

# Appendix A. Methodology

## A.1. What funding do we include for each service?

### NHS

Our measure of NHS funding in England in 2022–23 totals **£126.5 billion**. This includes funding for:

- core services – **£94.6 billion**
- primary care – **£9.7 billion**
- specialised services – **£22.3 billion**

For core services and primary care, we use actual funding allocations to Integrated Care Systems (ICSs) in 2022–23. For specialised services, there are no available allocations to ICSs to use, so we use the 2022–23 notional allocations of funding to Clinical Commissioning Groups (CCGs), which were produced in 2019, and adjust for changes in total specialised services funding over time.

Our measure of funding is lower than NHS England’s revenue departmental expenditure limit (RDEL) in 2022–23, which was around **£152.4 billion**. The rest comes from:

- other non-recurrent place-based allocations (COVID-19, recovery, adjustments): £4.4 billion
- ICS administration: £1.1 billion
- other primary care, including services such as dentistry: £5.3 billion
- other direct commissioning: £2.2 billion
- service development fund: £4.9 billion
- NHS England (NHSE) central: £1.2 billion
- other funding including central pension costs: £6.3 billion

These are not included because they are not recurrent, because they are not clearly allocated to specific places, or because we have no estimates of relevant spending needs. For instance, we have no estimates of the relative needs of different areas for spending on elective recovery or commissioning, and would not be able to compare shares of place-based NHS funding to shares of estimated needs if we included this funding.

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### Schools

Our total measure of school funding includes a total of **£52.6 billion** for state-funded primary and secondary schools in England. This includes:

- the Dedicated Schools Grant (excluding the Early Years block)
- the Schools Supplementary Grant, which was intended to support schools to meet the costs of the Health and Social Care Levy
- allocations of the Pupil Premium (**£2.7 billion**)

Note that this includes the teachers' pay and pensions grants, which have now been mainstreamed into the National Funding Formula. In our earlier report (Ogden et al., 2022), our measure of school funding in 2019–20 excluded what were then the teachers' pay and pensions grants, which were treated separately.

We restrict our analysis to schools, and so exclude government funding for childcare entitlements for children aged 2–4, which is included in the Early Years block of each local authority's Dedicated Schools Grant.

### Local government

For local government services, we include funding for main council types, including both shire districts and counties in two-tier areas. We exclude funding for other types of authority such as fire and police services, combined authorities and the Greater London Authority.

We include a total of **£49.2 billion** of local government funding in 2022–23, which consists of:

- Grants within core spending power, from the final local government finance settlement 2023 (**£6.1 billion**), specifically: rural services delivery grant; lower tier services grant; market sustainability and fair cost of care fund; services grant; improved better care fund; social care grant; new homes bonus. Note that this does not include grants that were subsequently rolled in at the 2023 settlement.
- Revenue support grant (**£1.5 billion**), also from the final local government finance settlement 2023. This is the actual amount received in each area, reflecting actual business rate retention arrangements.
- Estimated council tax revenues, based on the council tax base for council tax setting purposes, and either the actual council tax level for a band D property set in each area or the national average band D level (**£29.7 billion**). We calculate the national average band D level (£1596.74) at the upper-tier level (summing both the shire districts' and counties' portions in two-tier areas), and weight by council tax base. In calculating this average, we first subtract the average band D level for standalone fire authorities (£75.90) from the band

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D level in areas where councils have responsibility for fire services. For the Greater London Authority, this includes only the London Fire Brigade's portion (£58.80).

- Retained income from the business rate system, typically from councils' published budgets for 2022–23 (**£12.3 billion**). For nine councils, budgets for 2022–23 are missing. We use figures from 2021–22 revenue outturns where available (for seven councils) and figures from 2021–22 budgets for the remaining two councils.
- Furthermore, we subtract **£222 million** from the retained business rate revenues of councils in Greater Manchester, which forewent their allocations of public health grant as a result of business rate retention arrangements in 2022–23. We must subtract this funding from actual business rate revenues in Greater Manchester to avoid double-counting revenues associated with public health, as we consider notional allocations of public health grants separately.
- We also subtract **£32 million** from Cornwall's retained business rate revenues. Cornwall forewent local highways maintenance funding as a result of business rate retention arrangements in 2022–23, and instead retained a greater share of business rate revenues. This adjustment is required because we do not include this highways funding in other areas.

For each upper-tier local authority (UTLA) area, our main estimate of total funding includes actual council tax revenues (including any amount implicitly for fire in areas with no standalone fire authority), and we subtract from this net spending on Fire and Rescue services based on 2022–23 budgets. To estimate counterfactual funding if an area set its council tax level at the national average, we estimate each area's council tax revenues if they had set their council tax to the national average level (which excludes any assumed element for fire services) and then subtract the difference between an area's net spending on Fire and Rescue services and the estimated share of their actual council tax revenues which is assumed to relate to these services. By construction, these two measures of total funding sum to the same figure nationally.

As discussed in our first report (Ogden et al., 2022), councils are able to raise revenues from sales, fees and charges relating to the provision of their services. We do not include these sales, fees and charges in our estimate of total funding in each area, although areas will differ in their capacity to raise such revenues, and these may reduce councils' actual net spending needs. Councils are also able to draw down from reserves. As these can only be spent once, we do not include reserves in our measure of council revenues.

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### Police

Our measure of police funding includes the following sources of revenue:

- Police Main Grant: **£4.8 billion**
- Ex-DCLG formula funding: **£3.4 billion**
- Legacy council tax grants, including allocations from Local Council Tax Support Grant and Legacy Council Tax Freeze Grants: **£0.5 billion**
- local council tax revenues, calculated based on council tax bases for council tax setting purposes and police council tax precepts set in 2022–23: **£4.6 billion**

This sums to a total of **£13.2 billion** of police funding in 2022–23 in England, excluding Isles of Scilly and the City of London. This compares with total estimated current spending on police services in England in 2022–23 of around **£17 billion**. Funding for police services which we do not allocate to local areas includes:

- national security grants
- national crime agency
- pension grant funding
- additional funding for recruiting more officers (**£135 million**)

These are not included because they are not clearly allocated to specific places, and we have no estimates of relevant spending needs to compare this funding to.

### Public health

For public health, our funding measure consists of allocations of public health grant to upper-tier local authorities in England, which totalled **£3.4 billion** in 2022–23. We include notional grant amounts for councils in Greater Manchester which forewent their allocations of public health grant as a result of their business rate retention arrangements.

We do not include **£101 million** of additional funding that was provided to local authorities for drug and alcohol treatment in 2022–23 (Office for Health Improvement and Disparities, 2022). This is because we do not have estimated relative needs to which we could compare allocations of this funding.

## A.2. How do we estimate the relevant population for each area?

Much of our analysis is on a per capita basis, and requires estimates of the resident population of each area in 2022–23.

For most of our analysis, we use the latest Office for National Statistics (ONS) estimates of the population of local areas, which are for mid-2021 and are based on the Census 2021.

Subnational population projections consistent with these mid-2021 estimates have not yet been published. In each local area, we assume the population changed between 2021 and 2022 as was forecast based on the ONS's latest subnational population projections, which are 2018-based. We assume any change between 2021 and 2022 is equal across the age–gender distribution. This gives a total English population of 56.8 million in 2022–23.

As an alternative, we also consider the impact of using alternative population estimates which do not rely on the results of Census 2021 to produce per capita figures. This sensitivity analysis is discussed in Sections 2.2 and 3.2. We instead take the ONS's latest mid-2020 population estimates for each local area, which reflect the Census 2011, and increase these in line with forecast changes in each area's total population between 2020 and 2022 based on the ONS's 2018-based subnational population projections.

For some health analysis, we also use population estimates at other geographical levels. For GP populations, we take the GP registration numbers used in the allocations from October 2021 and scale them by our lower-tier local authority (LTLA) populations, so that the sum of GP populations in each LTLA is equal to the value we use elsewhere. For lower-layer super output area (LSOA) populations, we take the 2020 estimates and scale them in the same way, so that the sum of LSOA populations in each LTLA is equal to the value we use elsewhere.

Importantly, NHS funding is allocated based on GP registrations rather than population estimates. This gives a much larger estimate of the total population of England – that is, 61.5 million in 2022–23 compared to our forecast of 56.8 million. This may be because some people are registered at multiple GP surgeries or that expatriates are still registered. We use resident population estimates in calculating per capita NHS funding, to be consistent with the other services. We also show the sensitivity of our results to instead using GP registrations to estimate per capita NHS funding.

## A.3. How do we allocate funding for the NHS and police within geographical areas?

### NHS

For core services and primary care, we have the actual funding and estimated need for each ICS, and use these directly (after appropriate rescaling of need, discussed in Section A.4 when we explain how we updated needs assessments). For specialised services, up-to-date funding and need assessments have not been produced because of changes in how specialised services are commissioned. We instead use the notional 2022–23 allocations for CCGs produced in 2019, adjusting for differences in total specialised services funding.

Note that funding for services provided at specialist centres, such as Great Ormond Street Hospital in London, will still come from the ICS (and formerly CCG) covering the area where a patient lives, rather than where the centre is located. This means funding and spending needs for specialised NHS services should not be distorted by the location of such centres in London and other cities.

For our main estimates, we then allocate NHS funding (and needs) to local authority areas based on their estimated relative spending needs, and the funding received by ICSs with which they overlap. In particular, we use relative need for each of the three streams (core, primary care, specialised services) to allocate ICS funding and need for that stream within each ICS. This implicitly assumes that need for care within each UTLA area is equal per capita and that ICSs allocate funding according to need within their areas. For example, if an ICS contains two local authorities with equal total need (population multiplied by per capita need) for core services, we would allocate equal shares of funding and assessed need for core services to each local authority. But if one of the local authorities had double the need of the other (either because of a larger population or differences in per capita need), we would allocate double the share of funding and assessed need to this local authority.

We can test this assumption for in-patient hospital spending using detailed administrative hospital records. In particular, the Health Foundation has produced estimates of in-patient hospital spending for each LSOA using Hospital Episode Statistics for 2019–20. They did this by estimating the cost of each hospital spell using NHS reference costs and adjusting for differences in costs between areas with the Market Forces Factor. We use data from 2019–20 because of the large disruptions to hospital activity caused by the COVID-19 pandemic.

## 7 How much public spending does each area receive?

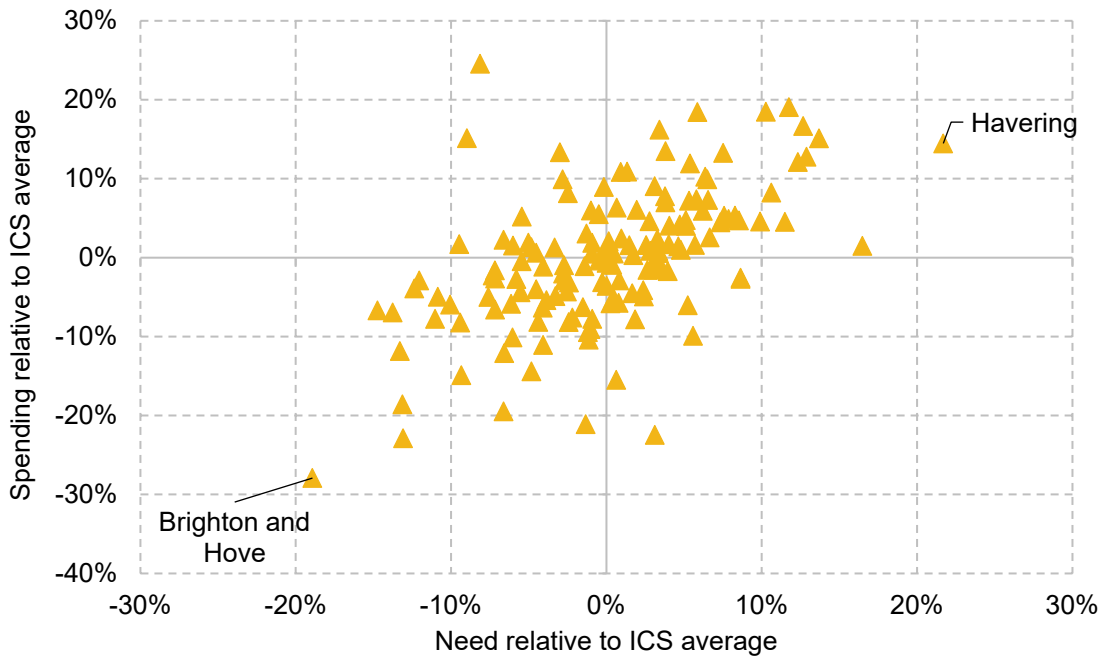
We use these estimated costs to compare the actual in-patient hospital spending in each ICS and in each local authority. First, we calculate how much higher or lower spending in each local authority is compared with the average(s) of the ICS(s) it is contained within. For example, a figure of 10% means that a local authority spent 10% more on in-patient hospital activity than the average for its ICS(s). To compare with assessed needs for in-hospital care, we use the general and acute needs assessment for 2022–23. We repeat the analysis for assessed need and calculate assessed need for each local authority relative to the ICS(s) average assessed need. As well as in-patient activity, general and acute need also includes A&E attendances and outpatient appointments, so is not a perfect measure of need for in-patient activity alone, but is the closest we have. We therefore view this analysis as an indicative test, rather than conclusive proof, of how funding is allocated within ICSs.

Figure A.1 shows the result of this analysis. For each local authority, the horizontal axis shows assessed general and acute need relative to the ICS average need, while the vertical axis shows actual in-patient hospital spending relative to the ICS average spending. There is a clear positive relationship: local authorities which have higher need than their ICS average also tend to receive higher spending. For example, Havering has 21.7% higher general and acute need than its ICS average (North East London). Spending on in-patient hospital treatment for Havering residents is also 14.5% higher than the ICS average spending. At the other end, Brighton and Hove has need 18.9% lower than its ICS average (Sussex) and spending is 27.9% lower than the ICS average. This clear positive relationship between relative spending and relative need within ICSs supports our assumption that funding is allocated within ICSs based on relative need.

As an alternative, we allocate funding within each ICS area on an equal per capita basis between individuals residing in that area, and aggregate up to estimate average per capita funding within each local authority area. If this was the actual way funding was allocated, we would expect to see the points in a horizontal line at 0% in Figure A.1. Nonetheless, we think this is a useful robustness test to highlight the importance of within-ICS allocations.

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Figure A.1. Relationship between actual spending on in-patient hospital activity in 2019–20 and assessed spending need for general and acute healthcare in 2022–23



### Police

Funding and assessed spending needs are available at the level of Police Force Areas (PFAs). Every UTLA is contained entirely within a single PFA, although some PFAs are made up of multiple UTLAs. This is described in Table A.1, and shown on the map in Figure A.2. The black solid lines show the borders of each PFA, which are also all local authority borders, while the red lines show additional local authority borders within a PFA.

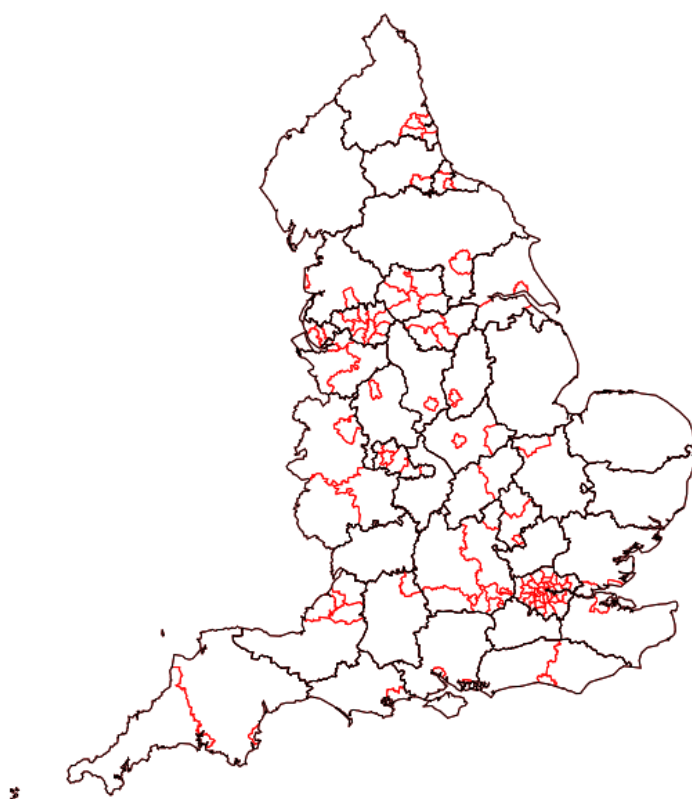


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Table A.1. Number of UTLAs per PFA

Number of UTLAs	Number of PFAs	Share of PFAs	Examples of PFAs
1	9	23.1%	Norfolk, Cumbria
2	10	25.6%	Kent, Dorset
3	5	12.8%	Sussex, Lancashire
4	6	15.4%	South Yorkshire
5	4	10.3%	Devon & Cornwall
6	1	2.6%	Northumbria
7	1	2.6%	West Midlands
8	0	0.0%	–
9	1	2.6%	Thames Valley
10	1	2.6%	Greater Manchester
⋮	⋮	⋮	⋮
32	1	2.6%	Metropolitan Police

Figure A.2. Map of PFAs and UTLA boundaries



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For our main estimates, we allocate funding (from both central grants and council tax revenues) to local authority areas within each PFA in line with their estimated relative spending needs. We apply the spending needs formula (updated as described in Section A.4) at the level of the UTLA, and then compare relative per capita spending needs between local authorities within the same PFA. As an alternative, we also estimate funding in each local authority if funding was allocated on an equal per capita basis between local authorities within each PFA.

Throughout, per capita figures use our estimates of the resident population of each area in 2022. However, police funding is based not only on resident population, but also daytime population. This will mean places where a large number of people commute out of the area (e.g. Lewisham, Sutton, Central Bedfordshire, Wigan) will have relatively low police funding per capita using ONS resident populations, while places where a large number of people commute into the area (e.g. Westminster, Manchester, Nottingham, Newcastle) will have relatively high police funding per capita using ONS resident populations.

## A.4. How have we updated spending needs assessments?

### NHS

Spending need assessments for NHS services are produced using a number of different needs formulae for different health services. Unlike the other public services included in this report, these needs assessments are relatively up to date: the needs assessments for core services (including hospital and community healthcare activity) and primary care were produced in December 2021. This means we do not need to update the needs assessments to the same extent that we need to for other services. The one part of the needs assessment we do update is the population figures, so they are consistent with our assessments of need for all other services.

As the needs assessments are relatively up to date, our main focus is to transform these into needs assessments at the UTLA level. Many of the needs assessments allow us to produce needs assessments at the LTLA level and, where possible, we use these directly to aggregate up to the UTLA level. In other cases, we estimate need at the GP practice level and aggregate up to UTLAs.

To provide more detail on how we estimate need at the local authority level, Table A.2 summarises how we apply the formulae for each different service. The second column shows the relative importance of each service and the third column summarises how we estimate need at the local authority level.

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Table A.2. Summary of components of NHS spending needs formulae

Component	Share of pre-cost adjusted allocations	Implementation to local authorities
General and acute	46.2%	Take the age by gender LTLA weights produced for the latest allocations and multiply these by our LTLA population estimates.
Community	3.8%	
Mental health	7.9%	
Maternity	2.5%	Aggregate GP practice need used in the formula to the UTLA level. This uses live births 2015–19, which we do not update.
Prescribing	6.3%	Multiply the national age by gender weights produced for the latest allocations by our LTLA population estimates. Make specific characteristic adjustments included in the formula for each area using ICS values from the allocations for each characteristic apart from the share of population aged over 85 where we use our LTLA population estimates.
Primary care	6.4%	Take estimated GP practice need from the latest allocations and adjust for differences in population using our estimates, then aggregate to the local authority level.
Specialised services (portion allocated by formula)	8.5%	Funding for specialised services was not allocated to ICSs in 2022–23. Instead, we use the CCG allocations for 2022–23 produced in 2019 as an estimate of specialised services spending. We multiply the age by gender CCG-specific weights from these allocations by our population estimates.
Specialised services (portion allocated by historic usage)	8.9%	Funding for specialised services was not allocated to ICSs in 2022–23. Instead, we use the CCG allocations for 2022–23 produced in 2019 as an estimate of specialised services spending. We assume equal per capita spending within CCGs.
Unavoidable mortality	9.5%	This is produced at the GP practice level in the latest allocations, and we aggregate these to the local authority level using our population estimates.

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As well as estimates of need for each service, the NHS allocations also consider differences in cost. Table A.3 summarises the assumptions we make about these cost adjustments.

**Table A.3. Summary of adjustments made to cost components of NHS spending needs formulae**

Component	Implementation to local authorities
Market forces factor	In the latest allocations, this is calculated at the LTLA level so we use this directly.
Emergency ambulance cost adjustment	We take the value used within the latest allocations for each ICS and assume it is equal within ICSs and then population weight to local authority level.
Remoteness adjustment	In the allocations, this is allocated to ICSs based on specific providers. We allocate this to the local authorities based on their usage of these providers (which is included in the latest allocations).
Public Finance Initiative adjustment	We take the value used within the latest allocations for each ICS and assume it is equal within ICSs, and then population weight to local authority level.

An important caveat when comparing our needs assessments to the latest NHS allocations is that the allocations estimated need based on a lower total funding envelope than the actual funding. NHS England have not updated this, and so their numbers suggest that the whole system is funded several per cent above need. This is misleading because the needs assessments only assess relative need for services, not absolute need. They therefore cannot say whether the whole system is actually overfunded or underfunded relative to need, because we have no assessments of absolute need. We therefore rescale their estimated needs using total funding numbers for 2022–23 by service.

### Local government

We do not have up-to-date assessments of local authority relative spending needs. The government has been consulting on producing updated assessments of the spending needs of different local areas since 2017, with new estimates initially due in 2019 as part of the Fair Funding Review. This has been repeatedly delayed, and new estimates are now not expected to be published until at least 2024–25.

There are separate relative needs formulae for different service sub-blocks. Table A.4 describes, for each sub-block, the variables included and to what extent we have been able to update these. Note that comparisons of means, and correlations, exclude Isles of Scilly, City of London and councils newly formed since 2013. Where we have not been able to find more up-to-date data,

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we use values from 2013–14 needs assessments. We have not changed any of the basic amounts or coefficients from their 2013–14 values. For full details of the formula used in 2013–14, and the underlying data, see Department for Communities and Local Government (2013).

Note that any new formulae are likely to include different sets of variables to the 2013–14 formulae, and to reflect new estimates of the importance of different factors in driving demand and costs. They are also likely to split local authority service into different sub-blocks, with much of environmental, protective and cultural services (EPCS) included in a new foundation formula, for instance. This means our updated needs estimates are not a prediction of what may result from the Fair Funding Review. Instead, they show how patterns of estimated needs would change if the old formulae were retained, and the latest publicly available data plugged in very crudely.

Percentages in Table A.5 show the shares of overall assessed relative needs accounted for by each sub-block, under the 2013–14 needs assessments (column 1), and when we use updated data to generate more up-to-date needs assessments (column 2). Note that this implicitly reweights spend towards service areas where updated data suggest needs have increased, particularly social services for younger adults.

However, there have also been big shifts in what local councils do and the make-up of their spending since 2013–14, with a rising share of spending on children’s social care and a smaller share on a range of more universal services. As an alternative, we also estimate relative needs updating the weighting of services in the needs formulae to match the national average share of spending relating to the relevant service lines in 2022–23 budgets (for the same set of councils). For this, we have mapped each service line to the relevant relative need formula sub-blocks, based on a mapping produced by the Ministry of Housing, Communities and Local Government in 2018. This gives more weight to drivers of needs for children’s social care, and less to EPCS. These shares are shown in column 3.

**Table A.4. Summary of updates to local authority area characteristics**

Sub-block	Variable	Data source	Notes	Old mean (SD)	New mean (SD)	Correlation
Children's social care	Resident population aged 0–17 (pop0to17)	Census 2021 and 2018-based population projections		76,535 (57,676)	78,506 (59,397)	0.998
	Proportion of dependent children without good health (kidhealth)	Not updatable	Change to census categories means not consistent after 2001	0.0947 (0.0138)		
	Proportion of adults aged 18–64 not in employment and in receipt of universal credit (UC) (is18643q)	From average 2009–12 to DWP Sep 2021–Aug 2022	Closest proxy (given changes to benefit system) for those of working age on income support, income-based jobseeker's allowance or the guarantee element of pension credit	0.0913 (0.0313)	0.0869 (0.0263)	0.910
	Proportion of children in out-of-work families who received child tax credit (ctckidunemp)	Not updatable	Changes to benefit system means not possible to update	0.2222 (0.0759)		
	Proportion of children aged 0–15 in Black ethnic groups (kidblacketh)	From Census 2001 to Census 2011	Relevant age breakdown not yet available for Census 2021	0.0389 (0.0770)	0.0576 (0.0855)	0.941
	Proportion of people in other ethnic groups (othereth)	From Census 2001 to Census 2021		0.0105 (0.0114)	0.0252 (0.0263)	0.886

	Proportion of people in mixed ethnic groups (mixeth)	From Census 2001 to Census 2021		0.0147 (0.0114)	0.0313 (0.0183)	0.960
	Proportion of people aged 16 years and over whose highest qualification attained was level 1 or 2 (qual12)	From Census 2001 to Census 2021	Changed from proportion of people aged 16–74, to proportion of people aged 16 and over	0.3535 (0.0520)	0.2260 (0.0389)	0.881
	Proportion of people aged 16 years and over whose highest qualification attained was level 4 or 5 (qual45)	From Census 2001 to Census 2021	Changed from proportion of people aged 16–74, to proportion of people aged 16 and over	0.2033 (0.0875)	0.3439 (0.0938)	0.963
	Proportion of females aged 16–74 whose economic activity is looking after the home and/or the family (f1674home)	From Census 2001 to Census 2011		0.1208 (0.0157)	0.0805 (0.0179)	0.8252
Youth and community	Resident population aged 13–19 (pop13to19)	Census 2021 and 2018-based popn projections		29,822 (23,085)	30,533 (23,298)	0.995



	Proportion of children in out-of-work families who received Child Tax Credit (ctckidunemp)	Not updatable	As above			
	Proportion of pupils in state-funded secondary schools who are in ethnic groups considered to be low achieving (ethsecnew)	From 2012 to DfE school census 2021–22		0.1650 (0.1680)	0.2153 (0.1649)	0.972
Social services for older people	Number of people aged 60 and over who were not in employment and in receipt of UC, plus number of individuals in receipt of the guarantee element of pension credit, divided by the resident population aged 65 and over (ispen3q)	From average 2009–12 to DWP Sep 2021–Aug 2022	UC and unemployed used as a proxy (given changes to benefit system) for in receipt of income support or income-based jobseeker's allowance	0.2406 (0.0952)	0.1517 (0.0777)	0.967
	The population sparsity of each local authority measured at LSOA level and including only those aged 65 and over, with extra weighting for supersparsity (oaspar65pl)	From Census 2001 to Census 2021		0.1586 (0.2232)	0.1197 (0.1715)	0.989

	Resident household population aged 65 and over, plus number aged over 65 accessing long-term support in a residential setting (proj65plhshr)	From 2011–13 to Census 2021 and NHS ASCAF data 2021–22	Taking users of long-term residential care as a proxy for number of local authority supported residents in permanent care homes	59,858 (53,987)	68,208 (62,331)	0.999
	Household and supported residents aged 90 and over, as a proportion of household and supported residents aged 65 and over (pop6590plus_ratio)	From 2011 to Census 2021	Taking ratio as estimated in 2011, and multiplying by change in share of resident population aged 65 and over who are 90 and over between 2011 and 2022	0.0394 (0.0053)	0.0423 (0.0055)	0.803
	Proportion of the population aged 65 and over who are in receipt of disability living allowance (DLA), PiP or attendance allowance (aa3q)	From 2008–11 to DWP Sep 2021–Aug 2022	Closest proxy for those in receipt of attendance allowance, given changes to benefit system	0.1587 (0.0272)	0.2109 (0.0532)	0.802
	Proportion of people 65 and over living in rented accommodation (oprented)	From Census 2001 to Census 2011	Relevant age breakdown not yet available for Census 2021	0.3029 (0.1197)	0.2552 (0.1121)	0.986
	Proportion of people 65 and over living alone (opalone)	From Census 2001 to Census 2021		0.3566 (0.0405)	0.3168 (0.0342)	0.874

Social services for younger adults	Resident population aged 18–64 (pop18to64)	Census 2021 and 2018-based population projections		221,035 (160,406)	229,069 (167,722)	0.999
	Proportion of the population aged 18–64 who are in receipt of DLA or PiP (dla_1864_q)	From 2009–12 to DWP Sep 2021–Aug 2022	Now includes PiP as well as DLA, given changes to benefit system	0.0502 (0.0159)	0.0632 (0.0195)	0.961
	Proportion of people aged 16–64 who are long-term unemployed or have never worked (nssec8)	From Census 2001 to Census 2011	Shifted age category from 18–64 to 16–64; only age breakdown available for Census 2021 so far is 16–74	0.0467 (0.0253)	0.0637 (0.0264)	0.934
	Proportion of people aged 16–64 who work in routine or semi-routine occupations (nssec67)	From Census 2001 to Census 2011	Shifted age category from 18–64 to 16–64; only age breakdown available for Census 2021 so far is 16–74	0.2357 (0.0567)	0.2410 (0.0593)	0.982
	Proportion of households with no family (nofamily)	From Census 2001 to Census 2021		0.3408 (0.0644)	0.3780 (0.0463)	0.953
Highway maintenance	Unweighted sum of road lengths (km) of all major principal and minor roads (unweighted_roads)	From 2012 to DfT 2021		1,886 (2,336)	1,967 (2,440)	0.999

	Weighted sum of road lengths (km) of all major principal and minor roads, where principal motorways and urban roads are given twice the weight of rural roads (weighted_roads)	From 2012 to DfT 2021	Published figures broken down by urban/rural instead of built-up/non-built up	2,930 (3,124)	2,802 (2,908)	0.998
	Annual average traffic flow of all motor vehicles (millions) on principal roads (flowall3)	From 2009–12 to DfT 2017–19	Taking flow as estimated for 2009–12, and multiplying by change in annual average motor vehicle traffic on all non-trunk roads between 2009–11 and 2017–19 in each local authority	5.907 (1.775)	6.203 (1.806)	0.988
	Average traffic flow for HGVs and buses and coaches on principal roads (flowhgvbus3)	Not updatable	Bespoke estimates, and published data not available for these vehicles by road type	0.2975 (0.1288)		
	Daytime population (daypoppos), which is the sum of:			373,257 (274,943)	398,209 (296,091)	0.999
	<i>Resident population, all ages (popallages)</i>			221,361 (220,848)	232,826 (233,047)	0.999

	<i>Positive daytime net inflow (dtnipos)</i>	From Census 2001 to Census 2011	Then scaled by population growth of resident area between 2011 and 2022; assumptions as per police estimates; Census 2021 figures not yet available	6,117 (27,865)	6,433 (33,095)	0.986
	<i>Average number of nights stayed by domestic visitors, divided by 365 (visnghtd)</i>	From 2008–10 to GB Tourism Survey, 2017–19	GB Tourism Survey is the successor to the UK Tourism Survey	5,195 (7,925)	5,607 (8,733)	0.963
	<i>Average number of nights stayed by foreign visitors, divided by 365 (visnghtf)</i>	Not updatable	Bespoke estimates based on 1991 census	3,692 (5,794)		
	Annual average number of days with snow lying at 9am (snowdays)	From 1978–90 to 2012–21 using Met Office data	Take old estimate by local authority and multiply by change in average snow days in relevant region between 1978–90 and 2012–21; has actually decreased significantly	11.52 (5.31)	5.40 (2.75)	0.938
	Average number of days needing gritting in the 10 winters to 2001 (gritdays)	Not updatable	Bespoke estimates based on road surface temperatures, which are proprietary data (Met Office)	46.69 (11.59)		

District-level and county-level EPCS	Number of people in receipt of employment support allowance, plus the number of households in receipt of UC with a limited capability for work entitlement (ibsda3qn)	From 2009–12 to DWP Sep 2021–Aug 2022	Closest proxy given benefit system changes; previously included: incapacity benefit, severe disablement allowance and employment and support allowance	8,436 (8,578)	8,123 (8,263)	0.996
	Number of people (all ages) who were not in employment and in receipt of UC, plus number of individuals in receipt of the guarantee element of pension credit (isalln3q)	From 2009–12 to DWP Sep 2021–Aug 2022	UC and unemployed used as a proxy (given changes to benefit system) for in receipt of income support or income-based jobseeker's allowance	16,418 (16,973)	15,024 (15,609)	0.991
	Number of people aged 60 and over who were not in employment and in receipt of UC, plus number of individuals in receipt of the guarantee element of pension credit (ispenn3q)	From 2009–12 to DWP Sep 2021–Aug 2022	UC and unemployed used as a proxy (given changes to benefit system) for in receipt of income support or income-based jobseeker's allowance	7,134 (7,259)	4,997 (5,018)	0.992
	Alternative claimant count (unempn)	From 2009–12 to DWP Sep 2021–Aug 2022	Closest proxy for the average number of claimants of unemployment-related benefits (jobseeker's allowance and National Insurance credits)	4,863 (5,249)	5,372 (6,156)	0.971

	Proportion of residents born outside the UK, EU Countries, Canada, USA, Australia and New Zealand (cobirthnew)	From Census 2001 to Census 2021	Note: will have been increased by EU expansion	10,986 (17,550)	21,094 (29,989)	0.955
	The population density of each local authority, measured at output area level (oadensity)	From Census 2001 to Census 2021		5.061 (3.534)	5.219 (3,741)	0.989
	The population sparsity of each local authority measured at output area level, with extra weighting for supersparsity (oaspar)	From Census 2001 to Census 2021		0.2561 (0.2831)	0.2297 (0.2587)	0.996
	The annual number of day visitors to the local authority's area divided by 365, excluding visits by residents of a local authority to attractions within the same authority and day visits where the purpose is to visit friends and relatives (visday)	Not updatable	Bespoke estimates based on various surveys covering the period from 1988 to 1991; not possible to match measure using the more recent Great Britain Day Visits Survey, but is likely to have changed over time	9,906 (11,120)		
	popallages, dtnipos	As above				

Concessionary travel	Modelled concessionary bus boardings by older and disabled people (boardings)	From 2013–19 using change in number of relevant journeys from DfT statistics	Proxy change using proportional change in number of elderly and disabled concessionary passenger journeys on local bus services in each local authority or the relevant transport authority	7,232,243 (4,516,956)	6,105,411 (3,869,325)	0.957
Flood defence	Net current expenditure on levies in relation to land drainage and related work (idblevy)	From Internal Drainage Board accounts 2012–13 to local authority budgets, 2022–23	Not adjusted for inflation	98,556 (336,974)	129,044 (441,603)	0.973
	The length of ordinary water courses not covered by an Internal Drainage Board in the authority area (ordwaterxidb)	Not updatable	Bespoke estimates based on river network database; unlikely to have changed much over time	619.2 (1,121)		
Continuing EA levies	Net current expenditure on Environment Agency levies (eaengland)	From Defra 2012–13 to local authority budgets, 2022–23	Not adjusted for inflation	195,049 (177,417)	240,559 (243,380)	0.937
Coast protection	Net current expenditure on coast protection (coast3new)	From 2008–10 average to local authority budgets, 2022–23	Not adjusted for inflation	41,848 (152,718)	32,412 (117,013)	0.870
Fixed costs		Not updatable	Not adjusted for inflation	325,000 (0)		



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Table A.5. Shares of need and spending by local authority service block

Relevant service blocks of 2013–14 needs formulae	Share of total needs in 2013–14 (1)	Share of total needs in 2022–23 (2)	Share of net spending in 2022–23 (3)
<b>Children’s services:</b>	<b>15.1%</b>	<b>14.2%</b>	<b>30.0%</b>
Children’s social care	13.4%	12.6%	22.5%
Youth and community	1.6%	1.6%	7.5%
<b>Adults’ personal social services:</b>	<b>44.5%</b>	<b>46.9%</b>	<b>39.8%</b>
Social services for older people	26.6%	25.9%	18.1%
Social services for younger adults	17.9%	21.0%	21.7%
<b>Highway maintenance</b>	<b>4.1%</b>	<b>3.7%</b>	<b>4.1%</b>
<b>EPCS:</b>	<b>36.3%</b>	<b>35.2%</b>	<b>26.1%</b>
District-level EPCS			
County-level EPCS	21.0%	20.2%	11.0%
Concessionary travel	12.5%	12.7%	9.5%
Flood defence	2.4%	1.8%	2.7%
Continuing Environment Agency levies	0.2%	0.2%	0.2%
Coast protection	0.0%	0.0%	0.1%
Fixed costs	0.0%	0.0%	0.0%
	0.2%	0.2%	2.6%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

The above excludes: police, fire and rescue, capital financing, and Local Authority Central Education Functions. The control totals include only relative needs for main types of councils, excluding Isles of Scilly and City of London.

**How does updating the underlying data affect patterns of relative per capita need across the country?** Estimated per capita needs in many areas change significantly, but this does not seem to relate to existing per capita needs. It is not that areas previously assessed to have higher per capita needs have become more or less ‘needy’ on average.

The biggest per capita changes in assessed needs as a result of updating the data underlying the formulae are in London, with the largest cash increase in Tower Hamlets (£185 per capita) and the largest decrease in Kensington and Chelsea (−£127 per capita). Estimated relative needs increase as a result of the updates in most outer London boroughs, and fall in many areas in the North East and South West of England. These changes will reflect a combination of differences in population growth (including for subgroups of the population, such as those aged 18 and under) and other socio-economic characteristics.

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Figure A.3. Estimated per capita need for local government funding based on 2013–14 needs assessments, and our updated estimates

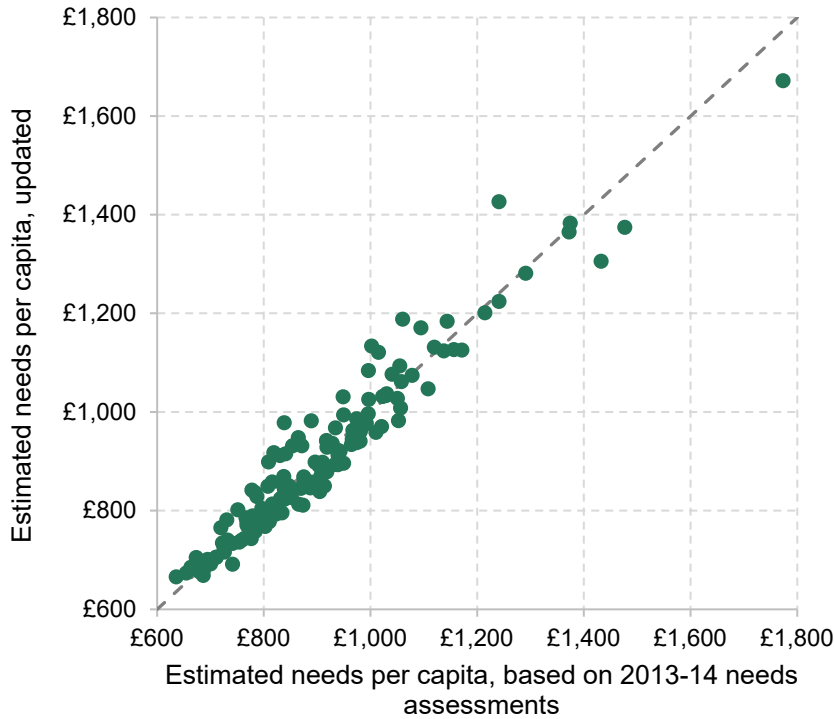
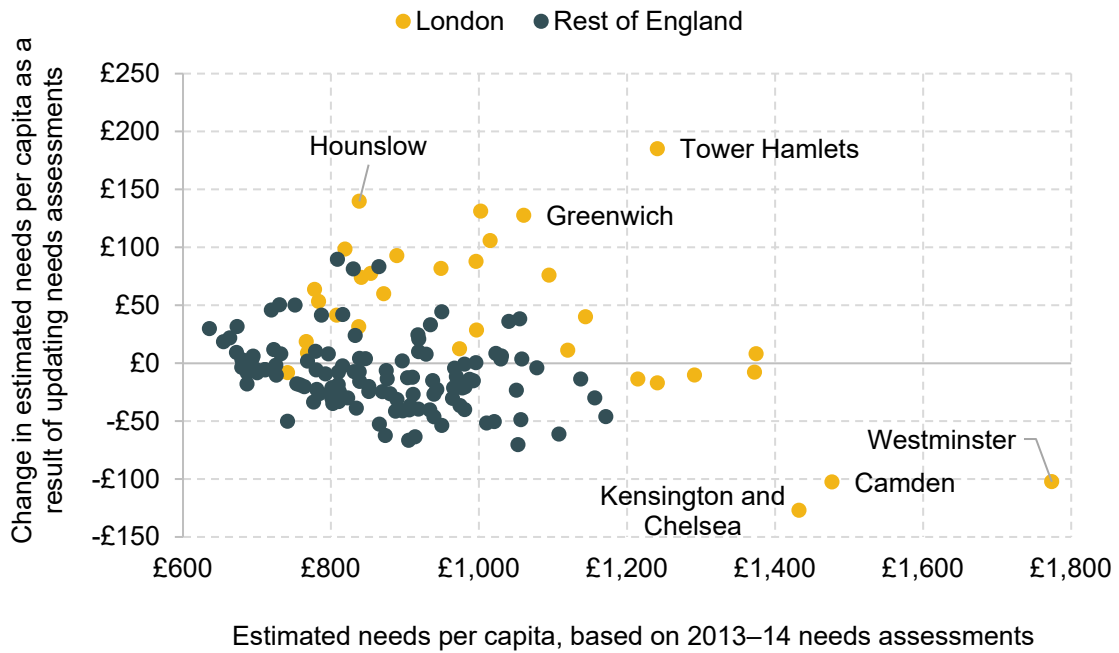
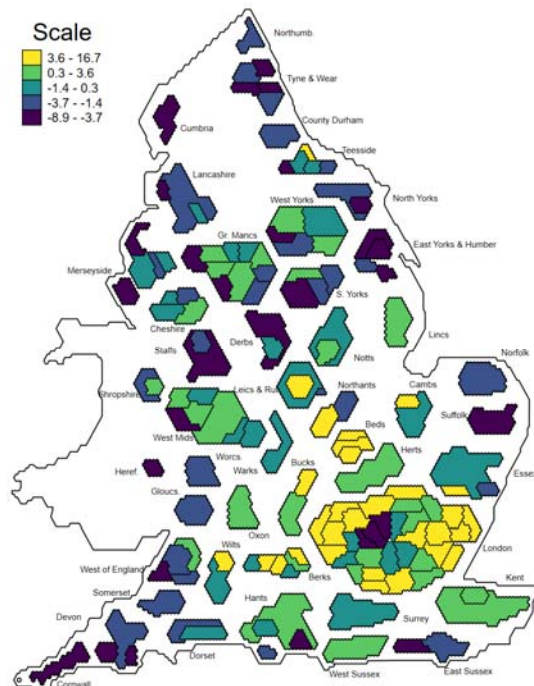


Figure A.4. Estimated per capita need for local government funding based on 2013–14 needs assessments, and the change using our updated estimates



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Figure A.5. Map of percentage point change in estimated per capita needs, as a result of updating 2013–14 needs assessments



**How does this compare to just updating needs estimates to reflect population growth between 2013–14 and 2022–23?** In our first report (Ogden et al., 2022), we took a much simpler approach to partially updating needs assessments. In particular, we assumed per capita relative needs were unchanged between areas (leaving the needs assessments produced in 2013–14 untouched), and accounted only for changes in the total resident populations of different areas.

In total, the 2013–14 needs assessments were based on a population of 54.1 billion. Since then, the overall population of England (using our main 2021-based population estimates) has risen by 5.1% on average, with very big differences in some areas. For instance, the population of Tower Hamlets has increased by +17.4%, while a small number of London councils have seen very substantial falls: Westminster (–9.9%), Kensington and Chelsea (–9.5%) and Camden (–7.9%).

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Figure A.6. Estimated per capita need for local government funding based on 2013–14 relative needs, and only adjusting for population growth between 2013 and 2022

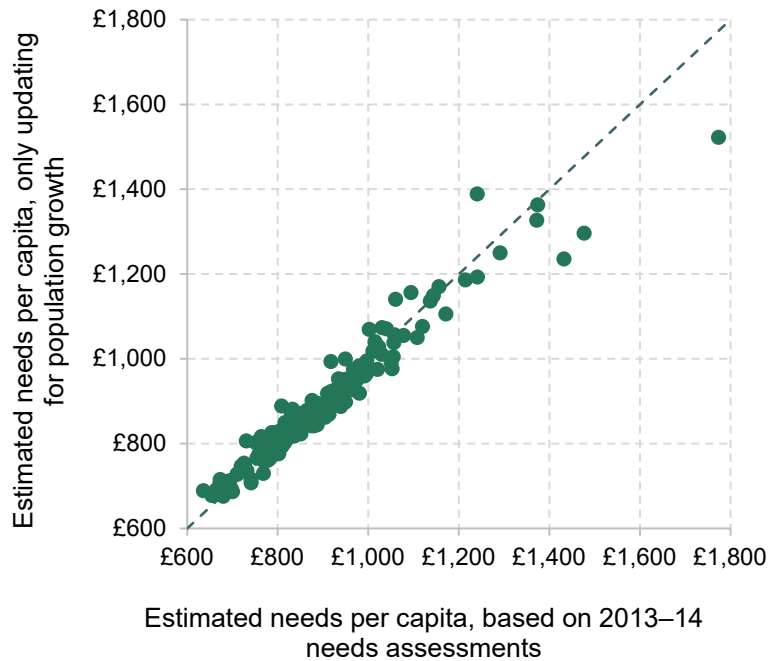
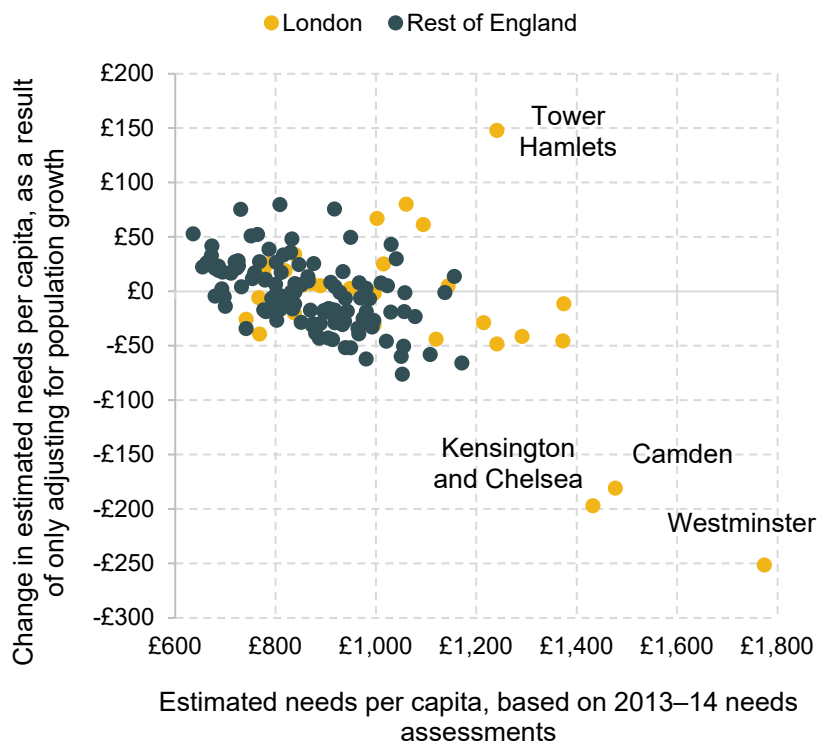


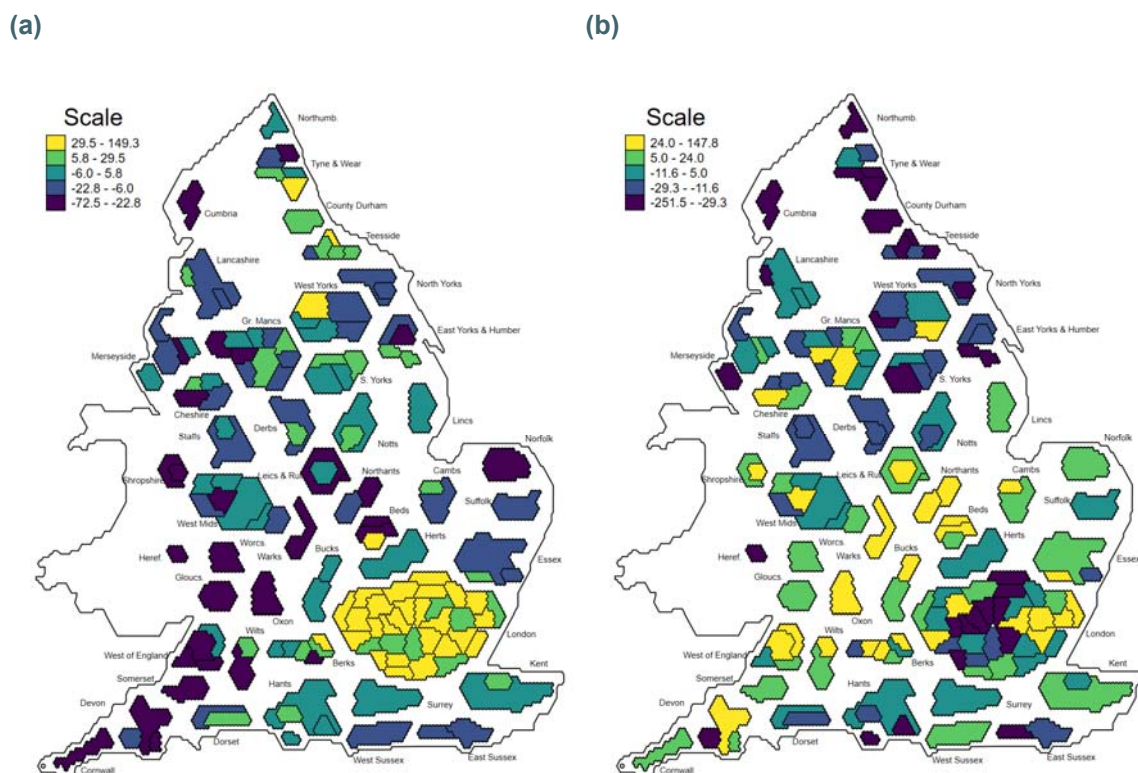
Figure A.7. Estimated per capita need for local government funding based on 2013–14 relative needs, and change in £ per capita if only adjusting for population growth between 2013 and 2022



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We can decompose changes in relative needs into an element explained by changes in the populations of each area, and an additional element driven by changes to other area characteristics. The maps in Figure A.8 show changes in estimated needs in each area: (a) between 2013–14 assessments, and 2022–23 assessments just adjusting for population growth; and (b) between the latter and our main estimates, which also update the other characteristics of each area.

**Figure A.8. Maps of changes in estimated need for local government funding, £ per capita, as a result of: (a) only updating to reflect population changes between 2013–14 and 2022–23; (b) the additional impact of fully updating needs assessments with new data**



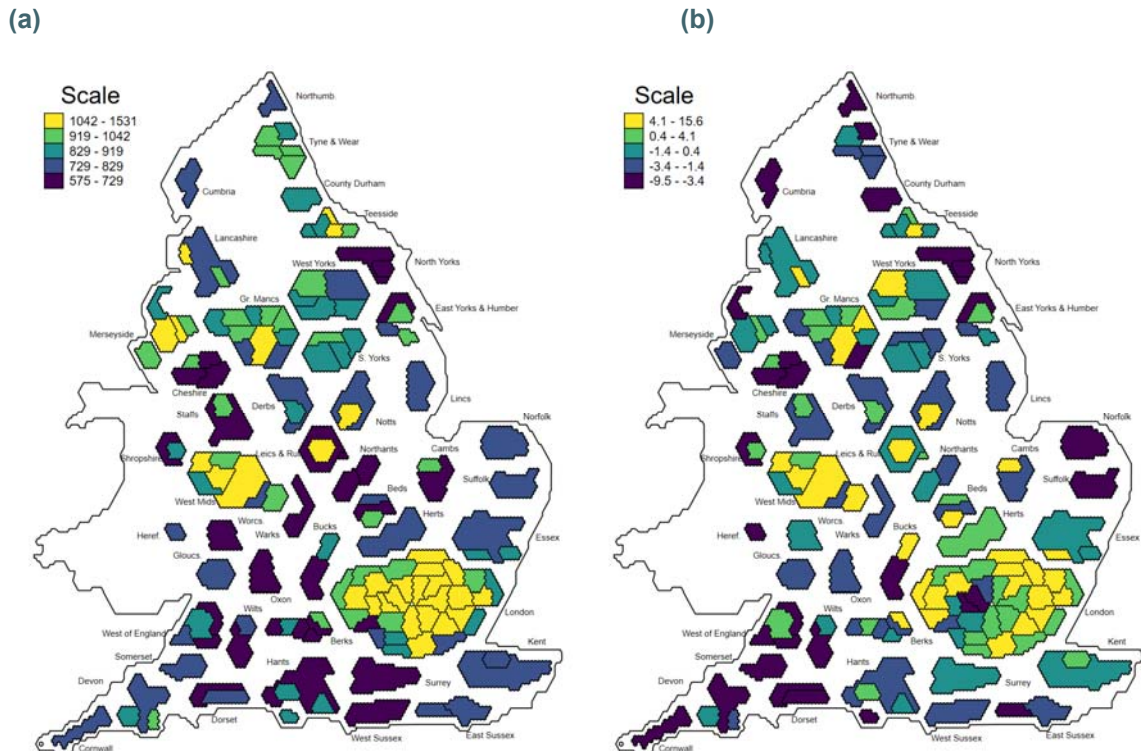
**How much difference would it make to reweigh sub-blocks to reflect the different activities of councils?** These updated needs assessments give each service delivered by councils the same weight as they were accorded in 2013–14, but the activities of councils have changed significantly since then.

If we instead reweight the formulae to match the updated shares of spending in column 3 of Table A.5, the maps look very similar (see Figure A.9). On average, areas with higher assessed needs per capita see their needs increase slightly. Reweighting increases estimated per capita needs in London by 3.7% (£40) and in the West Midlands by 1.7% (£15), and reduces estimated needs on average by 4.1% (£32) in the South West and 2.1% (£20) in the North East. The major

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exception in London is Westminster, where this reweighting reduces estimated need per capita by £140 (8.4%) – but this still leaves Westminster with the highest need per capita of any area.

**Figure A.9. Maps of (a) estimated per capita needs for local government funding if needs formulae are reweighted and (b) the percentage point change as a result of reweighting**



Differences in per capita needs between areas reflect both differences in demand for services – due to demographics, etc. – and differences in the costs of delivering services between areas. The latter are mostly included in the 2013–14 needs assessments as ‘area cost adjustments’ and we have not updated these in our main estimates. This means we have implicitly assumed that the relative costs of providing services have not changed since 2013–14.

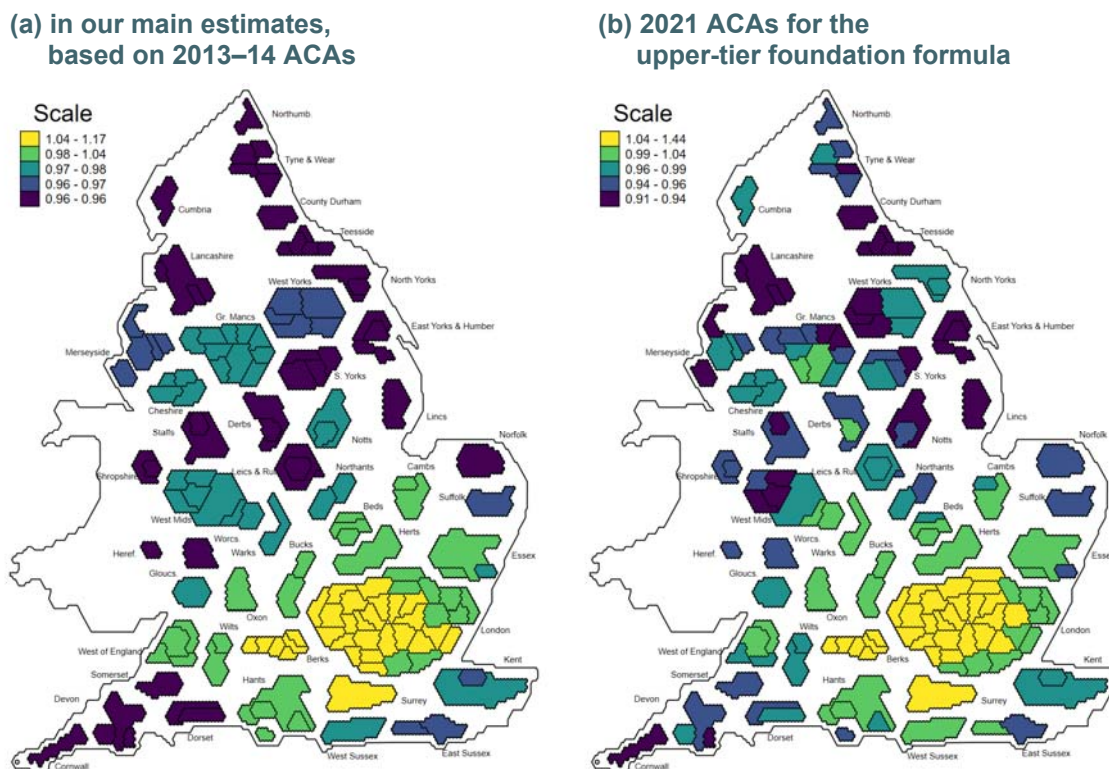
The government has published more up-to-date assessments of the relative costs of delivering services across England – the 2021 Area Cost Adjustments (ACAs). These reflect differences in labour and rental costs, as well as accessibility, which measures the impact of the difference in journey times to provide services on the cost of labour. These revised ACAs have only been used sparingly so far in allocating local government funding, such as for allocating the 2022/23 Local Council Tax Support (LCTS) admin subsidy grant. We have continued to use the 2013–14 ACAs in our analysis, as the 2013–14 needs assessments already include some variables (such as sparsity and super-sparsity), which are intended to capture the impact of journey times on costs.



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Figure A.10 shows the average area cost adjustment that we apply in our main estimates using the 2013–14 ACAs, and the 2021 ACAs for the new upper-tier foundation formula. The geographical patterns are broadly similar.

**Figure A.10. Maps of area cost adjustment applied in each area for local government services**



Source: (a) Authors' calculations based on 2013–14 needs formulae, updated to 2022 local authority boundaries and using updated data, and including both upper- and lower-tier services. (b) 2021 ACAs for the upper-tier foundation formula (Department for Levelling Up, Housing and Communities, 2022).

## Police

We can rearrange the formula used to estimate spending needs for police services to

$$Y_j = [(\alpha_1 + \alpha_2 + \beta_1 X_j)P_j + (\alpha_2 + \beta_3)N_j]C_j,$$

where:

- $Y_j$  is the assessed need for area  $j$ ;
- $P_j$  is the resident population;
- $N_j$  is the net-inflow population;
- $X_j$  are a set of area characteristics;

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- $\alpha_1$  is the police basic amount;
- $\alpha_2$  is the special events basic amount;
- $\beta_1$  and  $\beta_2$  are a set of coefficients;
- $C_j$  is the area cost adjustment.

Table A.6 summarises which parts of the formula we do and do not update. Where we cannot update characteristics, and for the ACAs, we use values from the 2013–14 assessments and assume they are equal for all local authorities within each PFA. Not updating the basic amounts and the coefficients applied to the area characteristics means changes in the variance of the area characteristics over time will change the contribution of these factors to overall variation in needs.

**Table A.6. Elements of the police needs formula we do and don't update**

Things we update	Things we don't update
$P_j$ , the resident population $N_j$ , the net-inflow population Some of the $X_j$ , area characteristics	Some of the $X_j$ , area characteristics $\alpha_1$ , the police basic amount $\alpha_2$ , the special events basic amount $\beta_1$ and $\beta_2$ , the coefficients $C_j$ , the area cost adjustment

Table A.7 summarises which area characteristics we are and are not able to update, and the data sources for the updated figures. The ‘univariate importance’ of each variable measures the share of variation in need per capita within the formula ( $\beta_1 X_j$ ) that is explained by the variable and its coefficient.

For area characteristics which we do update, Table A.8 summarises the difference in the mean and standard deviation of each characteristic between those used in 2013–14 needs assessments and the updated values we use. These are generally highly correlated (see final column), although note that there have been some large average changes. For instance, the average proportion of the population that is male, unemployed and under the age of 25 has fallen from 0.8% to 0.5%.



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Table A.7. Summary of updates to PFA characteristics

Variable	Importance (univariate)	New data source	Notes
Daytime net inflow (per person)	28.2%	Census 2011	Scaled by population growth of resident area between 2011 and 2022. Assume population of Wales, Scotland and Northern Ireland working in England grows in line with population growth. Westminster and City of London, and Cornwall and Isles of Scilly are merged in the census data. We assume all daytime net inflow is for Cornwall and split Westminster and City of London based on their daytime net inflow in 2001.
Bars per hectare	50.5%	ONS 2018	Make adjustments where CSPs have merged.
Unemployment/low-income benefits	82.6%	DWP Sep 2021– Aug 2022	Use UC for those out of work – not a perfect measure of unemployment – plus pension credit. Use these dates as this is the latest pension credit goes at the time of producing.
Single parents	90.7%	Census 2021	
Population density	53.7%	ONS 2022	
Long-term unemployment benefits	67.8%	Not updatable	UC benefit data has length of claim but not length of unemployment.
Low-skilled occupations	28.3%	Not updatable	Change to who is included between 2001 and 2011 censuses.
Students	22.7%	Census 2021	
Hard pressed	65.9%	Not updatable	Proprietary data
Male under 25 unemployment	62.3%	DWP Sep 2021– Aug 2022	Use UC for those out of work – not a perfect measure of unemployment. Changed denominator to 18–64 rather than 18–64 for men and 18–59 for women.
Population sparsity	74.9%	ONS 2020	This is logged in the formula. For some UTLAs, this is equal to zero and so cannot be logged. For these, we use the log value of the UTLA with the lowest non-negative value.
Overcrowded housing	27.8%	Census 2021	
Wealthy achievers	81.3%	Not updatable	Proprietary data
Terraced housing	38.6%	Census 2021	

### 34 How much public spending does each area receive?

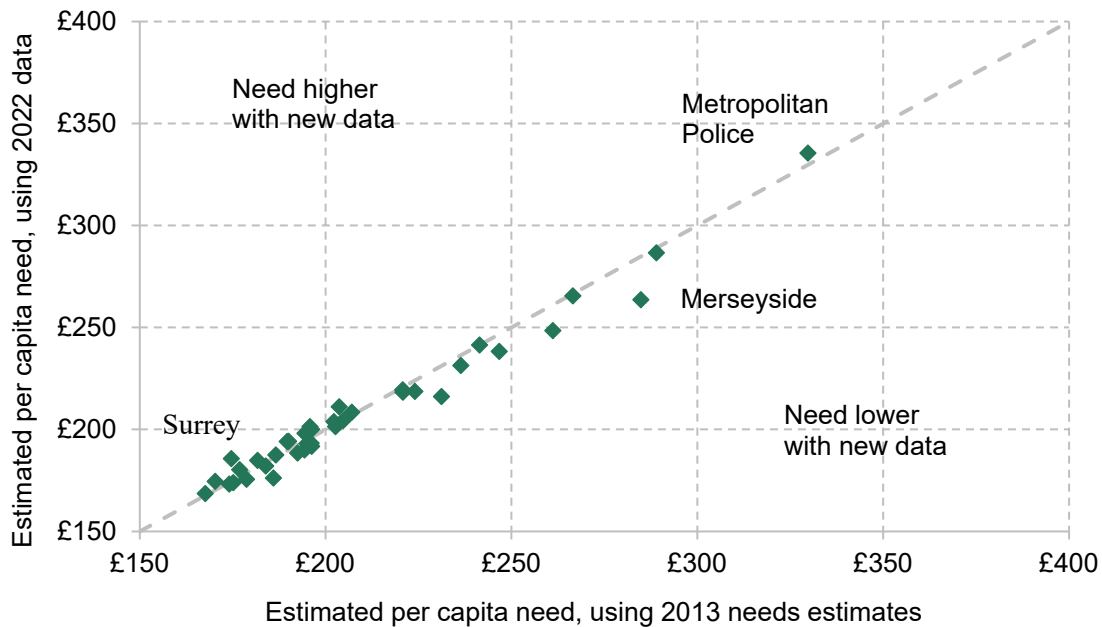
Table A.8. Differences between 2013–14 and 2022–23 sources, at the PFA level (excluding City of London)

Variable	2013–14		2022–23		Change in:		Corr.
	Mean	SD	Mean	SD	Mean	SD	
Daytime net inflow per person	-0.0157	0.0245	-0.0137	0.0213	-13.0%	-13.3%	+0.94
Bars per hectare	1.0117	1.2478	0.9295	1.2271	-8.1%	-1.7%	+1.00
Unemployment/low-income benefits	0.076	0.0202	0.064	0.0155	-15.8%	-23.1%	+0.98
Single parents	0.0604	0.012	0.0661	0.0105	+9.5%	-12.0%	+0.92
Population density	6.7557	9.7428	7.208	10.4372	+6.7%	+7.1%	+1.00
Students	0.0034	0.002	0.0039	0.0025	+15.4%	+25.0%	+0.87
Male under 25 unemployment	0.008	0.0029	0.0054	0.0017	-32.5%	-41.6%	+0.94
Population sparsity	0.2055	0.1274	0.1857	0.1176	-9.6%	-7.7%	+1.00
Overcrowded housing	0.0536	0.0227	0.0473	0.0232	-11.7%	+2.3%	+0.96
Terraced housing	0.2524	0.0552	0.2273	0.045	-10.0%	-18.4%	+0.99

We can compare estimated relative needs for each PFA with their relative assessed needs based on 2013–14 needs assessments. This gives an indication of how out of date these need estimates had become by 2022–23, compared to if these had been kept up to date using only publicly available data.

Figure A.11 shows the difference between per capita assessed need, only comparing the impact of updating characteristics (excluding total population) in the formula. Updating the formula makes little difference to assessed per capita need in each area. The largest change is for Merseyside, which moves from £285 per capita to £264. The largest increase is for Surrey, moving from £175 to £186 per capita. This is perhaps unsurprising given most area characteristics we updated are strongly positively correlated with their 2013–14 values.

Figure A.11. Estimated per capita need for police funding using 2013 needs estimates, and updating these using 2022 data



Note: Excludes City of London

## Public health

We can rearrange the formula used to estimate relative spending needs as the product of five service needs:

$$Need_i = \sum_{j=1}^5 \omega_j \times Need_{i,j} = \sum_{j=1}^5 \omega_j \times C_j \times \prod_{k=1}^{K_j} X_{i,j,k}$$

Here  $\omega_j$  are weights for each service,  $C_j$  are the scale adjustments for each service and  $X_{i,j,k}$  are characteristics – some of which may be used for several or all services.

Table A.9 summarises the data used in the formula that we do and do not update. For data we do not update, we continue to use their values from 2016–17, which are the last published estimates of needs for public health services.

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Table A.9. Summary of data we update for public health needs assessments

Data	Period they use	Do we update?	Details
Age–gender groups	2016	Yes	These population numbers are multiplied by coefficients estimated on micro-data that we cannot update.
Children in poverty	2012	No	The data used have been discontinued and replacement figures use different definitions (before and after housing costs, income versus benefit participation), meaning we cannot update these like-for-like.
Standardised mortality under 75 (SMR < 75)	2008–12	No	The public health allocations split middle-layer super output areas (MSOAs) into 16 groups, which are then weighted between 0 and 10 to give a UTLA score. CCG allocations in 2016 used the same approach. But they changed the approach for the 2019 onwards allocations, so we cannot use these to account for CCG changes over time.
Sparsity		No	‘There is an adjustment for sparsity for travel time for home visits, estimated from the travelling salesman methodology which has been used to estimate the minimum travel time within small areas (MSOAs) based on the road network rather than distance as the crow flies.’ This is not straightforward to update
Market forces factor	2011–12 to 2013–14	No	We do not update this, which accounts for differences in costs between areas, to be consistent with our approach towards other services.

In summary, we only update the demographic and population information. These are multiplied by local area specific coefficients that were estimated by using microdata on service usage. We do not update these coefficients. In some cases, we have to make assumptions to aggregate these coefficients to the UTLA, either because they were calculated for smaller/larger geographies or because there have been mergers of UTLAs. In general, we take the 2016 forecast population (i.e. what was used in the original formula) weighted average of these coefficients.

Another way of viewing this is that there are five different service areas and we can update per capita need for three of the five. Table A.10 summarises this. For all five service areas, we can update the populations that are used to scale per capita need to total need.

### 37 How much public spending does each area receive?

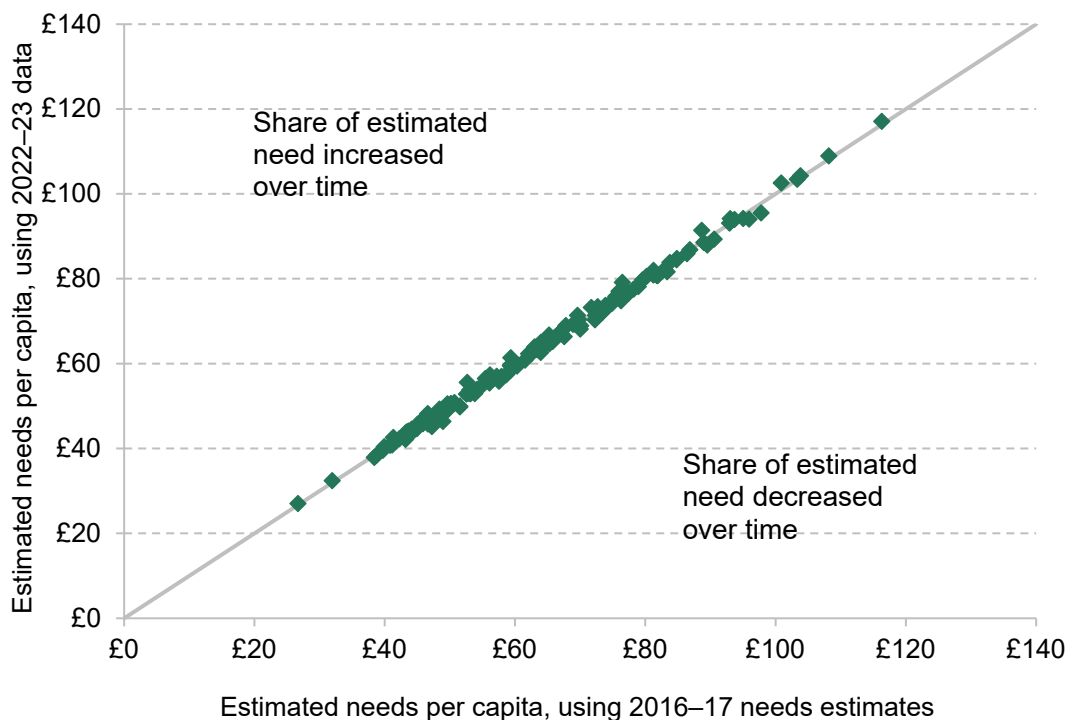
**Table A.10. Importance and updating of service areas within public health needs assessments**

Service area	Weight	Can update per capita need?
Non-mandated services	29.1%	No
Children aged under 5	25.5%	Yes
Substance misuse	23.6%	Yes
Sexual health	16.7%	Yes
Mandated services	5.2%	No

Updating the population and demographic numbers explains 82–98% of the variance for each of the three services that we can update. As a crude estimate, we can therefore explain about 60% of the total variation in per capita need.

Figure A.12 shows the relationship between our updated need per capita and the need per capita estimated for 2016–17. These have been rescaled so that total needs sum to the total funding envelope in 2022–23. The two estimates are clearly very similar, which reflects that the only per capita adjustments we have made are changes in the age and gender mix of the population. The largest increases in per capita need are for Havering (5%), Knowsley (3%) and Central Bedfordshire (3%). The largest decreases in per capita need are for Richmond upon Thames (–5%), Herefordshire (–4%) and Kingston upon Thames (–3%).

**Figure A.12. Estimated per capita needs for public health funding using 2016–17 needs estimates and updating these using 2022–23 data**



## A.5. Description of local area characteristics

As shown in Table A.11, local area characteristics are a combination of socio-demographic characteristics of areas, and measures which may be considered to be outcomes affected by public services (and potentially by their funding).

**Table A.11. Description of local area characteristics used for analysis in Sections 2.3 and 3.3**

Characteristic	Description
Population density	Our main population estimates (which are for 2022), divided by the land area (Area to Mean High Water Excluding Inland Water) in hectares
Deprivation	Average score on the English Indices of Deprivation, from IMD 2019 [latest available]; higher scores are associated with more-deprived areas
Proportion aged 0–18	Proportion of the resident population aged 18 and under, from the ONS mid-2021 population estimates, which are based on Census 2021
Proportion aged 65 and over	Proportion of the resident population aged 65 and over, from the ONS mid-2021 population estimates, which are based on Census 2021
Healthy life expectancy, male (female)	Healthy life expectancy at birth for males (females), ONS estimates for 2016–18 [latest available]
ONS Health Index	Experimental statistic that aims to capture a broad definition of health, over the period 2015–18 [latest available]; a higher Health Index is associated with better health
Average life satisfaction	Mean score for life satisfaction in 2021–22, based on ONS personal well-being statistics, which are survey-based [latest available]
School attainment	Average Attainment 8 score of all pupils, academic year 2021/22, from DfE KS4 attainment statistics
Proportion White ethnicity	Proportion of the resident population identifying their ethnic group as White, including White British and Other White ethnicities, based on Census 2021

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