quality/specific/crime-statistics-methodology/uk-statistics-authority-assessment/index.html
ID26, ID27, ID28, ID29	HMIC crime data integrity	https://www.justiceinspectorates.gov.uk/hmic/our-work/crime-data-integrity/
ID26, ID27, ID28, ID29	HMIC report ‘Crime recoding: making the victim count’	https://www.justiceinspectorates.gov.uk/hmic/publication/crime-recording-making-the-victim-count/
ID26, ID27, ID28, ID29	HMIC interim report ‘Crime recording: a matter of fact’	https://www.justiceinspectorates.gov.uk/hmic/publication/crime-recording-a-matter-of-fact-interim-report/
ID26, ID27, ID28, ID29	HMIC 2009 report ‘Crime counts: A review of data quality for offences of the most serious violence’	https://www.justiceinspectorates.gov.uk/hmic/publication/crime-counts/
ID26, ID27, ID28, ID29	HMIC 2012 report ‘The crime scene: a review of police crime and incident reports’ - also links to specific force reports	https://www.justiceinspectorates.gov.uk/hmic/publication/review-police-crime-incident-reports-20120125/
ID26, ID27, ID28, ID29	Crime and Justice data - Quality and Methodology Information papers	http://www.ons.gov.uk/ons/guide-method/method-quality/quality/quality-information/crime-and-justice/index.html

Table L.1. Quality assurance documents available for the input data sources		
Indicator codes(s)	Document / resource name	Web link (if available)
ID35	DCLG - Statement of administrative sources	https://www.gov.uk/government/publications/statement-of-administrative-sources-for-statistical-purposes
ID35	DCLG - Revisions policy	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7616/1466387.pdf
ID35	DCLG - quality guidelines	https://www.gov.uk/government/publications/statistical-notice-dclg-quality-guidelines
ID35	Homelessness statistical release - Jan to March 2014 - with note on data quality	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/339003/Statutory_Homelessness_1st_Quarter__Jan_-_March__2014_England_20140729.pdf
ID35	DCLG open data strategy 2012-2014 - includes details on data quality	http://data.gov.uk/sites/default/files/DCLG%20Open%20Data%20Strategy_10.pdf
ID31	Ordnance survey data positional accuracy improvement (PAI) programme	http://www.ordnancesurvey.co.uk/business-and-government/help-and-support/navigation-technology/pai.html
ID40	Road accident and safety statistics guidance	https://www.gov.uk/government/publications/road-accidents-and-safety-statistics-guidance
ID40	Guide to road traffic accident statistics and data sources (including data quality)	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/259012/rrcgb-quality-statement.pdf
ID40	DfT statistics - corporate information	https://www.gov.uk/government/organisations/department-for-transport/about/statistics#corporate-information
ID40	DfT - statement on data quality	https://www.gov.uk/government/publications/standards-for-official-statistics-published-by-the-department-for-transport
ID40	DfT - statement of administrative sources	https://www.gov.uk/government/publications/statement-of-administrative-sources-for-official-statistics-published-by-the-department-for-transport

Table L.2. Lookup from indicator codes used in Table L.1. to indicator names	
Indicator code	Indicator name
ID1	Adults and children in Income Support families
ID2	Adults and children in income-based Jobseeker's Allowance families
ID3	Adults and children in income-based Employment and Support Allowance families
ID4	Adults and children in Pension Credit (Guarantee) families
ID5	Adults and children in Working Tax Credit and Child Tax Credit families not already counted, that is those who are not in receipt of Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee) and whose equivalised income (excluding housing benefit) is below 60 per cent of the median before housing costs
ID6	Asylum seekers in England in receipt of subsistence support, accommodation support, or both
ID7	Claimants of Jobseeker's Allowance (both contribution-based and income-based), women aged 18-59 and men aged 18-64
ID8	Claimants of Employment and Support Allowance (both contribution-based and income-based), women aged 18-59 and men aged 18-64
ID9	Claimants of Incapacity Benefit, women aged 18-59 and men aged 18-64
ID10	Claimants of Severe Disablement Allowance, women aged 18-59 and men aged 18-64
ID11	Claimants of Carer's Allowance, women aged 18-59 and men aged 18-64
ID12	Key Stage 2 attainment: average points score
ID13	Key Stage 4 attainment: average points score
ID14	Secondary school absence
ID15	Staying on in education post 16
ID16	Entry to higher education
ID17	Adults with no or low qualifications, women aged 25-59 and men aged 25-64
ID18	English language proficiency, women aged 25-59 and men aged 25-64
ID19	Comparative Illness and Disability Ratio
ID20	Acute morbidity
ID21	Mood and anxiety disorders: Prescription data
ID22	Mood and anxiety disorders: Hospital episodes data
ID23	Mood and anxiety disorders: Suicide mortality data
ID24	Mood and anxiety disorders: Employment and Support Allowance and Incapacity Benefit for mental health reasons
ID25	Years of potential life lost
ID26	Recorded crime rate for Violence
ID27	Recorded crime rate for Criminal Damage
ID28	Recorded crime rate for Theft
ID29	Recorded crime rate for Burglary
ID30	Road distance to a post office
ID31	Road distance to general store or supermarket
ID32	Road distance to a primary school
ID33	Road distance to a GP surgery
ID34	Household overcrowding
ID35	Homelessness

ID36	Housing affordability
ID37	Houses without central heating
ID38	Housing in poor condition
ID39	Air quality
ID40	Road traffic accidents

Appendix M. Issues and potential indicators explored

M.1. Introduction

M.1.1. During the update of the Indices of Deprivation, a wide range of issues and indicators were explored in order to understand the potential to enhance the Indices. Where changes have been made to the Indices as a result, primarily new indicators and enhancements to existing indicators, these have been detailed in Chapter 4 and Appendix C.

M.1.2. This Appendix outlines those issues and potential indicators that were examined, but that did not result in changes to the Indices. The first section deals with issues relating to indicators that are included in the Indices of Deprivation 2015 but which did not result in changes to those indicators. The second section describes a number of indicators which were explored but were found not suitable for inclusion in this update.

M.2. Issues by domain

Income Deprivation Domain

M.2.1. *Seasonal variation in benefits*. Seasonal variation in benefit claims is taken into account in the Employment Deprivation Domain, but not the Income Deprivation Domain. While it may now be possible using data from the Department for Work and Pensions to capture claimants at more than one time point in the year, it was unfortunately not practicable to obtain corresponding data for this update of the Indices from HM Revenue & Customs.

M.2.2. *Adjusting benefits/tax credit data for geographical variations in take-up.* If benefits or tax credit take-up varies geographically, it would be desirable to adjust the administrative data in the Income Deprivation Domain to take that into account. Two recent reports on take-up have been published, one in respect of income-related benefits and published by the Department for Work and Pensions[92] and another in respect of tax credits published by HM Revenue & Customs[93] . Both reports have sections on geographical variation of take-up.

M.2.3. In respect of the Department for Work and Pensions' income related benefits there is a clear injunction in the report against reliance on regional estimates of take-up: "Due to the complexities of the methodology it is not possible to produce reliable estimates at geographies below Great Britain so when using the figures it should

[92] Department for Work and Pensions (2012). Income Related Benefits: Estimates of Take-up in 2009-10. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/222915/tkup_full_report_0910.pdf

[93] HM Revenue & Customs (2013). Child Benefit, Child Tax Credit and Working Tax Credit Take-up rates. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265488/cwtcchb-take-up2011-12_fin.pdf

always be considered that effects seen are an amalgamation of changes throughout the country rather than one geographical area" (paragraph 1.9.5, p 9).

M.2.4. As regards adjusting tax credit data, the take-up estimates are given by HM Revenue & Customs as a range and in almost all cases the ranges overlap between regions. There is also no indication of how take-up rates vary for deprived areas within the regions.

M.2.5. Having regard to these reports there is no adequate evidence to support geographical adjustments of the administrative data.

M.2.6. *Adjusting benefits data to include people affected by sanctions*. New sanctions regulations were introduced in 2012 for claimants of Jobseeker's Allowance and Employment and Support Allowance[94]. The effect of a sanction is that the benefit is stopped or reduced for a period of time. Those adults and their families affected by sanctions, but who otherwise would be eligible for income-based Jobseeker's Allowance or income-based Employment and Support Allowance, will not be counted in the domain despite meeting the low income criteria.

M.2.7. Although it would enhance the Income Deprivation Domain to include those affected by sanctions, unfortunately no suitable data is available to do this. The data required would be a count of those sanctioned at any given point in time. Data on sanctions is available from the Department for Work and Pensions' Decision Makers and Appeals System. However, data is only available on sanctions decisions taken during a particular month.

M.2.8. Unfortunately data is not available on the total number of people subject to sanctions at a particular time point, nor is it possible to derive this from the available data on sanctions decisions. There are a number of reasons for this relating to variability of the amount of time people remain sanctioned both within and between the old and new sanction regimes; the variability in the actual amount of time spent on sanctions irrespective of the period of sanction; and the review/appeal process impacting on decisions. This means that an adjustment to the Income Deprivation Domain to take into account those subject to sanctions was not possible within the timeframe of this update of the Indices.

Employment Deprivation Domain

M.2.9. *Adjusting benefits/tax credit data for geographical variations in take-up.* If benefits take-up varies geographically it would be desirable to adjust the administrative data in the Employment Deprivation Domain to take that into account. In the most recent report published by the Department for Work and Pensions on take-up in respect of income related benefits[95], there is a clear injunction in the report against reliance on regional estimates of take-up: "Due to the complexities of the methodology it is

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[94] See Department for Work and Pensions Jobseeker's Allowance and Employment and Support Allowance sanctions statistics for further details: https://www.gov.uk/government/collections/jobseekers-allowance-sanctions. For an overview of the rules see https://www.gov.uk/government/publications/jobseekers-allowance-overview-of-sanctions-rules and https://www.gov.uk/government/publications/employment-and-support-allowance-sanctions-amendment-regulations-2012--2

[95] Department for Work and Pensions (2012). Income Related Benefits: Estimates of Take-up in 2009-10. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/222915/tkup_full_report_0910.pdf

not possible to produce reliable estimates at geographies below Great Britain so when using the figures it should always be considered that effects seen are an amalgamation of changes throughout the country rather than one geographical area" (paragraph 1.9.5, p 9). Having regard to this report there is no adequate evidence to support geographical adjustments of the administrative data.

M.2.10. *Additional weight to long-term claimants.* The possibility of providing an additional weight to those who are long-term unemployed and incapacitated would fail to pick up 'cyclers' (i.e. people who repeatedly move in and out of employment, for example because of seasonal work). For example, many people who are 'seasonally' employed might otherwise be long-term unemployed. Their brief periods of employment may not raise the likelihood of their return to more permanent employment and yet they are not counted among those who are long-term unemployed. Another reason for rejecting this adjustment is that including it would fundamentally alter the structure of the domain, which could no longer be interpreted as a straightforward proportion of people experiencing employment deprivation.

M.2.11. *Inclusion of 16 and 17 year olds*. The 16 and 17 year old age group have been excluded from the English Indices of Deprivation from 2004 onwards. The primary reason for removing the 16 and 17 year old age group from the Employment Deprivation Domain in the Indices of Deprivation 2004 was because the overwhelming majority of this age group are in either school or training, neither of which could be considered a deprivation. The recent increase in school leaving age[96] provides further weight to the decision not to include 16 and 17 olds in this domain.

M.2.12. *Employment deprived females aged 60 to 64.* From 2010, the State Pension age has been gradually increased for females, and females aged 60 to 64 are now eligible for some of the benefits included in the Employment Deprivation Domain. However, by the mid-point of the Employment Deprivation Domain quarterly time points (September 2012) only a small cohort of females aged 60 to 64 were eligible for working-age benefits (those born between April 1950 and June 1951). As a result the number of females aged 60 to 64 receiving out-of-work benefits was significantly smaller than the number aged 55 to 59[97]. The decision was therefore to retain the age band used in previous Indices (18 to 59 for females and 18 to 64 for males).

M.2.13. *Adjusting benefits data to include people affected by sanctions.* As indicated above in respect of the Income Deprivation Domain, new sanctions regulations were introduced in 2012 for claimants of Jobseeker's Allowance and Employment and Support Allowance[98]. The effect of a sanction is that the benefit is stopped or

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[96] Children born on or after 1 September 1997 must stay in some form of education or training until their 18th birthday.

[97] Less than 210,000 employment deprived females in England aged 60-64, compared with more than 1,840,000 aged 55-59.

[98] See Department for Work and Pensions Jobseeker's Allowance and Employment and Support Allowance sanctions statistics for further details: https://www.gov.uk/government/collections/jobseekers-allowance-sanctions. For an overview of the rules see https://www.gov.uk/government/publications/jobseekers-allowance-overview-of-sanctions-rules and https://www.gov.uk/government/publications/employment-and-support-allowance-sanctions-amendment-regulations-2012--2

reduced for a period of time. Those adults affected by sanctions, but who otherwise would be eligible for Jobseeker's Allowance or Employment and Support Allowance, will not be counted in the domain despite meeting the criteria for inclusion in this domain. Although it would enhance the Employment Deprivation Domain to include those affected by sanctions, unfortunately no suitable data is available to do this (see sections M.2.7 and M.2.8 above).

Education, Skills and Training Deprivation Domain

M.2.14. *Cross border student flows*. Some English-resident students attend schools in Wales or Scotland, and vice versa. Pupils attending Welsh or Scottish schools have been excluded, as the point scoring system in schools differs between these administrations. Welsh and Scottish resident pupils who attend schools in England have also been removed from the dataset.

Health Deprivation and Disability Domain

M.2.15. *Emergency admissions*. The Acute Morbidity indicator is based on emergency admissions to hospital lasting more than one day. Some concerns have been raised over the possibility of practices by particular hospitals affecting the robustness of this indicator. Quality assurance analysis of the Indices of Deprivation 2015 has examined this issue, see Appendix J.3.

Crime Domain

M.2.16. Issues related to the use of police recorded crime datasets to construct the Crime Domain indicators are set out in Appendix J.3.

Barriers to Housing and Services Domain

M.2.17. *Travel times to services.* As part of data exploration, the possibility of switching the indicators in the Geographical Barriers to Services sub-domain from measures of *road distance* to services, to measures of *travel time* to services, was considered. The Department for Transport produces accessibility statistics at Lower-layer Super Output Area level in the form of measures of travel time to certain key services. Travel times are provided for travel by car, travel by public transport/walking, and travel by bicycle to key services[99]. Although the release includes travel times to primary schools, GPs and food shops, travel times to post offices are not currently produced. Site locations are for England only, whereas the Indices of Deprivation 2010's indicators for road distance to food shops and post offices take into account services beyond England's borders.

M.2.18. Travel time by car was not pursued as a potential indicator, as most Lower-layer Super Output Areas (97-99 per cent) were assigned the minimum score of less than 5 minutes for primary schools, GPs and food shops. The Lower-layer Super Output Area scores for travel time by public transport/walking did not correlate highly with the equivalent road distance indicators of the Indices of Deprivation 2010. After careful consideration, the decision was made to retain the road distance measures as these require fewer assumptions than travel time measures, which would need to take account of issues such as the time of day

[99] Department for Transport, accessibility statistics (2012) https://www.gov.uk/government/statistics/accessibility-statistics-2012

travelled, and (in the case of public transport) frequency of service and transport connections.

M.3. Potential indicators explored that are unsuitable for inclusion in the Indices of Deprivation 2015

M.3.1. The following section describes those indicators which were explored but not found suitable for inclusion in the Indices of Deprivation 2015.

Income Domain

M.3.2. *Housing Benefit and Council Tax Benefit*. Housing Benefit is payable to people living on low incomes who are liable to pay rent. Council Tax Benefit was payable (until April 2013) to provide assistance to those on low incomes liable for Council Tax (local councils are now able to design their own Council Tax support schemes). Eligibility for Housing Benefit, and, before it was withdrawn, Council Tax Benefit, is assessed by reference to an applicant's income, and also to local area rent levels and the Local Housing Allowance rental rate (and before April 2013, Council Tax). In addition, there is local variability in terms of the level of income which carries eligibility to the benefit(s). Finally, there are technical difficulties in avoiding double counting when combining this data with other benefits in the domain. For these reasons these benefits were identified as unsuitable for inclusion as indicators in the domain.

Employment Domain

M.3.3. *Hidden unemployment and under-employment*. The Employment Deprivation Domain aims to capture those who are involuntarily excluded from the labour market whether they are actively seeking work or not. As well as those receiving Jobseeker's Allowance, the domain includes those out of work due to ill health. However, wider definitions of hidden unemployment also include groups such as mothers who are not working due to restrictive child care costs but would otherwise like to work, those who have given up hope of looking for work, those who are not signed on for receipt of Jobseeker's Allowance but who are available for work, and those under-employed who want full-time work but have had to settle for part-time hours. However, despite wide ranging data exploration, it was not possible to identify suitable data sources for the construction of such an indicator.

M.3.4. *Zero-hours contracts*. Zero-hours contracts were considered as part of a wider definition of worklessness which includes the issue of under-employment. There are two main sources of data on zero-hours contracts: the Office for National Statistics business survey and the Labour Force Survey. Unfortunately, neither survey provides a sufficient sample size to provide robust estimates at Lower-layer Super Output Area level. In addition, there is no clear and agreed definition of 'zero-hours contracts', so, different groups and bodies will not only measure the number of such contracts in different ways, they will also have different perceptions of what should be included as 'zero-hours contracts'. Significantly, the perceptions of employers and employees on what constitutes a particular type of contract will differ.

M.3.5. *Lone parents receiving Income Support*. Lone parents have traditionally been regarded as 'economically inactive', while the Employment Deprivation Domain is concerned with capturing those who are involuntarily out of employment. Recent

changes have led to those lone parents whose youngest child is aged 5 or over shifting from receipt of Income Support, to receipt of Jobseeker's Allowance. So a large proportion of lone parents will now be included in the Employment Deprivation Domain. However, there remains the question of whether lone parents with children aged under 5 should be treated as voluntarily or involuntarily out of employment. If the former, they fall outside the definition for this domain. If the latter, they should be counted. As there is no information as to whether this group is voluntarily or involuntarily out of employment, this indicator was not pursued further for this update of the Indices.

Education, Skills and Training Deprivation Domain

M.3.6. *Average test score of pupils at Key Stage 1.* The Key Stage 1 average test score indicator is constructed in the same way as the Key Stage 2 indicator and held in the National Pupil Database linked to each pupil's postcode of residence. Each pupil is awarded a level for the four Key Stage exams. Values are assigned to the levels achieved in the examinations, and these values summed for each pupil. However, unlike Key Stage 2 assessments, not all Key Stage 1 results are externally moderated, with only 25 per cent of local authority schools receiving external moderation visits each year. Given there is only partial external moderation, and views expressed by users, this indicator was not pursued further for this update of the Indices.

M.3.7. *Average test score of pupils at Key Stage 3*. The Key Stage 3 attainment indicator included in the Indices of Deprivation 2010 was removed from the Children and Young People sub-domain, as statutory tests were abolished and Key Stage 3 assessments became teacher assessment only from 2008/9.

M.3.8. *Adult literacy and numeracy.* Small area level estimates of adults lacking literacy, numeracy and other skills are published based on the Skills for Life Survey[100]. This survey is based on a sample of 7,230 respondents, across 1,516 (of 6,781) Middle layer Super Output Areas. The data is modelled to neighbourhood level using small area estimation techniques. This produces an estimate at neighbourhood level which is not sufficiently robust to use in the Indices of Deprivation and which moreover uses area effects in the modelling process which draw directly from data published from the Indices of Deprivation 2010.

M.3.9. *Pupils with Special Educational Needs*. Special Educational Needs levels are a good predictor of individual level pupil performance, and of variation between schools. However, there are some surprising differences between local authority areas, which may reflect policy differences rather than actual differences in educational needs[101].

M.3.10. *Achieving a good level of development in the Early Years Foundation Stage.* The Early Years Foundation Stage is a series of assessments measuring children's

[100] Department for Business Innovation and Skills (2012). 2011 Skills for Life Survey: Small Area Estimation Technical Report. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/36077/12-1318-2011-skills-for-life-small-area-estimation-technical.pdf

[101] Mooney, A., et al. (2010). Special Educational Needs and Disability: Understanding Local Variation in Prevalence, Service Provision and Support, published by Department for Children, Schools and Families. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221970/DCSF-RB211ES.pdf

progress in terms of Personal, Social and Emotional Development and Communication, Language and Literacy. This indicator was considered for inclusion because it would introduce an element of early child development (aged 5) into the domain. The data is based on practitioners' observations over the course of the year against standard criteria, with local authorities responsible for carrying out moderation visits to ensure that assessment standards are consistent. However for the time point of mid-2012, this external moderation was only extended to 25 per cent of early years settings in the local authority area. Given the level of external moderation, and views expressed by users, this indicator was not pursued further for the update of the Indices.

M.3.11. *Exclusions from school*. Data on exclusions is collected via the School Census, with approximately 304,000 temporary and 5,000 permanent exclusions recorded in 2012. However, there is likely to be variability in how different schools apply exclusions, which could lead to differences in numbers being attributable to local policy differences as well as differences in educational deprivation levels.

Health Deprivation and Disability Domain

M.3.12. *Healthy lifestyle indicators*. The domain only includes direct measures of health deprivation, and does not include aspects of behaviour or environment that may be predictive of future health deprivation. Therefore healthy lifestyle indicators such as smoking, alcohol consumption and participation in sports are not appropriate to include in the domain, even where robust data is available at small area level.

M.3.13. *Obesity indicators*. Obesity is an increasing public health concern, with 23 per cent of adults, and 19 per cent of Year 6 children, classified as obese [102]. Assessment of school pupils is now routinely carried out for Reception and Year 6 pupils, however similar data is not collected for adults.

M.3.14. *Census 2011 indicators on limiting long-term illness and general health*. The 2011 Census contained questions on limiting long-term illness and on general health status. However, the comparative illness and disability ratio indicator (derived from health benefits data made available by the Department for Work and Pensions) is highly correlated with the 2011 Census health indicators and therefore adequately captures this element of health deprivation.

M.3.15. *Cancer incidence*. Information is collected about all new cases of cancer, of which there are around 140,000 per year. To adjust for variation in the age profile of the population, age and sex standardised cancer incidence rates are needed. Lower-layer Super Output Area level age and sex standardised estimates are unlikely to be sufficiently reliable to enable meaningful comparisons between areas, even when based on aggregate data over several years.

M.3.16. *People receiving publicly-funded residential care*. People living in publicly funded residential or nursing homes are not eligible for the care components of Disability Living Allowance or Attendance Allowance but meet the same qualifying

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[102] Sport England (2012), Active People Survey, http://archive.sportengland.org/research/active_people_survey/active_people_survey_7.aspx
Health and Social Care Information Centre (2012/13), National Child Measurement Programme, http://www.hscic.gov.uk/ncmp

conditions. This data is held by local authorities; however it is not collected nationally at individual or small area level. As sufficiently robust data is not readily available to produce this indicator, developing this indicator was outside the scope of this update.

M.3.17. *Low birth weight*. Low birth weight is linked to both increased mortality and morbidity in infancy, and an increased risk of cardio-vascular disease in later life. The indicator was considered as a potential indicator in the Indices of Deprivation 2000, and is used in the Welsh Indices of Deprivation. However, respondents to a previous consultation were concerned that certain ethnic groups have different distributions of birth weight, and that the ethnic composition of an area would therefore bias this indicator. As a result this indicator was not used in the English Indices.

M.3.18. *Infant mortality ratio*. The infant mortality ratio has previously been included in measures of deprivation such as the 1998 Index of Local Deprivation, on the basis that this represents particularly premature death, and that areas with high infant death rates would not necessarily correspond to those in which mortality levels are high at other ages. However, the numbers of infant deaths are small (nationally only around 4.7 per 1,000 live births) and, even when aggregating figures for several years, Lower-layer Super Output Area level estimates would not be sufficiently reliable to enable meaningful comparisons between areas. Also the mortality indicator (years of potential life lost) included in the domain is age standardised, giving high weightings to deaths among infants.

Crime Domain

M.3.19. *Police Anti-Social Behaviour incident data*. In addition to collating data on recorded crime, each police force in England is also required to collate data on reported incidents of Anti-Social Behaviour. Geocoded data is provided by each police force to the Home Office on a monthly basis in the same way as the recorded crime data is provided. This Anti-Social Behaviour data was deemed unsuitable for inclusion in the Indices of Deprivation 2015 due to known issues in relation to double counting of crimes and Anti-Social Behaviour incidents[103] in a number of police forces.

M.3.20. *Fire Service deliberate fires data*. These are official statistics collated by the Department for Communities and Local Government (Fire Statistics Monitor). Geocoded deliberate fire data is available from 2009/10 onwards. However, many of the deliberate fires recorded by the regional fire authorities across England will also be captured as ‘arson’ in the police recorded crime data. As such, including fire service data alongside police recorded crime data would result in double counting of many events.

M.3.21. *Shoplifting*. Shoplifting was rejected because it is often concentrated in large retail centres and because its reporting is often dependent upon the offender being caught in the act.

[103] See Data Quality, Known Issues, Double counting of ASB and Crime at: http://data.police.uk/about/#columns.

M.3.22. *Drug-related crime*. Drug-related crime was not deemed suitable for inclusion in the updated Indices since it could be argued that possession of an illegal drug is not in itself a form of deprivation. Certainly, drug-motivated crime (e.g. violence or burglary/theft) should be captured in a measure of deprivation, but these crimes types are already included in the Crime Domain.

M.3.23. *Sexual offences*. Sexual offence data was not previously pursued due to a number of reasons, including: sensitivity/disclosure issues; the particularly low reporting of these crimes; the way in which reporting is influenced by the relationship of the victim to the offender; and the difficulty of ascertaining the incidence.

M.3.24. *Domestic violence*. Domestic violence was not included as an indicator in its own right because violent offences against same-household members are already included in the composite violence indicator where these crimes are reported to the Police.

M.3.25. *Cycle thefts*. Cycle thefts were excluded because they are often concentrated in public areas (such as bike parks at train stations).

M.3.26. *Fraud*. Fraud was excluded because it is extremely difficult to locate geographically.

M.3.27. *Total crime*. A measure of total crime was not included because it would include the indicators described above, as well as other categories that are not relevant to deprivation.

Barriers to Housing and Services Domain

M.3.28. *Access to childcare*. The use of childcare is a complex issue: it depends on cost, flexibility, type and location. For example, some people prefer to use childcare nearer the workplace than close to the home. However, the number of childcare places in a district has been demonstrated to relate to the rate at which lone parents enter work in that area[104]. For previous Indices, an option was explored to model a local authority level ratio of pre-school children to pre-school childcare places, using a combination of Child Benefit data and Ofsted childcare places. However this was seen as a complex development, with significant time needed to develop a robust indicator. As sufficiently robust data was not readily available to produce this indicator without significant extra work, developing this indicator was outside the scope of this update.

M.3.29. *Households lacking the required number of bedrooms*. Chapter 4 describes the household overcrowding indicator used in the Indices of Deprivation 2015. An alternative measure was explored, also based on Census 2011 data, which considers the number of bedrooms required by the household (rather than the number of rooms). However, this measure only counts rooms as bedrooms if they were built as such or if they have been permanently converted into a bedroom. Given that many modern houses/apartments have rooms that can be used in different ways, this alternative indicator was not used.

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[104] Evans, Noble et al (2002). Growing Together or Growing Apart? Geographic Patterns of Change in IS and JSA-IB Claimants in England 1995-2000 (The Policy Press).

M.3.30. *Digital services access*. Ofcom publishes data on broadband speeds, including both 'actual broadband speed' (based on real connections and measured speeds) and 'availability of superfast broadband' (download speeds of at least 30 Megabits per second)[105]. Actual speed is dependent on broadband packages obtained by users, so is in large part based on user choices (which may or may not be driven by questions of affordability), rather than an indicator of accessibility. The availability of superfast broadband is very high, and increasing: 77 per cent of England's premises have superfast availability, and in 46 per cent of English Lower-layer Super Output Areas, *all* postcodes have superfast availability [106]. As indicators should measure major features of deprivation, not conditions just experienced by a small number of people or areas, this indicator was not included in this update of the Indices.

Living Environment Deprivation Domain

M.3.31. *Flood risk areas*. A measure of flood risk is used in the Welsh Indices of Deprivation, based on the proportion of people living in an area with a significant, moderate or low risk of flooding (risk was based on frequency rather than level of flooding damage). For England, flood risk data is available from the Environment Agency. However, the data measures *risk* of flooding, rather than *actual* flooding, and was not supported by members of the Advisory Group and Project Board as an indicator for this update of the Indices of Deprivation.

M.3.32. *Graffiti*. An indicator on graffiti was not proposed because recorded crime data for graffiti is not available separately from data on criminal damage as a whole. Moreover, some commentators have argued that graffiti may be variably reported.

M.3.33. *Households in fuel poverty*. The fuel poverty dataset published by the Department of Energy and Climate Change, which includes modelled estimates to Lower-layer Super Output Area level, is based on households with above average fuel costs that are pushed below the income poverty threshold once fuel costs are taken into account. In the survey of users in July 2014 and previous consultations there had been support from users for introducing a measure of fuel poverty into the Living Environment Deprivation Domain. However, discussion with the Fuel Poverty team at the Department of Energy and Climate Change identified that the methodology used to produce the sub-regional estimates of fuel poverty does not produce robust estimates at very low level geographies, and should not be used to compare between Lower-layer Super Output Areas[107]. A fuel poverty indicator was not therefore incorporated into this update of the Indices, but any improvement in methods may mean that the indicator could be further considered in future.

M.3.34. *Households lacking basic amenities*. The 2001 Census collected data on the number of households without exclusive use of a bathroom and inside toilet, but less than 1 per cent of households in England were lacking these amenities. The indicator would therefore not measure a significant aspect of deprivation at small

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[105] Office of Communications, broadband coverage (2013) http://data.gov.uk/dataset/broadband-coverage
[106] Ofcom (2014) Infrastructure Report 2014, http://stakeholders.ofcom.org.uk/market-data-research/market-data/infrastructure/infrastructure-2014/.
[107] 2014 review by the Department of Energy and Climate Change and Office for National Statistics statisticians, unpublished.

area level. Furthermore, this indicator was not updated as part of the 2011 Census, so up-to-date data would not have been available to produce such an indicator.

M.3.35. *Households not connected to the gas network*. It is now possible in principle to construct an indicator of households not connected to the gas network, as a proxy for high costs for heating. This would be based on comparing the number of domestic gas meters in each Lower-layer Super Output Area to the number of households. However, in 13,597 Lower-layer Super Output Areas (41 per cent of all such areas in England), *all* households were identified as being connected to the gas network[108]. As indicators should measure major features of deprivation, not conditions just experienced by a small number of people or areas, this indicator was not included in the updated Indices.

M.3.36. *Housing (or population) density*. The survey of users in July 2014 and a previous consultation suggested using a measure of high density housing in the Living Environment Deprivation Domain, to reflect the impact of housing on traffic congestion and pollution, and limited open space. However, housing (or population) density is only a proxy for these impacts and is not a deprivation in its own right, as high density living is not always seen as undesirable.

M.3.37. *Land use and derelict land*. The current method for measuring derelict land is the National Land Use Database, which is assembled from data collected by local authorities. However, the database is not comprehensive enough to give a sufficiently robust measure of derelict land at small area level for the whole of England, even if such an indicator was desirable.

M.3.38. *Noise pollution*. The Department for Environment, Food and Rural Affairs has estimated local environmental noise levels due to road, rail and air traffic and from industry[109]. Although this data potentially provides an additional indicator for the Outdoors sub-domain, data is only available for major urban areas, and for major roads and railways outside the major urban areas. There was therefore not sufficient geographic coverage to include noise pollution in this update of the Indices of Deprivation.

M.3.39. *Proximity to green spaces*. There is a range of research outlining the benefits of access to green spaces including reduced pollution, improved physical and psychological wellbeing and factors which encourage healthy lifestyle behaviours. Several location datasets could be used in a composite indicator of proximity to green spaces, including local nature reserves, woodland, local open spaces, coastal beaches and Areas of Outstanding Natural Beauty[110]. As sufficiently robust data was not readily available to produce this indicator without significant extra work, developing this indicator was outside the scope of this update. There may be value in exploring the development of such an indicator for a future update.

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[108] Based on data for 2013 available at https://www.gov.uk/government/statistics/lsoa-estimates-of-households-not-connected-to-the-gas-network.

[109] Online maps are available for major urban areas, with PDF maps available for major roads and railways outside the major urban areas. See http://services.defra.gov.uk/wps/portal/noise for maps and background.

[110] For a summary, see Environment Agency (2008) working towards a better quality of life: Environmental Justice in South Yorkshire. www.staffs.ac.uk/schools/sciences/geography/links/IESR/downloads/EnvJusticeinSouthYorksGENE0608BODZ-e-e.pdf

M.3.40. *Proximity to waste and landfill sites.* The most recent Welsh Index of Multiple Deprivation 2014 contains an indicator of proximity to waste and landfill sites, which ranks Lower-layer Super Output Areas based on the proportion of the population living within a 1km zone of each Pollution Prevention Control site and active landfill site. However, this indicator was not pursued further for the Indices of Deprivation 2015, as the impact of poor air quality resulting from proximity to waste and landfill sites is already captured as part of the air quality indicator. In addition, a systematic review of studies into the health impacts of people living in the vicinity of waste and landfill sites was unable to find sufficient evidence to establish a causal link between negative health effects and living in close proximity to waste and landfill sites[111].

M.3.41. *Vacant dwellings and low demand*. The Department for Communities and Local Government publishes data on empty homes at local authority district level [112]. As this data is not available at small area level, it was not considered suitable for use in a new indicator. It may be possible in future to model empty homes at small area level to provide a candidate indicator for the 'Outdoors' sub-domain, but this was outside the scope of this update of the Indices.

[111] For example, see information from the Envrionment Agency on exposure assessment of landfill sites www.gov.uk/government/publications/exposure-assessment-of-landfill-sites

[112] Department for Communities and Local Government. Live tables on dwelling stock (including vacants) https://www.gov.uk/government/statistical-data-sets/live-tables-on-dwelling-stock-including-vacants

Appendix N. History of the Indices of Deprivation

N.1.1. The Indices of Deprivation 2000 attempted to measure multiple deprivation with respect to a single overall index as well as separate domain indices. Previous indices (1981 z-scores, 1991 Index of Local Conditions and 1998 Index of Local Deprivation) that had been constructed did not attempt to measure each domain of deprivation separately before combining the indicators into an overall index; these earlier indices also comprised a smaller number of indicators, utilised proxy measures and relied heavily on Census data. The Indices of Deprivation 2000 therefore reflected an attempt to refine the conceptualisation of multiple deprivation and the methodology for constructing the indices, and included new and more up-to-date indicators.

N.1.2. In subsequent updates of the Indices of Deprivation, the number of domains and indicators has increased as more data sources become accessible, and the methodology has gradually been refined. The main focus in recent years has been to maintain a consistent methodology to allow meaningful comparisons between years.

N.1.3. The Index of Multiple Deprivation 2000 consisted of six domains: Income Deprivation; Employment Deprivation; Health Deprivation and Disability; Education, Skills and Training Deprivation; Housing Deprivation; and Geographical Access to Services Deprivation.

N.1.4. In updating these to the Indices of Deprivation 2004, the main change was the addition of the Crime Domain. Some changes were made to the Housing Deprivation Domain and the Geographical Access to Services Deprivation Domain, which became the Living Environment Deprivation Domain and the Barriers to Housing and Services Domain respectively. A small number of indicators were redistributed into these new domains. The Indices of Deprivation 2004 therefore consisted of seven domains:

- Income Deprivation
- Employment Deprivation
- Education, Skills and Training Deprivation
- Health Deprivation and Disability
- Crime
- Barriers to Housing and Services
- Living Environment Deprivation

N.1.5. There was also a change to the geography used, from wards in the Indices of Deprivation 2000 to Lower-layer Super Output Areas[113] in the Indices of Deprivation 2004. The intention has always been to construct the Indices at the smallest practicable spatial scale to provide a detailed measure of deprivation at a

[113] For further information about Lower-layer Super Output Areas see http://neighbourhood.statistics.gov.uk/dissemination/Info.do?page=nessgeography/superoutputareasexplained/output-areas-explained.htm.

small spatial unit. The 2004 Indices and all subsequent Indices have been constructed at using Lower-layer Super Output Area geography. This is a statistical geography which has more even and (on average) smaller population sizes than wards and, until it was reviewed following Census 2011, had not been subject to boundary changes (which happen regularly with wards). Lower-layer Super Output Areas are aggregations of Census Output Areas, the base unit for Census data releases.

N.1.6. The Indices of Deprivation 2007 aimed to maintain the methodology of previous Indices and no changes were made to the domains or spatial scale. The same was true of the Indices of Deprivation 2010.

N.1.7. The domains of deprivation and the methods used in developing the Indices of Deprivation 2015 update have remained consistent with those used for the 2010 Indices. This maintains comparability with previous versions of the Indices. There have been a modest number of changes to the basket of indicators used in the domains, resulting in a small number of new, modified and dropped indicators. These and changes to Lower-layer Super Output Area geography following the Census 2011 are described in Appendix C.

Appendix O. What data has been published?

O.1.1. The Indices of Deprivation 2015 datasets are available to download at www.gov.uk/government/statistics/english-indices-of-deprivation-2015

Lower-layer Super Output Area data

O.1.2. Nine sets of data have been published for Lower-layer Super Output Areas:

1. Index of Multiple Deprivation: The rank and decile for each area, on the overall Index of Multiple Deprivation.
2. Domains of deprivation: The rank and decile for each area, for each of the seven domains, as well as the Index of Multiple Deprivation
3. Supplementary Indices - Income Deprivation Affecting Children Index and Income Deprivation Affecting Older People Index: The rank and decile for each area, for the Income Deprivation Affecting Children Index and the Income Deprivation Affecting Older People Index, as well as the Index of Multiple Deprivation.
4. Sub-domains of deprivation: The rank and decile for each area, for each of the six sub-domains, as well as their respective domains.
5. Scores for the Indices of Deprivation: The scores for each area, for the overall Index of Multiple Deprivation, the seven domains, the supplementary indices, and the six sub-domains.
6. Population denominators: The primary population denominators (all people, children, working age, and older people) used in the Indices of Deprivation 2015. These can be used for aggregating the datasets, weighted by population, to other geographies such as wards (see Appendix A of Research Report).
7. All ranks, deciles and scores for the Indices of Deprivation, and population denominators (CSV file): A single text file containing all of the datasets listed above.
8. Underlying indicators. The indicators used to construct the seven domains, for those that are able to be published.
9. Transformed domain scores: The seven domain scores in this file have been standardised by ranking, and then transformed to an exponential distribution. These transformed domain scores can be used as the basis for users to combine the domains together using different weights (see Appendix B of Research Report).

Higher-level geography files

O.1.3. Four sets of data have been published for higher-level geographies:

10. Local Authority District Summaries.
11. Upper-tier Local Authority Summaries.
12. Local Enterprise Partnership Summaries.
13. Clinical Commissioning Group Summaries.

O.1.4. To summarise the level of deprivation in larger areas, a range of summary measures of the Index of Multiple Deprivation 2015, the domains and the two supplementary indices (Income Deprivation Affecting Children Index and Income Deprivation Affecting Older People Index) have been created [114]. For each of the larger areas the following measures have been published:

Table O.1. The summary measures published for the Index of Multiple Deprivation, the domains and supplementary indices

	Average rank	Average score	Proportion of Lower-layer Super Output Areas in most deprived 10 per cent nationally	Extent	Local concentration	Scale
Index of Multiple Deprivation	x	x	x	x	x	
Income	x	x	x			x
Employment	x	x	x			x
Education	x	x	x			
Health	x	x	x			
Crime	x	x	x			
Living	x	x	x			
Barriers	x	x	x			
IDACI	x	x	x			
IDAOPI	x	x	x			

O.1.5. These measures are described in section 3.8 of the Technical Report and advice on their interpretation is provided in section 3.3 of the Research Report.

[114] For the Indices of Deprivation 2010 and previous versions, the majority of summary measures published were for the Index of Multiple Deprivation only. In response to demand from users, additional summary measures for the domains and supplementary indices have been published here.

Appendix P. Worked examples of the higher-level summary measures

Overview

P.1.1. The summary measures have been produced for the following higher-level geographies for the Index of Multiple Deprivation, domains and supplementary indices: local authority districts, upper tier local authorities, local enterprise partnerships and clinical commissioning groups. As with the Lower-layer Super Output Area data, both ranks and scores are produced, with higher scores corresponding to higher levels of deprivation, and areas ranked so that a rank of 1 identifies the most deprived high-level area on that measure.

P.1.2. In order that higher scores can consistently be interpreted as corresponding to higher levels of deprivation, those summary measures that are based on Lower-layer Super Output Area *ranks* (the average rank and local concentration summary measures) use a reversed ranking – where 32,844 rather than 1 corresponds to the most deprived area – in the calculation of the summary measure *score*.

P.1.3. To help users understand each of the summary measures, the sections below describe how to calculate the measures for hypothetical local authority districts.

Average rank

P.1.4. A user wishes to calculate the Index of Multiple Deprivation average rank for their local authority district. The average rank measure summarises the average level of deprivation across the district, based on the population-weighted ranks of the Lower-layer Super Output Areas in the area.

P.1.5. The district contains five Lower-layer Super Output Areas, with populations of 1,200, 1,800, 1,400, 1,500 and 1,700, giving a total population of 7,600, and have Index of Multiple Deprivation ranks of 3,000, 10,000, 500, 1,000 and 20,000 respectively.

P.1.6. To calculate the average rank for the local authority district, each Lower-layer Super Output Area rank is multiplied by the Lower-layer Super Output Area population. These values are then summed, before dividing by the district's population to create the average rank for the district.

P.1.7. In order that higher scores can consistently be interpreted as corresponding to higher levels of deprivation, those summary measures that are based on Lower-layer Super Output Area *ranks* use a reversed ranking - where 32,844 rather than 1 corresponds to the most deprived area. The user would therefore calculate the average rank for the district as:

Average rank = 32,845 – (3,000 x 1,200 + 10,000 x 1,800 + 500 x 1,400 + 1,000 x 1,500 + 20,000 x 1,700) / 7,600

Average rank = 25,240

When the average rank score is itself ranked then the rank of 1 (most deprived) is given to the largest average rank value.

Average score

P.1.8. The same user wishes to calculate the Index of Multiple Deprivation average score for their local authority district. The average score measure summarises the average level of deprivation across the district, based on the population-weighted scores of the Lower-layer Super Output Areas in the area.

P.1.9. The district contains five Lower-layer Super Output Areas, with populations of 1,200, 1,800, 1,400, 1,500 and 1,700, giving a total population of 7,600, and have Index of Multiple Deprivation scores of 45.90, 26.51, 65.67, 59.14 and 13.64 respectively.

P.1.10. In order to calculate the average score for the local district authority, each Lower-layer Super Output Area score is multiplied by the Lower-layer Super Output Area population. These values are then summed, before dividing by the district's population to create the average score for the district. The user would calculate the average score for the district as:

Average score = (45.90 x 1,200 + 26.51 x 1,800 + 65.67 x 1,400 + 59.14 x 1,500 + 13.64 x 1,700) / 7,600

Average score = 40.35

When the average score is ranked then the rank of 1 (most deprived) is given to the largest average score value

Proportion of Lower-layer Super Output Areas in the most deprived 10 per cent nationally

P.1.11. A user wishes to calculate for their local authority district the proportion of Lower-layer Super Output Areas that are in the most deprived 10 per cent nationally.

P.1.12. Their local authority district contains 65 Lower-layer Super Output Areas. Of these, 18 are ranked in the most deprived decile (i.e., 10%) of all areas in England. The user would calculate the proportion of Lower-layer Super Output Areas in the most deprived 10 per cent nationally for the district as:

Proportion of Lower-layer Super Output Areas in the most deprived 10 per cent nationally = 18 / 65

Proportion of Lower-layer Super Output Areas in the most deprived 10 per cent nationally = 0.277 (i.e. 27.7%)

When the score for this summary measure is ranked then the rank of 1 (most deprived) is given to the largest proportion.

Extent

P.1.13. A user wishes to calculate the extent measure for their local authority district. The extent measure is a summary of the proportion of the local population that live in areas classified as among the most deprived in the country. The extent measure

uses a weighted measure of the population in the most deprived 30 per cent of all areas:

- The population living in the most deprived 10 per cent of Lower-layer Super Output Areas in England receive a 'weight' of 1.0;
- The population living in the most deprived 11 to 30 per cent of Lower-layer Super Output Areas receive a sliding weight, ranging from 0.95 for those in the most deprived eleventh percentile, to 0.05 for those in the most deprived thirtieth percentile. In practice this means that the weight starts from 0.95 in the most deprived eleventh percentile, and then decreases by (0.95-0.05)/19 for each of the subsequent nineteen percentiles until it reaches 0.05 for the most deprived thirtieth percentile, and zero for areas outside the most deprived 30 per cent.

P.1.14. A local authority district contains 70,000 people. Of the Lower-layer Super Output Areas in the district, only four are in the most deprived 30 per cent of all Lower-layer Super Output Areas in England; the populations for only these Lower-layer Super Output Areas are included in the extent calculation. The ranks for these four Lower-layer Super Output Areas are 500, 1,000, 3,000, and 9,000 respectively, with populations of 1,400, 1,500, 1,200, and 1,800 respectively.

- The first three Lower-layer Super Output Areas are in the most deprived 10 per cent of areas (with 32,844 areas in England, the areas ranked 1 to 3,284 are in the top 10 per cent). These receive a weight of 1.0, so contribute 100 per cent of their population.
- The fourth Lower-layer Super Output Area is ranked 9,000, so is in the 28th percentile (to find out which percentile an area is in, divide the rank by the total number of ranks, in this case 32,844, multiply by 100 and round up to the nearest integer). This receives a weight of 0.1447 so contributes 14.47% of its population: the weight decreases from 0.95 for the eleventh decile by (0.95-0.05)/19, so is 0.1447 for the 28th percentile.

P.1.15. The user would therefore calculate the extent summary measure for the district as:

Extent = (1,400 + 1,500 + 1,200 + 0.1447 x 1,800) / 70,000

Extent = 0.062292

When the extent score is ranked then the rank of 1 (most deprived) is given to the largest extent score.

Local concentration

P.1.16. A user wishes to calculate the local concentration measure for their local authority district. The local concentration measure is a summary of how the most deprived Lower-layer Super Output Areas in the higher-level area compare to those in other areas across the country, and measures the population-weighted average rank for the Lower-layer Super Output Areas that are ranked as most deprived in the higher-area, and that contain exactly 10 per cent of the higher-area population (in many cases, this will not be a whole number of Lower-layer Super Output Areas).

P.1.17. A local authority district contains 70,000 people; 10 per cent of this population is 7,000 people. The local concentration measure calculates the population-weighted rank of the most deprived Lower-layer Super Output Areas containing exactly

7,000 people. Having sorted the Lower-layer Super Output Areas in descending order of deprivation, the five most deprived Lower-layer Super Output Areas in the local authority district have populations of 1,400, 1,500, 1,200, 1,800, and 1,700, giving a total population of 7,600 (just higher than the 7,000 population required).

P.1.18. These Lower-layer Super Output Areas have ranks of 500, 1,000, 3,000, 10,000 and 20,000 according to the Index of Multiple Deprivation. In order that higher scores can consistently be interpreted as corresponding to higher levels of deprivation, those summary measures that are based on Lower-layer Super Output Area *ranks* use a reversed ranking - where 32,844 rather than 1 corresponds to the most deprived area.

P.1.19. To reach the required population of 7,000 (i.e., 10 per cent of the district's population) the first four Lower-layer Super Output Areas are included plus 1,100 of the fifth Lower-layer Super Output Area population. The user would calculate the local concentration measure for the district as:

Local concentration = 32,845 –
(1,400 x 500 + 1,500 x 1,000 + 1,200 x 3,000 +
1,800 x 10,000 + 1,100 x 20,000) / 7,000

Local concentration = 26,302.14

When the local concentration score is ranked then the rank of 1 (most deprived) is given to the largest local concentration score

Income scale and employment scale (two measures)

P.1.20. A user wishes to calculate the income scale and employment scale for their local authority district. The two scale measures summarise the number of people in the higher-level area who are income deprived (the income scale) or employment deprived (the employment scale).

P.1.21. A district contains five Lower-layer Super Output Areas. The number of people in low income families in each Lower-layer Super Output Area (i.e., the Income Deprivation Domain numerator) is 1,563, 1,672, 1,745, 1,499 and 1,812.

P.1.22. The user would calculate the income scale measure for the district as:

Income scale = 1,563 + 1,672 + 1,745 + 1,499 + 1,812

Income scale = 8,291

P.1.23. The employment scale measure is calculated in the same way, but using the numerator of the Employment Deprivation Domain.