Child Indicators Research (2024) 17:145–176
https://doi.org/10.1007/s12187-023-10081-7

Local Geographic Variations in Children's School Readiness - A Multilevel Analysis of the Development Gaps in England

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Accepted: 13 October 2023 / Published online: 25 November 2023

Abstract

The educational attainment levels of children in state-funded schools in England are lower than in many countries with comparable levels of economic development. There are also striking differences at the local level across England. To understand these differences it is important to examine children's development in their early years. This research uses multilevel analysis of the National Pupil Database to investigate child development at ages 4 and 5 years old at the individual, school and local levels including within a case study urban area. Child development is assessed using teachers' observations to measure what is termed School Readiness. This is based on a child's communication, literacy and numeracy skills and their physical, personal and social development. The findings reveal substantial differences in School Readiness at the individual, school and local area levels including in terms of sex, ethnic background, age in the school year, welfare benefit entitlement and local area income deprivation level. Such differences are also evident across the separate Early Learning Goals that are used to assess School Readiness. Between local areas children with similar backgrounds can vary considerably in their likelihood of being categorised as School Ready. Many children face multiple disadvantages as a consequence of different interlinked factors including where they live. The gap in the levels of School Readiness has long-term implications for the individuals themselves and for society more widely. Whilst increasing the levels of School Readiness is a key target in the UK Government's Levelling Up policy, tackling the stark inequalities will take considerable investment, highly targeted support and engagement across the home and school learning environments.

Keywords Child Development · Educational Attainment · Inequality · School Readiness

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1 Introduction

The educational attainment levels of children in state-funded schools in England are lower than in many countries with comparable levels of economic development. Evidence for the United Kingdom (UK) as a whole from the Organisation for Economic Cooperation and Development (OECD) Programme for International Student Assessment (PISA), which is based on an international sample survey of 15 year olds, suggests that children in the UK achieve just above the OECD average in English, Maths and Science (OECD, 2018). Evidence from UNICEF (2018) suggests that out of 41 industrialised countries England is ranked 23 for primary school inequality (based on the reading scores of children aged 10); and ranked 16 for secondary school inequality (based on the reading scores of children aged 15 years old).[1]

There are also differences in educational attainment between children from different socio-economic backgrounds across England. For example, by the time children leave primary school at the age of 11 years old, based on English and Maths scores, the attainment gap between economically disadvantaged children and the most economically advantaged is 9 months (Education Policy Institute, 2019). On completion of General Certificates of Secondary Education (GCSEs) in English and Maths (at the age of 16 years old) the attainment gap is almost two years. These gaps are all the more concerning given that they do not include the fee paying private school sector, which has some of the highest levels of educational achievement (Ofqual, 2023). It is also notable that children in the UK report high levels of unhappiness. Only 53% of children aged 15 years old stated that they were satisfied with their lives, compared to 67% on average across the OECD countries. Evidence from the charity The Children's Society (2020) also suggests that the levels of unhappiness amongst children in the UK are increasing. The level of reported bullying in schools in the UK has also been shown to be higher than in many other OECD countries (OECD, 2018).

A number of interlinked factors are associated with educational attainment including: sex, economic deprivation, ethnic background, the quality of Early Childhood Education and Care (ECEC) provision, parental education level, parental involvement and home learning environment (Cavaglia et al., 2020; Ghandour et al., 2019; Heath & Brinbaum, 2014 Henderson et al., 2018; Li, 2021; Tickell, 2011). Age within a school year has also been shown to be a factor, with younger children in the year (Summer-born children) facing a disadvantage (Campbell, 2022; Crawford et al., 2014; Department for Education, 2020; Long, 2020). Furthermore, as Leckie and Goldstein (2019) and Rasbash et al. (2010) have highlighted, school and area contextual factors are also important in explaining children's attainment levels. The Covid-19 Pandemic has also had a disproportionate impact on the development and wellbeing of children from low income households (Department for Education, 2021a; Education Endowment Foundation, 2022; IFS, 2021).

[1] The reading score ranking is based on the gap between the highest and lowest achieving children (UNICEF 2018).

To understand the differences in educational attainment amongst children it is important to look back to their early years of development up to the age of 5 years old (Gregory et al., 2021; La Paro & Pianta, 2000; Murray, 2023; Needham & Ülküer, 2020; UNICEF, 2019). The OECD (2018) and the United Nations (2021) have highlighted the importance of the early years of child development, including as part of the 2030 Sustainable Development Goals. The impact of lower levels of development and economic disadvantage in a child's early life can have long-term effects, not only in terms of their education, but their future health, employment and earnings (Duncan et al., 2012; Field, 2010; Garcia et al. 2020; Heckman et al., 2013; Pascal & Bertram, 2013).

In this article what is defined as School Readiness in the UK and the development levels reached by children aged 4 and 5 years old are examined. School Readiness is a composite measure of development based on teachers' observations of each child towards the end of the Reception Year (ages 4 and 5), which is their first formal year in full-time primary school education following care by parents, carers and time spent in ECEC settings.[2] It forms part of the government's Early Years Foundation Stage (EYFS) statutory framework, which places requirements for child development and learning including curriculum guidance on all ECEC providers (Department for Education, 2023a). The twelve Early Learning Goals (ELGs) that make up the School Readiness measure include: reading, writing, numbers, listening, health, self-care and making relationships. It is an important measure as it indicates to parents and carers, schools, and the children themselves their level of development before Key Stage 1 of the National Curriculum in England.

Previous research has shown that child development, including different measures of School Readiness, can vary by sex, age in school year and level of economic deprivation (Department for Education, 2018a; Janus & Duku, 2007; Kent & Pitsia, 2018; OECD, 2022). For example, in the UK the gap between the most economically disadvantaged and the most economically advantaged children aged 4 and 5 years old has been shown to be around 5 months (Education Policy Institute, 2019). In the USA research has highlighted the lower levels of development amongst children from economically deprived backgrounds (Issacs 2012). In Ireland research by Pitsia and Kent (2021) has shown how the development of young children can be impacted by the level of support at home including access to learning materials and the parent child relationship. Case study research by Besford (2017) has pointed to the importance of more coordinated links between the home and the ECEC provider and the need for the more active engagement of parents and carers in order to support the development of children.

A range of initiatives at the national and local levels in England have been put in place to try and support child development and School Readiness. At a national level, as part of the EYFS framework, the government covers the costs of up to 30 hours of childcare with an approved ECEC provider (Department for Education, 2023a). Such professional childcare and early years education is clearly important

[2] The age of the start of formal education varies internationally in relation to different approaches to child development. In England years 4 and 5 are a key phase (World Bank 2022).

alongside a supportive home learning environment. However concerns have been raised about the accessibility of such childcare and the take up of the free hours (Albakri et al., 2018; Melhuish & Gardiner, 2021). The government's new Family Hubs programme also aims to support child development through more joined up support across service providers (Department for Education, 2022). However many of the predecessor Sure Start Centres have been closed and funding for services has been reduced (Bate & Foster, 2017). At the local level in the UK many local authorities have developed interventions to support child development. Example interventions include: health care screening and support for children, school and health care provider led training programmes for parents and children, additional training for education professionals to support children with Special Educational Needs and Disability (SEND),[3] home visit family support delivered by volunteers, tool kits to engage parents and children in learning, online resources and information leaflets, interventions and support based around specific development skills including speech, language and communication and mobile phone based apps for parents with daily prompts and suggestions for engagement and learning (GMCA, 2023; Integrated Early Years Service, 2016; Public Health England, 2015, 2016; 2019).

Despite the national and local level initiatives, the variations in School Readiness across England and between children from different backgrounds remain substantial and there has been only limited research that has examined the variations at the individual, local and school levels. This article uses descriptive statistics and multilevel modelling of the administrative data from the Department for Education's National Pupil Database (NPD) to examine the variations in School Readiness at the individual child, school and local area levels across England.

The key research questions are: How does child development as measured by School Readiness vary amongst children aged 4 and 5 years old in England? How does School Readiness vary across the different Early Learning Goals? How does School Readiness vary at the local area and school levels including within the local case study urban area? What key factors are linked with School Readiness and how can the inequalities be addressed?

2 Methodology

2.1 Data and Variables

This research used individual level administrative data from the Department for Education Early Years Foundation Stage Profile (EYFSP) dataset. This is part of the NPD taken from the annual School Census of children in state education in England. The EYFSP is mandatory for all schools and ECEC providers (Department for Education, 2021b). The descriptive analysis was conducted using a combination of individual level and aggregate data as reported in official statistical releases (Department

[3] Special Education Needs and Disability (SEND) is additional learning support for children (Department for Education 2019a).

Table 1 The Areas of Development and the 17 Early Learning Goals (ELGs)

Included in School Readiness measure	Area of Development	ELG
Yes	a. Communication and Language	1. Listening and attention
		2. Understanding
		3. Speaking
	b. Physical development	4. Moving and handling
		5. Health and self-care
	c. Personal, Social and Emotional Development	6. Self-confidence and self-awareness
		7. Managing feelings and behaviour
		8. Making relationships
	d. Literacy	9. Reading
		10. Writing
	e. Mathematics	11. Numbers
		12. Shape, space and measures
No	f. Understanding the World	13. People and communities
		14. The World
		15. Technology
	g. Expressive arts, designing and making	16. Exploring and using media and materials
		17. Being imaginative

for Education, 2018a, 2018b). The data was accessed through the Secure Research Service of the Office for National Statistics (ONS).[4]

The individual-level child data included the following: 17 ELGs achieved by each child; the care setting the child attended; the local authority where the setting was located; the sex of the child, birth month and the local level of economic deprivation from the Income Deprivation Affecting Children Index (IDACI). The data also included: ethnic background, Free School Meal (FSM)[5] eligibility, English as an Additional Language (EAL) and Special Educational Needs and Disability (SEND). Not all the variables were available to be used in the modelling due to data access restrictions.

As outlined, School Readiness is a composite measure of how well prepared young children aged 4 and 5 years old are for primary school. It is based on teachers' observations of each child in relation to the 17 ELGs. Each child is given a grading of their level of development: 1: Emerging; 2: Expected; 3: Exceeding.

[4] Note: This work was produced using statistical data from the Office for National Statistics (ONS). The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets, which may not exactly reproduce National Statistics aggregates.

[5] Free Schools Meals (FSM) is a means tested benefit based on a child's parents and carers being in receipt of welfare benefits and living on a low income. However due to the stigma associated with the benefit not all children's parents and carers eligible for FSM claim it (llie et at., 2017).

Those children achieving Expected or Exceeding (i.e. a Good Level of Development (GLD)) classification on all of the first 12 of the goals in the final term of their Reception Year are categorised as being School Ready. Goals 1 to 12 are the seen as the main areas and include: (a) Communication and Language; (b) Physical Development; (c) Personal, Social and Emotional Development; (d) Literacy; (e) Mathematics. The other areas are important, but are not core to the School Readiness assessment. Table 1 lists the 17 ELGs.

The key socio-demographic variables used in the analysis were: (a) sex; (b) age of the child, which is split into four categories according to the month of birth: 1 - born between June and August (the youngest); 2 - born between March and May; 3 - born between December and February; 4 - born between September and November (the oldest); and (c) deciles of the IDACI which measures the proportion of children aged 0 to 15 years old in a given Lower Layer Super Output Area (LSOA)[6] who live in income deprived households. Income deprived households are those in receipt of welfare benefits, such as Income Support and Jobseekers Allowance, and families in receipt of Working Tax Credit or Child Tax Credit with an equivalised income below 60 per cent of the national median income before housing costs.

It should be noted that there is some debate about the accuracy and value of the School Readiness measure and child development measurement data more generally including in relation to the narrow focus of the assessment criteria, the reliability of the teachers' observation data, the constraints it can place on teaching and creative learning and the need to take more account of information about a child's individual circumstances and the wider context (Boardman, 2020; Bradbury, 2019; Bradbury & Roberts-Holmes, 2017; Campbell, 2022; Cartlon and Winsler 1999; Denham, 2006; Doyle et al., 2012; Kay, 2022; Ladd et al., 2010; Lupton & Williamson, 2017; Murray, 2020; Neaum, 2016; PACEY, 2013; Rouse et al., 2023; Snow, 2006). In the UK, the term School Ready has been questioned for being subjective and ambiguous (Tickell, 2011). In 2021 the Department for Education introduced a revised EYFS framework and ELGs, which have the aim of a stronger focus on early language and literacy including vocabulary (Department for Education, 2021a). A new Reception Baseline Assessment has also been introduced from 2021 for children aged 4 and 5 years old (Department for Education, 2019b). This takes place in the first few weeks of the Reception Year and comprises a maths and literacy test. The debates about measuring child development link to the wider issue of the measurement of socio-economic deprivation and the need for multidimensional approaches, which take into account individual capabilities and context (Alkire & Roche, 2012; Mitra et al., 2013; Sen, 1993; Trani & Cannings, 2013). The limitations concerning the School Readiness measure are examined in the Discussion and the Limitations sections.

2.2 Geographic Level Analysis and Statistical Modelling

Descriptive analysis and multilevel binary logistic regression models were produced at the individual, school and Local Education Authority (LEA) levels to develop the

[6] LSOAs are small areas with an average of 1,500 residents or 650 households (Ministry of Housing, Communities and Local Government 2018).

understanding of the impact of sex, age and local area economic deprivation level on the likelihood of being categorised as School Ready. In England an LEA is a government administrative area, which had oversight powers in relation to state education provision, but which are now overseen by the local authorities (ONS, 2012). There are 152 LEAs in England.

In the multilevel logistic regression modelling the binary outcome variable was School Ready, where 0 indicated not being School Ready and 1 indicated being School Ready. The covariates were: (a) whether the child is female (male as reference category); (b) age of the child within the school year (birth month, with the youngest as the reference category); and (c) deciles of the IDACI with the first decile (least income deprived) as the reference category. Given that these characteristics have been identified as key to understanding the differences in School Readiness, it may also be expected that children who have two or more of the characteristics that put them at a disadvantage may be at an increased risk of not being School Ready. Therefore all the two-way interactions between the three covariates were examined.

The models were estimated using maximum likelihood estimation as implemented in the melogit command in Stata 16. Missing data was treated with listwise deletion, resulting in 1,500 children (just 0.23% of the full sample of 653,693 children) being excluded from the final model. After the estimation of the full multilevel model, the average predicted probabilities of being School Ready for all the combination of categories present in the data were created to aid interpretation.

2.2.1 Case Study Area

In the descriptive analysis Greater Manchester (the Greater Manchester Combined Authority GMCA), in the North West of England, is examined as a case study urban area in order to explore the differences in School Readiness within a local area. Greater Manchester is a large combined metropolitan authority with a total population of 2.8 million people across ten metropolitan boroughs. It includes some areas with the highest levels of economic deprivation in England and some schools with the lowest educational attainment outcomes, but is also home to some of the most academically high achieving schools (GMCA, 2021).

3 Findings

3.1 Geographic Variations in School Readiness

Overall in England, based on data from 653,693 children aged between 4 and 5 years old, 71% were categorised as School Ready. Girls were much more likely to be School Ready than boys (78% compared 65%). There were also differences by LEA. For example, 80% of children in Richmond Upon Thames in South West London (the highest level of any LEA) were categorised as School Ready compared to 64% in Middlesbrough in North East England (the lowest of any LEA). Girls in Richmond upon Thames also had the highest level of School Readiness (86%) compared to girls in Oldham (North West England) (71%). Boys in Richmond upon Thames

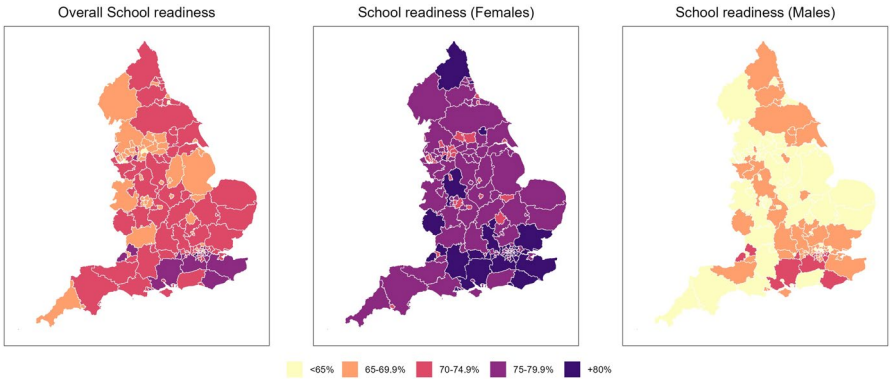

Fig. 1 The Level of School Readiness Across England by Sex and LEA. (England). Note: The Isles of Scilly have been suppressed due to low counts. Data source: Department for Education (2018a, 2018b)

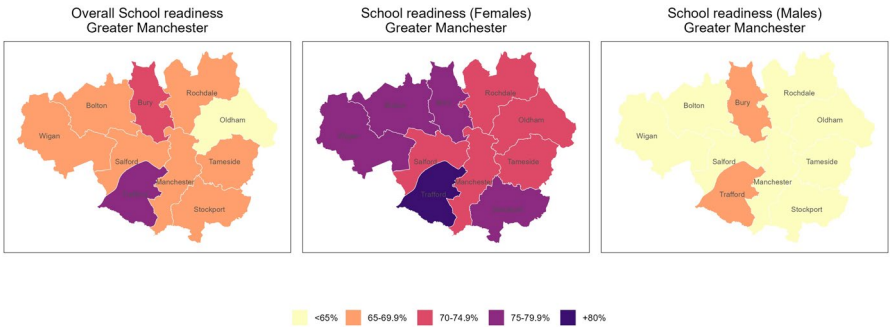

Fig. 2 The Level of School Readiness Across the Greater Manchester Combined Authority (GMCA) by LEA. Note: Data source: Department for Education (2018a, 2018b)

had the highest level of School Readiness (75%) compared to only just over half of the boys in Middlesbrough (54%).

In every LEA across England, girls were more likely to be categorised as School Ready than boys. The gap between girls and boys varied considerably across different LEAs, from 7 percentage points in Rutland (East Midlands) to 20 percentage points in Middlesbrough. The maps in Fig. 1 highlight the differences in the levels of School Readiness across England overall and by sex.

There was also evidence of considerable variations within an area. As outlined, Greater Manchester includes some areas with the highest levels of economic deprivation in England and some schools with the lowest educational attainment results. Across Greater Manchester, 68% of children aged between 4 and 5 years old were categorised as being School Ready (which is comparable to the national average). However, across Greater Manchester this varied from 73% in Trafford to 64% in Oldham. Amongst girls, the level of School Readiness varied from 80% in Trafford to 72% in Oldham. Amongst boys the level of School Readiness varied from 66%

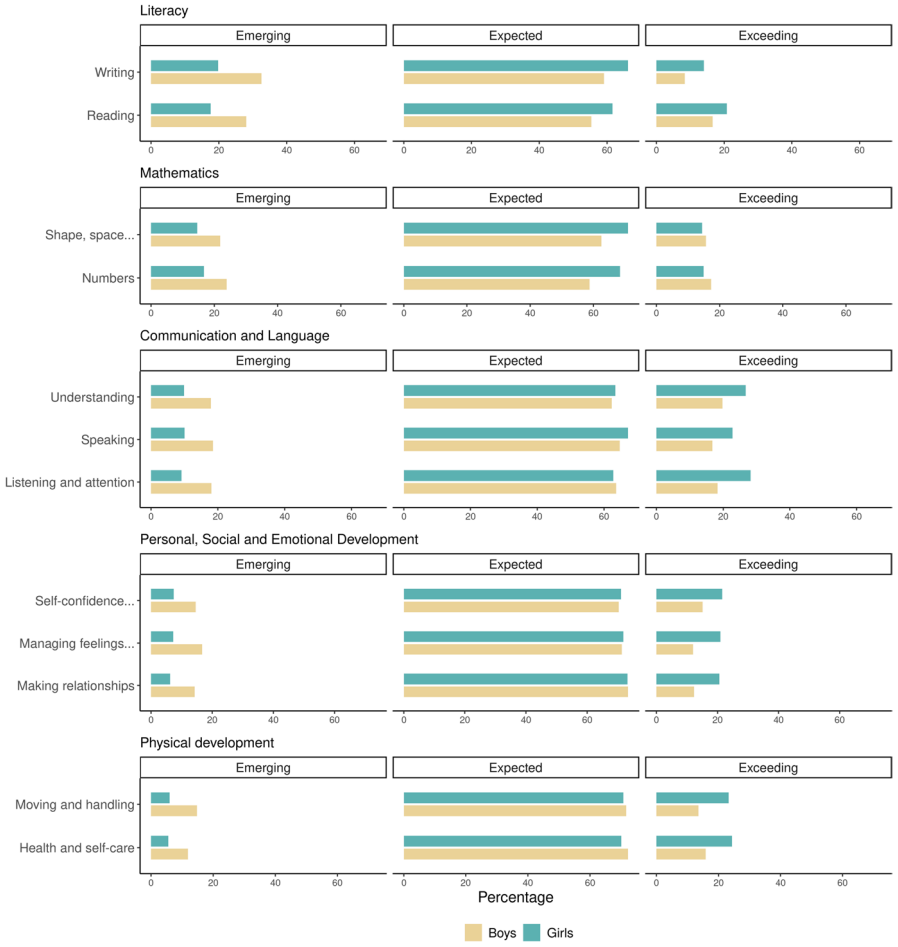

Fig. 3 The Level of School Readiness by ELG and Sex. (England). Note: Data source: Department for Education (2018a, 2018b)

in Trafford to 55% in both Oldham and Rochdale. As the maps in Fig. 2 show, even between adjacent LEAs, and therefore between some local areas near to each other, there can be substantial differences in the levels of School Readiness.

3.2 Variations in the ELGs and School Readiness

It is also important to look at the variations in School Readiness and the different individual ELGs. This could help inform the understanding of the overall differences and therefore where policy interventions could be targeted. As outlined, School Readiness is based on a child having a GLD categorisation (Expected or Exceeding) on all of the first 12 of the ELGs. As Fig. 3 shows, there were considerable variations in School Readiness across the different ELGs.

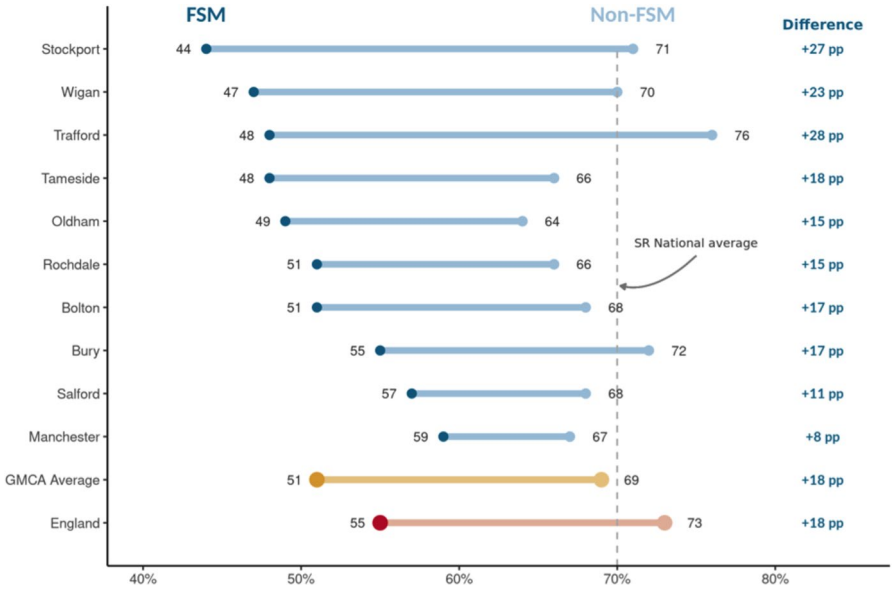

Fig. 4 School Readiness and Free School Meal (FSM) Eligibility Across the Greater Manchester Combined Authority (GMCA) by LEA. Note: Data source: Department for Education (2018a, 2018b)

Across the individual ELGs, the lowest levels of being School Ready were in relation to Writing, Reading, Numbers and Shape, Space and Measures. In terms of higher levels of development, it is notable that the lowest rate of Exceeding the Expected level was also in relation to Writing. Given the differences in terms of sex already discussed, it is important to examine the variations by sex across the different ELGs. Girls were much more likely to be categorised as School Ready compared to boys across all the ELGs. In terms of higher levels of development, girls were also considerably more likely to be Exceeding the Expected level on all the ELGs compared to boys, with the exception of Mathematics, where the proportion was relatively similar for girls and boys.

3.3 School Readiness and Income Deprivation (Free School Meals), Ethnic Background, Language, Age and SEND.

There were also substantial differences in the levels of School Readiness by the level of income deprivation of the area where a child lived. The lowest rates of being School Ready were amongst children living in income deprived areas. The variations in School Readiness by whether a child was eligible for Free School Meals (FSM), and therefore living in a household claiming welfare benefits and on a low income were also considerable. Children eligible for FSM were less likely to be categorised as School Ready. Girls who were eligible for FSM were much more likely to be categorised as School Ready compared to boys (63% compared to 43%), which is a larger gap than amongst girls and boys overall. There was also considerable

variation at the local level across England. For example, within an urban area such as Greater Manchester there was evidence of considerable differences in the levels of School Readiness, as shown in Fig. 4.

The lowest levels of School Readiness amongst children eligible for FSM were in Stockport, where only 44% of children were categorised as being School Ready compared to 71% of those children not eligible for FSM. The highest levels of being School Ready were in Manchester where 59% of children eligible for FSM were categorised as School Ready.

It is also important to examine differences in School Readiness by ethnic background. Children from Indian and Chinese ethnic backgrounds (both boys and girls) were the most likely to be categorised as School Ready. The lowest levels of School Readiness were amongst those children from a White Traveller of Irish heritage, Gypsy and Roma ethnic backgrounds. There were also considerable differences in the levels of School Readiness by ethnic background at the LEA level. For example, in Leicester (where the main South Asian background is Indian) there was a 10 percentage point gap in the level of School Readiness between children from White and South Asian ethnic backgrounds, whereas the national average difference between these groups was 3 percentage points. Some of the differences in School Readiness between local authorities for children from the same ethnic background were greater than between those from different ethnic backgrounds for a given area. For example, amongst children from a White ethnic background in Leicester, 61% were categorised as School Ready compared to 83% in Richmond upon Thames. Amongst children from a South Asian ethnic background, 56% in Kingston Upon Hull were categorised as being School Ready compared to 81% in Bournemouth. In the case study area of Greater Manchester, children from a White ethnic background were the most likely to be categorised as School Ready (69%); the least likely were those from a Black ethnic background (60%). Furthermore between ethnic groups there were also considerable differences in the levels of School Readiness amongst children eligible for FSM. Boys and girls eligible for FSM from White ethnic backgrounds were the least likely to be categorised as School Ready. Boys and girls who were eligible for FSM from Black and Chinese ethnic backgrounds were the most likely to be categorised as School Ready.

In terms of language, overall 71% of children whose first language was English were categorised as School Ready compared to 63% of children for whom English was an additional language. Again there were striking differences between LEAs. For example, as Fig. 5 highlights, there were considerable differences across areas in Greater Manchester where only 48% of children for whom English was an additional language in Oldham were categorised as being School Ready compared to 71% in Trafford.

As discussed, children in a single school year can be almost a year apart in age. A child born in early September will be 5 years old for all of the Reception Year, whilst a child born in August will be 4 years old for the whole year. This age gap can make a substantial difference in terms of child development. 79% of Autumn-born children were categorised as being School Ready compared to 60% of Summer-born children.

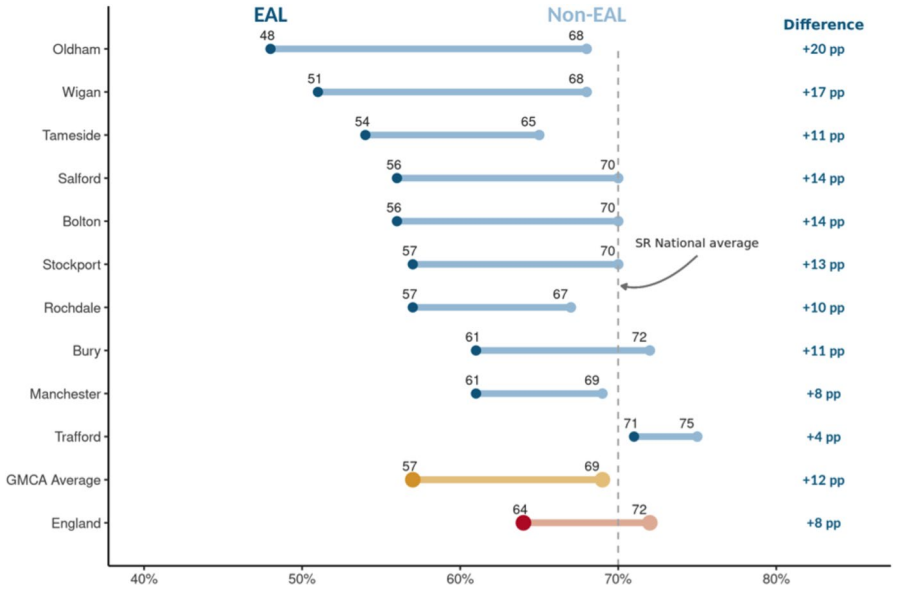

Fig. 5 School Readiness and English as an Additional Language (EAL) Across the Greater Manchester Combined Authority (GMCA) by LEA. Note: Data source: Department for Education (2018a, 2018b)

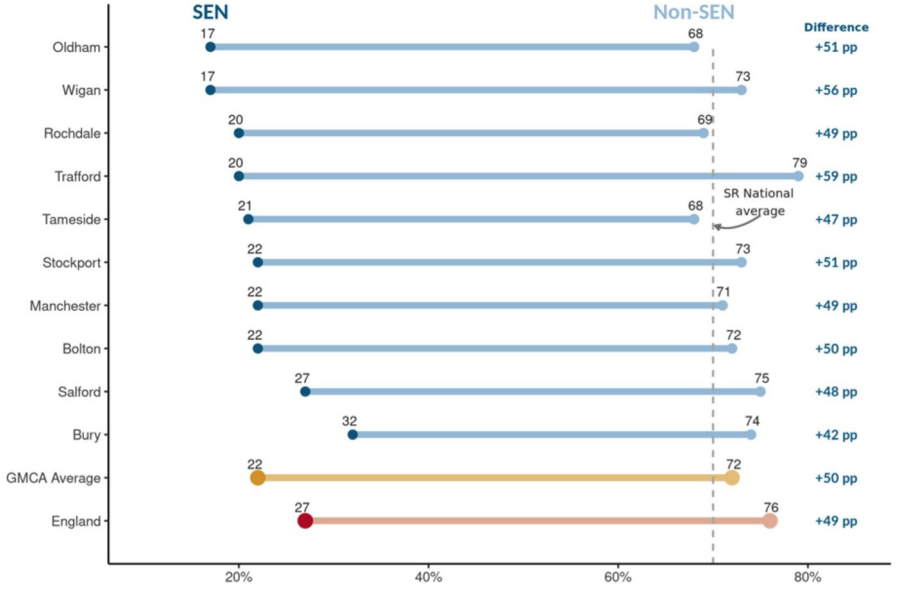

Fig. 6 School Readiness and SEND Across the Greater Manchester Combined Authority (GMCA) by LEA. Note: Data source: Department for Education (2018a, 2018b)

It is also important to examine differences in School Readiness by whether a child has Special Educational Needs and Disability (SEND). Overall, 27% of children who were identified as having SEND were categorised as being School Ready, with girls more likely to be School Ready than boys. There were also considerable differences by LEA across England. Figure 6 shows the levels of School Readiness amongst children with SEND across the case study area of Greater Manchester.

The differences in School Readiness amongst children with SEND range from 17% of children in Oldham and Wigan compared to 32% in Bury.

In order to further examine these interlinked individual socio-demographic factors, multilevel logistic regression models were conducted. The results are summarised in the next section.

3.4 Multilevel Modelling Results

The multilevel binary logistic regression models help quantify the relative variation in the likelihood of being categorised as School Ready in terms of sex, age, local area income deprivation at the school and the LEA levels. Two multilevel models were produced: Model 1—a three-level null model (without covariates) for the probability of children being School Ready nested within schools and within LEAs; Model 2—a three-level model that included covariates.

The comparison of these two models is presented in Table 2. The Variance Partition Coefficient (VPC) statistics measure the proportion of the overall variation in the propensity to be School Ready at each level of analysis. From the Model 1 estimates, on average only 0.6% of the variation in the propensity of being School Ready is between LEAs and 4.4% is between schools within a particular LEA. While 0.6% maybe small, it highlights important differences between LEAs. Assuming that the LEA effects are normally distributed (on the log-odds scale) with a mean of zero and a standard deviation of 0.145 ($\sqrt{0.021} = 0.145$), the 95% coverage interval ($[-1.96\sigma, +1.96\sigma] = [-0.284, +0.284]$), can be used to help show the magnitude of the variance. As such, 95% of LAs are expected to show School Readiness proportions in the range 0.653 to 0.769, i.e. $\exp(0.918 \pm 0.284)/\{1 + \exp(0.918 \pm 0.284)\}$, (note that this calculation uses the intercept, 0.918, as the baseline log-odds across all children).

The LEA variations reflect differences in socio-demographics and broader societal inequalities across England, as well as variations in, for example, ECEC access and school provision. These factors at the higher levels can be seen as structural (Rasbash et al., 2010; Troncoso, 2019; Troncoso et al., 2016). The estimated variation in School Readiness at the LEA and school level was considerably lower than the estimated variation between children. This suggests that the level of School Readiness is more dependent upon individual child characteristics such as sex and local area income deprivation level, although of course other factors not available for inclusion in the models are also likely to be important.

Model 2 is a binary logistic multilevel model of the likelihood of being School Ready after taking account of LEA and school variation (via random effects), the level of income deprivation where the child lives (IDACI), age and sex (child level

Table 2 Multilevel Binary Logistic Models for the Likelihood of Being School Ready

	Model 1					Model 2				
Parameter	Coef	S.E	95% C.I		OR	Coef	S.E	95% C.I		OR
Main effects										
Intercept	0.918	0.013	0.893	0.943	2.504	0.546	0.024	0.498	0.593	1.726
Male (Ref)										
Female						0.735	0.023	0.69	0.779	2.085
IDACI (deciles)										
1st (least deprived) (Ref)										
2nd						-0.153	0.028	-0.208	-0.099	0.858
3rd						-0.239	0.028	-0.293	-0.184	0.788
4th						-0.301	0.027	-0.355	-0.248	0.74
5th						-0.435	0.028	-0.489	-0.381	0.647
6th						-0.535	0.028	-0.589	-0.48	0.586
7th						-0.622	0.027	-0.675	-0.568	0.537
8th						-0.698	0.028	-0.752	-0.644	0.498
9th						-0.809	0.028	-0.864	-0.755	0.445
10th (most deprived)						-0.89	0.028	-0.944	-0.835	0.411
Birth month										
Jun-Aug (Ref)										
Mar-May						0.444	0.027	0.391	0.496	1.558
Dec-Feb						0.829	0.029	0.773	0.886	2.292
Sept-Nov						1.225	0.031	1.164	1.285	3.403
Interaction effects										
Sex and IDACI										
Female*2nd decile						0.015	0.029	-0.043	0.072	1.015
Female*3rd decile						-0.033	0.029	-0.089	0.024	0.968

Table 2 (continued)

Parameter	Model 1				Model 2				
	Coef	S.E	95% C.I	OR	Coef	S.E	95% C.I		OR
Female*4th decile					-0.056	0.028	-0.112	-0.001	0.945
Female*5th decile					-0.02	0.028	-0.075	0.036	0.981
Female*6th decile					-0.057	0.028	-0.111	-0.002	0.945
Female*7th decile					-0.052	0.028	-0.106	0.002	0.949
Female*8th decile					-0.06	0.028	-0.114	-0.005	0.942
Female*9th decile					-0.054	0.027	-0.108	0	0.948
Female*10th decile					-0.101	0.027	-0.154	-0.048	0.904
Sex and Birth month									
Fem*Mar-May					0.036	0.015	0.006	0.067	1.037
Fem*Dec-Feb					0.055	0.016	0.024	0.087	1.057
Fem*Sept-Nov					0.079	0.017	0.046	0.113	1.082
IDACI and Birth month									
2nd decile*Mar-May					0.01	0.036	-0.062	0.081	1.01
2nd decile*Dec-Feb					-0.021	0.039	-0.098	0.056	0.979
2nd decile*Sept-Nov					-0.006	0.042	-0.088	0.075	0.994
3rd decile*Mar-May					0.025	0.036	-0.046	0.096	1.025
3rd decile*Dec-Feb					-0.025	0.039	-0.102	0.051	0.975
3rd decile*Sept-Nov					-0.049	0.041	-0.13	0.032	0.952
4th decile*Mar-May					-0.057	0.036	-0.127	0.013	0.945
4th decile*Dec-Feb					-0.085	0.038	-0.16	-0.01	0.918
4th decile*Sept-Nov					-0.076	0.04	-0.155	0.004	0.927
5th decile*Mar-May					-0.049	0.036	-0.119	0.021	0.952
5th decile*Dec-Feb					-0.072	0.038	-0.147	0.003	0.93

Table 2 (continued)

	Model 1				Model 2				
Parameter	Coef	S.E	95% C.I	OR	Coef	S.E	95% C.I		OR
5th decile*Sept-Nov					-0.118	0.04	-0.197	-0.039	0.889
6th decile*Mar-May					-0.04	0.035	-0.109	0.03	0.961
6th decile*Dec-Feb					-0.095	0.038	-0.169	-0.021	0.909
6th decile*Sept-Nov					-0.077	0.04	-0.155	0.001	0.926
7th decile*Mar-May					-0.082	0.035	-0.15	-0.013	0.922
7th decile*Dec-Feb					-0.088	0.037	-0.161	-0.015	0.915
7th decile*Sept-Nov					-0.106	0.039	-0.183	-0.029	0.9
8th decile*Mar-May					-0.066	0.035	-0.135	0.003	0.936
8th decile*Dec-Feb					-0.097	0.037	-0.17	-0.024	0.908
8th decile*Sept-Nov					-0.073	0.039	-0.15	0.004	0.93
9th decile*Mar-May					-0.047	0.035	-0.116	0.021	0.954
9th decile*Dec-Feb					-0.055	0.037	-0.127	0.018	0.947
9th decile*Sept-Nov					-0.066	0.039	-0.142	0.011	0.936
10th decile*Mar-May					-0.067	0.035	-0.135	0.001	0.935
10th decile*Dec-Feb					-0.024	0.037	-0.096	0.049	0.976
10th decile*Sept-Nov					-0.052	0.039	-0.128	0.024	0.949
Random part	Coef				Coef				
School variance	0.153				0.115				
LEA variance	0.021				0.022				
N (children)	653693				652193				
N (schools)	17726				17716				
N (LEAs)	152				152				
Deviance	773901.2				727191.7				

characteristics) and the two-way interactions between these factors. With regard to the main effect of sex, the odds of being School Ready for girls in the least income deprived areas (IDACI decile 1) are much higher than for boys. However, this main effect needs to be interpreted in combination with the interaction effects.

To provide a comparison of the effects of age, sex and local area income deprivation level along with the two-way interactions, the average predicted probabilities of being School Ready are shown in the Figs. 7a, 7b and 7c. These adjusted probabilities were produced while holding the other fixed and random effects constant at their means.[7]

Figure 7a, shows that the youngest children (i.e. Summer-born between June and August) had a much lower predicted probability of being categorised as School Ready. This is even more marked in the case of boys who had a predicted probability of just above 0.5. This is in stark contrast to the oldest girls (Winter-born between September and November) who had a predicted probability of being School Ready of nearly 0.9.

The gap between boys and girls persisted after adjusting for IDACI deciles (and keeping month of birth constant at the mean); this is because there is no correlation between sex and area level income deprivation. This is shown in Fig. 7b, where there is a clear economic gradient, such that children living in the most income deprived areas were the least likely to be categorised as School Ready. Again the difference in predicted School Readiness according to the sex of the child is striking. Girls living in the least income deprived areas (decile 4 and below) had a probability of 0.8 or higher of being School Ready, whereas boys never reached that level, regardless of the area level income deprivation. Amongst the children living in the most income deprived areas (decile 10), girls had a predicted a probability of being School Ready of around 0.7, which is still higher than the predicted probabilities of boys living in areas in decile 4.

The area level income deprivation gradient in being School Ready was also evident when looking at differences according to age and month of birth (and regardless of sex of the child). As is shown in Fig. 7c below, Summer-born children (between June and August) were much less likely to be categorised as being School Ready. Even Summer-born children living in the least income deprived areas had a lower predicted probability of being School Ready than Winter-born children (between September and November) in the most income deprived areas.

In order to examine the differences in School Readiness further empirical Bayes predictions of the school and LEA random effects and their corresponding 95% confidence intervals (CI) were compared to each other and the national average after accounting for the children's characteristics of sex, age and local area income deprivation. These estimates adjust for the available individual characteristics that are known to be associated with child development that are beyond the control of the early years care setting and hence they can be termed as partially-adjusted

[7] For computational efficiency, this procedure was run on a 5% random sample (32,607 children) using the estimates of the full multilevel model. 95% confidence intervals are provided for all adjusted comparisons.

Table 2 (continued)

Parameter	Model 1				Model 2			
	Coef	S.E	95% C.I	OR	Coef	S.E	95% C.I	OR
VPC (Schools)	0.044				0.034			
VPC (LEAs)	0.006				0.006			

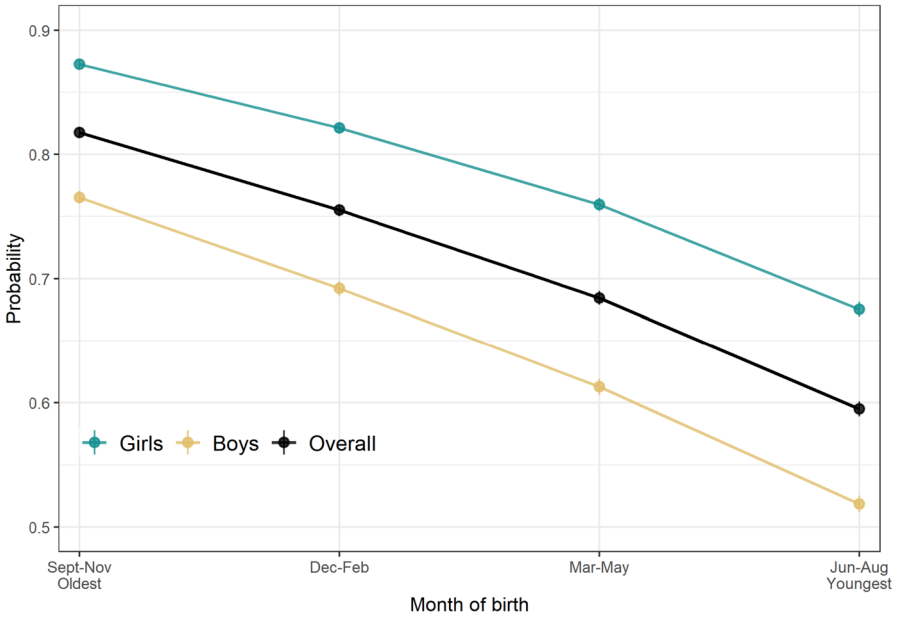

Fig. 7 **a** Predicted Probabilities of Being School Ready by Sex and Month of Birth of Child. **b**. Predicted Probabilities of Being School Ready by IDACI (deciles) and Sex of the Child. **c**: Predicted Probabilities of Being School Ready by IDACI (deciles) and Month of Birth of Child

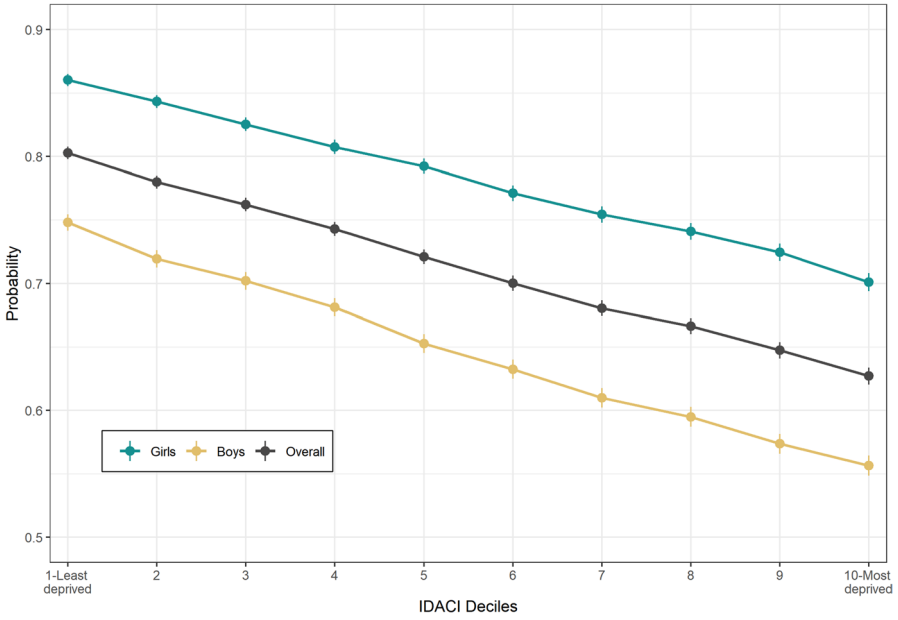

Fig. 7 (continued)

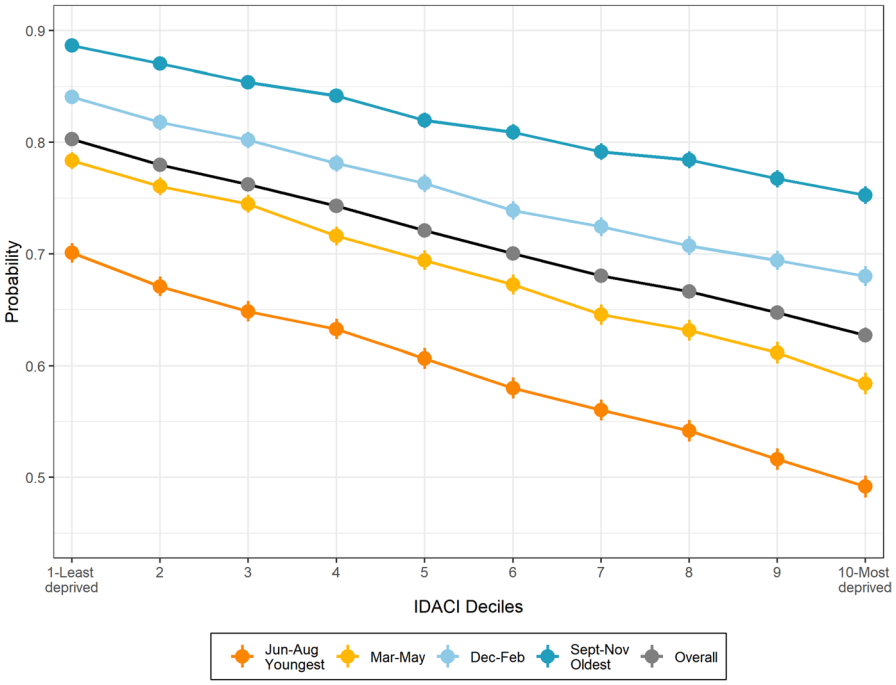

Fig. 7 (continued)

comparisons. As outlined, the model does not include other child characteristics that can be predictive of School Readiness which vary across schools and LEAs. These partially-adjusted estimates of the schools and the LEAs contributions to School Readiness can be classified into: a) average, i.e. when their CIs overlap with zero; b) above average, i.e. when the lower limits of CIs are situated above zero; and c) below average, i.e. when the upper limits of CIs are below zero. Tables 3a and 3b show the frequencies for each of these classifications across schools and LEAs.

This method of classification for schools reveals that the impact of the vast majority (96%) of the early years care setting provision (Pre-school and Reception year) is statistically indistinguishable from their LEA averages. This does not mean that most schools have the same level of School Readiness, but that the level of School Readiness of their children, after accounting for sex, age and level of income deprivation of where they live, is relatively similar to other schools in their LEAs. As such, the key differences are in relation to the child's sex, age and the level of deprivation where they live.

Table 3b shows that only around half of the LEAs can be classified as average, whereas a fifth are above average and nearly a third are below average. It is important to emphasise that this is the effect beyond that of the child's characteristics that have been adjusted for.

The Figs. 8a and 8b map the predicted probabilities of School Readiness, holding the covariate values constant. These indicators were estimated by adding the intercept term (common to all observations) and the predicted LEA random effects.

Table 3a Classification of Schools According to Their Partially Adjusted Contribution to School Readiness

Classification	Frequency	%
Below LEA average	457	2.58
Average	17,086	96.39
Above LEA average	183	1.03
Total	17,726	100

Table 3b Classification of LEAs According to Their Partially Adjusted Contribution to School Readiness

Classification	Frequency	%
Below average	45	29.61
Average	77	50.66
Above average	30	19.74
Total	152	100

Figure 8a shows that the baseline probabilities for being School Ready ranges approximately from 0.55 to 0.75, which implies that while variation at the LEA level is much lower than variation at the school and especially the child level, the variation between LEAs is still considerable. The scale differs from Figs. 7a, 7b and 7c because it sets all covariates to 0 (no other effects). Darker shades indicate a higher baseline probability of being School Ready for the particular LEA. Figure 8a also shows that the areas with the highest baseline probabilities are concentrated in the Greater London areas and the South East. This suggests that even children living in areas with the same IDACI are more likely to be categorised as School Ready in some LEAs compared to other LEAs.

Even though assessing changes in the variance components is not straightforward, due to the re-scaling of the higher-level variances in binary logistic multilevel models (Snijders & Bosker, 2011), it can be observed that large differences between LEAs persist even after controlling for IDACI, which would imply that differences across LEAs go beyond simply reflecting differences in income.

This is also evident in the case study area of Greater Manchester. Figure 8b maps the baseline probabilities of being School Ready across Greater Manchester. Again darker shades indicate a higher baseline probability of being School Ready for the particular LEA. There is noticeable variation in the levels of School Readiness, despite the geographical closeness of the LEAs. For example, Oldham, Tameside and Stockport have baseline probabilities of children being School Ready of between 0.55 and 0.60, whereas Central Manchester and Trafford have baseline probabilities between 0.60 and 0.65. This suggests that children with the same key characteristics (sex, age and area level income deprivation) and who live relatively close to each other could have very different probabilities of being School Ready.

The implications from the analysis are considered in the Discussion and Conclusions below.

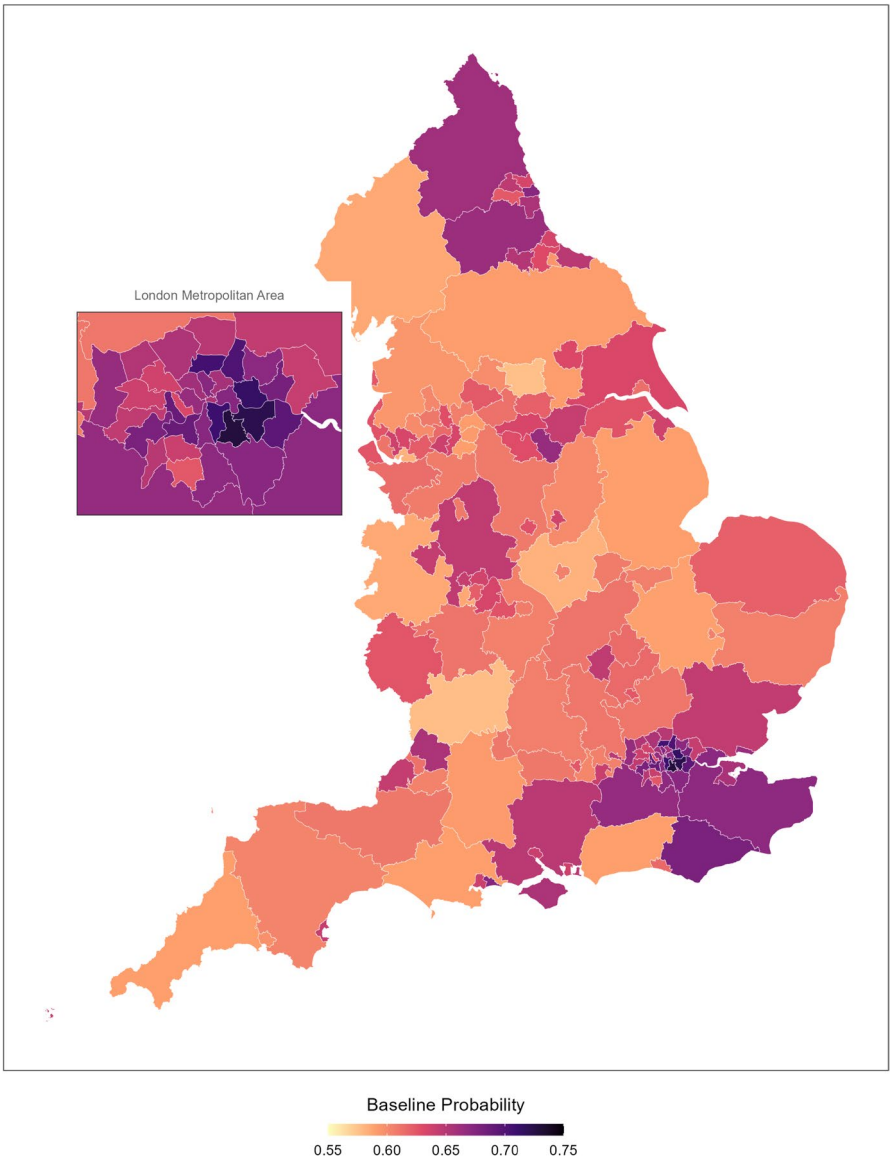

Fig. 8 **a** Baseline Probabilities of School Readiness Across LEAs in England. b. Case Study Area—Baseline Probabilities of School Readiness Across LEAs Across the Greater Manchester Combined Authority (GMCA)

4 Discussion and Conclusions

The educational attainment levels of children in England are lower than in many countries with comparable levels of economic development. Despite the national and local level initiatives to support child development and School Readiness there

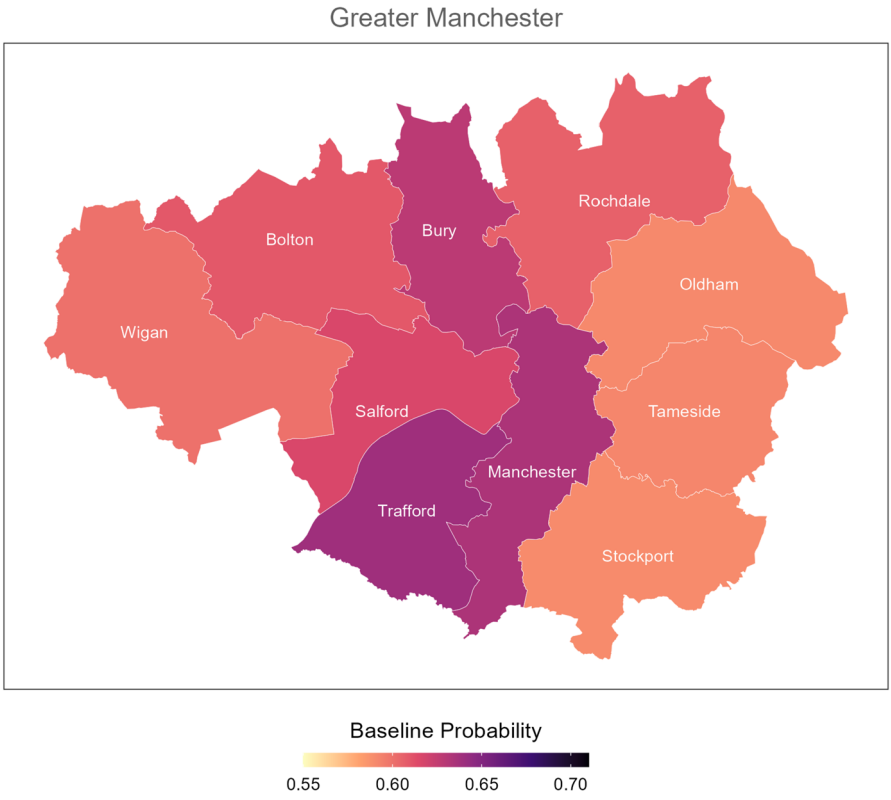

Fig. 8 (continued)

are striking differences at the individual, school and local levels including in terms of sex, age within school year, ethnic background, welfare benefit entitlement and local area income deprivation level. The differences are substantial and raise questions about how children from different backgrounds with different learning needs are being supported in their early years of development. Many children face unfair disadvantages even before their first year of primary education. Not being School Ready is arguably a child welfare issue and can have a long-term impact.

Overall boys were less likely to be categorised as School Ready than girls. Boys living in the most income deprived areas were much less likely to be categorised as School Ready than girls in comparable areas. In terms of higher levels of development, girls were also considerably more likely to be Exceeding the Expected level on all the ELGs compared to boys, with the exception of Mathematics. Summer-born children were much less likely to be categorised as School Ready than Winter-born children. Those children who were eligible for FSM were less likely to be categorised as School Ready; and within this group boys were again less likely to be School Ready. It seems that, to a certain degree, girls were able to overcome some of the challenges of living in income deprivation. It is notable that research has

identified the higher cognitive development of girls compared to boys in their early years of childhood (Kent & Pitsia, 2018). The level of School Readiness amongst children eligible for FSM and those children for whom English was as additional language varied considerably between LEAs. Children from Indian and Chinese ethnic backgrounds (both boys and girls) were the most likely to be categorised as School Ready. The level of School Readiness also varied by ethnic background at the LEA level. Amongst boys and girls eligible for FSM, those from a White ethnic background were the least likely to be School Ready.

The findings concerning the variations in School Readiness by age in a school year are in line with previous research (Campbell, 2022; Crawford et al., 2014 and Pettinger et al., 2020). Further support is needed for younger children within a school year, for example, mixed year classes have been shown to have benefits, as evidenced in Scotland where younger school starters who are exposed to older and more experienced peers can have higher levels of attainment (Borbely et al., 2023). Even Summer-born children living in the least income deprived areas had a lower predicted probability of being School Ready than Winter-born children (between September and November) in the most income deprived areas. This is especially relevant when considering that research suggests that Summer-born children are more frequently identified as having SEND and that children with SEND are more likely to come from economically deprived households (Campbell, 2021; Parsons & Platt, 2017). Even within an area such as Greater Manchester a child with SEND in one LEA can be more likely to be categorised as School Ready compared to a child with SEND in another LEA. This suggests that there could be differences in the resources and support provided to children in different LEAs. Evidence from the Children's Commissioner (2023) and Parsons and Platt (2017) has highlighted the importance of effective interventions and learning support for children with SEND.

The multilevel analysis highlights how the largest proportion of the variation in School Readiness was within schools and between individual children. However, the variation between schools and LEAs is still of concern for children, their carers and policy makers. The different factors associated with School Readiness can be interlinked, with many children facing multiple disadvantages including as a consequence of where they live. Children living in similar local areas from similar backgrounds can vary considerably in their likelihood of being School Ready, but income inequality between LEAs is only a partial explanation of the differences.

Good practice needs to be identified in LEAs where children in challenging circumstances have relatively high rates of School Readiness. As outlined above, ongoing initiatives include the targeting of support interventions prior to starting school and the creative use of mobile phone based apps to encourage links and engagement between home and school learning environments (Public Health England, 2019). Addressing one aspect of a child's development may help support the child's development in another area across the different ELGs. However the multiple factors linked with School Readiness need to be targeted in a joined up way. In relation to the specific ELGs the highest levels of not being School Ready for boys and girls were in relation to Writing, Reading, Numbers and Shape, Space and Measures. This could be the basis for targeting additional development support. For example, boys and particularly those from a White ethnic background who are eligible for

FSM should be targeted with further early interventions and support focused on the home and school learning environments and the underlying economic deprivation the children may be facing.

As has been discussed, there is some debate about the value and accuracy of the School Readiness measures and child development measures more generally including in relation as to whether the conception of development is too narrow. Moreover evidence suggests there is a lack of clarity amongst some parents and care providers about what aspects of child development are defined as School Ready (Ofsted, 2014). In England the revised EYFS Framework and ELGs introduced in 2021 have the aim of a stronger focus on language and literacy including vocabulary (Department for Education, 2021a). However there have been some concerns about these changes including in relation to the focus on a limited number of outcomes (Department for Education, 2021b; Gaunt, 2020). The new Reception Baseline Assessment tests for children aged 4 and 5 years old should hopefully provide some useful indicators, however the tests will pose challenges for children at different stages of development. Measuring a child's development should not just be about measuring the child. It can be argued that in England the School Readiness measure and the ELGs and the way they are measured and weighted in the overall assessment should be subject to further review to ensure that they are fully capturing the complex and interlinked factors of child development including, for example, health, nutrition, wellbeing, happiness, home and care network support, learning environment, creative play, social inclusion and participation and the context in which the child is growing up. These interlinked multiple factors can impact differently on children at different stages of their development. All children should be supported to be School Ready and children who are categorised as not being School Ready are not a homogenous group.

A key focus for policy interventions aimed at addressing the gap in child development needs to be individual children, but also the local context in which they are growing up including the school and local area. This is clearly a challenge for parents and carers, schools, education authorities as well as the children themselves (Education Endowment Foundation, 2021; Hodgen et al., 2020; Law et al., 2017). As has been argued by Tickell (2011), Besford (2017) and Mashburn and Pianta (2006) closer links between schools and carers could help address the inequalities in child development. This would also need to include increased partnership working including where necessary with health visitors. Early identification and follow up support should be a priority. The increased use of technology between carers could make a child's learning experience a more shared and responsive process.

Despite the provision of free hours of childcare for children aged 3 and 4 years old in England there are acute challenges in the childcare sector in relation to rising costs and staff recruitment, particularly in economically deprived areas, where there are some of the lowest levels of School Readiness (Ofsted, 2022). Additional targeted resources should be put in place at the school and local levels to create the context for all children to be enabled to be School Ready (Children's Commissioner, 2020; Hogg & Moody, 2023; Statham, 2023). In many ways the end of the Reception Year for the identification of whether a child is School Ready means that earlier opportunities for support will have been missed.

Moreover, to understand child development in a more comprehensive and robust way account could be taken of a wider range of approaches to measuring individual circumstances including drawing on Sen's (1993) capability approach. Children, parents and carers could be more directly involved in the development of the measures of child development as part of a more participatory approach to help ensure that the measures and policies are informed by first hand experiences alongside the teacher observation data. This evidence would help build the understanding of the experiences of learning and the barriers and challenges faced by children and their carers from different backgrounds both in and outside of the school context (Ben-Arieh, 2005; Brooks & Murray, 2018; Fattore et al., 2007; Minujin & Nandy, 2012; Montreuil et al., 2021; Murray, 2019). Such an approach would also support the empowerment of children and their carers. Participatory methods have informed the research of, for example, Parey (2020, 2021), Trani and Cannings (2013) and Uyan-Semerci and Erdoğan (2017) including in relation to using mixed methods and self-reported data to develop the understanding of the multidimensional nature of poverty and its impact on the lives of people with disabilities in developing countries and children living in poverty including in conflict zones. This kind of engagement and evidence will help identify, and therefore help target resources and support individual needs in a responsive way.

The gap in the levels of School Readiness and the negative consequences of difficulties in their early years of development can be long-term, not only for the children themselves and their future but for wider society including the economy (Bakken et al., 2017; Duncan et al., 2012; Marmot, 2010; OECD, 2022). This is of even greater urgency in the context of the Covid-19 Pandemic and the negative impact this has had on the development of young children, particularly for those from families whose parents were unable to work flexibly, those from economically deprived backgrounds and as a result of the closure of ECEC services (González et al., 2022; Pascal et al., 2020; Tracey et al., 2022). Evidence suggests that since the Covid-19 Pandemic some children have regressed in basic skills and learning and the levels of school absence have increased (Department for Education, 2023b; Ofsted, 2020).

The findings from this research have implications for young children, their carers and also for education policies nationally and locally. The widening educational attainment gap between different areas of England has again been highlighted in recent GCSE results (Ofqual, 2023) and is a key area in the government's Northern Powerhouse and Levelling Up policy initiatives (HM Government, 2021). However, whilst increasing the levels of School Readiness may be a government priority, tackling the stark inequalities will take considerable investment and highly targeted support and engagement across the home and school learning environments.

5 Limitations

Firstly, as discussed above, School Readiness assessments are based on teacher observations and these may be subject to measurement error and bias (Campbell, 2015, 2021; Doyle et al., 2012; Hansen & Jones, 2011; Kay, 2022). Moreover, the

score difference in a child being categorised as School Ready or not can be quite small. Secondly, due to data access restrictions the statistical modelling did not include all the potential child level variables collected by the Department for Education. As discussed, various other factors could also be important to consider. A further methodological issue is that in England many schools are part of academy trusts and these can exist across LEA boundaries. Despite these limitations, the findings add to the understanding of the inequalities in child development and the challenges facing many young children, their carers, schools and teachers as well as policy makers.

Acknowledgements Thank you to the Department for Education, the ONS and to the schools, teachers and children who provided and collected the data. Thanks also to the journal reviewers for their helpful feedback.

Authors Contribution All authors contributed to the study conception, design and data analysis. The first draft of the manuscript was written by Dr. K. Purdam. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Financial support was provided by the University of Manchester, UK and the Economic Social Research Council—grant ES/W000555/1. Dr Morales-Gómez and Dr Troncoso's contribution to this work was supported by the Economic and Social Research Council through the following grants: 1) Understanding Children's Lives and Outcomes and 2) Scottish Centre for Administrative Data Research (grant numbers ES/V011243/1 and ES/S007407/1). Dr Morales-Gómez and Dr Troncoso are affiliated with the Scottish Centre for Administrative Data Research (SCADR), which is part of the Administrative Data Research U.K. partnership, funded by the Economic and Social Research Council.

Data Availability The data used was accessed through the Secure Research Service of the Office for National Statistics in the UK. The data requires access approval.

Declarations

Ethical Approval The research was approved by the University of Manchester.

Informed Consent Not applicable.

Statement Regarding Research Involving Human Participants and/or Animals Not applicable.

Competing Interests The authors have no financial or competing interests to declare that are relevant to the content of this article.

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