PREPARE

Informing Policy with Evidence

Local NHS equity trends and their wider determinants

A pilot study of data on emergency admissions

Ana Cristina Castro, Tim Doran, Karen Bloor, Robert Shaw, Richard Cookson

March 2020

The Kings Fund

University of York

Partnership for REsponsive Policy Analysis and REsearch

This study is independent research commissioned and funded by the National Institute for Health Research (NIHR) Policy Research Programme (grant number PR-X06-1014- 22005)], as part of the PREPARE research programme. The Partnership for Responsive Policy Analysis and Research (PREPARE) is a collaboration between the University of York and the King's Fund, producing fast-response analysis and review to inform developing policy.

Tim Doran and Richard Cookson are also funded by Wellcome (Grant No. 205427/Z/16/Z).

The views expressed in this publication are those of the authors and not necessarily those of the NIHR, Wellcome or the Department of Health and Social Care.

Ana Cristina Castro Avila performed the analyses and drafted the report. Richard Cookson, Tim Doran and Karen Bloor supervised; Rob Shaw provided and interpreted admissions data. All authors contributed to revisions. We thank Ben Barr, Claire Bambra, Chris Bentley, John Brittain, John Ford, Peter Goldblatt, Julia Knight, Ieva Skarda, Sarah Sowden and Matthew Sutton, and participants at a DHSC analysts' seminar in January 2020 for useful comments and advice, though errors and opinions are our own. Data on admissions were sourced from NHS England and data on NHS funding allocations from Ben Barr, University of Liverpool.

Contents:

Key messages	1
Summary	3
Background	6
Purpose	7
Methods	8
Findings	15
Discussion	29
Conclusion	31
References	32
Appendices	34
Glossary	36

Key messages

Health inequalities cost the NHS at least £12.5 billion a year due to the excess burden of illness and use of health services in socially disadvantaged populations. People living in more deprived places are more likely to have an emergency hospital stay that could potentially have been avoided by high-quality care outside hospital.

In response to this, since 2016, NHS England has produced local health and care equity improvement indicators based on deprivation-related inequality in these potentially avoidable emergency admissions. This is a valuable first step, but these indicators have yet to be used systematically to identify local equity trends and learn lessons about health and care system quality improvement. In addition, it is not known how far these indicators are affected by changes in local public expenditure and local economic conditions that are outside the control of local NHS and social care managers. This pilot study was established to investigate these issues.

Our analysis found:

- 9% of local authorities showed consistent improvement (5%) or deterioration (4%) in health and care equity between 2012 and 2016.
- A small but robust association between short-term changes in total local expenditure and short-term changes in all-cause and avoidable emergency admissions. Specifically:
    - A £1 increase in per capita total expenditure was associated with 0.4 fewer avoidable and two fewer all-cause emergency admissions per 100,000 inhabitants.
    - Reducing one emergency admission would cost £81,224 in additional expenditure for a local authority with an average total expenditure and an average population in 2010.
    - A 1% rise in total expenditure relative to need results in ten fewer avoidable admissions and 47 fewer emergency admissions per 100,000 inhabitants.
- Short-term changes in services expenditure, social care expenditure and NHS allocations were not associated with short-term changes in avoidable emergency admissions.

This study reveals that disentangling the effects of individual, local government, and health services factors on the supply and demand for emergency admissions will require more detailed data and more sophisticated analysis of long-term trends and the interaction among these factors. Exploring the following issues further could provide a deeper understanding of the local NHS inequality landscape:

- **Wider determinants of change in emergency admission rates**: these are hard to disentangle, with different magnitudes and time lags for different age groups and conditions, and various unmeasured confounders and mediators including local social and economic conditions, lifestyle behaviours and population health.
- **Supply constraints**: with limited hospital beds and workforce, emergency departments tighten admission criteria in the face of increasing demand (i.e. increasing arrivals at emergency departments).
- **Expenditure and admissions influence each other:** worsening local population health causes increases in local expenditure on health and social care services as well as increased demand for emergency admissions.
- **Expenditure on social care:** this may have larger effects on hospital length of stay than admission rates.

A deeper understanding of this landscape would help more clearly identify and measure the wider social determinants of health beyond the control of the health and care system, which, in turn, will help local policy makers develop a more coordinated approach to health and well-being in their communities.

Summary

Background

- Local NHS and social care managers are ill-informed about the health equity impacts of their decisions.
- Since 2016, NHS England has produced local health and care equity improvement indicators based on deprivation-related inequality in ambulatory care sensitive emergency admissions ("avoidable emergency admissions", or AEAs) benchmarked against similar areas.
- These indicators have not yet been used systematically to identify local equity trends and learn lessons about local health and care system quality improvement.
- Furthermore, it is not known how far these indicators respond to changes in local public expenditure and economic conditions outside the control of local NHS and social care managers.
- This pilot study has been designed to feed into separate local equity case study work being conducted by NHS England and the University of York to learn quality improvement lessons for local health and care systems.
- The research was conducted in two phases. Phase one in late 2018 focused on 2012 to 2016, which was the most recent five-year period of data available to the research team when this phase of the analysis was undertaken to facilitate case study site selection. Phase two looked at a longer period of comparable data from 2009 to 2018 that became available in early 2019.

Aims

1. To identify local authority districts (LADs) showing sustained improvement and deterioration in inequality in avoidable and all-cause emergency admissions from 2012 to 2016.
2. To analyse whether LAD emergency admission inequality trends were associated with trends in local expenditure and economic conditions from 2009 to 2018.
3. To produce local data packs describing trends in deprivation-related inequality in avoidable and all-cause emergency admissions from 2009 to 2018, for all local authority districts (LADs) and clinical commissioning groups (CCGs).

Methods

- We constructed equity indicators for calendar years using the same methods as NHS England, except using ONS population data rather than GP registration data, and examining LADs as well as CCGs. We used IMD 2015 as a time-fixed measure of deprivation at small-area level (LSOA). To examine robustness, we looked at all-cause as well as avoidable emergency admissions, and relative inequality – the "relative gradient index" (RGI) – as well as the "absolute gradient index" (AGI). We excluded Isles of Scilly and West Somerset as deprivation spanned less than three deprivation quintile groups. This left us with 324 local authorities for the data packs. We included all 195 CCGs when producing the data packs. We included City of London in the data packs but excluded it from the similar ten and regression analyses, due to small size and lack of reliable explanatory variables, leaving us with 323 local authorities for the regression analyses of wider determinants.
- We benchmarked trends against a similar population composed of ten similar LADs. We selected the similar ten ourselves using ONS methods. We used data from Census 2011 on 59 standardised variables to calculate the Squared Euclidean Distance (SED), which ranks LADs from most similar to most dissimilar.

- We assessed LADs as showing a consistent change in local equity only when three criteria were all met: (i) sustained change: three out of the four annual changes in our 5-year period to show avoidable admissions AGI change in the same direction (i.e. improvement or worsening), (ii) doubly significant change: both avoidable admissions and all-cause emergency admissions AGI change between start and end year statistically significant at the 0.05 level, and (iii) robust change: no major inconsistencies with equity trends measured in other ways, i.e. using RGI rather than AGI or compared with similar ten benchmark trends.
- To examine wider determinants of trends in average emergency admissions, we used two main approaches: LAD level fixed effect regression models of emergency admissions, with time-varying explanatory variables including various categories of local public expenditure along with employment and income, and difference-in-difference models comparing LADs with "large", "medium" and "small" expenditure cuts.
- For the local government expenditure variables, we made an adjustment for expected growth in local need for expenditure by extrapolating the linear growth trend between 2008 to 2010 (prior to the large funding cuts in 2010). Arguably, focusing on change in the gap between current and projected expenditure gives a more accurate picture of the pace and scale of change in expenditure than focusing on the unadjusted change compared with the previous year.
- To examine wider determinants of equity trends we used two main approaches: fixed effect models of emergency admissions interacting the expenditure variable with local authority IMD 2015 deprivation score; and fixed-effect models of AGI inequality against time-varying expenditure, employment and income.

Results

- Five per cent of local authority districts (n = 16) were identified as consistently improving and four per cent (n =13) as consistently deteriorating in terms of health and care equity between 2012 and 2016, based on meeting all three of our criteria.
- In our fixed effects regressions, the only category of expenditure consistently associated with decreases in emergency admissions was total local government expenditure, and the association was small. A £1 increase in per capita total expenditure was associated with 0.4 fewer avoidable and two fewer all-cause emergency admissions per 100,000 inhabitants. If we interpret this as a simple causal effect, it implies that reducing one emergency admission would cost £81,224 in additional expenditure for a local authority with an average total expenditure and an average population in 2010. In the case of our measure of total expenditure per capita relative to need, a 1% increase was associated with ten fewer avoidable admissions and 47 fewer emergency admissions per 100,000 inhabitants. Translating this association into absolute monetary terms, this implies that preventing a single emergency admission would require an expenditure increase of £60,954 for a local authority with an average total expenditure and an average population in 2010.
- This association broke down, however, after excluding education and public health expenditure to focus on "services expenditure", and when looking at social care expenditure only. For both services expenditure and social care expenditure, the association was small and positive for unadjusted expenditure, though small and negative after adjusting for predicted growth in need. A 1% increase in social care expenditure per capita relative to need was associated with a mean reduction of 42 emergency admissions, while a 1% increase in services expenditure per capita relative to need was associated with a mean reduction of 38 emergency admissions per 100,000 inhabitants. In monetary terms, reducing one emergency admission would have cost £16,755 for a local authority with an average social care expenditure and an average population in 2010.
- Neither of these two associations was observed in our difference-in-difference approach comparing emergency admission trends between areas with "large", "medium" and "small" expenditure cuts.

- In the case of NHS allocations, an increase was associated with a decrease in all-cause emergency admissions, but this effect was very small (i.e. £1 per capita real terms increase is associated with two fewer admissions).
- We also found inconsistent results for inequalities in admissions. Total local government expenditure was negatively associated with AGIs for all-cause emergency admissions (i.e. appearing to reduce inequality), but there was no association between any category of expenditure and AGIs for avoidable admissions. Our interaction term approach found a counter-intuitive positive association between increased social care and services expenditure and increased admissions for the most deprived 20% of LADs, in contrast with the least deprived 80%, which was still significant when we compared deprivation decile groups of LADs.

Conclusions

- According to our analysis of emergency admissions data, nearly ten per cent of LADs showed consistent change in their local health and care equity indicators between 2012 and 2016 based on meeting all three of our criteria for consistent change (i.e. that change was sustained for 3 out of 4 periods, statistically significant and robust to different measurement approaches).
- It may be possible to learn quality improvement lessons from these LADs, although caution and case-by-case investigation is required because some of these cases may reflect chance events or measurement error.
- Our analysis of the wider determinants of change in local equity indicators was inconclusive, finding only small and inconsistent associations between changes in local public expenditure and changes in emergency admission inequalities.
- This pilot study was unable to unpick the causal pathways underpinning these apparently inconsistent associations, and it is unlikely they reflect straightforward causal effects for various reasons:
    - The wider determinants of change in emergency admission rates are hard to disentangle, with differential magnitudes and time lags for different age groups and conditions and various unmeasured confounding and mediating factors including local social and economic conditions, lifestyle behaviours and population health.
    - Supply constraints: there is a limited number of beds and workforce capacity available in hospitals; therefore, physicians in the emergency department have to tighten admission criteria in the face of increasing demand (i.e. increasing arrivals at accident and emergency departments) to match activity to supply.
    - Endogeneity of expenditure: worsening local health causes increases in local expenditure on health and social services (with a formula lag) as well as increased demand for emergency admissions.
    - Expenditure on social care may have larger effects on hospital length of stay than admission rates.
- These complex issues of causal inference could potentially be addressed in future research using more detailed data and more sophisticated econometric methods of causal inference.
- From this pilot study, we can conclude that short-term changes in local public expenditure do not have substantial and systematic short-term effects on inequalities in emergency admissions. However, we cannot conclude that changes in local public expenditure do not have substantial and systematic effects on local inequalities in health risks and the short- and long-term demand for emergency admissions.

Further information

LA and CCG data packs for 2009 to 2018 are available at this website:

https://www.york.ac.uk/che/research/equity/monitoring/

1 Background

Health inequality costs the NHS at least £12.5 billion a year in excess hospital and primary care costs due to the excess burden of illness in socially disadvantaged populations (Asaria, 2017). Much of this excess burden of illness results from wider social determinants of health beyond the control of the health and care system (McCormick et al., 2018). However, some of it can be reduced by getting hospital care, primary care and social care providers to work better together to treat disadvantaged patients with ongoing illnesses more effectively, to facilitate recovery following episodes of acute illness and inpatient hospital care, and to prevent health from deteriorating (Cookson et al., 2018, Cookson et al., 2016).

People living in more deprived neighbourhoods are more likely to have an emergency stay in hospital that could potentially have been avoided by high-quality care outside the emergency hospital setting ("avoidable emergency admissions", AEAs). Since 2016, NHS England has produced local health and care equity improvement indicators based on deprivation-related inequality in AEAs benchmarked against similar areas. However, these indicators have not yet been used systematically to identify local equity trends and learn lessons about local health and care system quality improvement. Furthermore, it is not known how far these indicators respond to changes in local public expenditure and local economic conditions outside the control of local NHS and social care managers.

In this study, we used the same measure of AEAs that NHS England uses to construct their CCG equity indicator in the CCG Improvement and Assessment Framework, known as "Indicator 106a: Inequality in unplanned hospitalisations for chronic ambulatory care sensitive and urgent care sensitive conditions". We also examined all-cause emergency admissions as a robustness check on our findings. Many different lists of Ambulatory Care Sensitive Conditions (ACSCs) exist and merely knowing a patient's primary diagnosis is not enough to be certain about how far their emergency hospital admission was "avoidable" by high-quality ambulatory care.

2 Purpose

This pilot study sits within a broader programme of research that seeks to provide analytical building blocks to help NHS and LA managers in different parts of the country to learn from each other's experiences about the best ways of improving the coordination of care for disadvantaged patients. This pilot study was designed to explore the influence of wider determinants on health inequalities, which are beyond the control of local NHS, social care and public health managers. It was also designed to feed into separate qualitative case study work being conducted by NHS England and the University of York to learn local care system equity improvement lessons, by facilitating case study site selection in late 2018 and by providing local authority and CCG data packs used in case study fieldwork visits in 2019.

The three specific objectives were:

1. To identify local authority districts (LADs) showing sustained improvement and deterioration on inequality in avoidable and all-cause emergency admissions from 2012 to 2016
2. To analyse whether LAD emergency admission inequality trends were associated with trends in local expenditure and economic conditions from 2009 to 2018
3. To produce local data packs describing trends in deprivation-related inequality in avoidable and all-cause emergency admissions from 2009 to 2018, for all local authority districts (LADs) and clinical commissioning groups (CCGs)

This pilot study was conducted in two phases. Phase one in late 2018 focused on 2012 to 2016, which was the most recent five-year period of data available to the research team when this phase of the analysis was undertaken to facilitate case study site selection. Phase two looked at a longer period of comparable data from 2009 to 2018 that became available to the research team in early 2019.

3 Methods

This report is organised in two parts. The first part outlines the methods used to describe equity trends and assess which local authority districts had consistently improving or deteriorating equity indicators during the observation period. The outputs generated were initially used to describe LAD equity trends from 2009-2016 to help identify case studies for qualitative research, as per objective 1. When further data became available, data packs were created showing both LAD and CCG equity trends from 2009-2018, as per objective 3. The second part describes the methods used to investigate wider determinants of equity trends, as per objective 2, by exploring local authority district level associations between change in public expenditure and change in emergency admissions, including both average admissions and deprivation-related inequalities in admissions.

3.1 Equity trends at local authority level

We constructed equity indicators from 2009 to 2018 using the same methods as NHS England, except using ONS population data rather than GP registration data and examining local authority districts (LADs) as well as clinical commissioning groups (CCGs). LADs have remained relatively stable over time in terms of geography and are more relevant than CCGs for analysing the impacts of wider determinants of emergency admissions. The non-healthcare determinants examined in this study were local economic conditions and local public services that are primarily funded and provided at local authority level – including social care and, since 2012, public health services, following a re-organisation of public health responsibilities. We also examine associations with local NHS funding trends, since the level of NHS funding is set nationally and so for the purposes of this study can be considered a wider determinant of emergency admissions beyond the control of local NHS managers.

Both CCGs and LADs can be divided into smaller geographical units called lower-layer super output areas (LSOAs) with stable boundaries and an average population in 2011 of just over 1,500 residents. This enables the analysis of deprivation-related inequalities within local administrative areas (i.e. within CCGs or LADs), and the estimation of local inequality "gradients" which can be compared between different local administrative areas and over time.

3.1.1 Data

3.1.1.1 Deprivation

We used the Index of Multiple Deprivation 2015 as a time-fixed measure of deprivation at small area level (2011 LSOAs). This commonly used measure combines a wide range of data sources on multiple aspects of social deprivation. Seven indicator domains are combined into a single deprivation score for each LSOA. The indicator domains comprise 'crime', 'barriers to housing and services', 'health deprivation and disability', 'income', 'employment', 'living environment', and, 'education, skills, and training' deprivation. Each neighbourhood is ranked relative to one another according to its level of deprivation measured with this index. The 2015 version of the index was calculated using data from 2012/13, which falls in the middle of the observation period. The index was used as constant for each year of study to detect potential changes in healthcare delivery or local authority decision-making, instead of changes in the composition of the neighbourhoods or the methods of measuring deprivation. The IMD rank was transformed into a fractional rank between 0 (least deprived) and 1 (most deprived). Additionally, IMD quintile groups were defined based on the ranked 2015 IMD. Areas where deprivation spanned less than 60% of the 2015 IMD scale were excluded.

3.1.1.2 Emergency admissions

To help distinguish between "avoidable" and "unavoidable" emergency admissions, there are lists of ambulatory care sensitive conditions (ACSCs) for which there is evidence that emergency admissions can potentially be avoided by high-quality care outside the emergency hospital setting. We use the shorthand term "avoidable emergency admissions" (AEAs) for this general concept and the specific measure we use is the one used by NHS England to construct their local equity indicator in the CCG Improvement and Assessment Framework, known as "Indicator 106a: Unplanned hospitalisations for chronic ambulatory care sensitive and urgent care sensitive conditions" (NHS England, 2018). This measure of AEAs combines Indicator 2.3i (chronic care sensitive conditions) from the NHS Outcomes Framework and Indicator 127b (urgent care sensitive conditions) from the CCG Improvement and Assessment Framework (NHS England, 2018). In 2018, AEAs of this kind made up approximately 27% of all-cause emergency admissions in England.

We used both all-cause emergency and avoidable emergency admissions as outcome measures. All-cause emergency admissions were defined as the total number of people admitted to hospital through an Accident and Emergency (A&E) department or referred for emergency admission directly by a General Practitioner. Avoidable emergency admissions were defined as the number of people with an emergency admission for a chronic or urgent care sensitive condition as defined by the indicator 106a of the CCG Improvement and Assessment framework. Both rates are presented as indirectly standardised rates for age and sex per 100,000 inhabitants. Number of admissions per LSOA were obtained from the Secondary Uses Service (SUS) dataset by year of discharge. Total population per LSOA were obtained from the Office for National Statistics (ONS) mid-year population estimates.

3.1.2 Analysis

We obtained the local and national gradient of inequality using linear models of the relationship between neighbourhood-level deprivation and rates of emergency admissions for the years 2009 to 2018. The coefficient on deprivation percentile rank is the absolute gradient for any given local authority (or CCG) for each year of observation. The absolute gradient of inequality (AGI) represents the modelled gap in emergency admissions between the most and least deprived small area in England, if the local authority or CCG patterns were replicated nation-wide. Additionally, we calculated a relative index of inequality (RGI) as follows.

$$RGI = \frac{\text{intercept} + \text{AGI}}{\text{intercept} + 0.5 \times \text{AGI}}$$

This can be interpreted as the modelled ratio between the most deprived small area in England and the average. According to this modelled ratio, the most deprived small area is estimated to have (RGI - 1) * 100% more admissions than the average small area. There are various other ways of calculating an RGI index, for example AGI / intercept + 0.5 * AGI which represents the modelled gap between the most and least deprived small area as a proportion of the modelled average.

3.1.2.1 Improving or deteriorating inequalities at local authority level

To identify a sustained recent change in local equity we required:

1) Three out of four periods between 2012 and 2016 to show AGI change in the same direction (i.e. improvement or worsening),
2) AGI change between 2012 and 2016 to be statistically significant at the 0.05 level, and
3) Consistent AGI and RGI patterns for all-cause as well as avoidable emergency admissions, and for own equity trends compared with similar ten population benchmark equity trends

3.1.2.2 Similar ten local authorities

For each local authority, we benchmarked trends against a similar population composed of ten similar local authority districts. We selected the similar ten ourselves using ONS methods (ONS, 2015). We used data from Census 2011 on 59 standardized variables to calculate the Squared Euclidean Distance (SED), which ranks local authorities from most similar to most dissimilar. The first ten local authorities in that rank were considered the similar ten and AGIs and RGIs were obtained for them.

3.1.3 Data packs

For each LAD and CCG, we produced a data pack containing descriptive information regarding its demographic profile, crude and standardised rates of all-cause and avoidable emergency admissions, and its AGI and RGI for the years 2009 to 2018. The methods used for producing absolute and relative gradients of inequalities for local authorities were replicated for producing the same indicators at CCG level. These data packs were used to facilitate case study site selection of improving and deteriorating areas.

We plan to make available these data packs publicly at https://www.york.ac.uk/che/research/equity/monitoring/

3.2 Wider determinants of avoidable admissions inequalities

To examine wider determinants of emergency admission trends, we used two main approaches. First, local authority level fixed-effect regression models of emergency admissions, with time-varying explanatory variables including various categories of local expenditure along with employment and income. Second, difference-in-difference models comparing local authorities with “large”, “medium” and “small” expenditure cuts (see section 3.2.3 for more details).

To examine wider determinants of equity trends we used two main approaches. First, fixed effect models of emergency admissions interacting the expenditure variable with local authority IMD 2015 quintile group. Second, fixed effect models of AGI as the outcome variable against time-varying expenditure, employment and income

3.2.1 Local government and NHS geography

Local government is organised as a single-tier in unitary authorities, London boroughs and metropolitan boroughs. The rest of the country has two tiers of local government: district, borough and city councils (lower-tier) and county councils (upper-tier). The upper tier is responsible for the commissioning of education, highways, transport planning, passenger transport, social care, libraries, waste disposal and strategic planning. Since 2012, the responsibility for public health resides in the upper-tier or unitary local authorities. The lower-tier is responsible for housing, leisure and recreation, environmental services including environmental health services, waste collection, planning applications, and local taxation collection. In the case of single-tier authorities, all these responsibilities are centralised.

We focus on local authority districts, which comprise lower-tier authorities where available and single-tier authorities where no lower-tier exists.

NHS allocations are determined by a national formula. Before 2012, allocations were assigned at Primary Care Trust level, and after the 2012 reform, these allocations are assigned at CCG level. The reform not only meant a change in the commissioning structure, but a change in the national formula and a transfer of public health responsibility to local authorities.

3.2.2 Data

3.2.2.1 Expenditure data

Local government expenditure at local authority district level for years 2007 to 2018 was extracted from the revenue outturn service expenditure summaries available from the Ministry of Housing, Communities and Local Government. Three measures of expenditure were used: total expenditure, services expenditure and social care expenditure. NHS digital also reports social care expenditure as part of the Adult Social Care Activity and Finance Report (ASC-FR); however, the reporting methodology changed between 2013-14 and 2014-15, which made these figures unsuitable for a time series; therefore, we used data from the revenue outturns instead.

Total expenditure refers to the sum of all services except police and fire services because these services have a different commissioning structure. Services expenditure excludes education and public health services because responsibility for their commissioning changed during the observation period. Social care expenditure includes both adult and children's social care. An indication of the proportion of local government expenditure in each category is given in Figure 1.

For county districts, upper-tier expenditure was apportioned to the population of each constituent lower-tier authority and any expenditure at the lower-tier level for that item added to the final value. All expenditures are expressed as expenditure per head.

NHS allocations to the local commissioning organisations (i.e. Primary Care Trusts up to 2012 and Clinical Commissioning Groups thereafter) were extracted from Department of Health and Social Care data archives for years 2009 up to 2018. NHS allocations include the core programme of services, GPs and other primary care services, running costs and specialised services. We mapped these allocations to LSOA populations using look-up tables provided by the UK data archive. These values were later aggregated at local authority level. When a commissioning organisation spanned several local authorities, allocations were apportioned to the corresponding population. NHS allocations are expressed as allocations per head.

We adjusted expenditure data and allocations using Consumer Price Inflation annual average with 2016 as the reference year.

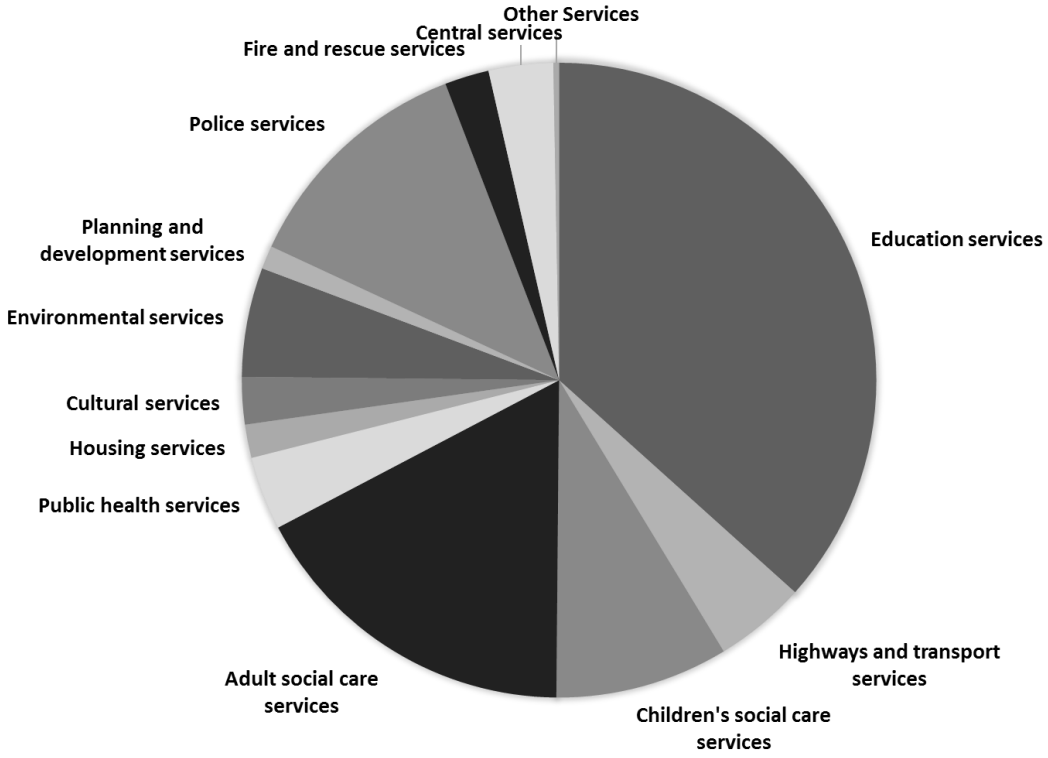

Figure 1 Local Authority Service Expenditure by Category, 2017-18

Source: Ministry of Housing Communities and Local Government (2019).
Note: This excludes capital expenditure and housing benefit, which is not a local government service but a cash benefit administered by local government under central government rules.

3.2.2.2 Adjusting for growth in need for expenditure after 2010

There were large across-the-board cuts in central government funding for local government in 2010, which resulted in a substantial shift away from the previous general upward trend in local government expenditure. In these circumstances, it could be argued that the use of unadjusted expenditure figures could potentially misrepresent both the direction and magnitude of change in expenditure relative to needed expenditure after 2010. For example, if needed expenditure is growing year-on-year, then no change in unadjusted expenditure between 2009 and 2010 would represent a "cut" relative to needed expenditure.

To allow for this potential bias, we made an adjustment to our local government expenditure variables after 2010 to allow for expected growth in local need for expenditure. We did this by computing the percentage expenditure reduction or increase relative to predicted need as well as unadjusted expenditure.

We estimated the predicted expenditure per capita for each local authority for 2010 onwards using data for 2007 to 2009 in a multilevel linear model. Then, we calculated the percentage reduction or increase as follows:

$$\text{Diff pred-curr} = \left(1 - \frac{Current\ exp}{Predicted\ exp}\right) \times 100\ if\ Predicted > \quad Current$$

$$\left(\frac{Current\ exp}{Predicted\ exp} - 1\right) \times 100\ if\ Current > \quad Predicted$$

In our regressions, we only use data from 2009 onwards, since we only have comparable data on emergency admissions from 2009 onwards. For 2009, we assigned a value equal to 0, reflecting an assumption that the need predicted and current expenditure are the same in that initial year prior to national-level expenditure cuts, and

only start to diverge thereafter. This assumption might not be true, however, there are not good methods to estimate the magnitude of the unmet need.

In the case of NHS allocations per capita we applied a similar need adjustment, but starting from the year 2012 which is when the NHS expenditure slowdown began in earnest. We thus used NHS allocations data up to 2012 to predict needed allocations from 2013 to 2018.

3.2.2.3 Adjustment variables

We used income and unemployment as proxies for changing local economic conditions within each local authority. Income is collected in the annual survey of hours and earnings (ONS, 2019a) and is measured as the median annual gross earnings for full time workers in pounds at each lower-tier local authority district. From 2011 onwards, the estimate of income uses a weighing scheme based on occupations; therefore, data from previous years are not comparable and were excluded. We only have data on income from 2011 to 2018, not for the first two years of our period 2009 and 2010.

Two measures of unemployment were used. One is the model-based unemployment rates at lower-tier local authority districts collected as part of the annual population survey/ labour force survey (ONS, 2019b). The ONS recommends using model-based estimates instead of estimates from the annual population survey because at local authority level the samples are very small and the estimates are unreliable. The model-based estimates use data on claimant counts to increase precision and the measure is the proportion of people over 16 years old who are unemployed divided by the population in that area. The other measure of unemployment is similar to the employment deprivation index. The measure was constructed using data collected as part of the work and pensions longitudinal study (ONS, 2019c). This measures the proportion of working age population that are excluded from the labour market due to sickness, disability or caring responsibilities. It uses the number of working age claimants of jobseeker's allowance, employment and support allowance, incapacity benefits, severe disablement allowance and carer's allowance, divided by the total population in that area.

3.2.3 Analysis

We used two different approaches to test for a relationship between average emergency admissions and expenditure at the local authority level between 2009 and 2018:

- Fixed-effects analysis: Models were run separately for any avoidable and all-cause emergency admissions using robust standard errors. Separate models were run for various adjusted and unadjusted categories of expenditure: expenditure per head (total, services and social care), NHS and public health allocations per head, difference between predicted and current expenditure (total, social care and services), differences between predicted and actual NHS allocations and public health allocations. These models test for an immediate year-on-year effect of changes in actual or predicted expenditure on emergency admissions. To test for a lagged effect of these changes, we used one- and two-years lags for each of these expenditure variables. All these models were run with and without allowing for median annual income and unemployment as explanatory variables.
- Difference-in-difference comparing growth in admissions between LADs that experienced "large", "medium" and "small" cuts. 2010 was used as the intervention year when cuts were first applied. Two different cut-points were used for each local government expenditure variable to define "large", "medium" and "small" cuts. These cut-off points were defined for expenditure relative to need in 2010 and 2011. The group with the smallest cut served as reference. The groups were defined as stated below:

Difference predicted-current	Total expenditure	Social care expenditure	Services expenditure
2010	cut below 3% between 3 - 7% above 7%	Cut below 3.5% between 3.5 - 8% above 8%	Cut below 5% between 5 - 9% above 9%
2011	cut below 16% between 16 - 20% above 20%	cut below 8% between 8 - 15% above 15%	cut below 13% between 13 - 18% above 18%

We also implemented two other approaches to test whether changes in expenditure at local authority level had an effect on emergency admissions inequalities.

- Fixed-effects analysis: Models were run separately for the absolute gradient of inequality of any avoidable and all-cause emergency admissions using robust standard errors. Similarly to our modelling approach of average emergency admissions, we used different adjusted and unadjusted categories of expenditure. All models were adjusted for income and unemployment rates.
- Interaction term approach: We also tested whether there was an interaction between LAD level deprivation and the association between changes in emergency admission and changes in expenditure. We estimated the effect in two separate models using fixed-effects regressions adding an interaction term between expenditure data and the Index of Multiple Deprivation 2015. In one specification, we used a dummy variable for the most deprived quintile group of LADs, while in the second one, we used a continuous variable from 1 to 10 indicating LAD decile group of deprivation.

All analyses were conducted using Stata version/SE 15.0.

4 Findings

4.1 Equity trends at local authority level

This section reports the results for the first stage of our analysis, based on data from 2010 to 2016. We analysed data for 324 local authority districts, excluding Isle of Scilly because it has one LSOA and West Somerset because deprivation spanned less than three deprivation quintile groups. The mean standardised rate of all-cause emergency admissions ranged from 847 to 33,659 per 100,000 inhabitants at the LSOA level in 2016.

Table 1 Descriptive information for England for year 2016

	National level	Small level (LSOA)	
		Min	Max
Total population, n	55,231,453	430	11,263
All emergency admissions, n	5,350,250	7	610
Avoidable emergency admissions, n	1,488,189	1	196
All emergency admissions, mean crude rate	.097	.0066	.34
Avoidable emergency admissions, mean crude rate	.027	.0005	.13
All emergency admissions, mean std rate	9,766	847	33,659
Avoidable emergency admissions, mean std rate	2,741	73	11,808
Age, mean	40	21	64

IMD 2015: Index of multiple deprivation 2015, which used data from 2012/2013. IMD fractional is a transformation of the national rank into a number between 0 and 1, where the most deprived LSOA has a value of 1.
All-cause and avoidable emergency admissions are indirectly standardised for age and sex for 100,000 population. Avoidable admissions are unplanned hospitalisations for chronic and urgent care sensitive conditions measured by the CCG improvement and assessment framework (IAF) indicator 106a (Indicator 2.3i (long-term ambulatory CSCs) from the NHS outcomes framework and indicator 127b from the CCG IAF).

During the observation period, all-cause emergency admissions increased at national level for all quintile groups of deprivation while any avoidable admissions remained mostly flat (Figure 2).

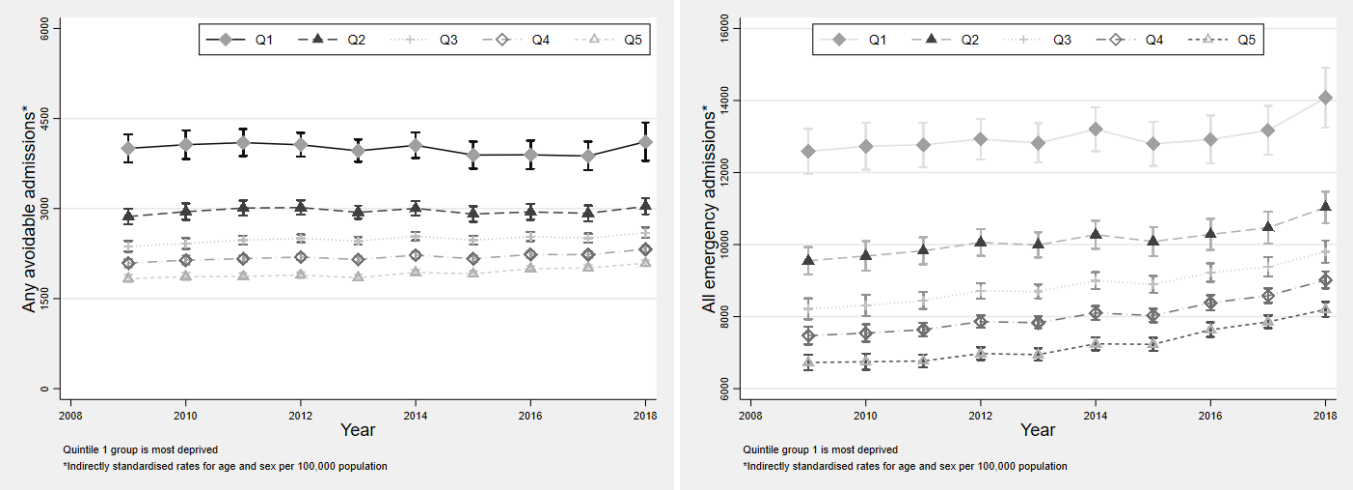

Figure 2 England mean avoidable (left panel) and all-cause emergency admissions (right panel) for the observation period.

Since the changes in emergency admissions were similar across deprivation quintile groups, AGIs remained fairly flat for both measures nationally, with a small improvement (fall in AGI) between 2015 and 2017 and an uptick in 2018.

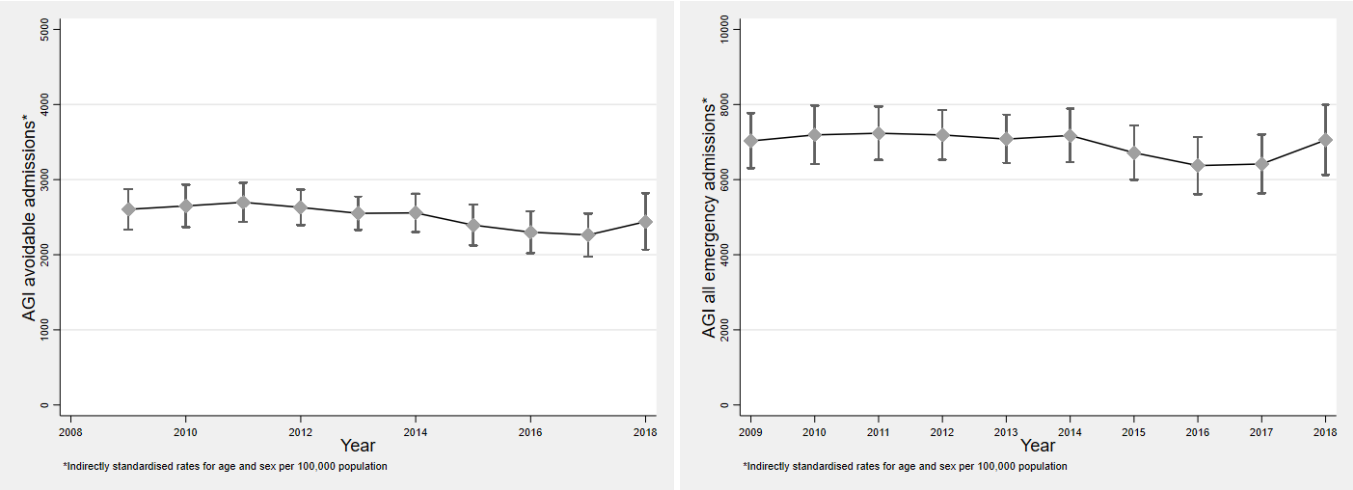

Figure 3 England AGIs for avoidable (left panel) and all-cause emergency admissions (right panel) during the observation period.

At the local authority level, we identified 173 (53%) local authorities that met at least one of the criteria for a change in their inequalities trend. We observed a consistent improvement with a significant change between 2012 and 2016 for any avoidable admissions in 28 local authorities; while 16 showed that pattern for all-cause emergency admissions. Nineteen districts (5.9%) showed consistent worsening with a significant change between 2012 and 2016 for avoidable admissions, and 18 local authority districts (5.5%) had a deteriorating trend for emergency admissions. Overall, 16 (5%) local authorities met the three criteria for improvement and 13 (4%) met these criteria for worsening inequalities (see Table 2 and Table 3 for the list of authorities and its absolute difference in AGI between 2012 and 2016). The trends for these local authorities compared to the national trend and its similar ten are shown in the Appendix.

Areas with improving trends were mainly located in three clusters: Leeds, Wakefield and Doncaster in Yorkshire, Oldham, Bury and Rochdale in Greater Manchester, and Brent, Hammersmith, Kensington and Westminster in the Greater London area. Conversely, most areas with deteriorating trends were small geographical areas spread across the country such as Dudley, Southend-on-Sea, Walsall, Stevenage, Reading, Torbay and Plymouth. Interestingly, two areas with worsening trends were neighbours of areas with improving inequalities: Haringey and Hounslow.

Table 2 Difference in AGI between 2012 and 2016 for local authorities meeting three criteria for improving trend in inequalities.

Local Authority	Difference 2012-2016 in AGI for any avoidable admissions	95% confidence interval		Difference 2012-2016 in AGI for all-cause emergency admissions	95% confidence interval	
Brent	2,446.9	1,386.5	3,507.4	6,980.5	4,416.2	9,544.8
Bromley	896	302.5	1,489.5	2,062.1	793	3,331.2
Bury	1,238.4	610.5	1,866.2	2,091.1	670	3,512.2
Doncaster	794.1	187.5	1,400.6	1,790.1	364.6	3,215.6
Fareham	887.5	179.9	1,595.1	1,919.2	418	3,420.4
Hammersmith and Fulham	3,551	2,558.1	4,543.9	10,423.5	8,183.1	12,663.9
Kensington and Chelsea	3,290.6	2,411.9	4,169.3	8,471	6,044.2	10,897.7
Leeds	443.8	20.7	866.8	1,184.1	279.3	2,088.9
Oldham	1,124.4	552	1,696.8	2,838.7	1,560.4	4,117.1
Pendle	1,224.5	170.1	2,278.9	2,661.4	178	5,144.8
Rochdale	1,348.9	693.3	2,004.5	2,324	819.1	3,828.9
Telford and Wrekin	967.6	286.5	1,648.7	2,405.2	996.3	3,814.1
Tower Hamlets	1,109.2	675.5	1,542.9	2,954	1,953.8	3,954.3
Wakefield	614.8	67.2	1,162.4	1,381.7	56.8	2,706.5
Waltham Forest	1,678.5	593.5	2,763.6	3,057.1	556.1	5,558.1
Westminster	3,213.7	2,105.2	4,322.2	9,339.6	6,726.4	11,952.8

Table 3 Difference in AGI between 2012 and 2016 for local authorities meeting all criteria for worsening trend in inequalities.

Local Authority	Difference 2012-2016 in AGI for any avoidable admissions	95% confidence interval		Difference 2012-2016 in AGI for all-cause emergency admissions	95% confidence interval	
Cherwell	-1,674.3	-2,569.3	-779.4	-3,618.5	-5,883.9	-1,353.1
Cheshire West and Chester	-768.7	-1,285.7	-251.6	-1,496	-2,741.8	-250.2
Dudley	-980.4	-1,577.5	-383.4	-2,086.1	-3,456.1	-715.1
Haringey	-989.3	-1,661.2	-317.3	-4,780.7	-6,703.6	-2,857.9
Hounslow	-1,668.4	-2,986.5	-350.2	-5,828.6	-9,087.8	-2,569.3
North Somerset	-1,334.9	-1,777.8	-892.1	-4,359.5	-5,472.3	-3,246.7
Plymouth	-1,957.6	-2,388.9	-1,526.2	-5,611.8	-6,720	-4,503.7
Reading	-1,099.7	-1,794.2	-405.3	-2,774.3	-4,557.2	-991.3
Southend-on-Sea	-890.9	-1,594.5	-187.4	-2,726.2	-4,236	-1,216.4
Stevenage	-1,946.4	-3,520.5	-372.4	-4,671.9	-8,245.1	-1,098.6
Test Valley	-1,264.7	-2,064.6	-464.8	-4,075.8	-6,314.5	-1,837.1
Torbay	-2,253.7	-2,919.2	-1,588.2	-7,099.1	-8,677.3	-5,520.9
Walsall	-631.3	-1,132.9	-129.6	-1,724	-2,851	-597.1

These data were used to facilitate the selection of case study sites for in-depth qualitative research. The methods for case study selection are described elsewhere.

4.2 Wider determinants of avoidable admissions inequalities

This section reports the results for the second phase of our analysis looking at the wider determinants of equity trends based on a longer time series from 2009 to 2018. We included 323 local authorities, excluding the Isles of Scilly and West Somerset as before and also City of London this time due to its small and transient resident population and consequent lack of reliability of the per capita expenditure variables. Total expenditure per capita varied substantially among local authorities with a mean of £1,307 and a range of £875 to £2,293 in 2016. The magnitude of the cuts also varied substantially, as can be seen from the three need adjusted "diff" variables representing our estimate of annual change in expenditure relative to need (Table 4).

Table 4 Expenditure per capita at local authority district level for 2016.

	Local authority districts			
	Mean	SD	Min	Max
Any avoidable admissions, per 100,000 population	2,715	720	552	4,568
All emergency admissions, per 100,000 population	9,725	2,160	2,314	15,002
Total expenditure per capita, £	1,307	196	875	2,293
Social care expenditure per capita, £	416	57	262	636
NHS allocation per capita, £	1,760	169	1,417	2,537
Public health allocation per capita, £	55	21	32	140
Predicted total expenditure per capita, £	2,043	261	1,608	3,362
Predicted social care expenditure per capita, £	527	62	430	777
Predicted NHS allocation per capita, £	1,972	242	1,466	2,883
Diff pred-current total expenditure (percent)	-36	7.9	-58	-13
Diff pred-current social care expenditure (percent)	-21	7.6	-54	1.2
Diff pred-current NHS allocation (percent)	-10	5.9	-28	16

In general, expenditure (total, services and social care) increased between 2007 and 2009 and declined in the years afterwards. In the case of NHS allocations, a decrease was observed from 2013 onwards (Figure 3).

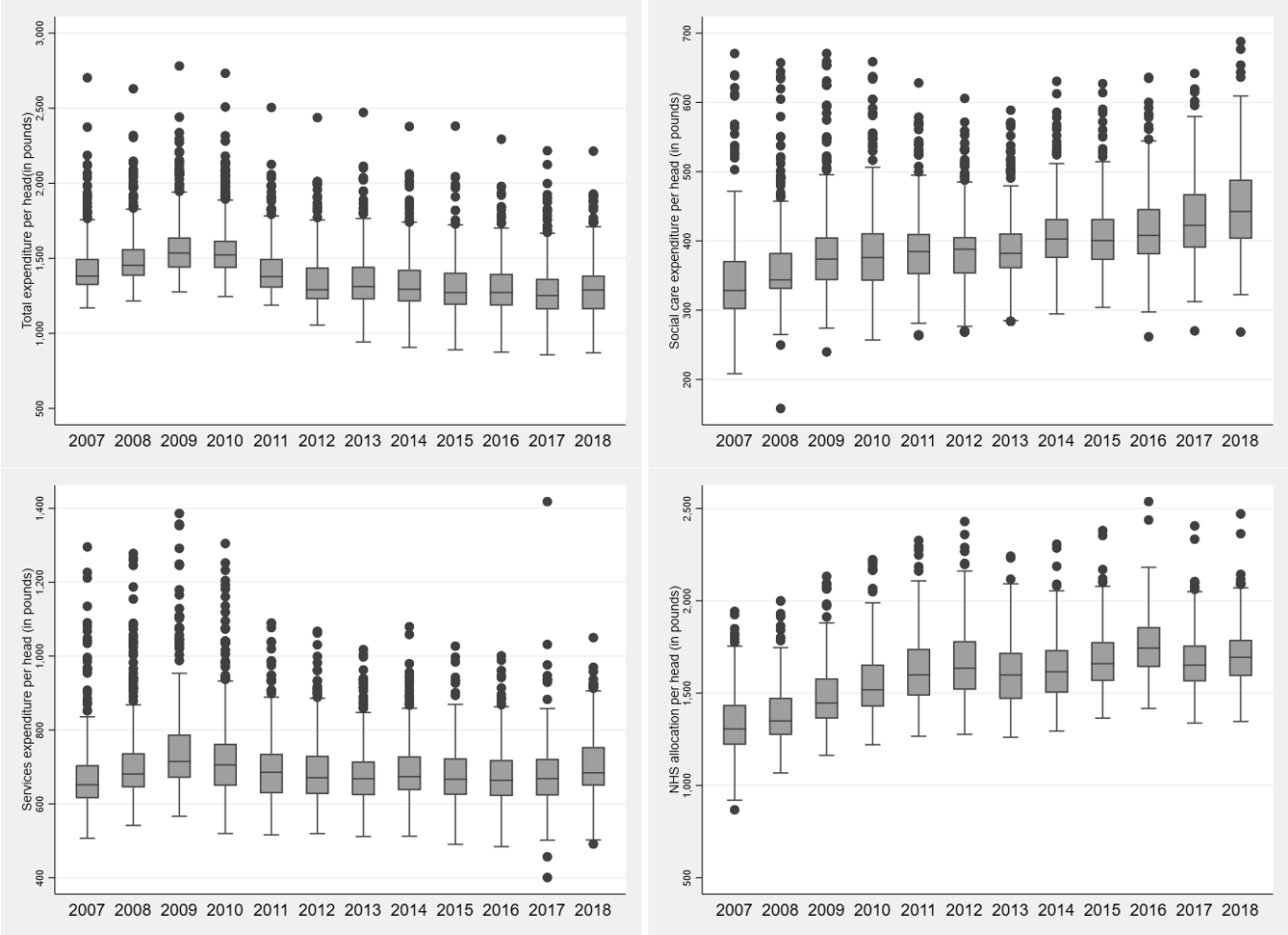

Figure 4 Local authority expenditure and NHS allocations at local authority district level from 2007 to 2018 (top left panel total expenditure, top right social care expenditure; bottom left services expenditure, bottom right NHS allocations).

4.2.1 Effect of expenditure on mean emergency admissions.

4.2.1.1 Fixed effects analysis of panel data

Total expenditure had a consistent negative association with both measures of emergency admissions i.e. local authorities experiencing increased total expenditure had fewer admissions. This also applies when expenditure relative to need and its lagged variants were used as explanatory variable (Top right panel in Figures 5 and 6). However, more counter-intuitively, we found that services expenditure, social care expenditure, and NHS allocations were positively associated with avoidable emergency admissions; while there were mixed effects on all-cause admissions.

When the adjusted social care and services expenditure relative to need were used as explanatory variables, we found a negative association with emergency admissions. This suggests that cuts in expenditure in services and social care were associated with increases in all-cause emergency admissions. Models using the adjusted NHS allocations showed mixed effects on avoidable and all-cause emergency admissions.

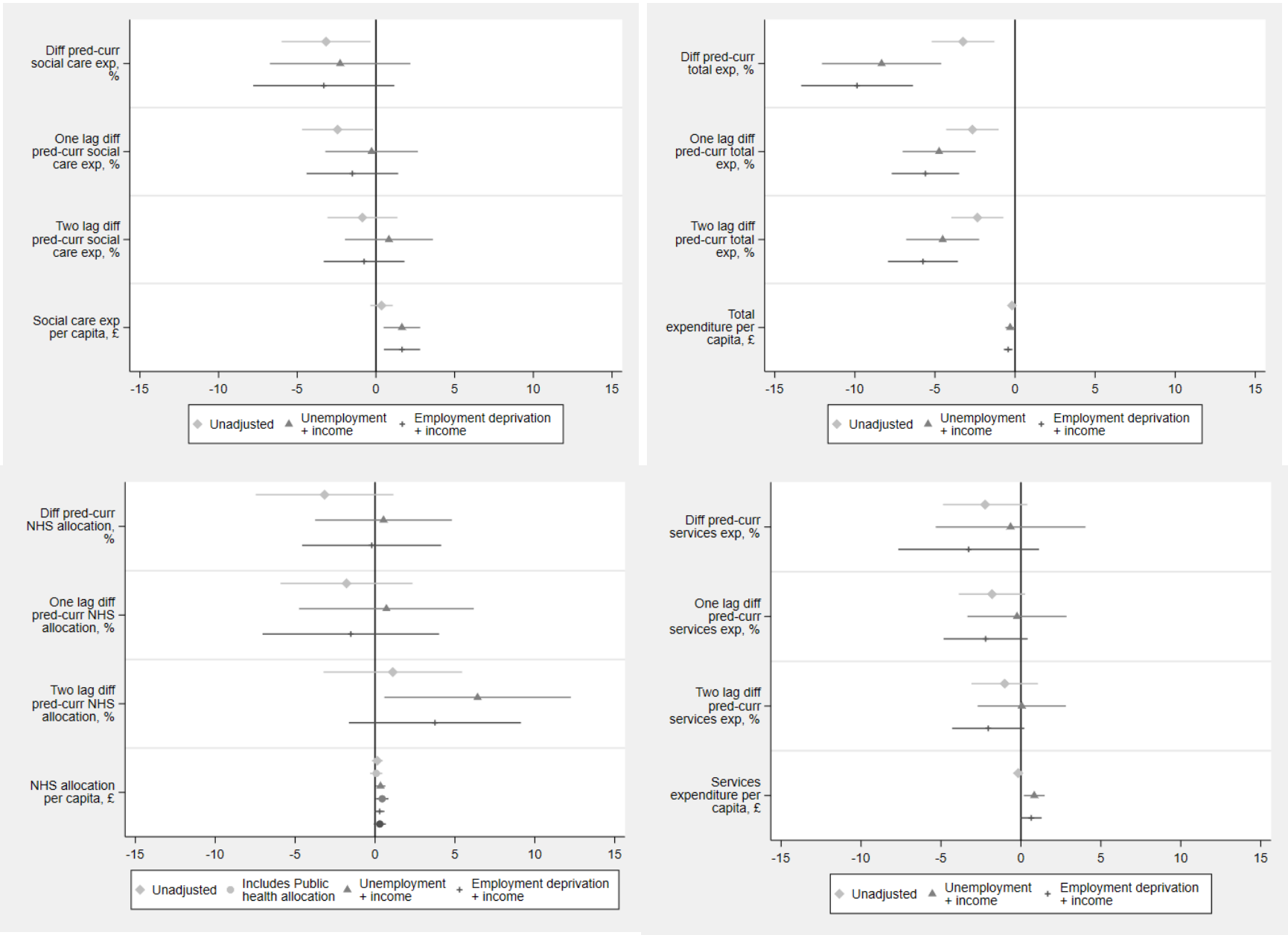

Figure 5 Effect of spending level over time on any avoidable admissions rates. Effects are expressed as the increase or reduction in number of avoidable admissions per 100,000 inhabitants per 1% or £1 change in the expenditure variable.

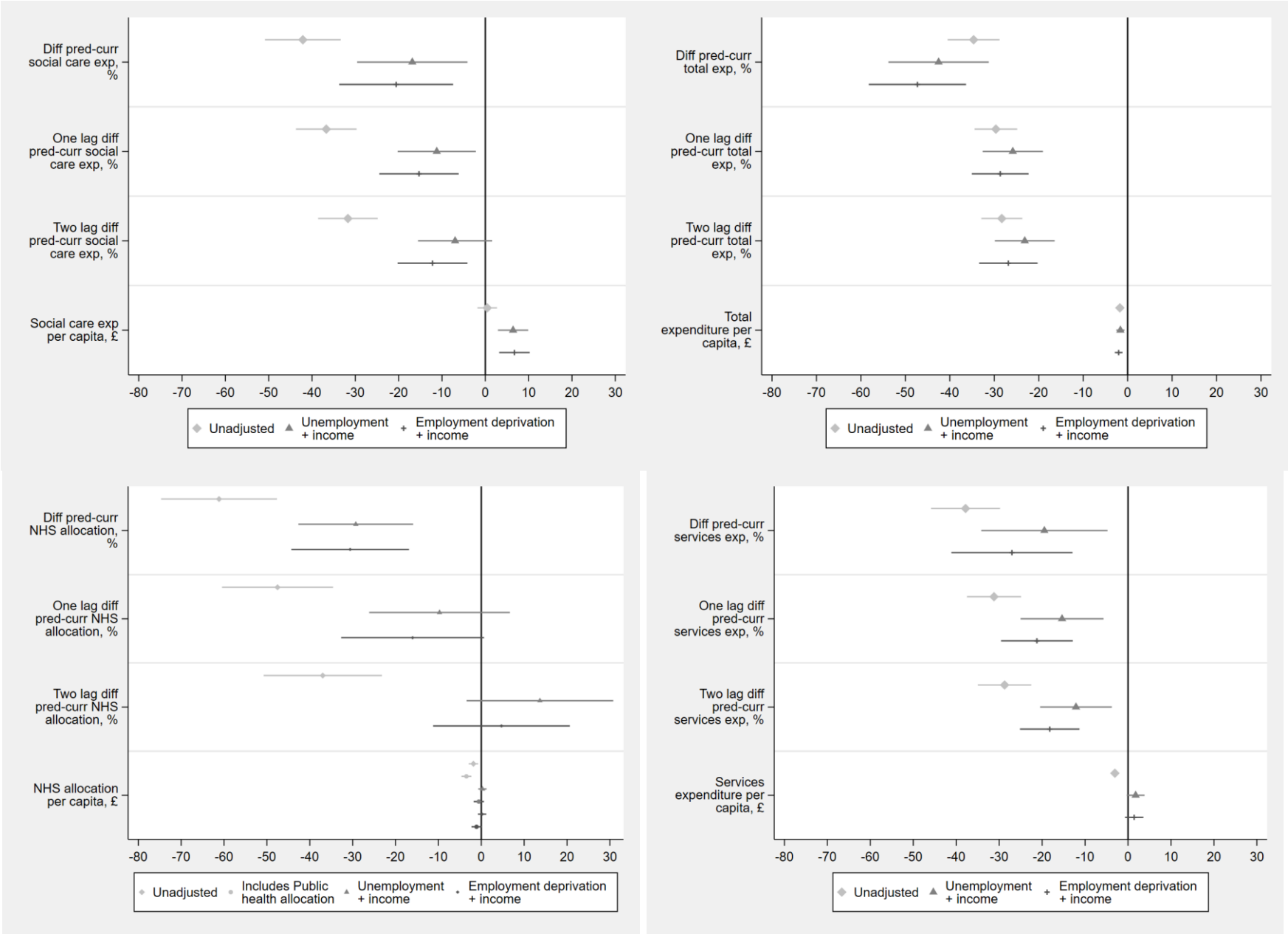

Figure 6 Effect of spending level on all-cause emergency admissions rates. Effects are expressed as the increase or reduction in number of all-cause emergency admissions per 100,000 inhabitants per 1% or £1 change in the expenditure variable.

4.2.1.2 Difference-in-difference analysis

We found that the magnitude of the reduction in expenditure (total, services and social care) between 2009 and 2010 was not associated with changes in all-cause or avoidable emergency admissions, which was similar across all three “large”, “medium” and “small” expenditure cut groups, between 2010 and 2018 See Figure 7, 8 , and 9).

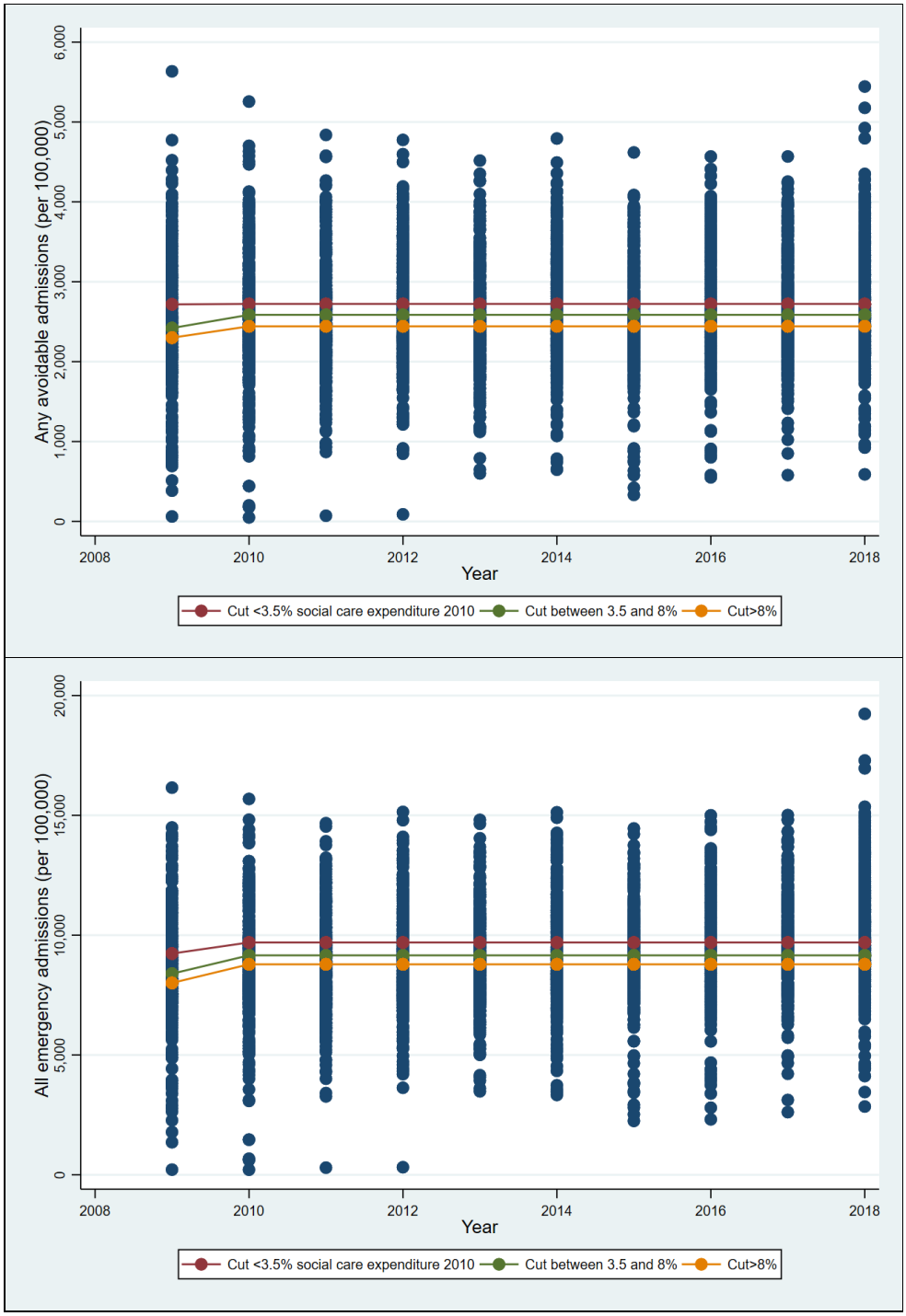

Figure 7 Difference-in-difference analysis of any avoidable admissions (top panel) and all emergency admissions (bottom panel) for different magnitudes of social care expenditure cuts.

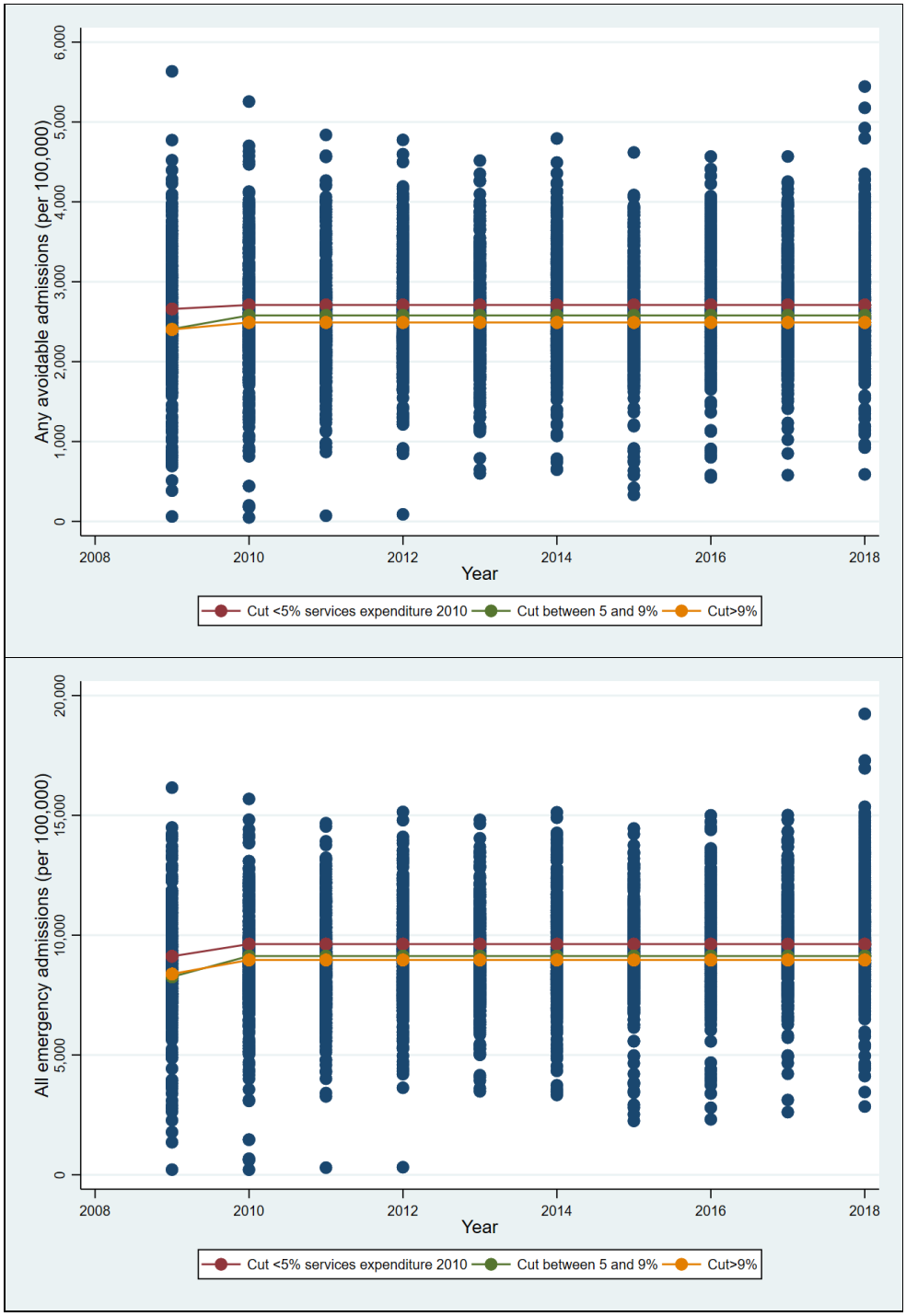

Figure 8 Difference-in-difference analysis of any avoidable admissions (top panel) and all emergency admissions (bottom panel) for different magnitudes of services expenditure cuts.

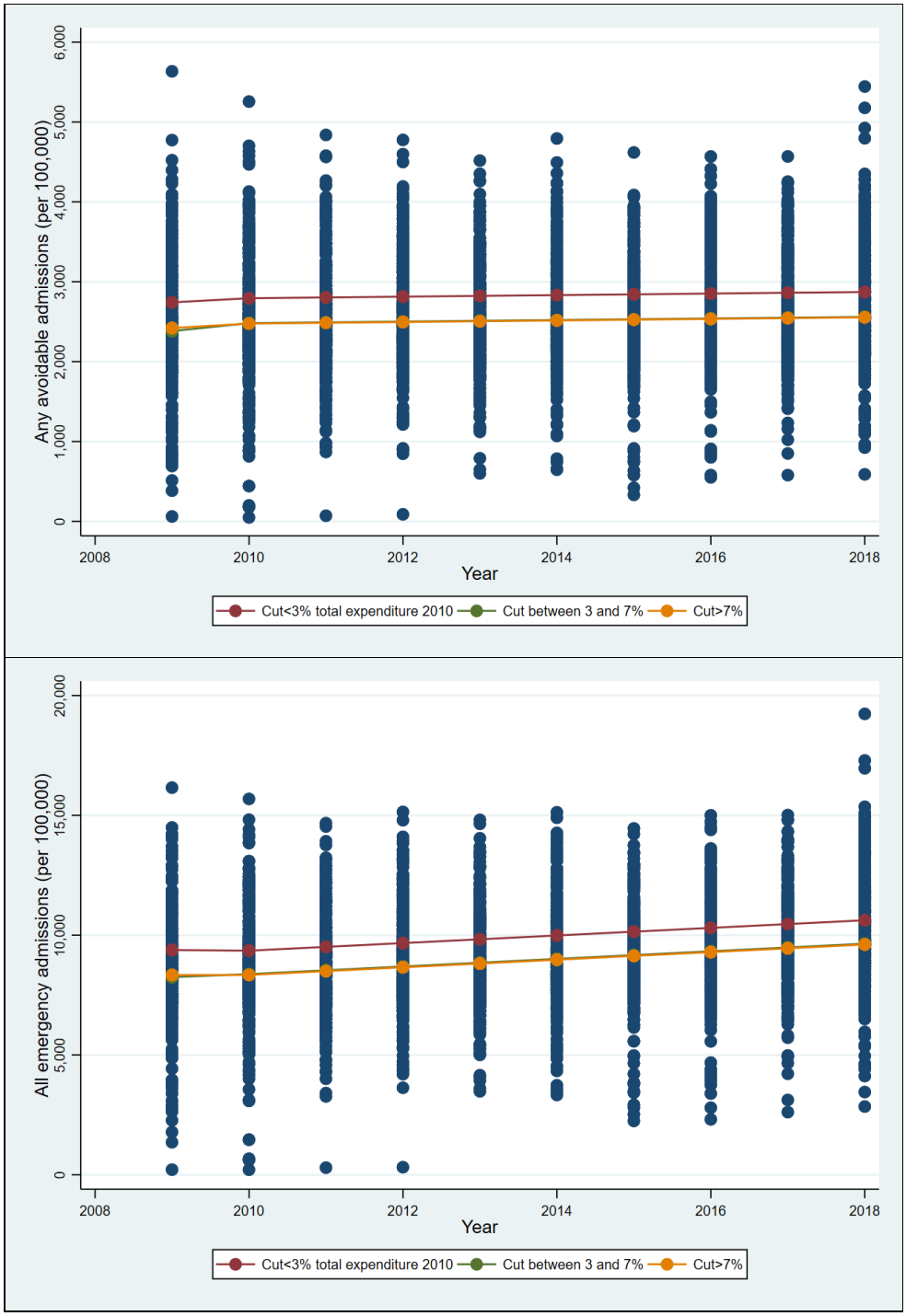

Figure 9 Difference-in-difference analysis of any avoidable admissions (top panel) and all emergency admissions (bottom panel) for different magnitudes of total expenditure cuts.

4.2.2 Influence of local authority deprivation and expenditure on emergency admissions.

4.2.2.1 Fixed effects analysis of panel data

When we used the absolute gradient of inequalities as the outcome variable, we found that none of the expenditure measures were associated with changes in the AGI for avoidable admissions (top panels Figure 10). In the case of the AGI for all-cause emergency admissions, only total expenditure was associated with reductions in the gradient of inequalities (bottom panels Figure 10).

4.2.2.2 Interaction term approach

When we compared the most deprived quintile group with the remaining least deprived 80%, we found a small effect of changes in total, services and social care expenditure at local authority district level on avoidable emergency admissions. The effect means that an increase in expenditure was associated with increases in rates of avoidable admissions in the 20% most deprived local authorities (top panels Figure 11).

In the case of all-cause emergency admissions, increases in social care and services expenditure were associated with increases in the rates of admissions (bottom panels Figure 11).

When we estimated the effect of changes in expenditure per decile group of deprivation (where 1 is the least deprived and 10 is the most deprived), we found a very small association between changes in total, services and social care expenditure and NHS allocations at local authority district level and both measures of emergency admissions. The effect means that an increase in expenditure is associated with increases in rates of avoidable and all-cause admissions in the most deprived local authorities (Figure 12).

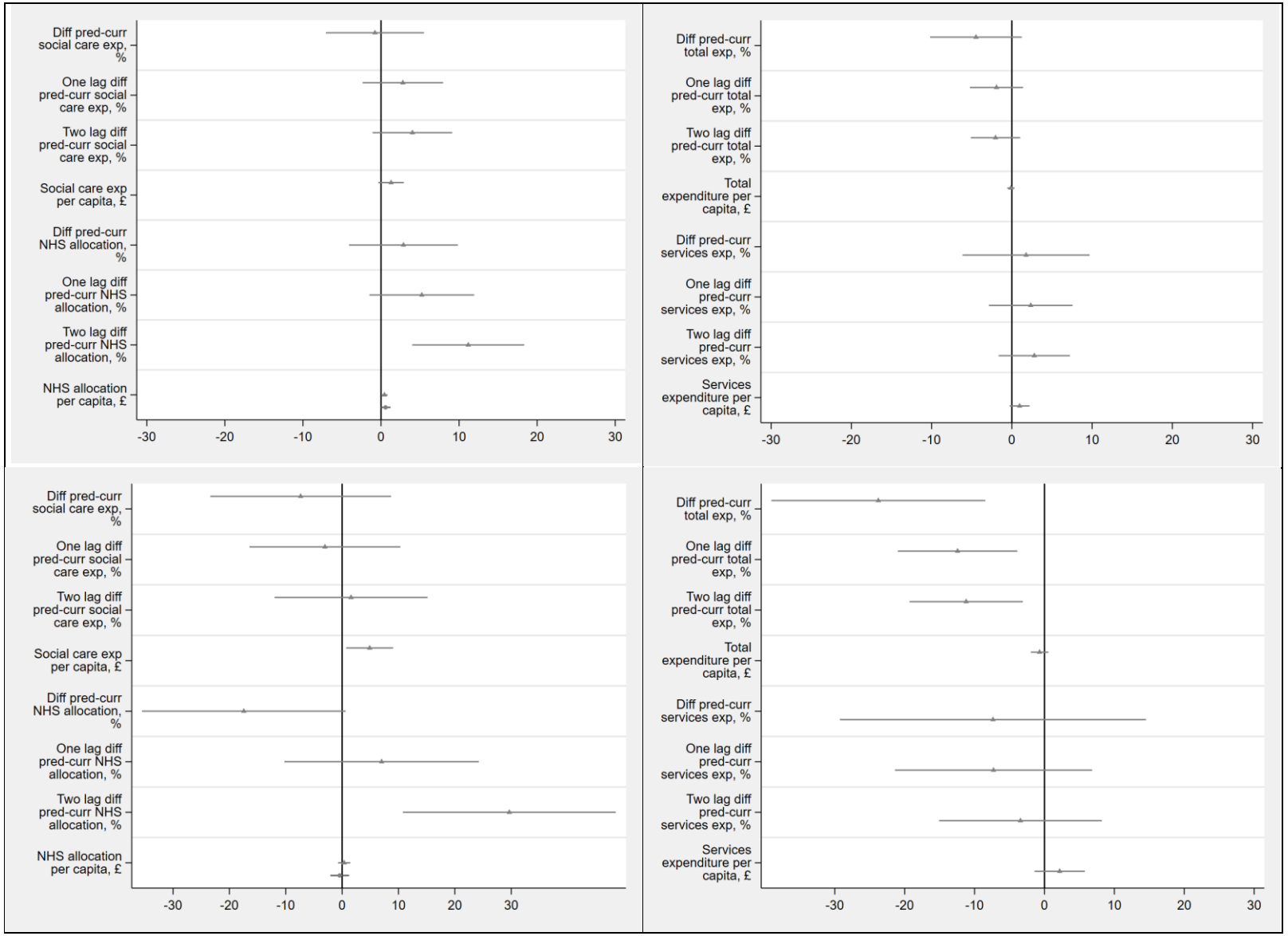

Figure 10 Effect of spending level on the absolute gradient of inequalities for avoidable emergency admissions (top panels) and all-cause emergency admissions (bottom panel)

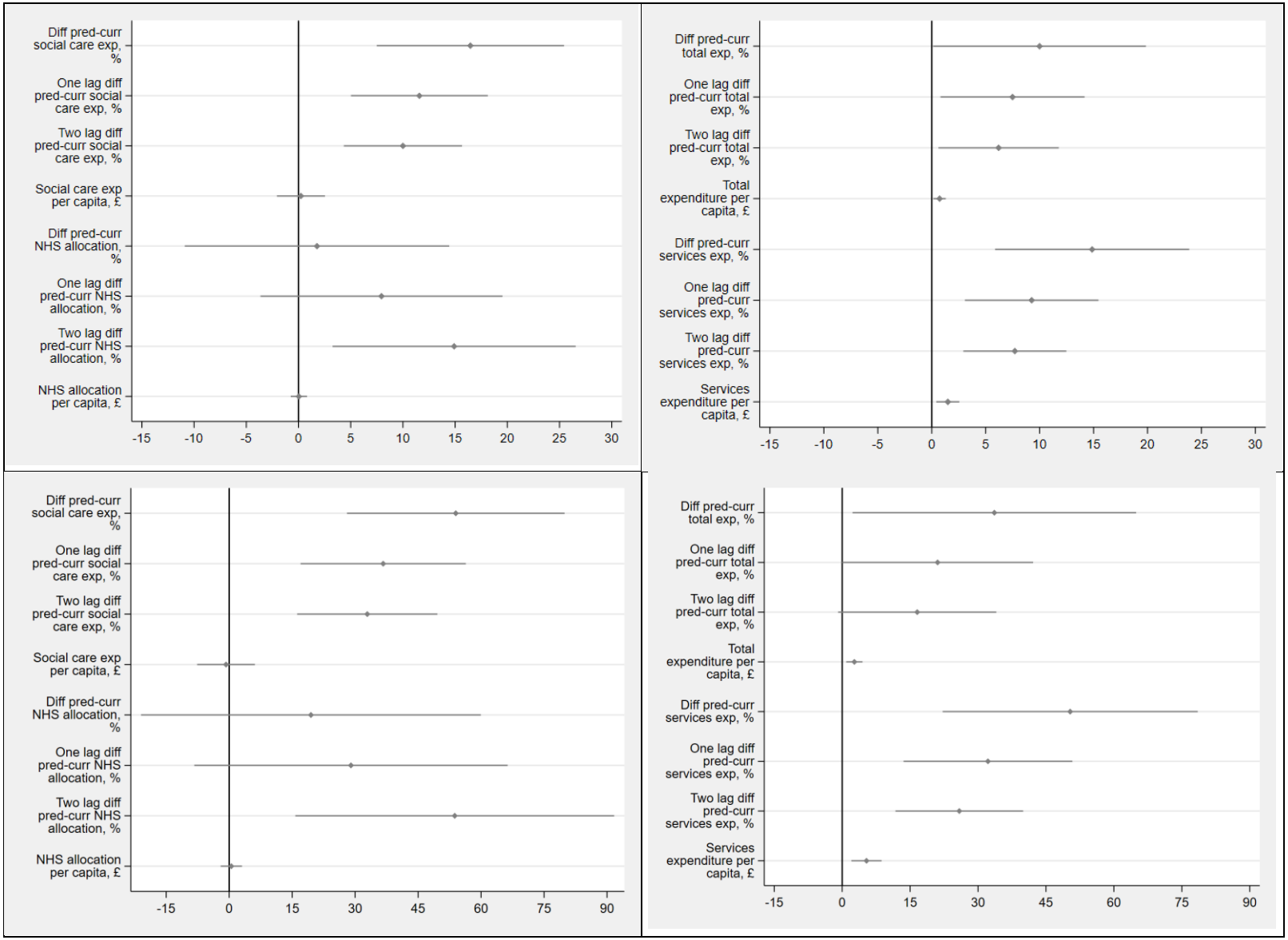

Figure 11 Effect of expenditure on bottom quintile group of deprivation on avoidable admissions (top panel) and all-cause emergency admissions (bottom panel).

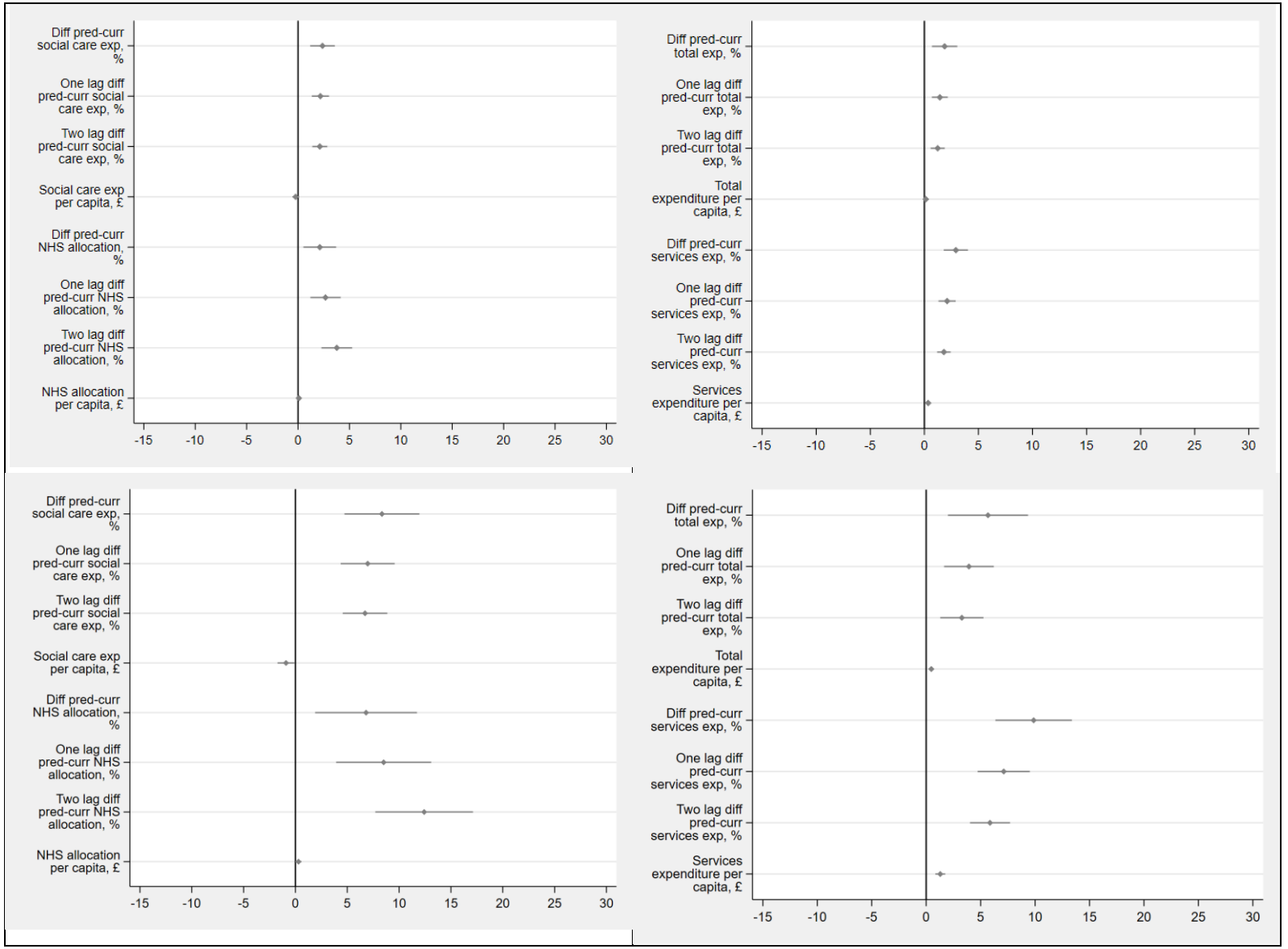

Figure 12 Effect of expenditure per decile group of deprivation on avoidable admissions (top panel) and all-cause emergency admissions (bottom panel). First decile is least deprived. The diamond represents the coefficient from the fixed effect regression for the first decile, for the 10th decile this effect is multiplied by 10.

5 Discussion

The proportion of local authorities exhibiting a consistent pattern of improvement or deterioration between 2012-2016 was 9%. Our findings regarding the number of local authorities with changing inequality trends during the 2010s are consistent with the findings of Sheringham et al. (2017) for data from 2004 to 2011.

Areas with improving trends were mainly located in three clusters in Yorkshire, Greater Manchester area, and Greater London area. Conversely, most areas with deteriorating trends were small geographical areas spread across the country. Interestingly, two areas with worsening trends were neighbours of areas with improving inequalities. When we triangulated the information on local authority performance with performance at Clinical Commissioning Groups (data not reported here), we also identified clusters of improving and deteriorating inequalities. This raises the question whether integration of health and social care services could explain the existence of these clusters.

One of the limitations of this analysis is that our criteria for identifying improving or deteriorating LADs could be considered over restrictive. Our first criterion was that three of four annual changes were in the same direction, which makes it less likely that small local authorities can be included because the overall change between 2012 and 2016 would need to be of a greater magnitude to be deemed significant.

Our analysis of wider determinants was inconclusive. It found a small negative association between total local authority expenditure and average emergency admissions, but mixed and inconsistent findings for all other associations including associations with emergency admission inequalities.

The inconclusive nature of this analysis could be explained by various phenomena.

First, supply constraints mean that the possible number of admissions in a given service is limited by the doctor and bed supply, leading to endogeneity of admission thresholds. Wyatt et al. (2017) analysed more than 20 million attendances to A&E between 2010 and 2015 finding that the case-mix adjusted probability of admission for walk-in adults fell by 22.9% during the study period. Moreover, they estimate that should the admission thresholds not have changed, admission would have been 11.9% higher in 2015. In an extension of this analysis, Wyatt (2017) found that the number of attendances with the highest odds of admission have grown the fastest between 2010 and 2016, which has resulted in an increase in the average acuity of patients attending A&E.

Second, simultaneity between expenditure and admissions where increasing need can lead to both more expenditure and more admissions. The allocation formulae for local government and the health services take into consideration the demographic profile, the relative need and level of deprivation in each area, which are variables that influence at the same time rates of emergency admissions. However, the allocation formula responds more slowly to changes in need because it is not updated every year and uses adjustments to avoid sudden shifts in expenditure; therefore, actual expenditure gradually increases reflecting observed need. Although we tested for a lagged effect of expenditure, it is worth considering that changes in expenditure may need a longer time to affect emergency admission rates.

Third, other complex causal pathways including unmeasured trends in the population health determinants of demand for emergency admissions, interactions between wider determinants and the quality and coordination of health and social care, and more complex dynamic time lag patterns than those we examined. According to NHS England (2014), various factors influence demand for emergency admissions. For example, the proportion of the

population aged over 65 and under 16 years old, the heavy smoker proportion of the population, and rates of admissions to long-term institutional care for adults are associated with more emergency admissions whereas ease of access to a GP surgery, continuity of primary care, more expenditure on social care and higher rates of employment are associated with fewer emergency admissions (Purdy and Huntley, 2013, Rosano et al., 2013, O'Cathain et al., 2014, Wilson et al., 2015, Steventon et al., 2018, van der Pol et al., 2019). Additionally, Busby et al. (2017) showed that higher rates of day case admissions, shorter distances to an A&E department and higher availability of beds are associated with higher rates of emergency admissions.

These three explanations for our findings could potentially be explored using more granular data allowing for the interaction between patient, hospital-level and local authority characteristics, and using more sophisticated causal inference modelling to unpick the complex causal pathways.

One of the limitations of our analysis of wider determinants of health inequalities is that the growth of need for social care has not been linear in the last decade. The long-term impact of variations of birth rates between 1914 and 1921 has been translated into an exponential increase after 2008 of the population over 90 years old. This means that there is an increase in the number of people near 100 years, who have greater need for social care than those in the early 90s. Additionally, we assumed that local government expenditure before 2009 and NHS allocations before 2012 were enough to meet need in each area. This might not be true given that there are not good methods to estimate unmet need in an area. These weaknesses could be addressed in future research allowing for an exponential growth in need and using different methods to model potentially unmet need.

The distribution of local government cuts has not been equal in all areas of England (Amin-Smith and Phillips, 2019); therefore, the impact of those cuts will depend on what specific services have been affected in each area and to what extent the local population has the capacity to substitute those services through informal care or paying privately. If there is substitution, then the impact of cuts in social care expenditure could not be detectable. The limited data available on what proportion of the population needing social care services pay privately or receive informal care prevented us from including these factors in our models.

A potential area for future research is exploring how expenditure in each local area affects the relative gradient of inequalities instead of the AGI. Since the AGI is an absolute measure, it tends to be correlated with the overall rate of admissions, deprivation and, potentially, local government expenditure.

6 Conclusion

According to our analysis of emergency admissions data, nearly ten per cent of LADs showed consistent change in their local health and care equity indicators between 2012 and 2016 based on meeting all three of our criteria for consistent change (i.e. that change was sustained for 3 out of 4 periods, statistically significant and robust to different measurement approaches). It may be possible to learn quality improvement lessons from these LADs, although caution and case-by-case investigation are required because some of these cases may reflect chance events or measurement error.

Our analysis of the wider determinants of change in local equity indicators was inconclusive, finding only small and inconsistent associations between changes in local public expenditure and changes in emergency admission inequalities. This pilot study was unable to unpick the causal pathways underpinning these apparently inconsistent associations for various reasons:

- The wider determinants of change in emergency admission rates are hard to disentangle, with differential magnitudes and time lags for different age groups and conditions and various unmeasured confounding and mediating factors including local social and economic conditions, lifestyle behaviours and population health.
- Supply constraints: there is limited bed space and workforce capacity available in a hospital; therefore, physicians in the emergency department have to tighten admission criteria in the face of increasing demand (i.e. increasing arrivals at accident and emergency departments) to match activity to supply.
- Endogeneity of expenditure: worsening local population health causes increases in local expenditure on health and social care services (with a formula lag) as well as increased demand for emergency admissions.
- Expenditure on social care may have larger effects on length of stay in hospital than on admission rates.

Disentangling the effects of individual, local government, and health services factors on the supply and demand for emergency admissions will require more detailed data and more sophisticated analysis of the interaction among these factors.

From this pilot study, we can conclude that short-term changes in local public expenditure do not have substantial and systematic short-term effects on local health equity indicators based on inequalities in emergency admissions. However, we cannot conclude that changes in local public expenditure do not have important short- and long-term effects on local inequalities in health risks and the demand for emergency admissions

7 References

AMIN-SMITH, N. & PHILLIPS, D. 2019. English council funding: what's happened and what's next? . *In:* LUMPKIN, R. (ed.). The Institute for Fiscal Studies.

ASARIA, M. 2017. Health care costs in the English NHS. *reference tables for average annual NHS spend by age, sex and deprivation group.* Centre for Health Economics, University of York.

BUSBY, J., PURDY, S. & HOLLINGWORTH, W. 2017. How do population, general practice and hospital factors influence ambulatory care sensitive admissions: a cross sectional study. *BMC Family Practice,* 18**,** 67.

COOKSON, R., ASARIA, M., ALI, S., FERGUSON, B., FLEETCROFT, R., GODDARD, M., GOLDBLATT, P., LAUDICELLA, M. & RAINE, R. 2016. Health Equity Indicators for the English NHS: a longitudinal whole-population study at the small-area level. *Health Services and Delivery Research,,* 4.

COOKSON, R., ASARIA, M., ALI, S., SHAW, R., DORAN, T. & GOLDBLATT, P. 2018. Health equity monitoring for healthcare quality assurance. *Social Science & Medicine,* 198**,** 148-156.

MCCORMICK, B., HILL, P.-S. & REDDING, S. 2018. Comparative morbidities and the share of emergencies in hospital admissions in deprived areas: a method and evidence from English administrative data. *BMJ Open,* 8.

MINISTRY OF HOUSING COMMUNITIES AND LOCAL GOVERNMENT. 2019. *Table 1* [Online]. Available: https://www.gov.uk/government/statistics/local-authority-revenue-expenditure-and-financing-england-2018-to-2019-budget. [Accessed 01/05/2019].

NHS ENGLAND 2014. What actions could be taken to reduce emergency admissions?

NHS ENGLAND 2018. CCG improvement and assessment framework 2018/19: Technical Annex. London: NHS England.

O'CATHAIN, A., KNOWLES, E., TURNER, J., MAHESWARAN, R., GOODACRE, S., HIRST, E. & NICHOLL, J. 2014. Explaining variation in emergency admissions: a mixed-methods study of emergency and urgent care systems. *Health Services and Delivery Research,* 2.

ONS. 2015. *Details of the methodology and 2011 Census statistics used for the 2011 area classifications* [Online]. Available: https://www.ons.gov.uk/methodology/geography/geographicalproducts/areaclassifications/2011areaclassifications/methodologyandvariables [Accessed 02/05/2019].

ONS 2019a. Annual Survey of Hours and Earnings. *In:* DURHAM UNIVERSITY (ed.). Nomis: official labour market statistics.

ONS 2019b. Model-based estimates of unemployment. *In:* DURHAM UNIVERSITY (ed.) *Annual Population Survey/Labour Force Survey.* Nomis: official labour market statistics.

ONS 2019c. Work and pensions longitudinal study. *In:* DURHAM UNIVERSITY (ed.). Nomis: official labour market statistics.

PURDY, S. & HUNTLEY, A. 2013. Predicting and preventing avoidable hospital admissions: a review. *J R Coll Physicians Edinb,* 43**,** 340-4.

ROSANO, A., GUASTICCHI, G., DE BELVIS, A. G., LOHA, C. A., FALVO, R., RICCIARDI, W. & VAN DER ZEE, J. 2013. The relationship between avoidable hospitalization and accessibility to primary care: a systematic review. *European Journal of Public Health,* 23**,** 356-360.

SHERINGHAM, J., ASARIA, M., BARRATT, H., RAINE, R. & COOKSON, R. 2017. Are some areas more equal than others? Socioeconomic inequality in potentially avoidable emergency hospital admissions within English local authority areas. *Journal of Health Services Research & Policy,* 22**,** 83-90.

STEVENTON, A., DEENY, S., FRIEBEL, R., GARDNER, T. & THORLBY, R. 2018. Briefing: Emergency hospital admissions in England: which may be avoidable and how? : The Health Foundation.

VAN DER POL, M., OLAJIDE, D., DUSHEIKO, M., ELLIOTT, R., GUTHRIE, B., JORM, L. & LEYLAND, A. H. 2019. The impact of quality and accessibility of primary care on emergency admissions for a range of chronic ambulatory care sensitive conditions (ACSCs) in Scotland: longitudinal analysis. *BMC Family Practice,* 20**,** 32.

WILSON, A., BAKER, R., BANKART, J., BANERJEE, J., BHAMRA, R., CONROY, S., KURTEV, S., PHELPS, K., REGEN, E., RODGERS, S. & WARING, J. 2015. Establishing and implementing best practice to reduce unplanned admissions in those aged 85 years and over through system change [Establishing System Change for Admissions of People 85+ (ESCAPE 85+)]: a mixed-methods case study approach. *Health Serv Deliv Res,* 3**,** 161.

WYATT, S. 2017. Changes in the Acuity of Patients Presenting at Emergency Departments and the Propensity of Emergency Departments to Admit Patients in England (2010 to 2016). The Strategy Unit.

WYATT, S., CHILD, K., HOOD, A., COOKE, M. & MOHAMMED, M. A. 2017. Changes in admission thresholds in English emergency departments. *Emergency Medicine Journal,* 34**,** 773-779.

8 Appendix

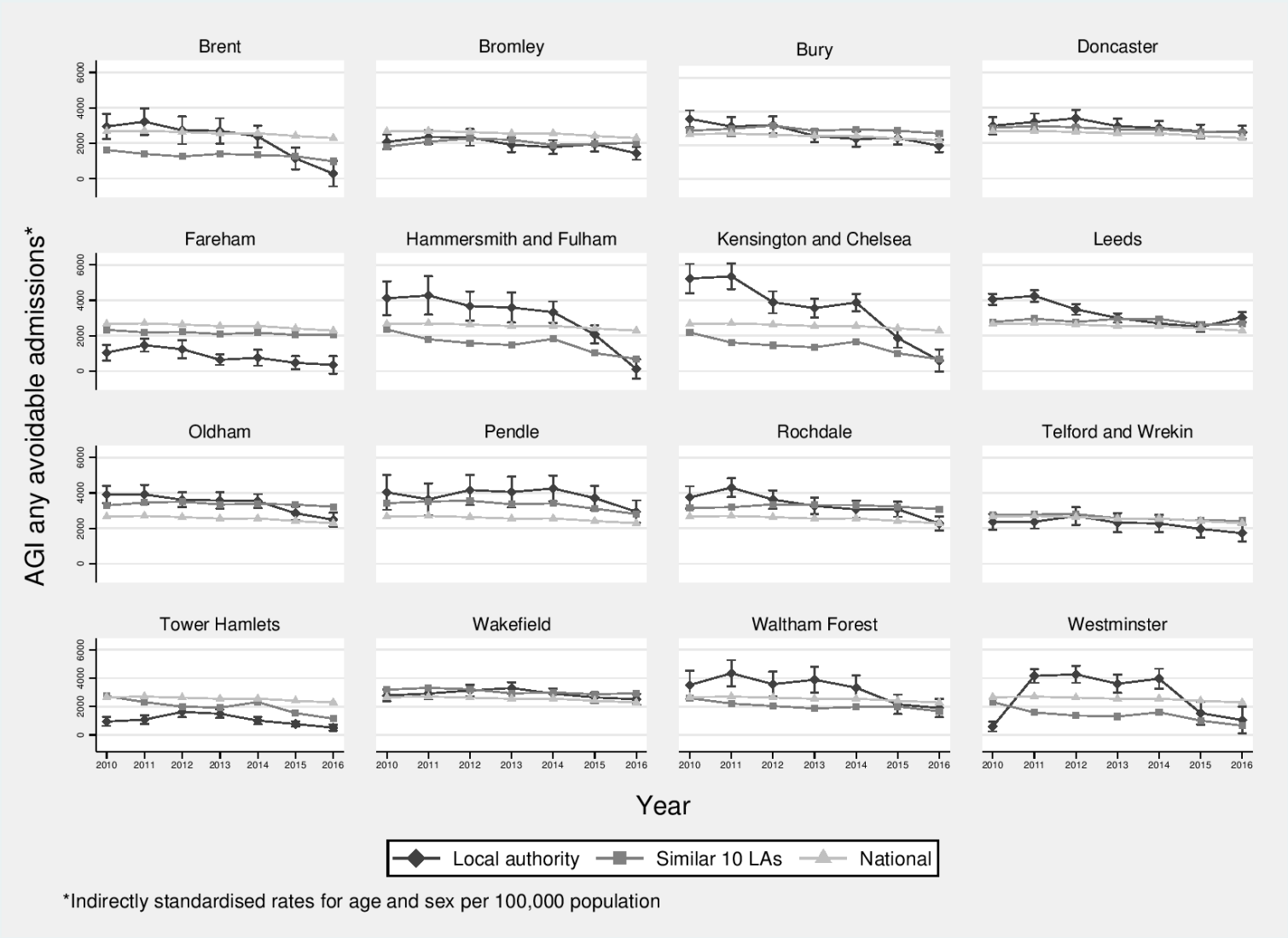

Figure 13 Trends of AGIs for avoidable admissions for the 16 improving local authorities between 2012 and 2016.

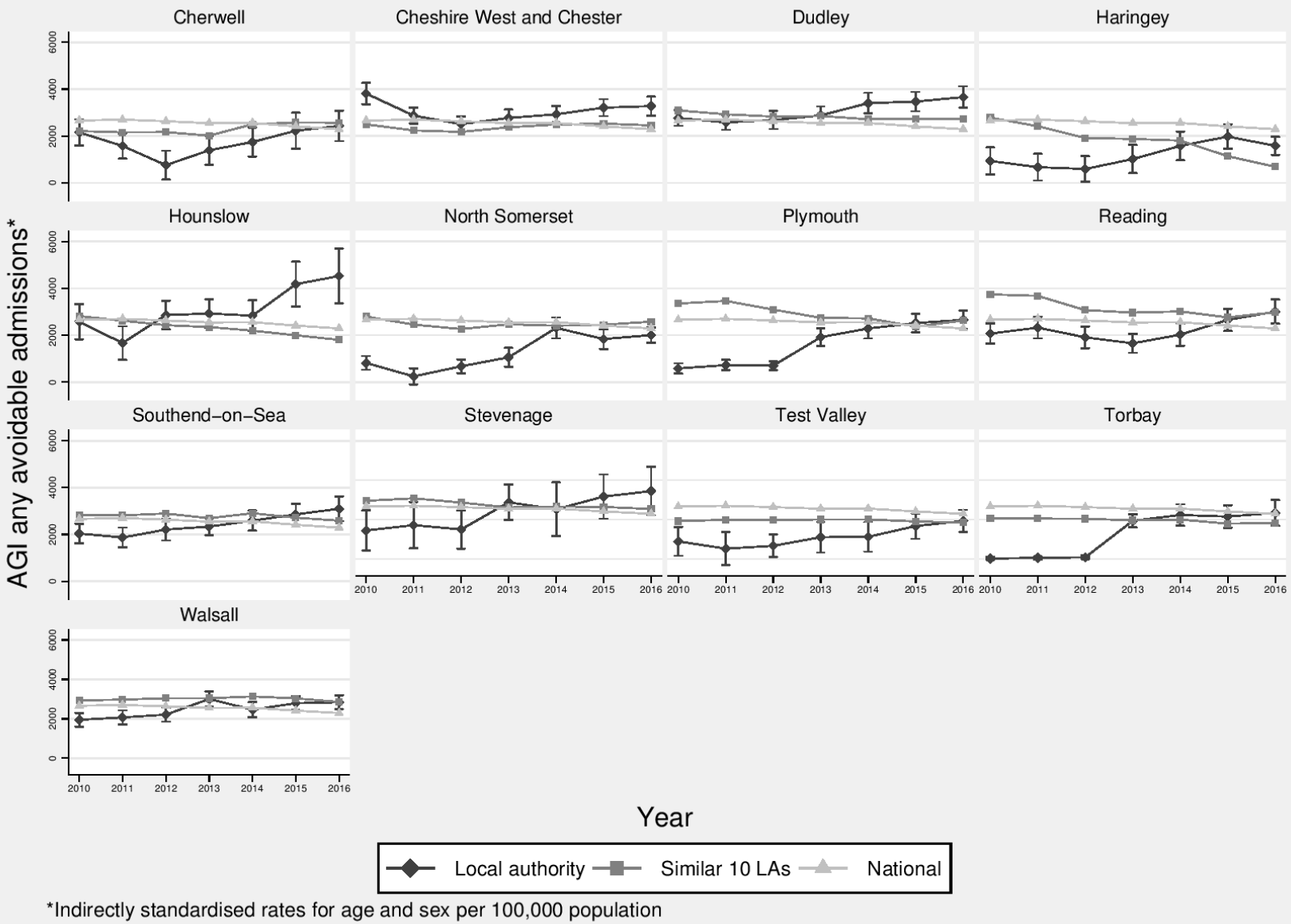

Figure 14 Trends of AGIs for avoidable admissions for the 13 deteriorating local authorities between 2012 and 2016.

9 Glossary

AGI: Absolute index of inequality, which is the modelled gap in emergency admissions between the most and least deprived small area in England, if the local authority or CCG patterns were replicated nation-wide.

RGI: Relative index of inequality, which is the modelled ratio between the most deprived small area in England and an average area.

ACSC: Ambulatory care sensitive conditions

AEA: Avoidable emergency admission. For this study, we used the Indicator 106a of the CCG improvement and assessment framework, which includes unplanned hospitalisations for chronic ambulatory care sensitive and urgent care sensitive conditions. These are expressed as indirectly standardised rates for age and sex per 100,000 population.

LSOA: Lower super output area

LAD: Lower-tier local authority districts.

IAF: Improvement and assessment framework.

Total expenditure: This excludes expenditure on police, fire and rescue services, and on NHS services, but includes expenditure on education, highways, transport planning, passenger transport, social care, libraries, waste disposal, strategic planning, housing, leisure and recreation, environmental services including environmental health services, waste collection, planning applications, and local taxation collection. From 2012 onwards, public health expenditure is also included.

Services expenditure: This excludes total expenditure on education and public health, which involved structural changes during the period, but includes all other categories of total expenditure.

Social care expenditure: This includes expenditure on both adult and child social care.


P R
E P A
L R E
Partnership for
REsponsive
Policy
Analysis and
REsearch