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SHINE[★]

**Using inferential statistical analysis to investigate factors influencing GCSE achievement in secondary education –
A descriptive and multi-level modelling approach**

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**University of
Sunderland**

EXECUTIVE SUMMARY

SHINE commissioned this research project to the University of Sunderland, in late 2023. The purpose of the project was to investigate the factors contributing to low secondary school attainment in Sunderland relative to national and regional averages. This report recounts the quantitative element of this project, in which the University of Sunderland interrogated child-level data received from Together for Children (TfC).

AIM

While the overarching project has two aims, this quantitative investigation attempts to address one of these aims:

Aim 1. Investigate the factors impacting GCSE achievement in secondary education in Sunderland

OBJECTIVES

This research has the following objectives:

- O1.** Establish how socio-economic, demographic or community factors influence their attainment during their secondary school journey.
- O2.** Provide analysis of the available attainment data for children in Sunderland across and beyond the transition from Primary to secondary school, for example, impacts on and influences of numeracy, literacy, oracy, and other factors such as aspirations, special, educational needs, or disability (SEND), inclusion or attendance
- O3.** Provide high-level recommendations for establishing a school fund in Sunderland.

Ethical approval was gained from the University of Sunderland Ethics Committee (Application 023355). General Data Protection Regulation (GDPR) guidelines were recognised and adhered to with informed consent, the right to withdraw and safe data storage.

METHODOLOGY

Following robust information governance procedures and arrangements, the three key datasets; Key Stage 4 (KS4) Attainment, KS4 Attendance, and KS4 Exclusions, were linked by the researchers using the Unique Pupil Number (UPN) as a unique identifier. Descriptive statistics were used to highlight the distribution of pupils throughout demographic categories in Sunderland, and overall Attainment 8 and Progress 8 outcomes relative to these demographic characteristics. A multi-level modelling approach was taken to conduct inferential statistical analysis on these datasets, distinguishing between school-level and individual-level factors, and focusing on Attainment 8 and Progress 8 as outcome variables. The aim was to generate a model that identified factors that significantly predicted attainment and progress outcomes at the end of secondary school.

FINDINGS

Descriptive statistics indicated that Attainment 8 and Progress 8 varied considerably depending on the demographic makeup of each pupil. In particular, KS2 prior attainment band appeared to be associated with pupils' KS4 attainment. These effects were further investigated using multi-linear modelling, which identified that, while there was some variability in attainment and progress outcomes between schools, these effects disappeared once individual-level factors were accounted for. Attainment in English and Maths broadly adheres to overall Attainment 8 scores.

The relationships within this data set are the same for both of the school years that were analysed (2018-19 and 2022-23), lending confidence to the analysis. Across both years, the largest impact on both attainment and progression appears to be the pupil's prior attainment band at KS2, where high prior attainers were likely to have higher KS4 attainment than 'Middle' or 'Low' band prior attainers. The sizes of these effects are by far the largest in the data set and outweigh any other influences.

Many demographic effects were consistent across cohorts and across prior attainment groups. Girls predominantly outperformed boys aside from Maths scores, and Asian/British Asian pupils

tended to outperform White and Black/British pupils. Those with no SEN status showed higher attainment and progress scores than those on SEN support or possessing an education, health and care plan (EHCP).

Some effects are more pronounced in certain cohorts or prior attainment groups, such as being a looked after child, receiving at least one suspension, being eligible for free school meals, and higher rates of absence. Frequently, these effects were greater in the high prior attainment band.

The best model generated by this analysis explained 60% of the variability in KS4 attainment and progress, while explained variability dropped to 20-30% for some more specified models. This suggests that there are other unmeasured factors associated with variability in the outcomes, and these factors are not measurable using this study's data.



RECOMMENDATIONS

This quantitative analysis serves to complement the larger research project commissioned by the SHINE Trust, and thus the majority of the project's recommendations can be found in the in-depth consultation exercise conducted by the researchers. However, some recommendations are unique to this quantitative element of the project:

1. An emphasis on early intervention, especially for pupils receiving free school meals, looked after children, and White or Black/British Black boys, as attainment and progress scores for KS4 pupils are highly associated with their prior attainment in KS2.
2. Reduce suspension and permanent exclusion rates in the local area, as each day of suspension is statistically associated with a drop off in Attainment 8 score.
3. Support data-sharing arrangements and promote opportunities for information-sharing and data linkage to increase the quality and richness of child-level datasets. Additional data could include social care and healthcare data, which may contain geographical-level or individual-level factors that account for missing variability in attainment and progress scores in the present study.

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ACRONYMS AND ABBREVIATIONS

AIC	Akaike Information Criterion	GDPR	The General Data Protection Regulation
ANOVA	Analysis of Variance	ICC	Intraclass Correlation Coefficient
APS	Average Point Score	IMD	Index of Multiple Deprivation
Att8	Attainment 8	KS(2, 3, 4)	Key Stage
BIC	Bayesian Information Criterion	Prog8	Progress 8
C.I.	Confidence Interval	SD	Standard Deviation
CLA	Child(ren) Looked After	SE	Standard Error
DfE	Department for Education	SEN	Special Educational Needs
EBacc	English Baccalaureate	TfC	Together for Children
EHCP	Education Health and Care Plan	UoS	University of Sunderland
F	F-test statistic	UPN	Unique Pupil Number
FSM	Free School Meals	χ^2	Chi-Square
GCSE	General Certificate of Secondary Education		



GLOSSARY OF TERMS

Akaike Information Criterion (AIC)	AIC is calculated from the number of independent variables used to build a model, and the maximum likelihood estimate of this model (how well the model reproduces the data). The best-fit model according to AIC is the one that explains the greatest amount of variation using the fewest possible independent variables.
Analysis of Variance (ANOVA)	Analysis of variance (ANOVA) is a statistical test used to assess the difference between the means of more than two groups.
Bayesian Information Criterion (BIC)	Similar to BIC, another criteria for model selection that measures the trade-off between model fit and complexity of the model.
Chi-Square (χ^2)	A statistical test for categorical data used to determine whether data are significantly different from expected figures.
Confidence Interval (C.I.)	A confidence interval is the mean of an estimate plus and minus the variation in that estimate. This is the range of values that the estimate is expected to fall in if the test is repeated. Typically, a confidence level is 95%, so 95% of estimates should fall within the lower and upper confidence intervals.
Education, Health and Care Plan (EHCP)	A legal document describing a child or young person's special educational needs, the support they need, and their aspirations.
F-test (F)	The ratio of explained variance to unexplained variance, as the result of an F-test.
Intraclass Correlation Coefficient (ICC)	The ICC is a measure of how similar the outcomes of individuals within a cluster are likely to be, relative to those of other clusters.
Index of Multiple Deprivation (IMD)	A unique measure of relative deprivation at a small local area level (Lower-layer Super Output Areas) across England.
p-value	A number describing how likely it is that observed data would have occurred by random chance. Typically a p-value under 0.05 suggests that a result is 'significant', as it only has a 5% probability of occurring by chance/ coincidence.
R ²	A measure that provides information about the goodness of fit of a model.
Standard Deviation (SD)	A measure of how dispersed the data is in relation to the mean, calculated by the square root of the sum of squared differences from the mean divided by the size of the data set.
Standard Error (SE)	The standard deviation of a sample population. It measures the accuracy with which a sample represents a population.
Together for Children (TfC)	Organisation delivering children's services on behalf of Sunderland City Council. TfC are the data controllers of the datasets used in the present study.



1.0 Introduction

1.0 INTRODUCTION

This research was commissioned to Dr Sarah Martin-Denham, Associate Professor of Care and Education at the University of Sunderland. This research aims to investigate the risk and protective factors that impact GCSE attainment in secondary schools in Sunderland. The findings and recommendations of the research will inform the areas of focus for a philanthropic donation of over £10m that aims to improve GCSE outcomes for all children in Sunderland over the next 10 years. Secondary schools in Sunderland will be able to apply for funding from Autumn 2024 through the SHINE Trust, a UK-registered charity.

1.1 AIMS AND OBJECTIVES

This report is a quantitative analysis of child-level attainment data from Sunderland secondary schools. The information governance in place allowed for the transfer of child-level Key Stage 4 (KS4) attainment data, exclusions data, attendance data, and school census data from Sunderland City Council to the University of Sunderland to perform a one-off quantitative analysis of attainment trends in Sunderland.

The direction of this analysis was driven by the overarching project's research aims and objectives. The aim relating to the quantitative element of this research project is:

- Investigate the factors impacting GCSE achievement in secondary education in Sunderland

The objectives relating to the quantitative element of this research project are:

- Establish how socio-economic, demographic or community factors influence their attainment during their secondary school journey.
- Provide analysis of the available attainment data for children in Sunderland across and beyond the transition from Primary to secondary school, for example, impacts on and influences of numeracy, literacy, oracy, and other factors such as aspirations, SEND, inclusion or attendance
- Provide high-level recommendations for establishing a school fund in Sunderland.

Out of the last five years (2018/19 - 2022/23), there are only three years of child-level attainment data available for Sunderland. Data for school years 2019/20 and 2020/21 are omitted as they occurred during the COVID-19 pandemic and are highly variable. Furthermore, while data published by the Department for Education (DfE) does contain attainment averages for these two years, progress scores are not included. This analysis will use Attainment 8 scores and Progress 8 scores as the primary outcome variables; therefore, it would be inappropriate to include 2019/20 and 2020/21 datasets.

Of the remaining school years, the researchers also chose to omit the 2021/22 dataset, as GCSE marks for this year were subject to "changes to grade boundaries and methods of assessment" (DfE, 2022). This produced highly anomalous data in the child-level datasets received by the University, such as a considerably larger proportion of pupils receiving a 'pass' or a 'strong pass' for their EBacc compared to pre-pandemic years.

The statistical releases by the DfE summarise the complications involved in interpreting attainment data from these three school years: "Given the unprecedented change in the way GCSE results were awarded in the summers of 2020 and 2021, as well as the changes to methods of assessment for 2021/22, users need to exercise caution when considering comparisons over time, as they may not reflect changes in pupil performance alone." (DfE, 2022).

For these reasons, this quantitative analysis only includes the 2018/19 school year and the 2022/23 school year, as it is believed that assessment methods in 2022/23 have returned to 2018/19 pre-pandemic standards.

1.2 ATTAINMENT METRICS

The DfE uses various metrics to measure attainment on an aggregate basis and at child-level. In KS4, pupils take GCSE-level qualifications, and usually finish these when they are 16 years old. The primary method of measuring attainment in KS4 is Attainment 8, introduced by the DfE in 2016 (DfE, 2016). A pupil's Attainment 8 score can consist of a maximum of 8 GCSE-level qualification entries, which are each given a mark of 1-9. The eligible subjects are:

- English
- English Literature
- Maths
- Three subjects that count towards the English Baccalaureate such as:
 - Sciences
 - Languages
 - Humanities
- Three other subjects which can be EBacc subjects or others from a list approved by the DfE

The 8 marks are summed, with Maths counting for double, and English counting for double if a pupil took both English and English Literature. The total is a student's Attainment 8 score. The maximum Attainment 8 score that can be achieved is 90 (a pupil being awarded a 9 on all 8 subjects, taking both English and English Literature, and counting Maths twice).

Another measure of attainment found in most KS4 attainment datasets is a pupil's EBacc Average Point Score (APS) or whether they achieved a 'pass' (4-9 APS) or a 'strong pass' (5-9 APS). This metric takes a pupil's best scores from 5 possible bins:

- English (take the best score)
- Maths
- Science (take the two best scores if entered)
- Language (take the best score)
- Humanities (take the best score)

This results in a maximum of six scores, and the average of these scores is taken to calculate a pupil's EBacc APS. If this APS is between 4 and 5, the pupil receives an EBacc 'pass', and if their APS is higher than 5, then they receive a 'strong pass'.

However, this is contingent on a pupil being eligible for an EBacc pass. Eligibility can be affected by a pupil's choice of subjects, and a pupil receiving a 99th percentile Attainment 8 score may not be eligible for an EBacc pass if they did not take a Language (one such instance was observed in the present study's data). For this reason, while the EBacc is a more forgiving attainment metric in most aspects, it could be debated whether it is the best representation of a pupil's academic attainment.

Another key statistic involved in exploring a child's academic attainment is their Progress 8 score. This metric serves as a comparison of a child's attainment relative to the national average of students who had a similar 'academic starting position', which is based on results from the end of primary school. A value of 0 indicates that the pupil's attainment is the same as the average pupil with similar prior attainment. A positive or negative score indicates a higher or lower (respectively) attainment than would be expected by the average pupil with similar prior attainment. It should be noted that the Progress 8 score can be presented as capped or uncapped. Capping is used when a progress score is extremely negative, resulting in the placement of a minimum value cap on a pupil's Progress 8 score dependent on their prior attainment. Usually, there are no more than one or two capped Progress 8 scores per school (DfE, 2015).



1.3 PUBLICLY AVAILABLE AGGREGATE STATISTICS

This quantitative analysis begins with an overview of the annual DfE statistical releases on KS4 performance metrics. These datasets include averages for various attainment measures at national, regional, and local authority levels.

During both 2018/19 and 2022/23, national attainment averages were consistently higher than equivalent values in the Northeast, which were themselves consistently higher than average attainment figures in Sunderland. Figures from 2022/23 have returned to extremely similar pre-pandemic levels. These clear trends are illustrated in Table 1.

To justify a more detailed analysis of Sunderland's low attainment figures, demographic trends were also investigated at national, regional, and local authority levels in a similar fashion to Table 1.

The aim of this particular investigation was to evaluate whether these clear trends in attainment could be accounted for by simple demographic characteristics.

National trends for gender differences in attainment data have shown that girls outperform boys on Attainment 8, Progress 8, and Attainment 8 English marks, while there is no clear difference in Attainment 8 Maths marks. The difference is considerable for Progress 8 scores, as shown in Table 2.

These trends are directionally similar for both the Northeast and Sunderland, however, the differences, especially regarding Progress 8 scores, are less pronounced, as seen in Tables 3 and 4.

Table 1. Average attainment trends between pre-pandemic (2018/19) and post-pandemic (2022/23) school years (state-funded schools only)

Year	2018/19			2022/23		
	National	Northeast	Sunderland	National	Northeast	Sunderland
Average Att8 8 score	46.8	44.7	42.9	46.4	44.5	42.9
Average Prog8 score	-0.03	-0.24	-0.39	-0.03	-0.27	-0.5
Average Att8 English	10	9.6	9.3	9.9	9.5	9.2
Average Att8 Maths	9.1	8.6	8.3	9.1	8.7	8.4

Table 2. Percentage difference of boys' secondary school attainment relative to girls (National)

School year	Att8 Difference	Prog8 Difference	Att8 English Difference	Att8 Maths Difference
2022/23	-10.18%	-170.59%	-17.58%	1.09%
2018/19	-12.22%	-181.48%	-19.78%	-1.11%

Table 3. Percentage difference of boys' secondary school attainment relative to girls (Northeast)

School year	Att8 Difference	Prog8 Difference	Att8 English Difference	Att8 Maths Difference
2022/23	-11.14%	-65.00%	-17.05%	0%
2018/19	-11.32%	-95.65%	-18.18%	0%

Table 4. Percentage difference of boys' secondary school attainment relative to girls (Sunderland)

School year	Att8 Difference	Prog8 Difference	Att8 English Difference	Att8 Maths Difference
2022/23	-10.81%	-30.51%	-16.47%	0%
2018/19	-13.65%	-69.49%	-21.18%	-2.44%

Although girls still outperform boys in Northeast and Sunderland secondary schools, the disparity is lower than national averages. Therefore, it is unlikely that low attainment in Sunderland is accounted for by gender differences. Nevertheless, any gender differences in the KS4 attainment data provided as part of this research project will be investigated.

It is difficult to draw conclusions about the association between ethnicity and attainment in Sunderland, as 94.6% of secondary school pupils were White in 2018/19, as opposed to 75.1% nationally. There were fewer than 20 secondary school pupils in each major ethnic group in Sunderland other than White (2638 pupils) and Asian (95 pupils). Similar figures were found in the 2022/23 data. The researchers have deemed the number of non-White pupils in Sunderland to be too low to account for variance in attainment in the local authority.

One of the factors most strongly associated with attainment throughout England is a pupil's Special Educational Needs (SEN) status. The DfE uses three categories for a pupil's SEN status: No SEN Support (N), SEN Support (K), and EHC Plan (E). The distribution of pupils among these three categories is highly consistent across the three regions queried (National, Northeast, Sunderland): 82%-84% with No SEN Support, 12%-13% with SEN Support, and 4%-5% with an EHC Plan.

Pupils with no SEN have the highest Attainment 8 and Progress 8 scores, followed by pupils on SEN support, with pupils on an EHCP scoring the lowest. Table 5 shows that this trend is also consistent across regions:

While those on SEN support or an EHC plan in Sunderland have lower attainment and progress scores than those in the same categories nationally, it is unclear whether this is simply due to lower average attainment in Sunderland, or a disproportionate underperformance of pupils in SEN support or EHC Plan categories in Sunderland.

Aggregate KS4 attainment data also includes a 'Disadvantaged' characteristic. Pupils in this category are those who receive free school meals (FSM) or are looked after by the local authority (LA). According to the 2022/23 release, 26.17% of KS4 pupils were disadvantaged, rising to 31.97% in the Northeast and 34.12% in Sunderland.

There is a considerable difference between the Attainment 8 and Progress 8 scores of disadvantaged pupils and those without a disadvantage as shown in Table 6 recorded in the DfE attainment data:

In a similar fashion to the SEN status breakdown, it is difficult to infer whether the disparity in Attainment 8 and Progress 8 scores is due to disproportionately poor attainment for disadvantaged pupils in Sunderland, or lower overall attainment in Sunderland. Figures for the 2018/19 school year were similar.

Table 5. Average Attainment 8 and Progress 8 scores in 2022/23 by region and SEN category

SEN Category	Region	Average Att8	Average Prog8
No SEN	National	50.2	0.1
	Northeast	48.5	-0.14
	Sunderland	46.7	-0.38
SEN Support	National	33.3	-0.45
	Northeast	31.8	-0.68
	Sunderland	28.7	-0.95
EHC Plan	National	14	-1.12
	Northeast	11.9	-1.36
	Sunderland	13.1	-1.4

Table 6. Average Attainment 8 and Progress 8 scores in 2022/23 by disadvantaged status

Region	Disadvantaged status	Average Att8 Score	Average Prog8 Score
National	Not Disadvantaged	50.4	0.17
	Disadvantaged	35.1	-0.57
Northeast	Not Disadvantaged	49.7	-0.01
	Disadvantaged	33.6	-0.83
Sunderland	Not Disadvantaged	47.9	-0.23
	Disadvantaged	33.1	-1.01

This introductory descriptive analysis of aggregate level data published annually by the DfE illustrates the clear disparity between attainment in Sunderland (and the Northeast as a whole) and national averages. However, there is no clear evidence in the aggregate level data suggesting that certain demographic characteristics can account for this disparity. This justifies a more detailed analysis of why Sunderland secondary school pupils underperform compared to the average secondary school pupil in England, and which specific factors can account for the variance between these two regions. Descriptive and inferential analysis of child-level data supplied by Sunderland City Council allows for such an analysis.



2.0 METHODOLOGY

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2.1 INFORMATION GOVERNANCE AND DATA TRANSFER

Prior to receiving the relevant datasets, the researchers followed robust information governance processes to receive permission to access Sunderland City Council's child-level education data. Ethical approval was gained from the University of Sunderland Ethics Committee (Application 023355). GDPR guidelines were recognised and adhered to with informed consent, the right to withdraw and safe data storage. Upon approval of the ethics application, the researchers proceeded with the University's Data Protection by Design (DPBD) toolkit, and a Data Protection and Impact Assessment (DPIA). The researchers were advised that the DPIA would not be necessary, as the data was not to include any identifiable information.

TfC, as the data controller, would forward data to the University of Sunderland, and TfC would direct data subjects to their own Privacy Notice. Although the data was anonymised, the data was still subject to UK GDPR and as such, it was deemed to be beneficial to have a data sharing agreement in place (TfC as the Controller and UoS as the processor). The Data Sharing Agreement with TfC was reviewed and approved by the University's Data Protection officers.

Once IG arrangements were in place, a Teams channel was created, approved by the University's IT department, and a staff member from TfC was invited to join the channel. The staff member uploaded a password-protected ZIP folder to the Teams channel and provided the password to the researchers. The password was used to open this folder and extract the contents. The TfC staff member was then removed from the Teams channel once receipt of the datasets was confirmed.

2.2 DATA CLEANING AND MANIPULATION

This investigation will consist of descriptive and inferential statistical analysis of child-level education data for Sunderland secondary school pupils. The datasets interrogated were:

1. KS4 attainment metrics
2. Full year attendance data
3. Full year exclusions data
4. School census dataset

All these datasets contained child-level data attached to each child's Unique Pupil Number (UPN). This allowed the four datasets to be linked to one another. Firstly, each individual dataset was viewed to ascertain which columns would need to be linked to the KS4 attainment metrics dataset.

The majority of the columns from the attendance dataset were used in the linkage process, however, there were some cases of a child having two rows in the attendance dataset. It was detected that children who changed schools during the academic year would be given a new record in the attendance data. These children's duplicate records were manually merged into one record, as there were few cases of this occurrence.

The format of the exclusions dataset was problematic for the purposes of data linkage, as each unique child did not occupy one row. Rather, each separate exclusion was recorded in a new row, and most children in this dataset had multiple records. To merge multiple records into one row, Excel Power-Query was used to combine all of a child's exclusion data into one row.

Finally, the relevant School Census data were appended to the linked dataset. There was considerable overlap between the School Census data and existing demographic data found in the attainment and attendance datasets, therefore, only the 'SEN Type' column was added from the School Census to the linked dataset.

The data linkage process was thoroughly documented, including how much data was missing for each child. For example, of the 3006 unique children in the KS4 attainment dataset, 2854 (94.94%) of these UPNs were also present in the attainment dataset. Despite the absence of attendance data for some children, the linkage rate was considered adequate.

2.3 INFERENCE ANALYSIS

The purpose of the inferential analysis in this study is to answer the questions:

- Can we determine which factors in the data set are related to KS4 attainment?
- What are the relative importances of the variables in determining this outcome?

Given that school level data is inherently clustered by school, the appropriate analytic method is linear mixed methods modelling. This allows the data to be clustered by school to account for any school level effects that should be separated from those affecting the individual. As the data set contains a large number of possible outcome and predictor variables, a subset of these was chosen, as shown in Table 7. This also shows the school-level (contextual) variables which were constructed from the data set. All statistical analysis was performed using R 4.4.1 (R Core Team, 2024) implementing the *tidyverse* (Wickham et al. 2019) using the package *lmerTest* (Kuznetsova, Brockhoff and Christensen, 2017).

As the requirement is to produce an analysis that can be generalised to a wider population, schools which cater solely to SEN pupils, schools with small numbers, and schools targeting special populations e.g., teenage mothers, were excluded from this analysis. Analysis was confined to the data sets 2018-29 and 2022-23 to avoid the confounding effects of the COVID-19 pandemic (see page 6). A pragmatic approach was taken throughout, using the principle of parsimony to obtain the simplest model that would explain the greatest amount of variability in the outcome variables. As there was no strong theoretical basis to determine the order of consideration of predictors, school-level (contextual) variables were considered first, followed by individual-level variables. Variables were entered into the model individually and retained if they produced a significant difference in likelihood ratio tests. Initially, modelling was confined to allow random intercepts, but fixed slopes. This means that each school had their own average outcome level, but shapes of relationships with predictors were considered the same across schools. Similarly, predictors were entered separately, and to avoid overfitting, interactions were only considered once the simplest model that explained the most variance had already been fitted. Modelling was

performed for the data set covering years 2022-23 in the first instance, then the model structure was confirmed by applying it to the data set for 2018-19.

The alpha level for significance was set at $p < .05$ throughout. Model fit was determined by changes in the log-likelihood and information criteria (Akaike and Bayesian Information Criteria) statistics. Significance of individual predictors was determined using the Satterthwaite correction, and robust confidence intervals were obtained by bootstrapping. Overall variance was explained and expressed as pseudo- R^2 .

Table 7. Details of variables included in inferential analysis

Outcome variables	Attainment8, Attainment8 English, Attainment 8 Maths, Progress 8
School level variables (calculated)	Cohort size, % in receipt of free school meals (FSM), % with an EHCP, % who have no SEN status, average number of GCSE entries, type of school (mixed or single sex), type of school (religious ethos or not), % of cohort who have ever been suspended, IMD decile based on school postcode ¹
Individual level variables (from linked data set) Additional variables for subsequent analysis	Gender, Ethnicity, in receipt of FSM (yes/no), SEN status (none vs. EHCP/Support), KS2 prior achievement band (high, middle, low), Looked after child (yes/no), has ever been suspended (yes/no), Percentage absence rate Total number of days suspended
Variables excluded after initial consideration	English as an additional language (co-linear with ethnicity)

¹Obtained using the Ministry of Housing, Communities and Local Government Lookup service: <https://imd-by-postcode.opendatacommunities.org/imd/2019>



3.0 FINDINGS

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3.1 DESCRIPTIVE STATISTICS

3.1.1 DEMOGRAPHIC DATA IN KS4 ATTAINMENT DATASET

The key dataset for this study was the KS4 Attainment Dataset, which included data from school years 2018/19, 2021/22 and 2022/23. The researchers elected to omit the 2021/22 dataset (see page 6 for details).

The 2022/23 dataset contained 3006 rows of data. All but one of these rows included a unique UPN, and the row with a missing UPN was removed from the sample as their data could not be linked to the other datasets without their unique identifier. The 2018/19 dataset contained 2788 rows of data with no missing UPNs. Demographic characteristics for each year are illustrated in Tables 8 - 13 below:



Table 8. KS4 Attainment dataset – Gender breakdown

Gender	2022/23		2018/19	
	Count	%	Count	%
Male	1526	50.78	1458	52.30
Female	1479	49.22	1330	47.70

Table 9: KS4 Attainment dataset –Ethnicity breakdown²

Ethnicity	2022/23		2018/19	
	Count	%	Count	%
White	2729	90.82	2638	94.62
Asian or Asian British	150	4.99	99	3.55
Mixed/dual background	60	2.00	19	0.68
Black or Black British	41	1.36	19	0.68
Information not yet obtained	12	0.40	4	0.14
Any other ethnic group	9	0.30	5	0.18
Refused	4	0.13	4	0.14

²The 2018/19 data uses more specific ethnicity codes, which the researchers converted into the broader ethnicity codes used in the 2022/23 data

Table 10. KS4 Attainment dataset – EAL category breakdown

EAL Category	2022/23		2018/19	
	Count	%	Count	%
English	2820	93.84	2664	95.55
EAL	181	6.02	122	4.38
Unclassified	4	0.13	2	0.07

Table 11. KS4 Attainment dataset – SEN status

SEN	2022/23		2018/19	
	Count	%	Count	%
No SEN	2482	82.60	2331	83.61
SEN Support	380	12.65	332	11.91
EHC Plan	143	4.76	125	4.48

Table 12. KS4 Attainment dataset – Disadvantaged status (FSM + CLA)

Disadvantaged	2022/23		2018/19	
	Count	%	Count	%
No	1980	65.89	1854	66.50
Yes	1025	34.11	934	33.50

There are no clear differences between the demographic makeup of KS4 students between 2022/23 and 2018/19, save for a slight increase in ethnicities other than ‘White’ in 2022/23. This further illustrates why comparisons can be made across these two school years.

Table 13. KS4 Attainment dataset – KS2 Prior attainment band

KS2 Prior Attainment Band	2022/23		2018/19	
	Count	%	Count	%
High	750	24.96	1192	42.75
Medium	1580	52.58	1215	43.58
Low	600	19.97	343	12.30

Table 13 shows a considerable difference between the distribution of pupils in each KS2 prior attainment band in 2022/23 compared to 2018/19. While there was a 27.62% difference in pupils in the high and medium prior attainment bands in 2022/23, this difference was only 0.83% in 2018/19. This is of considerable interest to the present study, as inferential analysis will show the significance of KS2 prior attainment as a predictor of Attainment 8 and Progress 8 scores.

3.1.2 DESCRIPTIVE ANALYSIS OF ATTAINMENT 8 AND PROGRESS 8 SCORES

The following Table 14 and Figures 1-2 illustrate how Attainment 8 and Progress 8 scores vary depending on pupil characteristics:

Table 14: KS4 Attainment dataset – Median Att8 and Prog8 scores (and Standard Deviations, SD) for all aforementioned pupil characteristics and associated categories – 2022/23

Characteristic		Median Att8 Score (SD)	Median Prog8 Score (SD)
Gender	Female	46.00 (20.01)	-0.319 (1.47)
	Male	41.50 (20.98)	-0.489 (1.50)
Ethnicity	White	43.00 (20.40)	-0.457 (1.47)
	Asian or Asian British	55.75 (20.25)	0.523 (1.28)
	Mixed/dual background	43.00 (24.51)	-0.091 (1.62)
	Black or Black British	46.50 (16.47)	0.255 (1.17)
EAL Category	English	43.00 (20.50)	-0.455 (1.47)
	EAL	53.00 (20.47)	0.580 (1.24)
SEN Status	No SEN	46.88 (18.80)	-0.307 (1.45)
	SEN Support	27.25 (17.98)	-0.739 (1.56)
	EHC Plan	6.00 (16.18)	-1.586 (1.39)
Disadvantaged	Yes	32.50 (19.60)	-0.919 (1.51)
	No	48.50 (19.22)	-0.163 (1.40)
KS2 Prior Attainment Band	High	62.50 (16.26)	-0.410 (1.53)
	Medium	43.00 (16.49)	-0.391 (1.54)
	Low	23.00 (14.77)	-0.421 (1.27)

Note: This table and the following figures exclude categories such as ‘Unclassified’ ‘Information not known’ etc. The medians and standard deviations do not exclude any pupils in the remaining categories, in contrast to the inferential statistics in this study that excludes certain schools with low numbers of GCSE entries.

Figure 1. KS4 Attainment dataset - Bar plot of median Att8 scores by pupil characteristics in 2022/23

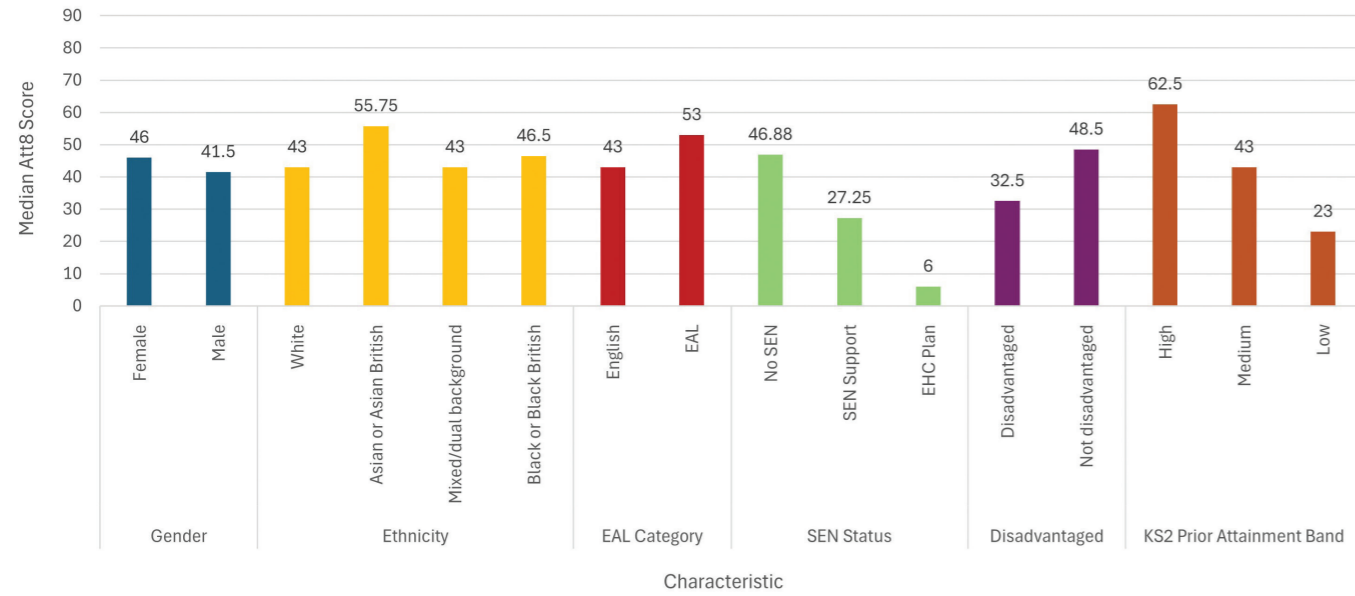


Figure 2. KS4 Attainment dataset - Bar plot of median Prog8 scores by pupil characteristics in 2022/23

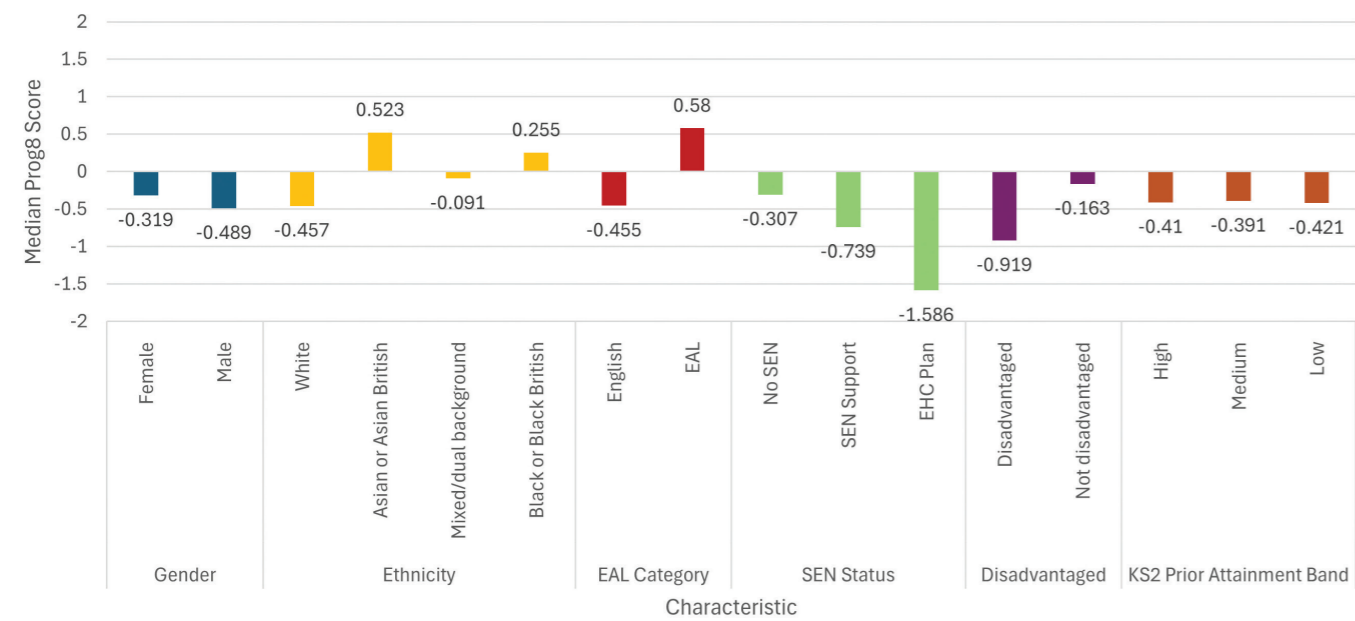


Table 14, and respective visualisations in Figures 1 and 2, demonstrate how median Attainment 8 and Progress 8 scores vary by pupil characteristics. This breakdown indicates possible candidates for predictive factors associated with Attainment

8 and Progress 8 scores. A major outlier is the Attainment 8 median and Progress 8 median for pupils with an EHCP, as many of these pupils attend special schools, in which GCSE entries are low.

Despite this outlier, there is clear variation between pupils in different demographic categories, and a large difference between pupils in different KS2 prior attainment bands. This suggests that variability in Attainment 8 scores and Progress 8 scores may be attributable to demographic characteristics and prior attainment measures. This will be investigated in the inferential statistics section of this report (see section 3.2)

The corresponding 2018/19 table and figures are in Appendix 1, Figures 9-10, Table 27. Since the trends and direction of Attainment 8 and Progress 8 differences are highly similar, they have not been included in this descriptive statistics section.

3.2 INFERENTIAL ANALYSIS

3.2.1 DATA SET COVERING YEARS 2022-2023

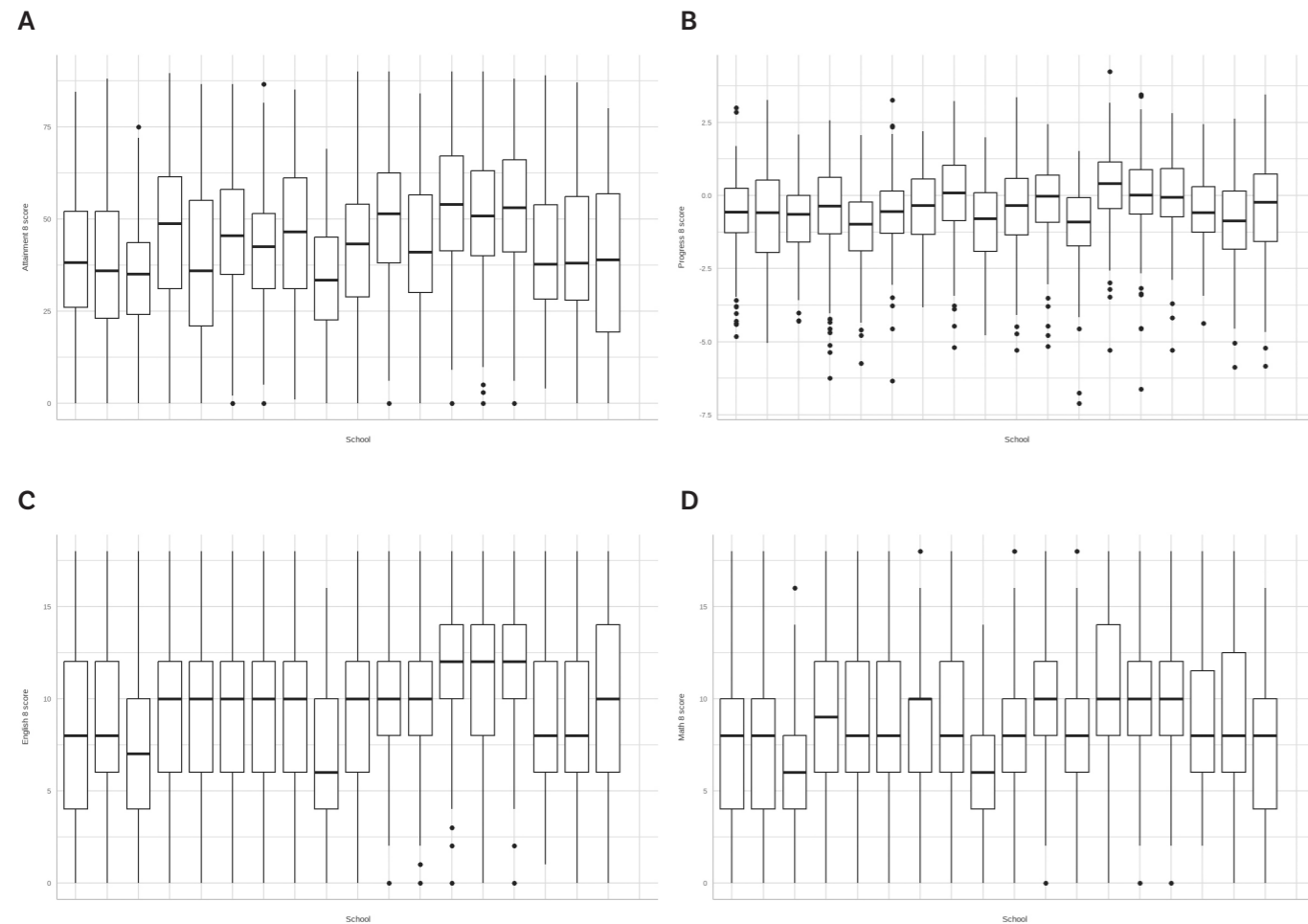
Figure 3 shows the differences in attainment and progression metrics broken down by school. Analysis using one-way ANOVA confirms that all four metrics differ significantly across schools (Attainment 8 $F(17,2908) = 16.22, p < .001$; Att8 English $F(17,2908) = 16.13, p < .001$; Att8 Maths $F(17,2908) = 12.97, p < .001$; Progress 8 $F(17,2841) = 13.52, p < .001$) suggesting that a multi-level approach was needed. Initial intercept-only models were fitted, yielding the intraclass correlation coefficients (ICC) for the base models as shown in Table 15.

Table 15. Intraclass correlation coefficients for null (intercept only) models for each outcome variable

Outcome variable	Intraclass Correlation Coefficient (ICC)
Attainment8	0.089
Att8 English	0.086
Att8 Maths	0.074
Progress8	0.071



Figure 3. Boxplots of (A) Attainment 8, (B) Attainment 8 English, (C) Attainment 8 Maths and (D) Progress 8 for each school for the 2022-23 data set. Heavy line indicates median with the box containing the central 50% of scores. Whiskers indicate 95% confidence intervals with outliers shown as dots.



ICCs (Table 15) are generally small, suggesting that between 7.1% and 8.9% of the outcome variability is accounted for by school level effects. However, given the known importance of school effects and the standard nature of linear mixed modelling in the educational outcome literature, the researchers deemed that this is still the most appropriate choice of modelling.

In turn, models fitting the school level effects were constructed, retaining predictors which significantly improved the fit of the model. The final models for each outcome variable are shown in Table 16. For Attainment 8, Att8 English and Att8 Maths, average school level performance is significantly predicted by the percentage of those who are in receipt of free school meals (higher FSM percentage – lower attainment), whilst for Progress 8, average school results are predicted by average attendance (higher attendance predicts higher average progress). In all cases the effects

are small. The variables; cohort size, SEN status, average number of GCSE entries, type of school (mixed or single sex), type of school (religious ethos or not), percentage of cohort who have ever been suspended, and IMD decile based on school postcode, were not significantly related to any of the outcome variables.

Following this observation, for each outcome variable, individual-level predictors were added, retaining those which led to a significant improvement in fit. Finally, the complete model (contextual plus individual predictors) was compared with a model consisting of individual predictors only. For all four outcomes, removal of the contextual effects resulted in no significant change to the fit of the model. Therefore, for parsimony, the final model for each outcome consists of the individual level predictors only, as shown in Table 17.

Note: The present report displays model estimates in table format. Each ‘Estimate’ can be interpreted as the difference in the outcome variable between the former category and the latter. For example, in Table 17 under the ‘Ethnicity’ section, a comparison is made between Asian/British Asian pupils and White/White British pupils. The ‘Estimate’ of 6.05 for this comparison indicates that, according to

the statistical model employed, Asian/British Asian pupils are estimated to perform 6.05 Attainment 8 points higher than White/White British pupils on average. Where percentages are used rather than comparisons, the ‘Estimate’ indicates the estimated difference in the outcome for each percentage point (every 1 percent).

Table 16. School level (contextual) effects on outcome variables for the 2022-23 cohort

Outcome variable: Fixed Effects	Attainment 8 Estimate (S.E.)	95% C.I.	p
Intercept	31.21 (13.45)	4.48 – 58.38	.04
% Free school meals	-0.26 (0.07)	-0.40 – -0.12	.001
% Non SEN	0.27 (0.14)	-0.02 – 0.56	.08
% with EHCP	-0.76 (0.39)	-1.52 – -0.03	.07
AIC	25568.65		
BIC	25604.54		
Pseudo R2 (fixed)	0.06		
Pseudo R2 (total)	0.08		
Outcome variable: Fixed Effects	Att8 English Estimate (S.E.)	95% C.I.	p
Intercept	8.84 (3.99)	1.15 – 16.34	.04
% Free school meals	-0.05 (0.02)	-0.09 – -0.01	.03
% Non SEN	0.03 (0.04)	-0.05 – 0.11	.51
% with EHCP	-0.18 (0.12)	-0.39 – 0.08	.15
AIC	16574.78		
BIC	16610.67		
Pseudo R2 (fixed)	0.04		
Pseudo R2 (total)	0.09		
Outcome variable: Fixed Effects	Att8 Maths Estimate (S.E.)	95% C.I.	p
Intercept	8.17 (3.35)	1.79 – 14.41	.03
% Free school meals	-0.06 (0.02)	-0.08 – -0.02	.004
% Non SEN	0.03 (0.04)	-0.04 – 0.10	.43
% with EHCP	-0.12 (0.10)	-0.30 – 0.07	.24
AIC	16715.07		
BIC	16750.96		
Pseudo R2 (fixed)	0.05		
Pseudo R2 (total)	0.07		
Outcome variable: Fixed Effects	Progress 8 Estimate (S.E.)	95% C.I.	p
Intercept	-8.99 (2.17)	-13.47 – -5.00	.0001
Percent attendance	0.10 (0.03)	0.05 – 0.15	.001
AIC	10189.05		
BIC	10212.88		
Pseudo R2 (fixed)	0.04		
Pseudo R2 (total)	0.07		

Table 17. Individual level effects on each outcome measure for the 2022-23 cohort

Outcome variable: Fixed Effects	Attainment 8 Estimate (S.E.)	95% C.I.	p
Intercept	65.84 (1.03)	63.8 - 67.74	<.001
Gender (M v F)	-2.16 (0.50)	-3.16 - -1.14	<.001
<i>Ethnicity</i>			
Asian v White	6.05 (1.14)	3.76 - 8.51	<.001
Black v White	-0.57 (2.17)	-4.37 - 3.80	.79
Mixed v White	3.98 (1.69)	-4.37 - 3.80	.02
Other v White	9.01 (4.10)	0.86 - 17.10	.03
<i>KS2 Prior attainment</i>			
Mid v High	-15.12 (0.57)	-16.13 - -14.07	<.001
Low v High	-26.67 (0.77)	-28.14 - -25.24	<.001
Unknown v High	-17.07 (1.81)	-20.75 - -13.79	<.001
Suspended (v never)	-9.15 (0.96)	-10.97 - -7.29	<.001
<i>SEN status</i>			
SEN support v none	-5.81 (0.75)	-7.28 - -4.33	<.001
EHCP v none	-8.77 (1.81)	-12.18 - -4.89	<.001
In receipt of FSM	-3.42 (0.54)	-4.50 - -2.23	<.001
Looked after v not	-9.80 (2.08)	-14.30 - -5.81	<.001
Percentage attendance	-0.42 (0.01)	-0.45 - -0.40	<.001
AIC	21632.73		
BIC	21733.42		
Pseudo R2 (fixed)	0.58		
Pseudo R2 (total)	0.61		
Outcome variable: Fixed Effects	Att8 English Estimate (S.E.)	95% C.I.	p
Intercept	13.82 (0.27)	13.33 - 14.31	<.001
Gender (M v F)	-1.03 (0.12)	-1.25 - -0.78	<.001
<i>Ethnicity</i>			
Asian v White	1.32 (0.28)	0.74 - 1.83	<.001
Black v White	0.23 (0.28)	-0.83 - 1.25	.66
Mixed v White	1.04 (0.41)	0.30 - 1.81	.01
Other v White	1.37 (1.00)	-0.52 - -3.41	.17
<i>KS2 Prior attainment</i>			
Mid v High	-2.81 (0.14)	-3.06 - -2.57	<.001
Low v High	-4.87 (0.19)	-5.22 - -4.51	<.001
Unknown v High	-3.50 (0.44)	-4.37 - -2.65	<.001
Suspended (v never)	-1.95 (0.23)	-2.42 - -1.51	<.001
<i>SEN status</i>			
SEN support v none	-1.33 (0.18)	-1.68 - -0.97	<.001
EHCP v none	-2.04 (0.44)	-2.89 - -1.22	<.001
In receipt of FSM	-0.68 (0.13)	-0.06 - -0.39	<.001
Looked after v not	-1.98 (0.50)	-3.03 - -0.94	<.001
Percentage attendance	-0.08 (0.003)	-0.082 - 0.068	<.001
AIC	13869.52		
BIC	13970.21		
Pseudo R2 (fixed)	0.46		
Pseudo R2 (total)	0.51		

Outcome variable: Fixed Effects	Att8 Maths Estimate (S.E.)	95% C.I.	p
Intercept	12.88 (0.23)	12.41 - 13.33	<.001
Gender (M v F)	0.54 (0.12)	0.31 - 0.77	<.001
<i>Ethnicity</i>			
Asian v White	1.05 (0.26)	0.54 - 1.58	<.001
Black v White	-0.38 (0.51)	-1.31 - 0.59	.45
Mixed v White	0.60 (0.39)	-0.21 - 1.38	.13
Other v White	2.66 (0.95)	0.73 - 4.63	.005
<i>KS2 Prior attainment</i>			
Mid v High	-3.59 (0.13)	-3.84 - -3.33	<.001
Low v High	-6.65 (0.18)	-6.98 - -6.31	<.001
Unknown v High	-3.79 (0.42)	-4.62 - -2.95	<.001
Suspended (v never)	-1.48 (0.22)	-1.92 - -1.03	<.001
<i>SEN status</i>			
SEN support v none	-1.13 (0.17)	-1.45 - -0.79	<.001
EHCP v none	-1.38 (0.42)	-2.90 - -0.57	.001
In receipt of FSM	-0.66 (0.13)	-0.91 - -0.40	<.001
Looked after v not	-1.96 (0.48)	-2.90 - -1.03	<.001
Percentage attendance	-0.08 (0.003)	-0.083 - -0.07	<.001
AIC	13613.92		
BIC	13714.61		
Pseudo R2 (fixed)	0.54		
Pseudo R2 (total)	0.57		
Outcome variable: Fixed Effects	Progress 8 Estimate (S.E.)	95% C.I.	p
Intercept	-0.08 (0.10)	-0.25 - 0.11	.39
Gender (M v F)	-0.24 (0.05)	-0.26 - -0.15	<.001
<i>Ethnicity</i>			
Asian v White	0.67 (0.11)	0.44 - 0.91	<.001
Black v White	0.43 (0.27)	-0.05 - 1.02	.11
Mixed v White	0.54 (0.16)	0.21 - 0.85	.001
Other v White	0.54 (0.43)	-0.37 - 1.41	.21
<i>KS2 Prior attainment</i>			
Mid v High	0.35 (0.05)	0.25 - 0.45	<.001
Low v High	0.97 (0.07)	0.84 - 1.12	<.001
Unknown v High	N/A	-	-
Suspended (v never)	-0.81 (0.09)	-0.99 - -0.63	<.001
<i>SEN status</i>			
SEN support v none	-0.36 (0.07)	-0.48 - -0.22	<.001
EHCP v none	-0.25 (0.18)	-0.60 - -0.10	.16
In receipt of FSM	-0.28 (0.05)	-0.38 - -0.19	<.001
Looked after v not	-0.66 (0.20)	-1.05 - -0.32	.001
Percentage attendance	-0.04 (0.001)	-0.043 - -0.038	<.001
AIC	8376.44		
BIC	8470.84		
Pseudo R2 (fixed)	0.36		
Pseudo R2 (total)	0.41		

Upon examining each section of Tables 16 and 17, it can be seen that the effects are broadly similar across each outcome. The variable with the strongest association is prior attainment at KS2, with lower KS2 attainment being related to lower scores on Attainment 8, Att8 English, and Att8 Maths. However, lower KS2 attainment is associated with a higher Progress 8 score. The magnitude of the effect is greater comparing the low to high achievement bands, than the mid to high achievement bands.

Gender has a significant impact. Boys on average score lower than girls on Attainment 8 (-2.16 points), Att8 English (-1.03 points), and Progress 8 (-0.24 points), but score higher than girls in Att8 Maths (+0.54 points).

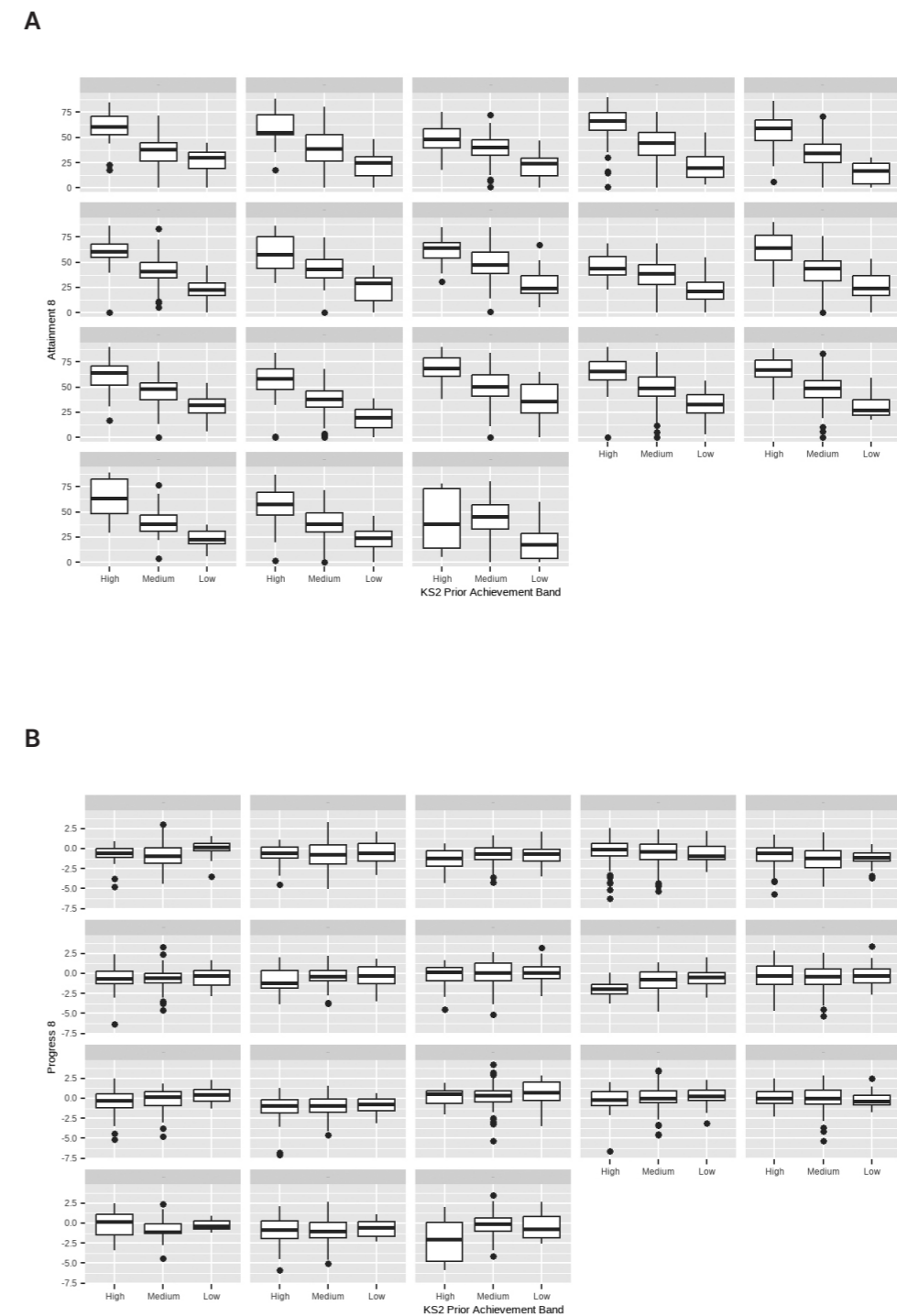
There is some effect of ethnicity. Across all metrics, Asian and British Asian students outperform White/White British and Black/Black British students. The cohorts of mixed race and other race students are very small; therefore, results should be interpreted with caution, although there is some evidence that they also outperform the White/White British and Black/Black British students in some areas.

Across all metrics, receiving at least one suspension has a markedly negative effect. The effect on overall Attainment 8 is particularly large (-9.15 points versus those never suspended), but also in Att8 English (-1.95 points), Att8 Maths (-1.48 points) and Progress 8 (-0.81 points). Similarly, SEN status has a negative effect on most outcomes, with the magnitude of the effect being greater for those with an EHCP compared to those with school SEN support. This was the case for Attainment 8 and Att8 English (Attainment 8: -8.77 with EHCP, -5.81 with SEN support; Att8 English: -2.04 with EHCP, -1.33 with SEN support), whilst for Att8 Maths both groups scored lower than those without SEN, but not differently to each other (Att8 Maths: -1.38 with EHCP, -1.13 with SEN support). Those who receive SEN support make significantly less progress than those without (-0.36 points), whereas those with an EHCP and those without any SEN support do not differ on the progress measure.

In terms of markers of disadvantage, being in receipt of free school meals is associated with significantly poorer performance throughout (Attainment 8: -3.42, Att8 English: -0.68, Att8 Maths: -0.66 and Progress 8: -0.28). Being a looked after child had a similarly significant effect, although the disparity was even more pronounced (Attainment 8: -9.80, Att8 English: -1.98, Att8 Maths: -1.96 and Progress 8: -0.66). Across all measures, there is a significant negative association between absence rates and attainment/progression, with an increase in absence rate corresponding with a decrease in all outcome measures (Attainment 8: -0.42, Att8 English: -0.08, Att8 Maths: -0.08 and Progress 8: -0.04). Interpreting these tests, the four negative values indicate a mean reduction in score for every 1% increase in absence from zero.

Given that the effect on all measures appears to be most affected by KS2 prior attainment, the data file was split into the three bands (high, middle, and low prior attainment) to determine if any of the factors affected these groups of pupils differently. Since the pattern of findings for Att8 English and Att8 Maths appears to broadly replicate overall Attainment 8 findings, this was only performed for Attainment 8 and Progress 8. The overall ranges, quartiles and medians of Attainment 8 and Progress 8, in the form of boxplots, are broken down by KS2 prior attainment bands for each school, shown in Figure 4, with coefficients for the models shown in Tables 18 and 19.

Figure 4. Boxplots of (A) Attainment 8 and (B) Progress 8 for each school broken down by KS2 Prior Achievement Band. Heavy line indicates median with the box containing the central 50% of scores. Whiskers indicate 95% confidence intervals with outliers shown as dots



³While 'care experienced child' is the preferred terminology, the dataset uses 'looked after child', and this term will be used to prevent confusion in the analyses

Table 18. Individual level effects on Attainment 8 broken down by KS2 prior achievement band

Fixed Effects	High KS2 band		Mid KS2 band		Low KS2 band	
	Estimate (S.E.)	p	Estimate (S.E.)	p	Estimate (S.E.)	p
Intercept	67.39 (1.48)	<.001	51.09 (1.03)	<.001	35.60 (1.32)	<.001
Gender (M v F)	-3.19 (1.05)	.002	-2.16 (0.67)	.001	-1.16 (0.95)	.22
<i>Ethnicity</i>						
Asian v White	4.04 (2.17)	.06	8.32 (1.61)	<.001	3.02 (2.25)	.18
Black v White	-5.59 (6.31)	.38	5.80 (3.88)	.14	7.02 (5.02)	.16
Mixed v White	8.99 (3.50)	.01	2.19 (2.41)	.37	3.74 (3.01)	.23
Other v White	14.43 (12.63)	.25	5.25 (4.98)	.29	-	
Suspended v never	-11.67 (2.79)	<.001	-10.05 (1.30)		-6.20 (0.96)	<.001
<i>SEN status</i>						
SEN support v none	-6.45 (2.03)	.002	-5.24 (1.15)	<.001	-5.94 (0.96)	<.001
EHCP v none	-11.92 (9.00)	.19	-3.07 (3.25)	.35	-9.77 (2.00)	<.001
In receipt of FSM	-4.17 (1.23)	.001	-3.70 (0.72)	<.001	-4.63 (3.07)	.01
Looked after v not	0.12 (6.34)	.99	-12.14 (2.88)	<.001	-4.63 (3.07)	.13
Percentage attendance	-0.56 (0.04)	<.001	-0.45 (0.02)	<.001	-0.30 (0.02)	<.001
AIC	5530.01		11664.29		3758.50	
BIC	5593.75		11738.59		3813.45	
Pseudo R2 (fixed)	0.33		0.39		0.41	
Pseudo R2 (total)	.42		0.44		0.49	

When looking at the three KS2 attainment groups individually, it appears that whilst broadly the same factors influence each group, there are some differences. Particular care should be taken when considering the effect of ethnicity, as there was considerable sorting by group, and after sorting, the size of the groups other than White or Asian became particularly small. However, across ethnicity in general, the performance advantage of Asian / British Asian children was maintained. Similarly, the differing effects of SEN status seen here are partly accounted for by different numbers in each KS2 prior group. For instance, 41% of the children in the lower KS2 band have SEN support / EHCP compared to only 6.7% in the highest KS2 band. Regarding attainment measures, those with an EHCP score considerably lower than those with no SEN status in the low prior attainment group, but do not differ in the middle or high prior attainment groups. Additionally, those with an EHCP do not differ in their progress scores

compared to the no SEN cohort across all prior attainment groups. In contrast, those with SEN support had lower scores than those in the non-SEN cohort across all performance groups on all metrics except for their Progress 8 scores in the high prior attainment band.

There are only 4 looked after children in the high KS2 performance group, making these results difficult to interpret. However, Tables 18 and 19 suggest that looked after status has the most deleterious effect on those in the middle performing group.

There are some variables that vary systematically across the three prior attainment groups, such as gender, suspension, receiving free school meals, and the impact of absence. This was probed by repeating the modelling, including the interaction of each variable with prior attainment, and checking for an increase in explanatory value.

Table 19. Individual level effects on Progress 8 broken down by KS2 prior achievement band

Fixed Effects	High KS2 band		Mid KS2 band		Low KS2 band	
	Estimate (S.E.)	p	Estimate (S.E.)	p	Estimate (S.E.)	p
Intercept	0.05 (0.13)	.73	0.32 (0.09)	.002	0.44 (0.13)	.002
Gender (M v F)	-0.27 (0.10)	.007	-0.24 (0.06)	<.001	-0.11 (0.09)	.22
<i>Ethnicity</i>						
Asian v White	0.37 (0.20)	.07	0.98 (0.15)	<.001	0.58 (0.21)	.007
Black v White	-0.54 (0.60)	.37	0.79 (0.36)	.03	0.71 (0.47)	.13
Mixed v White	0.91 (0.33)	.006	0.32 (0.22)	.16	0.75 (0.29)	.01
Other v White	1.07 (1.19)	.37	0.57 (0.46)	.22	-	
Suspended (v never)	-1.44 (0.26)	<.001	-0.75 (0.12)	<.001	-0.64 (0.13)	<.001
<i>SEN status</i>						
SEN support v none	-0.53 (0.19)	.006	-0.50 (0.11)	<.001	-0.15 (0.09)	.10
EHCP v none	-1.05 (0.85)	.22	-0.05 (0.30)	.87	-0.19 (0.19)	.31
In receipt of FSM	-0.29 (0.12)	.01	-0.31 (0.07)	<.001	-0.18 (0.09)	.04
Looked after v not	0.46 (0.60)	.44	-0.95 (0.27)	<.001	-0.52 (0.29)	.07
Percentage attendance	-0.05 (0.003)	<.001	-0.04 (0.002)	<.001	-0.03 (0.002)	<.001
AIC	2277.803		4628.86		1421.09	
BIC	2341.54		4703.15		1476.04	
Pseudo R2 (fixed)	0.33		0.41		0.36	
Pseudo R2 (total)	0.40		0.45		0.45	

The apparent difference in effect of gender across the prior attainment groups is not significant for either Attainment 8 or Progress 8 (Attainment 8: $\chi^2(2) = 2.05, p=.36$; Progress 8: $\chi^2(2) = 3.56, p=.17$). However, there are significant interactions between prior attainment and suspension status for both outcome variables (Attainment 8: $\chi^2(2) = 14.67, p<.001$; Progress 8: $\chi^2(2) = 21.33, p<.001$). Interactions were also detected between prior attainment and absence (Attainment 8: $\chi^2(2) = 55.87, p<.001$; Progress 8: $\chi^2(2) = 68.81, p<.001$), and being in receipt of free school meals (Attainment 8: $\chi^2(2) = 10.36, p=.005$; Progress 8: $\chi^2(2) = 9.51, p=.008$). In all cases, the interaction effect is such that the effect is greater in those with high KS2 attainment. For example, the impact of exclusion, absence, or being in receipt of free school meals is greater on both progression and attainment in the high prior attainment band than the middle and low bands, with the effect also being greater in the

middle band than the low band. The interaction between attendance and prior attainment bands is broken down by school in Figures 5 (Attainment 8) and 6 (Progress 8). Short or absent lines in these plots indicate a lack of data in that particular combination of variables. Given that receiving a suspension and being in receipt of free school meals are binary variables, similar graphical presentation is not possible.

Figure 5. Line plots demonstrating the relationship between percentage absence and Attainment 8 for each school broken down by KS2 prior attainment group. Each line represents a KS2 prior attainment group, and the direction of the line indicates the best fit for each set of data points.

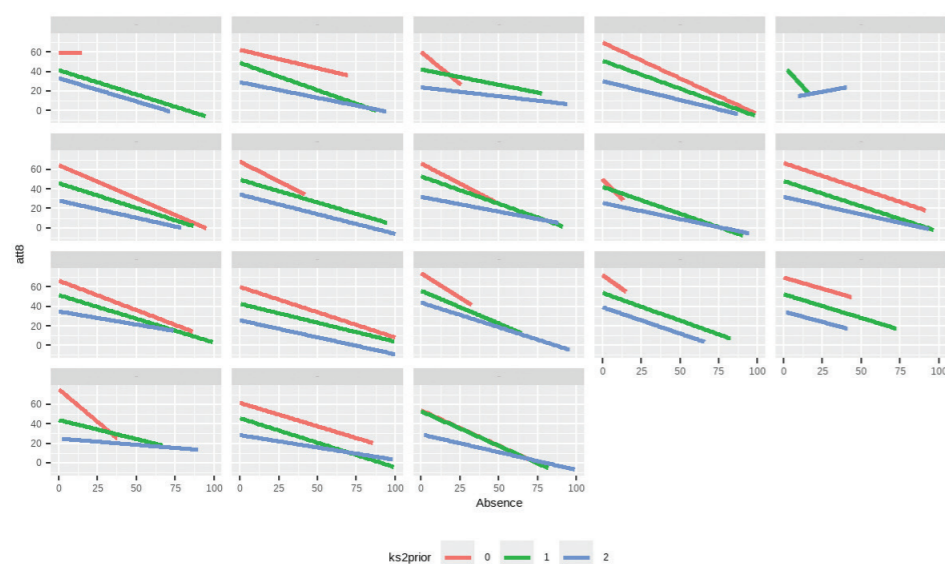
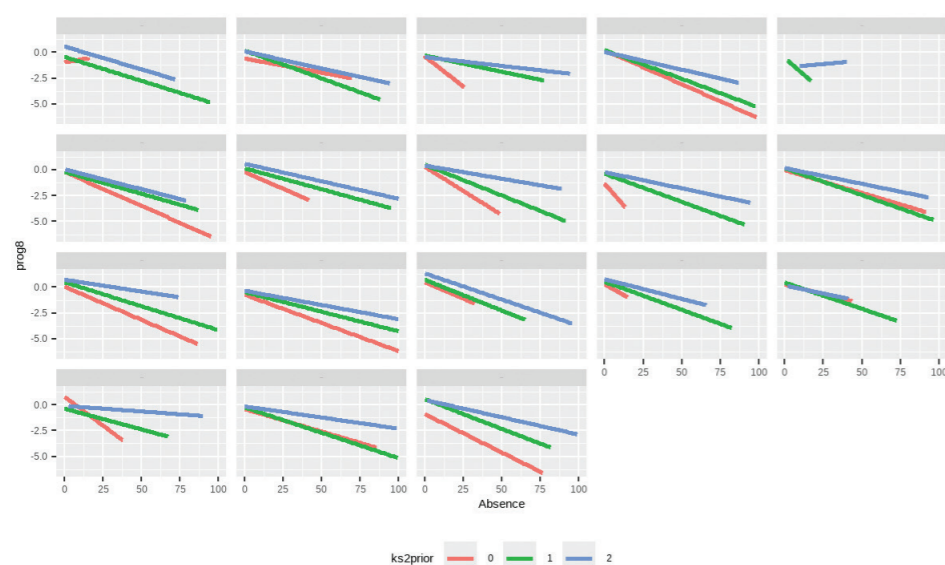


Figure 6. Line plots demonstrating the relationship between percentage absence and Progress 8 for each school broken down by KS2 prior attainment group. Each line represents a KS2 prior attainment group, and the direction of the line indicates the best fit for each set of data points.



3.2.2 2022/23 COHORT – SUMMARY OF FINDINGS

3.2.2.1 SCHOOL-LEVEL AND INDIVIDUAL-LEVEL FACTORS

- All four outcome measures in this section differed significantly across schools (see Figure 3)
- Despite significant variation across schools, school-level effects (e.g proportion of school eligible for free school meals or proportion of school who had received at least one suspension) only accounted for between 7-9% of outcome variability
- The two small school-level effects observed were:
 - Proportion of children eligible for free school meals at each school and Attainment 8, Att8 English and Att8 Maths scores
 - Average attendance at each school and Progress 8 scores
- Once individual-level factors were added to the multi-level model, there were no longer any significant school-level factors
- The significant individual-level effects were broadly similar across all four outcome measures
 - KS2 prior attainment band had the largest effect, with high prior attainers more likely to score higher on Attainment 8, Att8 English and Att8 Maths
 - Conversely, low prior attainers were more likely to have higher Progress 8 scores
 - Girls scored significantly higher than boys on Attainment 8, Att8 English, and Progress 8
 - Boys scored significantly higher than girls on Att8 Maths
 - Asian and British Asian students scored significantly higher on all outcome measures than White/White British and Black/Black British students
 - Receiving at least one suspension had a significant negative effect on all four outcome measures
 - Pupils on an EHCP were significantly more

likely to receive lower Attainment 8 and Att8 English scores than those on SEN support, or without any SEN support

- Att8 Maths scores were significantly for pupils with no SEN support
- Progress 8 scores were only significantly lower for SEN support pupils, as opposed to those with no SEN support and those with an EHCP
- Eligibility for free school meals was significantly associated with poorer scores on all four outcome measures
- Being a looked after child had a similar (but more pronounced) effect to free school meal eligibility
- There is a significant association between higher absence rates and poorer scores on all four outcome measures

3.2.2.2 INTERACTIONS BETWEEN KS2 PRIOR ATTAINMENT BANDS AND OTHER INDIVIDUAL-LEVEL FACTORS

- Boxplot A in Figure 4 demonstrates that, in all schools, Attainment 8 medians and quartiles aligned with pupils' prior attainment bands.
- In Figure 4 Boxplot B however, the relationship between Progress 8 and prior attainment band appears to be less obvious.
- Once the pupils were broken down by prior attainment band, attempting to determine the effect of some factors such as ethnicity became problematic, as the sample sizes of each subgroup became small.
 - Asian/British Asian pupils maintained their Attainment 8 advantage over White/White British pupils throughout all prior attainment bands
 - Once broken down by prior attainment band, all other ethnic groups became too small to draw meaningful statistical conclusions
- Subgroups broken down by prior attainment band and SEN category also became skewed in some cases, with 41% of the children in the low prior attainment band having SEN support/EHCP compared to only 6.7% in the high prior attainment band
 - In middle and high prior attainment

groups, those with an EHCP do not differ significantly from other pupils regarding Attainment 8, however in the low prior attainment band, in which most EHCP pupils are concentrated, they performed significantly worse than other pupils.

- Pupils with an EHCP also do not differ in Progress 8 scores when compared to other pupils across all prior attainment bands.
- Those with SEN support had lower scores than those in the non-SEN cohort across all performance groups on all metrics except for their Progress 8 scores in the high prior attainment band
- Numbers of looked after children in each subgroup also became very small, but the greatest effects on Attainment 8 were found in the middle prior attainment band compared to pupils who were not looked after
- The effects of gender, suspension, receiving free school meals, and the impact of absence on Attainment 8 and Progress 8 varied systematically depending on pupils' prior attainment band
- Follow-up tests no significant association was found between gender and prior attainment band regarding Attainment 8 or Progress 8 scores
- However, significant effects were

detected for receiving a suspension, absence rates, and free school meal eligibility

- In all cases, the interaction effect is such that the effect of these three factors on Attainment 8 and Progress 8 was greater for pupils in the high KS2 prior attainment band
- Figures 5 and 6 demonstrate the interaction between absence percentage and prior attainment bands for each school, showing that pupils from the high attainment bands tend to have steeper slopes compared to medium and low attainment band pupils

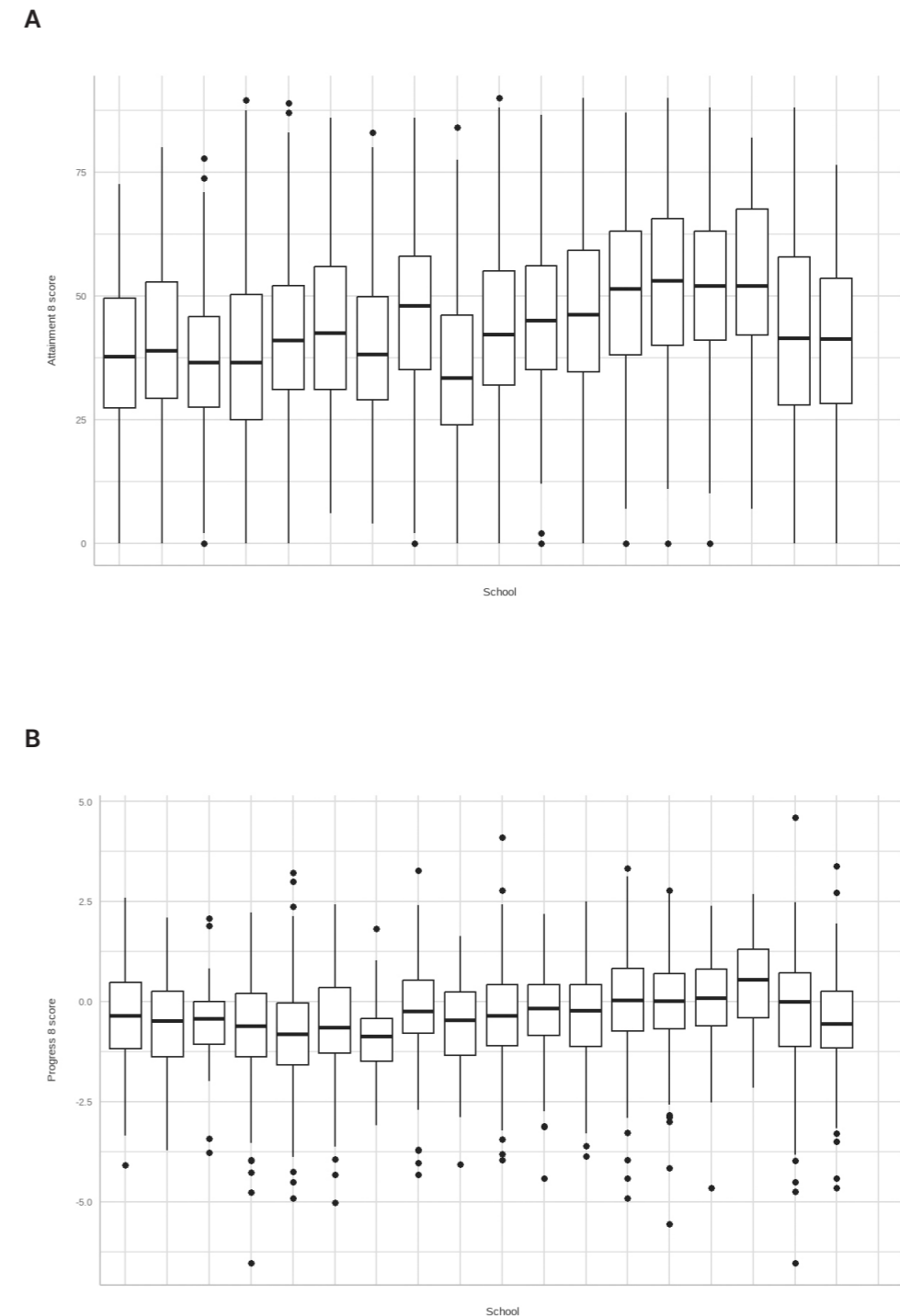
3.2.3 DATA SET COVERING YEARS 2018-19

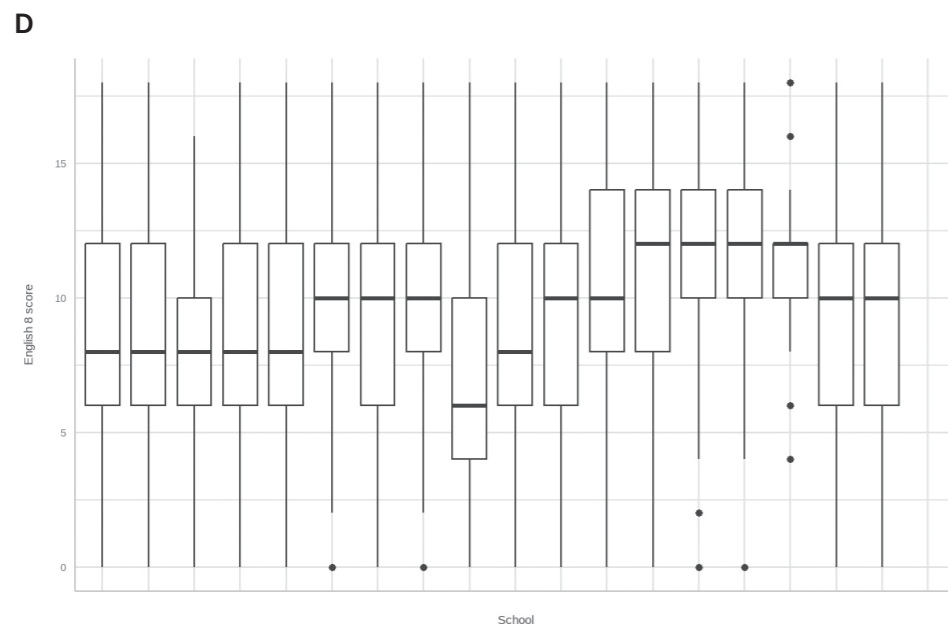
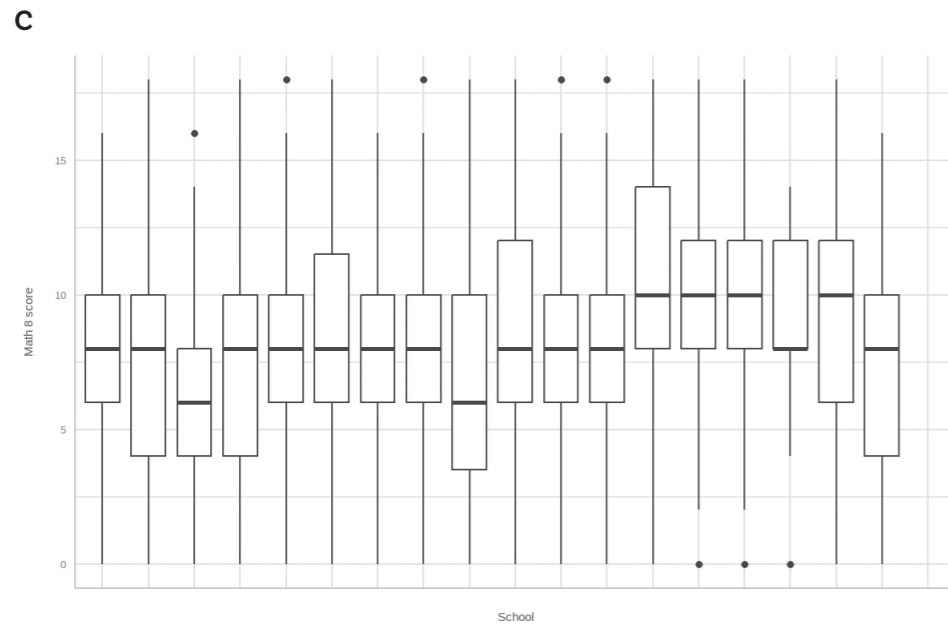
A similar approach was taken to examining the 2018-19 data set and it was used to confirm the findings from the 2022-23 data presented above. Mirroring the 2022-23 data, analysis using a one-way ANOVA confirms that all four metrics differ significantly across schools (Attainment 8 $F(16, 2964) = 14.64, p < .001$; Att8 English $F(16, 2965) = 15.44, p < .001$; Att8 Maths $F(16, 2695) = 10.37, p < .001$; Progress 8 $F(16, 2659) = 8.96, p < .001$) as shown in Figure 7, confirming that a multi-level approach was needed. Initial intercept-only models were fitted yielding the ICCs for the base models as shown in Table 20.

Table 20. Intraclass correlation coefficients for null (intercept only) models for each outcome variable for the 2018-2019 data set

Outcome variable	Intraclass Correlation Coefficient (ICC)
Attainment8	0.090
Att8 English	0.092
Att8 Maths	0.066
Progress8	0.062

Figure 7. Boxplots of (A) Attainment 8, (B) Attainment 8 English, (C) Attainment 8 Maths and (D) Progress 8 for each school for the 2018-19 data set. Heavy line indicates median with the box containing the central 50% of scores. Whiskers indicate 95% confidence intervals with outliers shown as dots





The ICCs are generally very small and are in the same order as those in the 2022-23 data. Given these observations, and the non-significance of the contextual school-level variables in the 2022-23 data once individual factors were fitted to the model, the decision was made to omit the school level factors and fit the individual factors directly. The procedure for the 2022-2023 data set was replicated for the 2018-19 data set, and the following final models were obtained as shown in Table 21.



Table 21. Individual level effects on Attainment 8 broken down by KS2 prior achievement band for the 2019-2019 cohort

Outcome variable: Fixed Effects	Attainment 8 Estimate (S.E.)	95% C.I.	p
Intercept	61.94 (0.90)	60.30 – 63.65	<.001
Gender (M v F)	-3.90 (0.49)	-4.87- -2.98	<.001
<i>Ethnicity</i>			
Asian v White	6.44 (1.26)	3.92 – 8.98	<.001
Black v White	0.01 (2.73)	-5.51 – 5.83	.98
Mixed v White	4.05 (2.97)	-0.81 – 9.62	.06
Other v White	10.68 (5.77)	-1.01 – 23.05	<.001
<i>KS2 Prior attainment</i>			
Mid v High	-16.32 (0.50)	-17.28 – -15.35	<.001
Low v High	-26.38 (0.88)	-27.97 – -24.53	<.001
Unknown v High	-18.20 (2.22)	-22.46 – -13.65	<.001
Suspended (v never)	-6.78 (1.14)	-9.14.677 – -	<.001
<i>SEN status</i>			
SEN support v none	-5.90 (0.77)	-7.21 – -4.23	<.001
EHCP v none	-9.93 (1.70)	-13.34 – -6.44	<.001
In receipt of FSM	-3.33 (0.53)	-4.34 – -2.37	<.001
Looked after v not	-2.46 (2.02)	-6.79 – 1.26	.22
Percentage attendance	-0.46 (0.02)	-0.51 – -0.42	<.001
AIC	19469.97		
BIC	19569.13		
Pseudo R2 (fixed)	0.58		
Pseudo R2 (total)	0.61		

Outcome variable: Fixed Effects	Att8 English Estimate (S.E.)	95% C.I.	p
Intercept	13.39 (0.20)	12.92 - 13.68	<.001
Gender (M v F)	-1.45 (0.12)	-1.67 - -1.21	<.001
<i>Ethnicity</i>			
Asian v White	1.09 (0.30)	0.47 - 1.65	<.001
Black v White	0.28 (0.65)	-0.96 - 1.51	.68
Mixed v White	1.56 (0.67)	-1.40 - 3.85	.02
Other v White	1.40 (1.38)		.31
<i>KS2 Prior attainment</i>			
Mid v High	-2.99 (0.12)	-3.21 - -2.74	<.001
Low v High	-4.90 (0.53)	-5.38 - -4.47	<.001
Unknown v High	-4.01 (0.21)	-5.508 - -2.92	<.001
Suspended v never	-1.19 (0.27)	-1.73 - -0.62	<.001
<i>SEN status</i>			
SEN support v none	-1.30 (0.19)	-1.63 - -0.93	<.001
EHCP v none	-2.54 (0.41)	-3.41 - -1.71	<.001
In receipt of FSM	-0.62 (0.13)	-1.29 - -0.72	<.001
Looked after v not	-0.32 (0.48)	-1.29 - 0.72	.51
Percentage attendance	-0.09 (0.005)	-0.10 - 0.08	<.001
AIC	12298.79		
BIC	12397.94		
Pseudo R2 (fixed)	0.48		
Pseudo R2 (total)	0.51		

Outcome variable: Fixed Effects	Att8 Maths Estimate (S.E.)	95% C.I.	p
Intercept	11.91 (0.19)	11.54 - 12.28	<.001
Gender (M v F)	0.11 (0.11)	-0.10 - 0.33	.32
<i>Ethnicity</i>			
Asian v White	1.11 (0.27)	0.57 - 1.65	<.001
Black v White	-0.02 (0.62)	-1.15 - 1.24	.98
Mixed v White	0.21 (0.63)	-1.02 - 1.46	.74
Other v White	2.77 (1.31)	0.33 - 5.29	.03
<i>KS2 Prior attainment</i>			
Mid v High	-3.93 (0.11)	-4.13 - -3.72	<.001
Low v High	-6.76 (0.20)	-7.18 - -6.37	<.001
Unknown v High	-4.45 (0.50)	-5.41 - -3.35	<.001
Suspended v never	-1.01 (0.26)	-1.49 - -0.79	<.001
<i>SEN status</i>			
SEN support v none	-1.12 (0.18)	-1.45 - -0.79	<.001
EHCP v none	-1.81 (0.39)	-2.58 - -1.04	<.001

Outcome variable: Fixed Effects	Att8 Maths Estimate (S.E.)	95% C.I.	p
In receipt of FSM	-0.74 (0.12)	-0.96 - -0.50	<.001
Looked after v not	-0.43 (0.46)	-1.34 - 0.41	.35
Percentage attendance	-0.08 (0.005)	-0.09 - -0.07	<.001
AIC	12017.38		
BIC	12116.54		
Pseudo R2 (fixed)	0.56		
Pseudo R2 (total)	0.59		

Outcome variable: Fixed Effects	Progress 8 Estimate (S.E.)	95% C.I.	p
Intercept	0.11 (0.09)	-0.06 - 0.27	.22
Gender (M v F)	-0.40 (0.04)	-0.48 - -0.31	<.001
<i>Ethnicity</i>			
Asian v White	0.71 (0.11)	0.49 - 0.92	<.001
Black v White	0.32 (0.25)	-0.22 - 0.81	.20
Mixed v White	0.55 (0.24)	0.05 - 1.02	.02
Other v White	0.84 (0.58)	-0.33 - 2.03	.15
<i>KS2 Prior attainment</i>			
Mid v High	0.34 (0.04)	0.25 - 0.44	<.001
Low v High	0.72 (0.08)	0.57 - 0.88	<.001
Unknown v High	N/A	-	-
Suspended (v never)	-0.74 (0.10)	-0.92 - -0.55	<.001
<i>SEN status</i>			
SEN support v none	-0.29 (0.07)	-0.42 - -0.16	<.001
EHCP v none	-0.38 (0.15)	-0.53 - -0.07	<.001
In receipt of FSM	-0.24 (0.05)	-0.33 - -0.15	<.001
Looked after v not	-0.16 (0.18)	-0.53 - 0.23	.36
Percentage attendance	-0.04 (0.002)	-0.05 - 0.04	<.001
AIC	7172.46		
BIC	7265.61		
Pseudo R2 (fixed)	0.29		
Pseudo R2 (total)	0.35		

Broadly, the findings are extremely similar across the two years with very similar relationships shown. In both cases, the largest effects are due to KS2 prior attainment with gender, being in receipt of free school meals, suspension, ethnicity, SEN status, and level of absence having similar magnitudes and directions of effect. Notably, the gender difference in Att8 Maths attainment is not apparent in the 2018-19 data set (whereas in 2022-23, boys outperform girls). Importantly, in the 2018-19 data set, the effect of being a looked after child is non-significant (whereas it is a significant negative factor related to all outcomes in 2022-23).

The large impact of KS2 prior attainment found in the 2022-23 data set was also identified in the 2018-19 data set, therefore, the process of splitting the data by prior attainment band and subsequent analysis was repeated, as shown in Tables 21 and 23.

In Tables 22 and 23, the pattern of outcomes is very similar to that seen in the 2022-23 data set. Given the absence of children in some categories, ethnicity effects are difficult to determine. In alignment with the 2022-23 data, children with an EHCP scored lower on Attainment 8 than those with no SEN status if they were in the low prior attainment group. However, in the 2018-2019 data, this pattern is also seen in the middle prior attainment group, which was also the case for children with SEN support (but no EHCP).

Lower Progress 8 scores were found in the low prior attainment group for children with either an

EHCP or SEN support, while only children with SEN support had lower Progress 8 scores in the middle prior attainment group. These differences across prior attainment groups and cohorts are based on relatively small numbers and should be treated with some caution, although the subject could be worth further investigation.

Another similarity to the 2022-23 data was the systematic variance of gender, suspension, being in receipt of free school meals, and the impact of absence across the three prior attainment groups. This was probed by repeating the modelling, including the interaction of each variable with prior attainment, and checking for an increase in explanatory value.

The apparent difference in effect of gender across the prior attainment groups is not significant for either Attainment 8 or Progress 8 (Attainment 8: $\chi^2(2) = 1.28, p = .53$; Progress 8: $\chi^2(2) = 3.92, p = .14$). However, both Attainment 8 and Progress 8 are affected by significant interactions between prior attainment and suspension status (Attainment 8: $\chi^2(2) = 17.15, p < .001$; Progress 8: $\chi^2(2) = 14.41, p < .001$), absence (Attainment 8: $\chi^2(2) = 58.12, p < .001$; Progress 8: $\chi^2(2) = 55.61, p < .001$) and being in receipt of free school meals (Attainment 8: $\chi^2(2) = 23.43, p < .001$; Progress 8: $\chi^2(2) = 15.86, p < .001$). As in the 2022-23 cohort, the interaction effect is such that the effect is greater in those with high KS2 attainment – i.e. the impact of exclusion, absence or being in receipt of free school meals is greater on both progression and attainment in those in the high compared to middle, compared to low prior attainment bands.



Table 22. Individual level effects on Attainment 8 broken down by KS2 prior achievement band for the 2019-2019 cohort

Fixed Effects	High KS2 band		Mid KS2 band		Low KS2 band	
	Estimate (S.E.)	p	Estimate (S.E.)	p	Estimate (S.E.)	p
Intercept	63.74 (1.04)	<.001	45.04 (0.97)	<.001	31.35 (1.42)	<.001
Gender (M v F)	-4.42 (0.80)	<.001	-3.80 (0.67)	<.001	-2.47 (1.22)	.04
<i>Ethnicity</i>						
Asian v White	6.14 (2.0)	.002	7.07 (1.89)	<.001	5.66 (2.94)	.06
Black v White	2.29 (4.62)	.62	-0.98 (3.55)	.78	-	-
Mixed v White	0.15 (3.88)	.97	9.41 (4.72)	.05	11.88 (6.93)	.08
Other v White	10.56 (7.06)	.14	-	-	-	-
Suspended v never	-12.00 (2.38)	<.001	-4.89 (1.36)	<.001	-5.80 (2.69)	.03
<i>SEN status</i>						
SEN support v none	-2.92 (1.69)	.09	-7.46 (1.02)	<.001	-4.54 (1.29)	.001
EHCP v none	-3.45 (6.11)	.57	-7.51 (2.87)	.009	-11.94 (1.93)	<.001
In receipt of FSM	-5.33 (0.96)	<.001	-2.5 (0.68)	<.001	-1.89 (1.24)	.13
Looked after v not	-9.86 (4.68)	.04	0.55 (2.86)	.85	0.79 (2.93)	.79
Percentage attendance	-0.68 (0.05)	<.001	-0.46 (0.03)	<.001	-0.26 (0.04)	<.001
AIC	8670.14		8432.55		1973.99	
BIC	8740.27		8497.79		2017.17	
Pseudo R2 (fixed)	0.26		0.35		0.31	
Pseudo R2 (total)	0.31		0.41		0.35	

Table 23. Individual level effects on Progress 8 broken down by KS2 prior achievement band for the 2018-2019 cohort

Fixed Effects	High KS2 band		Mid KS2 band		Low KS2 band	
	Estimate (S.E.)	p	Estimate (S.E.)	p	Estimate (S.E.)	p
Intercept	0.28 (0.11)	.018	0.39 (0.09)	<.001	0.41 (0.13)	.002
Gender (M v F)	-0.46 (0.07)	<.001	-0.41 (0.06)	<.001	-0.17 (0.11)	.14
<i>Ethnicity</i>						
Asian v White	0.57 (0.17)	.001	0.89 (0.18)	<.001	0.63 (0.27)	.02
Black v White	0.50 (0.38)	.19	0.13 (0.33)	.69	-	-
Mixed v White	0.32 (0.32)	.33	0.96 (0.44)	.03	0.78 (0.64)	.22
Other v White	0.73 (0.20)	.22	-	-	-	-
Suspended v never	-1.13	<.001	-0.55 (0.13)	<.001	-0.65 (0.25)	.01
<i>SEN status</i>						
SEN support v none	0.07 (0.14)	.60	-0.45 (0.10)	<.001	-0.21 (0.12)	.07
EHCP v none	0.44 (0.51)	.39	-0.30 (0.27)	.27	-0.54 (0.18)	.002
In receipt of FSM	-0.36 (0.08)	<.001	-0.17 (0.06)	.007	-0.15 (0.11)	.18
Looked after v not	-1.12 (0.34)	.004	0.14 (0.27)	.61	0.11 (0.27)	.69
Percentage attendance	-0.06 (0.004)	<.001	-0.04 (0.002)	<.001	-0.03 (0.004)	<.001
AIC	3227.76		3193.89		732.19	
BIC	3297.89		3259.13		775.37	
Pseudo R2 (fixed)	0.28		0.35		0.26	
Pseudo R2 (total)	0.37		0.40		0.30	



3.2.4 2018/2019 COHORT – SUMMARY OF FINDINGS

3.2.4.1 SCHOOL-LEVEL AND INDIVIDUAL-LEVEL FACTORS

- All four outcome metrics (Attainment 8, English 8, Maths 8 and Progress 8) differ significantly between schools
 - This can also be seen in the Figure 7 boxplots
- School-level effects initially accounted for 6-9% variability in outcome measures (Table 20)
- Any school-level effects were non-significant once individual-level factors were added to the model
- Individual-level effects were similar to those in the 2022/23 cohort in both magnitude and direction
 - KS2 prior attainment band was the most impactful individual-level factor
 - Girls significantly outperformed boys in Attainment 8, Att8 English and Progress 8 scores, but boys no longer outperformed girls in Att 8 Maths scores
 - Pupils in the following categories performed significantly worse than their counterparts:
 - Pupils eligible for free school meals
 - Pupils who received a suspension
 - White/White British and Black/Black British pupils
 - Pupils with an EHCP or with SEN support
 - Pupils with higher absence rates
- Being a looked after child was not a significant risk factor in receiving poor attainment and progress outcomes, contrary to its severe effect in the 2022/23 cohort
- 3.2.2.2 Interactions between KS2 prior attainment bands and other individual-level factors
- Many similarities in the interaction effects between KS2 prior attainment and other individual-level factors between the 2018/19 cohort and the 2022/23 cohort



- It was difficult to determine the effect of gender as the Gender x Prior attainment band subgroups were small
- The negative effect of having an EHCP or SEN support was of a significantly disproportionate magnitude for pupils in the high prior attainment band
 - However, contrary to the 2022/23 cohort, this was also the case for those on SEN support in the middle prior attainment band
 - Pupils in the low prior attainment band were also significantly more likely to have poorer Progress 8 scores if they had SEN support or an EHCP
 - All of these observations are based on low sub-group numbers, so caution must be taken in interpreting these figures
- Further testing revealed that, similar to the 2022/23 cohort, there was systematic variation between prior attainment bands with regards to three key risk factors
 - Those in the high prior attainment bands were disproportionately affected by:
 - Suspensions
 - Absence rates
 - Free school meal eligibility

3.2.5 SCHOOL-LEVEL FACTORS, INDIVIDUAL-LEVEL FACTORS AND INTERACTIONS ACROSS BOTH 2018/19 AND 2022/23 COHORTS – SUMMARY OF FINDINGS

In summary, across both cohorts, a similar pattern has been observed in the relationship between factors in the data set and attainment and progression:

1. School-level factors explain a small amount of variability between outcomes, but these are non-significant once individual level factors are accounted for. There are weak relationships between the school-level factor of free school meals and attainment (lower attainment in schools with higher proportions of those in receipt of free school meals), and between school average attendance and progression (higher progression in schools with higher average attendance).
2. Individual level factors can account for the majority of variability in attainment and progression, with the effects on Attainment 8, Att8 English, and Att8 Maths being extremely similar.
3. The largest influence on attainment and progression is KS2 prior attainment – with higher performance being linked to higher attainment and lower performance to higher progression.
4. Across all cohorts and performance groups there are relatively small effects of gender (girls score significantly higher, though this difference is reversed for Att8 Maths in the most recent cohort and is much smaller and non-significant in the low KS2 prior attainment groups, possibly due to girls' performance dropping to meet the boys).
5. There are some differences due to ethnicity but given small numbers in cohorts other than White/ White British, the significance of these is difficult to determine. Generally, Asian/British Asian children score higher on attainment and progress measures than both White/White British and Black/Black British children. Children of mixed race and 'other' ethnicities perform variably, though the numbers in these cohorts are extremely small.

6. SEN status – both having an EHCP or school SEN support – is associated with lower attainment. The effects on progression and across KS2 prior attainment groups vary with cohort, but numbers are low, and care should be taken not to overanalyse minor differences in subgroups.
7. In the 2022-23 cohort, being cared for is associated with lower attainment and progress scores, but this effect is not present in the 2018-19 data set.
8. Suspension has a strong relationship with lower attainment and progress scores, and this varies by prior attainment group, with the effect most apparent in those with highest prior attainment.
9. Being in receipt of free school meals is related to lower attainment and progress scores in all groups. This effect is also strongest in those with highest prior attainment.
10. Absence from school has a consistent negative relationship with attainment and progress scores. This effect is also strongest in those with highest prior attainment.

3.2.6 ADDITIONAL ANALYSIS – EFFECTS OF AND ASSOCIATIONS WITH SUSPENSION

Given the large effect of suspension on attainment, some further modelling was performed to determine the relationship between length of suspension and attainment. The final models for each cohort were re-calculated, replacing the binary variable of “has ever been suspended” with a scale variable indicating the total length of combined suspensions.

Results of this analysis are shown in Table 24. Individual-level effects are similar across both cohorts, with the intercepts demonstrating an increase in overall performance in Attainment 8 between the years. Notably, while length of suspension is a significant factor in both cohorts, the coefficients are markedly different; each day of suspension in 2018-19 was associated with a drop in performance of 6.89 points, but only a drop of 1.83 points in the 2022-23 cohort. Reasons for this change in the size of the effect are unclear and cannot be determined from this data set.

Table 24. Final models for cohorts 22-23 and 18-19 replacing “suspended” variable with total length of combined suspensions

Years	2022-23		2018-19	
	Estimate (S.E.)	p	Estimate (S.E.)	p
Fixed Effects				
Intercept	65.89 (1.05)	<0.001	61.94 (0.89)	<0.001
Gender (M v F)	-2.40 (0.50)	<0.001	-3.90 (0.49)	<0.001
<i>Ethnicity</i>				
Asian v White	6.19 (1.14)	<0.001	6.44 (1.26)	<0.001
Black v White	-0.34 (2.19)	.88	0.01 (2.73)	.99
Mixed v White	3.90 (1.70)	.02	4.05 (2.79)	.15
Other v White	9.45 (4.12)	.02	10.68 (5.77)	.06
<i>KS2 Prior attainment</i>				
Mid v High	-15.21 (0.57)	<0.001	-16.32 (0.50)	<0.001
Low v High	-26.84 (0.77)	<0.001	-26.38 (0.88)	<0.001
Unknown v High	-17.24 (1.82)	<0.001	-18.19 (2.22)	<0.001
<i>SEN status</i>				
SEN support v none	-6.06 (0.75)	<0.001	-5.90 (0.77)	<0.001
EHCP v none	-8.77 (1.82)	<0.001	-9.93 (1.70)	<0.001
In receipt of FSM	-3.54 (0.54)	<0.001	-3.33 (0.53)	<0.001
Looked after v not	-9.75 (2.09)	<0.001	-2.46 (2.02)	.22
Percentage attendance	-0.43 (0.01)	<0.001	-0.46 (0.02)	<0.001
Length of suspensions (days)	-1.83 (0.23)	<0.001	-6.89	<0.001
AIC	21663.24		19469.97	
BIC	21763.94		19569.13	
Pseudo R2 (fixed)	0.58		0.58	
Pseudo R2 (total)	0.61		0.61	

Finally, factors related to the occurrence of suspension were investigated by constructing a generalised linear model for the demographic factors in each year. Initial investigation suggested that, once again, school level factors became non-significant once individual variables were accounted for and so these are not included. Given the relatively small numbers of suspended students, and the grouping by ethnicity and SEN status, it was not possible to include these in this analysis. Factors which predict a pupil being suspended are shown in Table 25.

Notably, the variance explained by the fixed effects (pseudo R²) is a relatively small proportion of the total variance explained, suggesting that contextual (between-school) factors play a part in predicting suspension, though all of those included in this data set were non-significant. This implies that other contextual factors which have not been measured should be investigated in order to fully understand the risk factors for suspension. Across both years, being male is strongly associated with suspension, as is being in receipt of free school meals, with a smaller association present for poor

Table 25. Factors associated with being suspended in both cohorts

Years	2022-23		2018-19	
	Odds Ratio [95% CI]	p	Odds Ratio [95% CI]	p
Fixed Effects				
Intercept	0.01 [0.006 - 0.023]	<0.001	0.01 [0.004 - 0.02]	<0.001
Gender (M v F)	2.43 [1.71 - 3.46]	<0.001	2.47 [1.58 - 3.89]	<0.001
<i>KS2 Prior attainment</i>				
Mid v High	1.59 [0.99 - 2.56]	.055	2.09 [1.32 - 3.31]	.002
Low v High	2.62 [1.55 - 4.42]	<0.001	1.34 [0.67 - 2.67]	.42
In receipt of FSM	2.23 [1.59 - 3.15]	<0.001	1.85 [1.21 - 2.82]	.004
Looked after v not	0.93 [0.25 - 3.41]	.91	4.72 [1.71 - 13.03]	<.001
Percentage attendance	1.02 [1.01 - 1.03]	<.001	1.03 [1.02 - 1.05]	.003
AIC	1168.43		824.14	
BIC	1215.67		870.73	
Pseudo R2 (fixed)	0.15		0.15	
Pseudo R2 (total)	0.34		0.30	

attendance. In both cohorts, those with high KS2 prior attainment scores are the least likely to be suspended. However, the exact pattern differs slightly across cohorts, with the low performing cohort in 2018-19 not at significantly increased risk. A very notable difference is the risk associated with being looked after, which decreased from a considerable 4.72 x in 2018-19 to a non-significant 0.93 in 2022-23. However, the reason for this difference is not evident in the provided data set.

3.2.7 ADDITIONAL ANALYSIS – YEAR-ON-YEAR DIFFERENCES

Year-on-year differences are as shown in Table 26. Differences in proportion were examined using the chi-square test and differences in numerical variables examined using the Welch corrected t-test or Mann-Whitney test for non-parametric differences as appropriate

There is no difference in the percentage in receipt of free school meals $\chi^2(1) = 0.24, p=.63$ but there is a significant increase in the proportion of pupils ever suspended $\chi^2(1) = 24.0, p<.001$. There is no change in the proportion of children who have looked after status $\chi^2(1) = 0.63, p=.43$ and no

change in the proportion of these looked after being suspended $\chi^2(1) = 0.62, p=.42$.

There is a marked difference across years with children coming from different KS2 prior attainment bands ($\chi^2(3) = 227.0, p<.001$) with the largest change being the reduction in the proportion in the highest band. None of the attainment measures are significantly different between the two years (attainment8 $p=.85$, English 8 $p=.25$, Maths 8 $p = 0.45$) and a very small but significant reduction in progress 8 ($p=.04$, effect size $d = 0.08 [0.03 - 0.14]$).

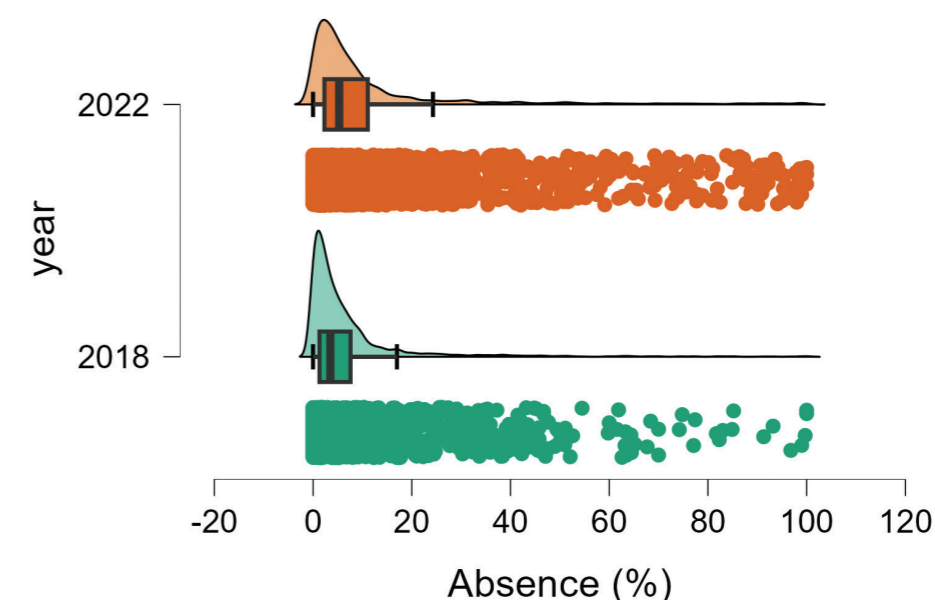
Absence rates are markedly different across the two years ($p<.001$, effect size $d = 0.30 [0.24 - 0.35]$) with the distribution of absence rates changing as shown in the raincloud plot in Figure 8

The differences in outcomes between students of different ethnicities were investigated in the data, but given the small numbers here, few meaningful factors could be determined. Asian students appear less likely to be in receipt of free school meals than white students but all other rates similar. There is a higher proportion of ethnic minority children in the “unknown” KS2 prior achievement group but no other significant differences.

Table 26. Year-on-year differences between the cohorts. Asterisk (*) indicates a significant difference between cohorts

Measure	Cohort	
	2018-19	2022-23
Number in cohort	2712	2926
Free school meals (N, %)	865 (31.9%)	951 (32.5%)
Ever suspended (N, %) *	124 (4.6%)	226 (7.7%)
Looked after status (N, %)	40 (1.5%)	36 (1.2%)
If looked after ever suspended (N, %)	7 (17.5%)	4 (11.1)
Percentage Absence (mode, mean (SD)) *	3.5, 7.0 (11.4)	5.3, 11.4 (17.6)
<i>KS2 prior achievement band</i>		
High (N,%) *	1188 (43.8%)	749 (25.6%)
Medium (N,%)*	1201 (44.3%)	1572 (53.8%)
Low (N,%) *	287 (10.6%)	538 (18.4%)
Unknown (N, %) *	36 (1.3%)	67 (2.3%)
<i>Outcome measures (median, mean (SD))</i>		
Attainment 8	44.0, 44.0 (18.4)	44.5, 43.9 (19.8)
English 8	10, 09.6 (4.0)	10, 0,9.4 (4.2)
Maths 8	8.0, 8.5 (4.0)	8.0, 8.6 (4.3)
Progress 8 *	-0.3, -0.4 (1.2)	-0.4, -0.5 (1.5)

Figure 8. Raincloud plot showing absence rates across the two years, and illustrating the marked increase in pupils with higher absence rates in the most recent cohort



4.0 DISCUSSION

4.0 DISCUSSION

The analysis presented here attempts to relate the demographic and educational variables recorded in the provided data set to attainment and progression at KS4, in an attempt to understand the nature and magnitude of these relationships. It must be emphasized that, given the retrospective correlative nature of the analysis, relationships that are demonstrated must not be thought of as causal. This is because it is impossible to determine the direction of any effects from such analysis, and the outcomes will be influenced by a large range of unmeasured factors, many of which will likely also correlate with both predictors and outcomes listed here. For example, being in receipt of free school meals is identified as an important factor, but it is clear that it is not the causal effect of the meals themselves that matters, but rather that being in receipt of them is a marker for some other unmeasured factor or factors such as the effects of socio-economic status, relative poverty, and nutrition.

The analysis concerns two cohorts - those of 2018-19 and 2022-23 - and it is clear that, on the whole, the relationships within this data set are the same for both groups, lending confidence to the analysis. The analysis was also focused on individual-level variables - though it was possible to calculate some school-level variables by aggregating these - so it is possible that other school-level contextual variables, such as historical school performance or teacher to child ratios, influenced attainment and progress outcomes. Future analysis of this or similar data could be broadened by including such data, as well as further individual-level variables outside the educational domain, to obtain a fuller picture of the relationships between these factors and educational outcome.

The school-level factors, which were calculated from the data set or determined from the school website (e.g. religious ethos) were overall non-significant predictors of outcome. There was a small negative relationship between all three attainment measures and the percentage of each school that was receiving school meals (possibly a reflection of relative deprivation of the school cohort) and a small positive relationship between school average attendance and progression. However, once individual factors were accounted for, these relationships no longer explained significant variance in the models, suggesting

that, at least in this data set, the majority of the differences in attainment between pupils is attributable to individual, rather than school, factors.

Across both years, the largest impact on both attainment and progression appears to be the pupil's prior attainment band at KS2 - with those in higher bands having higher achievement as measured by Attainment 8, Att8 English, and Att8 Maths, and those in lower achievement bands experiencing greater progress as measured by Progress 8. The sizes of these effects are by far the largest in the data set (approximately a drop of 15 points between high and middle bands and another 10 points between middle and low bands) and outweigh any other influences. Therefore, it is vital that any intervention aiming to improve attainment at KS4 extends its scope to earlier educational milestones and considers the child's whole educational journey. Achievement in Att8 Maths and Att8 English broadly adheres to Attainment 8 overall, and the factors that affect overall attainment appear to affect Att8 English and Att8 Maths similarly.

Demographic factors have a small but consistent effect. Boys generally score lower than girls (except in Att8 Maths in the 2018-19 cohort) and Asian students tend to outperform White or Black/Black British students. The small numbers of mixed race and 'Other' ethnicity students suggest that any differences are of doubtful significance. It appears that the highest performing students would be Asian girls, whilst the lowest performing would be White or Black/Black British boys.

SEN status is also consistently related to attainment, with the effect of holding an EHCP being larger (approx. 8-9 Attainment 8 points) than receiving school SEN support (approximately 3-4 Attainment 8 points). The effect on progression is of similar direction and relative magnitude.

Being a looked after child* is associated with considerable negative effects on both attainment and progression in the 2022-23 cohort, but the effects in 2018-19 are non-significant. The reason for this difference between years is unknown. However, the number of children in this group is quite small and their distribution across the achievement groups may differ markedly from year to year. The greater disparity between looked

after children and non-looked after children in the most recent cohort may simply reflect random variation due to these small numbers. However, given the change is in the negative direction, it may be prudent to investigate this further and monitor this group carefully.

Thus far, all the effects discussed have been of similar size across prior attainment groups. For the remaining variables, this is not the case – all have largest negative effects in those who were in the high achievement band at KS2 and smallest negative effects in those in the lowest achievement band.

Receiving at least one suspension has a large negative effect on both attainment and progression. In the high KS2 attainment bands, this exceeds the size of the effect of all other factors but is approximately half this size in the lowest achievement group. Additional analysis demonstrates that there is a significant dosage effect of suspension, with **each day** of suspension associated with an average reduction in attainment of -6.89 points in 2018-19, and -1.83 points in 2022-23. While still a considerable daily penalty in the most recent cohort, this is a substantial reduction from the 2018-19 figure. It is not possible to determine why this has shifted between the two cohorts, but it may suggest some change either in who is suspended or in how those suspended are supported. A change in the pattern of suspension may be suggested by examining the factors associated with suspension, which shows that, in the earlier cohort, being in the lowest achievement group was not a factor linked with likelihood of suspension. While the reduction in negative effects is welcome, it would be wise to confirm this with analysis of subsequent years' data, and to attempt to understand the cause of the change.

Being in receipt of free school meals is associated with poorer attainment and progression, as are higher rates of absence. The magnitudes of these changes are consistent in both cohorts and are largest in those who were in the high KS2 attainment band. Receiving at least one suspension is associated both with being in receipt of free school meals, and with a higher rate of absence. This indicates that these three factors are not independent and suggests a pattern of vulnerability to low attainment and poor progression, which is most damaging in those who previously achieved best at KS2. It is possible that

this reflects a subgroup of children who score well at KS2 but are vulnerable (receipt of free school meals indicating relatively lower socio-economic status) and who develop a pattern of poor attendance and behaviour resulting in suspension. Given the factors associated with risk of suspension, it is likely that these are male pupils. It is likely that any intervention to alter this trajectory would be needed early in their secondary school career.

Absence has a remarkably consistent relationship with outcome in both cohorts, but the pattern of absence is markedly different with far more pupils having higher absence rates in the more recent cohort and the median absence almost doubling. Reasons for this should be investigated. It is important to note that as this modelling cannot determine causal relationships, although there is a relationship between absence and lower attainment it is likely that absence rates are a marker of more significant and widespread factors which also lead to poorer outcome. Thus measures which simply increase attendance (e.g. parental fines) would be unlikely to automatically improve attainment and any steps taken to improve this measure need to see absence rates as a symptom or marker of wider issues that are associated with poor outcome.

A final consideration is the magnitude of the overall pseudo-R² values for the models. Although the results presented are all significant, this value helps to understand the proportion of variability in outcome which is not explained by the modelling. Even the best-fitting models used in the present study do not explain 40% of the variability of the outcome variables, and in some cases, unexplained variability rises to 70-80%. This is a reminder that many other unmeasured factors are associated with variability in the outcomes, and the models presented can only be a partial explanation for the patterns observed. Future work could consider what such factors are - whether at school- or individual-level - and whether they include factors beyond those captured in an educational data set, such as socioeconomic status, family factors, and variables associated with physical and mental health. Inclusion of such a wider range of predictive variables could deepen our understanding of the issues of attainment and progression and suggest different targets for successful intervention.

In summary, this analysis has demonstrated that a number of factors are associated with poorer attainment at KS4, the largest being prior attainment at KS2. White male pupils are likely to underachieve compared to Asian female pupils, and poor attendance, being in receipt of free school meals, and suspension are significant contributors to low performance, particularly in those who previously achieved well at KS2. Students with an EHCP score lower than those who receive SEN support, as do looked after

children. A number of these factors interrelate with each other and may result in particular subgroups of pupils who are prone to underachievement. In contrast, school-level effects (as determined from this data set) appear to play only a small role in influencing attainment and progress compared to individual-level factors. Any intervention to target these issues needs to consider the complex interplay of these factors, while recognising that the largest influence is that of prior attainment, therefore, timely support is essential.





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APPENDICES

APPENDIX 1

Table and bar plots for median Att8 and Prog8 scores (and standard deviations) broken down by pupil characteristic – 2018/19

Table 27. KS4 Attainment dataset – Median Att8 and Prog8 scores (and Standard Deviations, SD) for all pupil characteristics and associated categories – 2018/19

Characteristic	Category	Median Att8 Score (SD)	Median Prog8 Score (SD)
Gender	Female	46 (18.53)	-0.105 (1.21)
	Male	40.5 (19.72)	-0.567 (1.29)
Ethnicity	White	43 (19.31)	-0.405 (1.26)
	Asian or Asian British	52 (18.22)	0.699 (1.16)
	Mixed/dual background	45 (20.03)	0.436 (1.51)
	Black or Black British	44 (18.63)	0.640 (1.22)
EAL Category	English	43 (19.27)	-0.402 (1.26)
	EAL	50 (19.84)	0.641 (1.17)
SEN Status	No SEN	46 (17.16)	-0.267 (1.21)
	SEN Support	26 (16.94)	-0.611 (1.43)
	EHC Plan	3 (14.82)	-1.513 (1.24)
Disadvantaged	Disadvantaged	34 (17.86)	-0.714 (1.34)
	Not disadvantaged	48 (18.29)	-0.202 (1.18)
KS2 Prior Attainment Band	High	56 (15.1)	-0.369 (1.29)
	Medium	37 (13.91)	-0.325 (1.29)
	Low	19 (13.55)	-0.479 (1.13)

Figure 9. KS4 Attainment dataset - Bar plot of median Att8 scores by pupil characteristics in 2018/19

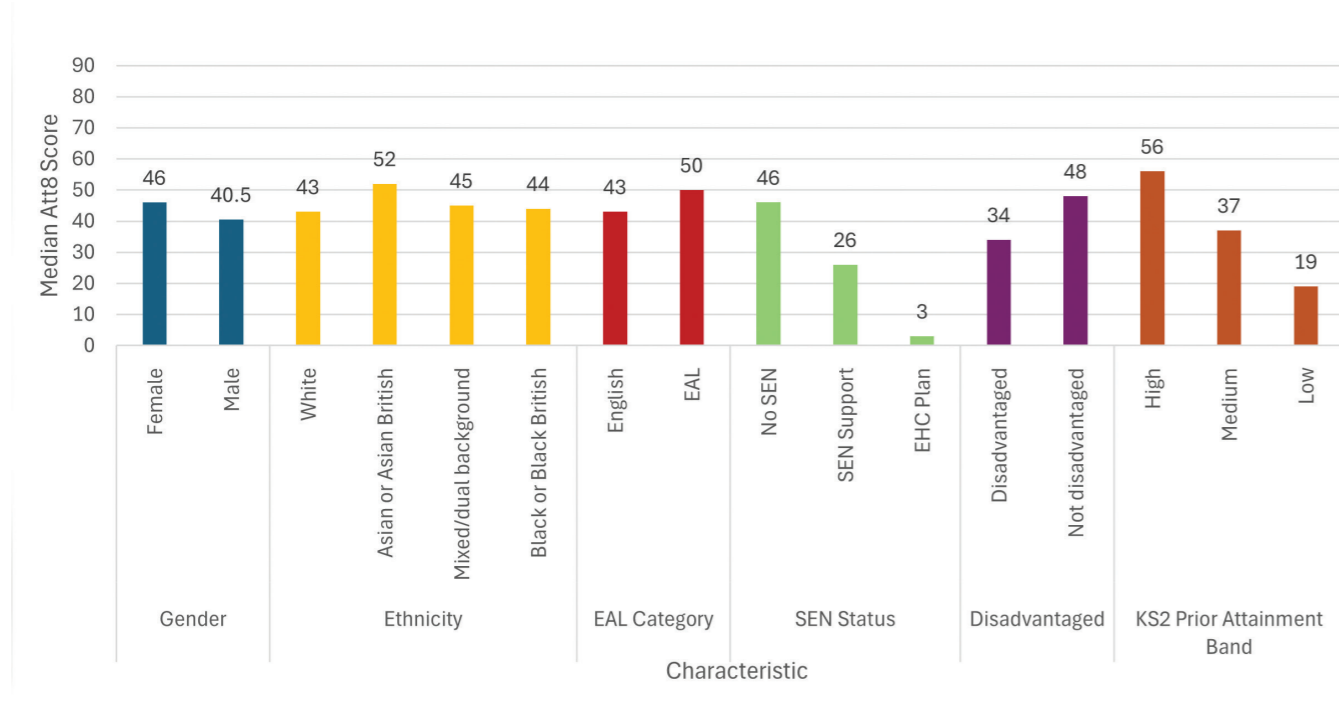
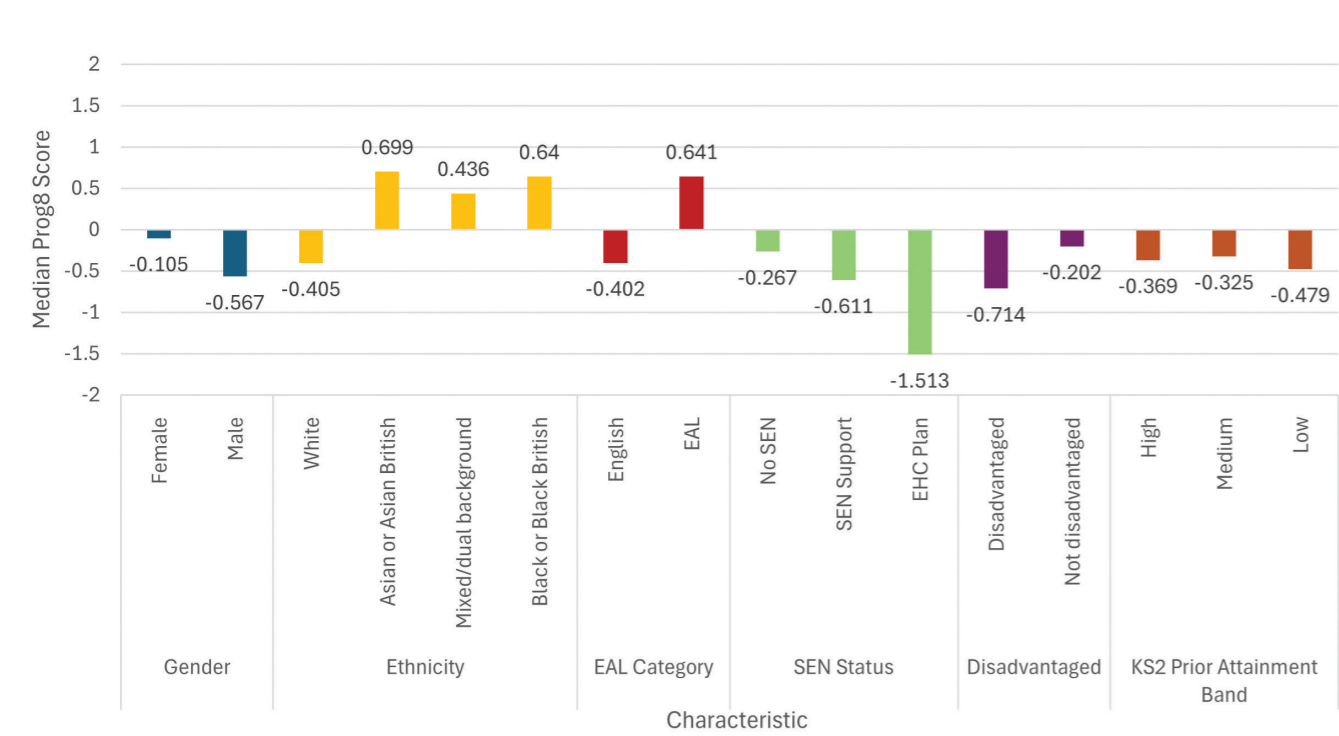


Figure 10. KS4 Attainment dataset - Bar plot of median Prog8 scores by pupil characteristics in 2018/19



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