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Diversity in the United Kingdom: Quantification for higher education in comparison to the general population

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Abstract

Diversity in the United Kingdom is regularly quantified through Census data. The latest figures (2021) for England and Wales indicate that 82% of the population identifies as white, 51% are females, 17.7%–22.3% are disabled, 18.2% hold no qualifications and 51.7% of households are deprived in at least one dimension. Furthermore, the median age in England and Wales is 40. All of these figures vary significantly across local geographical areas. Diversity in Higher Education (HE) is also monitored yearly by the Office for Students. The latest figures (2020/2021) indicate that 68.4% of entrants are under 21 years old, 56.5% are females, 14.8% report a disability and 21.8% are categorized as severely deprived. Some differences were observed between these figures and those from previous years. The current study aims to highlight how diversity in HE has evolved since 2010 and how the current landscape can illustrate significant differences between courses. Furthermore, comparisons with the general population are also measured in an attempt to describe potential bias in HE, together with new avenues that should be explored to level the HE field in regard to diversity. Our results indicate that access to HE needs to be improved for males, while strong discrepancies were observed between disciplines.

Ethnic diversity remains high throughout the HE sector, although subject-specific biases were noted. An increase in students from the most deprived areas has been found, although it was not the case for all subjects within the sector. Finally, reported disabilities are on the rise, especially regarding mental health, warranting additional support for affected students. These findings are discussed and put into context. To conclude, HE providers might need to collegially address subject-specific discrepancies.

KEYWORDS
diversity, England and Wales, higher education, United Kingdom, university

1 | INTRODUCTION

The notion of diversity encompasses several different categories. These include age, gender, ethnicity, disability and religion. While some are controlled by genetic factors (Mirazón Lahr, 2016), others are explained by external factors (Kim, 2011; Lin, 2019), such as history, access to health care (Bhopal et al., 2018; Evandrou et al., 2016; Gruer et al., 2016; Schofield et al., 2019), migration (Bove & Elia, 2017), the environment (Foley & Mirazón Lahr, 2011) and social/cultural phenomena.

The population of the United Kingdom (UK) is currently increasing and estimations predict there will be more than 70 million of inhabitants in the UK by 2041 (Office for National Statistics, 2022c). Interestingly, the highest growth (0.64%) will be in Northern Ireland. Growth is largely driven by net migration, which is the difference between emigration and immigration (Office for National Statistics, 2022c). The median age in the UK is 40 years old (Office for National Statistics, 2022d) and life expectancy at birth in 2020 was 79 years old for males and 82.9 for females (Office for National Statistics, 2021c).

At the beginning of January 2021, there were 49.4% of males in the UK, which is not explained by higher female births. In fact, the latest figures indicate a gender ratio at birth in favour of males, with 105.4 males born for 100 females (Office for National Statistics, 2022e). Explanations for such a complex observation have been explored recently and indicate that such a phenomenon is driven by higher mortality rates for males during infancy, which is then compensated by fathers wishing to replace deceased male offspring (Gellatly, 2019). Such a bias in favour of males at birth is seen across the globe (Austad, 2015; Edvardsson et al., 2018), not only in humans (Hagen et al., 2022; Perret, 2018) and does not seem to be caused by environmental factors (Hagen et al., 2022), although this is disputed for humans (Lavoie et al., 2019; Schacht et al., 2019). However, due to public policies (Fan et al., 2020; Hesketh & Xing, 2006), these figures tend to be different in some countries, such as China, Afghanistan, Pakistan, Iran, Taiwan, India and Bangladesh, probably due to external pressure.

The results of the 2021 census indicate that the majority of the population in the UK identified as white (Office for National Statistics, 2022a). Indeed, 81.7% of residents in England and Wales identified as white, while the next more common answer was residents of Asian ethnicities (Asian, Asian British or Asian Welsh). Besides, mixed ethnic backgrounds were accounted for in 10.1% of households. Finally, 2.1% of residents selected "other ethnic group" as their answers (Office for National Statistics, 2022a). Similar to previous figures, ethnicity varied greatly across counties in England and Wales.

In England and Wales, between 16.5 and 22.3% of people reported a disability (Office for National Statistics, 2023a). As expected, disability increased in proportion to age, as increasing health-related issues occur in the older age groups. In a model predicting the trends in disability for 2025 (Guzman-Castillo et al., 2017), a rise of 25% in the projected numbers of residents living with a disability is anticipated in the over 65 years old, by 18.9% in the 65–84 age group and by 43.2% for residents over 85. The concern is that these figures thus suggest that the population will live for longer (Bennett et al., 2015), but with increasing disabilities. However, a gain in life expectancy does not imply a population aging more quickly. In fact, a study demonstrated that a faster life expectancy rate would induce a slower aging of the population (Sanderson & Scherbov, 2015). In addition, striking differences in projected disabilities were observed between genders, with men expected to present more disabilities than women (Guzman-Castillo et al., 2017). On a more positive note, the proportions of males and females with disabilities have been decreasing steadily in England and Wales since 2011, although this is not the case for residents aged 5 to 54 years old (Office for National Statistics, 2023a).

Deprivation is based upon 4 distinct dimensions by the UK government. These include employment, education, health/disability and housing (Office for National Statistics, 2022b). In the latest census (2021), 51.7% of all households were considered deprived in at least one of the four dimensions (Office for National Statistics, 2022b), which is a 6% decrease from the 2011 figures. Major geographical disparities were observed, with a North to South gradient as well as a suburb bias around major metropolitan areas, especially for London, Birmingham, Manchester, Liverpool and Newcastle (Office for National Statistics, 2021a). The county with the lowest proportion of income-deprived residents was Middlesbrough (together with Knowsley), while the county with the highest proportion of income-deprived residents was Hart. The results also showed 3.7% of households with three dimensions of deprivation, while 0.2% of households (57 thousands) experienced the highest deprivation (all four dimensions) (Office for National Statistics, 2022b). Finally, compared to other regions, Wales, the North East and the West Midlands had the highest proportions of deprived households (at least in one dimension), respectively at 54.1, 54.6 and 54.1%.

In Higher Education (HE), diversity is monitored on a yearly basis by the Office for Students, as part as the legal requirement for Equality and Diversity (Equality Act, 2010). Reports are published annually for different variables, such as age, sex, sexual orientation, ethnicity, religion, disability and deprivation, as well as a few other variables. However, HE providers are all aggregated to maintain anonymity across the board. The report also categorizes students based upon domicile, level, mode of study and subjects. Time-course details are also available, ranging from 2010/2011 to 2020/2021. However, not all possible combinations (subgrouping) are covered. Key findings were published in June 2022 and cover age, disability, ethnicity, sex, gender, religion, sexual orientation, parental education, deprivation indices, household income, estrangement, socioeconomic background and areas of underrepresentation (Office for Students, 2022b). Only a summary of these results are available from the publisher, which would justify further investigation by the current study.

In the last years, access to HE has increased for ethnic minorities (UK Government, 2022a), although academic success for these students was recently found to be lower than white ethnic groups (Madriaga, 2022) while another study indicated lower level of access, support and wellbeing for ethnic minorities (Botticello & West, 2022). Students with disabilities face some barriers. Indeed, a recent systematic review found three major barriers in HE for these students: (i) infrastructure, (ii) teaching methods and (iii) institutional management (Fernández-Batanero et al., 2022). Whilst the first item would be easily addressed when planning new facilities, the remaining two can be more challenging, thus highlighting how institutional support is paramount for such specific groups of students. A recent report found that access to HE seemed to be more problematic for men, people with a disability and those from deprived areas (Bolton & Lewis, 2023). Furthermore, there seem to be disparities in the choices of subjects in HE depending on sex, age, ethnicity, disability and deprivation (Bolton & Lewis, 2023).

To answer the research question "can we quantify diversity in HE *versus* the general population?", the current study aims to provide insight on diversity, in order to identify potential avenues that would increase access to HE for minorities. Data from the 2021 Census will thus be compared to the latest available data from the Office for

Students, focusing on diversity. Statistical analyses, together with quantifications, will also highlight trends between 2010 and 2020, and how HE providers could diversify the sector.

2 | METHOD

2.1 | Datasets

Open access data was retrieved from the following providers: the UK Data Service, the Office for National Statistics, the Higher Education Statistics Agency and the Office for Students. The list of databases used in the present study can be found in Table 1. Additional details surrounding data extraction and corresponding links can be located in Table S1.

2.2 | Geographical areas

The present study is limited to the UK. However, some data could not be retrieved from providers, due to the different coding methods used across providers. Geographical areas included the UK (when possible), or England and Wales. Data in Scotland was accessed for demographics purposes via the UK Data Service. For geographical mapping, local authority district codes were retrieved from the Office for National Statistics and were put in parallel with the LAD19CD *shaper* file (December 2019) from the Open Geography Portal (https://geoportal.statistics.gov.uk/datasets).

2.3 | Data analysis and representation

Analysis was performed with RStudio (R Core Team, 2013) version 4.0.3. Following data retrieval from providers, datasets were loaded into RStudio for data analysis and representation. The following packages were used: *maps*, *gplots*, *ggplot2*, *ggpubr*, *tidyverse*, *rstatix*, *viridis*, *rgeos*, *rgdal*, *maptools*, *terra*, *dplyr*, *gridextra*, *tibble* and *patchwork*. These packages are available to download from the Comprehensive R Archive Network (CRAN) at https://cran.r-project.org/. For geographical data representation, mean scores or proportions were mapped for each local authority district. For data quantification, proportions of residents or students were analysed with binomial tests

TABLE 1 List of the datasets used in the present study.

Provider	Dataset	Data
UK Data Service	GN3357 SN9039	Age, ethnicity, qualifications, NVQ stratification, disability
OFNS	TS007	Age, population
	TS008	Sex
	TS011	Deprivation
	TS021	Ethnicity
	TS038	Disability
	TS067	Qualifications
HESA	/	Number of undergraduates
OfS	ED-Data-2022	Sex, ethnicity, age, deprivation, disability

Abbreviations: HESA, higher education statistics agency; OFSN, Office for National Statistics; OfS, Office for Students.

by inputting total numbers into the analysis software (RStudio) and comparing these numbers to the corresponding expected values (national results). When assessing how proportions might differ according to several variables, Chi-square (χ^2) tests were used. Normal distributions were assessed with Shapiro–Wilk tests ($n \leq 5000$) or Kolmogorov–Smirnov tests ($n > 5000$). Associations (correlations) between two variables were assessed with Spearman's rank correlation rho tests (non-normally distributed data) or Pearson's product–moment tests (normally distributed data). On histograms, proportions of residents or students are represented together with standard deviations (*SD*), when possible. For statistical results, p values strictly below 0.05 ($p < .05$) were considered significant. Extremely low p values are encoded as $p < 2.2e^{-16}$. Total numbers are indicated with *n* values.

2.4 | Data subsetting and terminology

The OfS datasets encompass all students studying in the UK. These contain both UK-domiciled and non-UK-domiciled students. To answer our research question, we performed data subsetting by only taking into account data extracted from UK-domiciled students. Furthermore, a distinction was also made in regard to level of study. Indeed, we have quantified results for all UK-domiciled students (irrespective of level of study) or UK-domiciled undergraduate students only. Our terminology thus used 'entire sector' to refer to all levels of study.

3 | RESULTS

3.1 | Population in England, Wales and Scotland as of mid-2021

In England, Wales and Scotland, the 2021 Census data (Labor Force Survey) aggregated data from 201336 participants. In such a cohort, the median age was 52 years old (Figure 1a), with a mean of 47.35 years old ($SD = 24.12$). Residents aged 99 years or older are grouped into the 99 years old category. As expected, age distribution does not follow a normal distribution (Kolmogorov–Smirnov test, $D = 0.977$, $p < 2.2e^{-16}$). The majority of the population

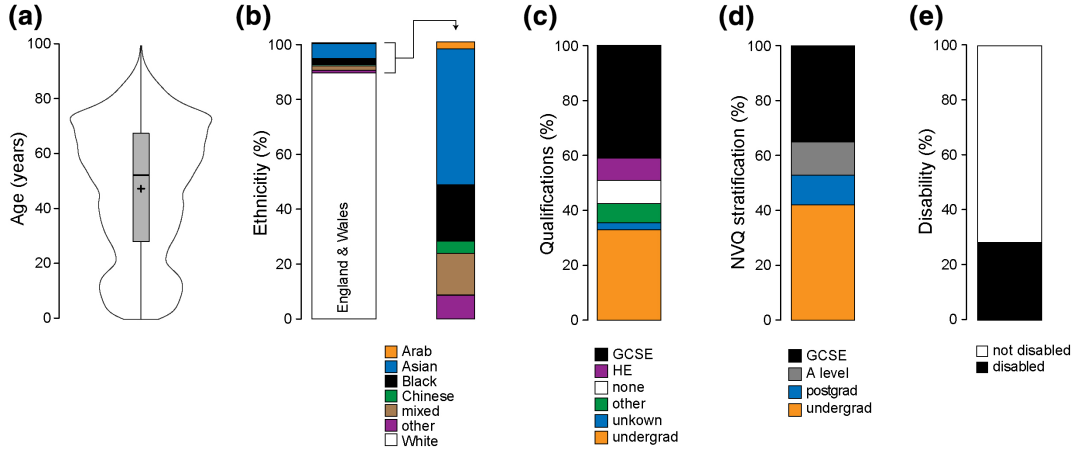

FIGURE 1 Diversity in England, Wales and Scotland. (a) Violin plot showing age distribution in the 2021 Census. The box-and-whiskers plot indicates minimum/maximum values, quartiles, median (horizontal line) and mean (+) values. (b) Ethnicity in England and Wales or Scotland. (c) Highest qualification achieved by respondents. (d) National Vocational Qualification (NVQ) stratification by level. (e) Disabilities in respondents.

in England and Wales was white (89.1%, Figure 1b). The second largest ethnic group were Asians, followed by residents identifying as 'black' (Figure 1b).

In regard to qualifications, we compiled data from either the highest qualification achieved (Figure 1c) or the highest NVQ level achieved (Figure 1d). Whilst a few disparities were observed, the two variables produced similar outputs, with around 33%–40% of respondents achieving GCSE levels and 35%–40% of respondents achieving an undergraduate/graduate degree. Interestingly, the NVQ stratification within the 2021 Census also quantifies postgraduate attainment, achieved by 10.7% of respondents (Figure 1d). We observed quantification variations throughout the dataset, probably due to the different categorizations used in the Census survey (Office for National Statistics, 2021b).

In the population samples, 28.4% of respondents indicated a disability (Figure 1e). However, it is worth noting that 51833 responders were not eligible to be asked that question (or not applicable), which represent 25.7% of all responders within the dataset (51833/201336).

3.2 | Stratification of age across England and Wales

Focusing on age distributions, the most representative groups in England and Wales are the 30–40 years old and the 50–60 years old (Figure 2a). We also observed significant variation in mean age across England and Wales (Figure 2b). Indeed, coastal areas appear to be inhabited by an older population, while a younger generation tends to prefer London and its suburbs (Figure 2b). Strikingly, the major metropolitan areas, such as London, Manchester, Liverpool, Leeds, Cardiff and Bristol, presented a younger population than the rest of the territory. On the opposite side of the spectrum, local districts such as North Norfolk (Norfolk), East Lindsey (Lincolnshire) and Rother (East Sussex) were inhabited by older residents. Finally, we quantified the proportion of 18–21, 22–25 and 26–30 years old residents in the 331 local authority districts from England and Wales. We found that the 18–21, 22–25 and 26–30 year-old groups represented 4.3, 4.7 and 6.4% of all

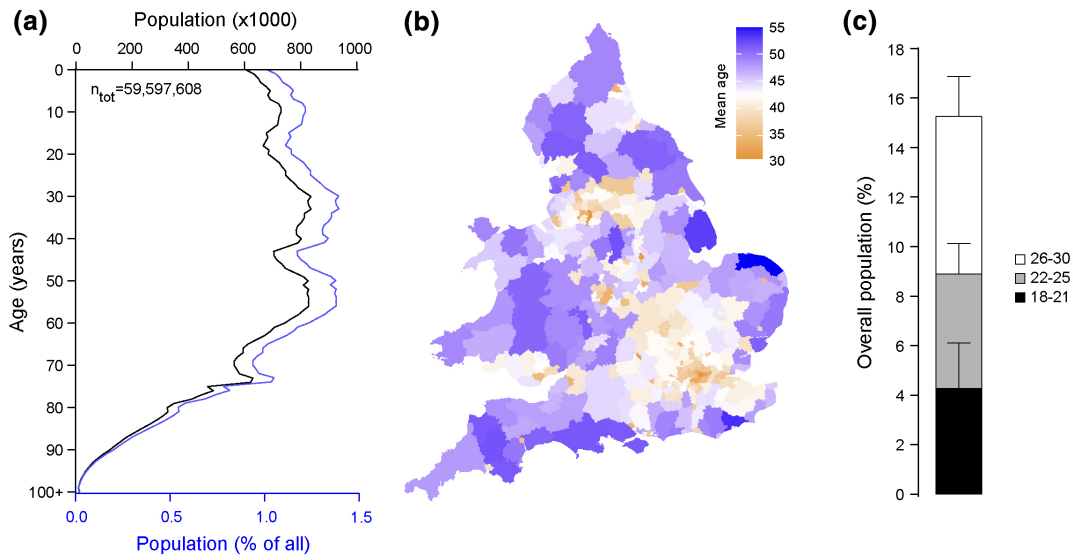

FIGURE 2 Age distribution in England and Wales. (a) Inverted population pyramid (age) of the respondents (2021 Census). (b) Geographical analysis by local authority districts (LAD) of median age. (c) Quantification of 18–30 year-old as proportions of total population, based on LAD data.

residents, respectively ($SD = 1.8$, 1.2 and 1.6, respectively), indicative of a slight variation across geographical areas.

3.3 | Sex, disability and ethnicity across England and Wales

Consistent with previous findings, we observed that females represent the majority of the population in England and Wales, with 51.03% of females (Figure 3a). Small variations in this figure were observed at local levels, where Richmondshire (North Yorkshire) and Rutland had a majority of males (48.84% and 48.66% of females, respectively, Figure 3b). Interestingly, the City of London had the lowest proportion of females (44.98), the lowest within England or Wales.

Across England and Wales, 74.8% of residents ($SD = 3.5$) were found to live without a disability (Figure 3c). More precisely, 7.1% of respondents reported a disability that did not affect day-to-day activities ($SD = 1.1$), 10.3% reported a mild disability ($SD = 1.5$) while 7.4% reported a severe disability ($SD = 1.9$). Furthermore, a gradient for disability across England and Wales was also noted. Indeed, the closer the districts are to London, the greater the decrease in the proportion of disabled residents (Figure 3d). Since we previously reported a similar gradient for age, we ascertained whether this could possibly be due to an age bias. Such a hypothesis was confirmed by quantifying the correlation between the proportion of residents reporting a disability and their age, for which a significant correlation was observed. As expected, increasing age is significantly correlated (rho = −0.59) to decreasing proportions of residents without a disability (Spearman correlation test, $p < 2.2e^{-16}$, Figure S1). Such results were expected, as disabilities can be explained by medical conditions, known to statistically increase with age.

As observed earlier, the geographical analysis of ethnic diversity across England and Wales revealed a majority of counties with a white ethnic majority (Figure 3e,f). Similar to previous observations, large metropolitan cities presented the highest diversity index (Figure 3f). Wales, the North East/West and the South East clearly appear to have a lower ethnic diversity than the rest of the country.

3.4 | Qualification and deprivation across England and Wales

In the 2021 Census dataset, 18.1% ($SD = 2.1$) of respondents did not qualify for the question related to the highest qualification held (Figure 4a). When the question was applicable to participants, 14.6% answered that they did not hold any qualifications ($SD = 3.1$), which contrasted sharply with those holding level-4 qualifications or above (27.3%, $SD = 7.2$). Interestingly, the HE sector may be in need of more apprenticeships, with only 4.6% of respondents holding such qualification types ($SD = 1.1$). Across English and Welsh local authority counties, strong disparities were observed regarding the proportion of residents with no (Figure 4b) or level 4 (degree, master's degree, doctorate, Figure 4c) qualifications.

In England and Wales, 24.7 million households were surveyed in the 2021 Census. Results indicated that the proportion of households without any dimension of deprivation was 49.0% ($SD = 5.3$, Figure 4d). One dimension of deprivation was experienced by 33.5% of households ($SD = 1.7$), while two dimensions of deprivation were found in 13.8% of households ($SD = 2.8$). Three or four dimensions were found in 3.5% and 0.2% of households, respectively ($SD = 1.3$ and 0.1, respectively, Figure 4d). Geographically, we observed that the counties close to the metropolitan area of London presented high proportions of households without any dimension of deprivation (Figure 4e). This was also true for some Northern counties, such as Ribble Valley (Lancashire), Craven, Richmondshire, Harrogate and Hambleton (all in North Yorkshire). Figure 4f shows similar results with the most deprived households (in 3 to 4 dimensions), which matched our previous results on households without any dimension of deprivation. Finally, a strong positive

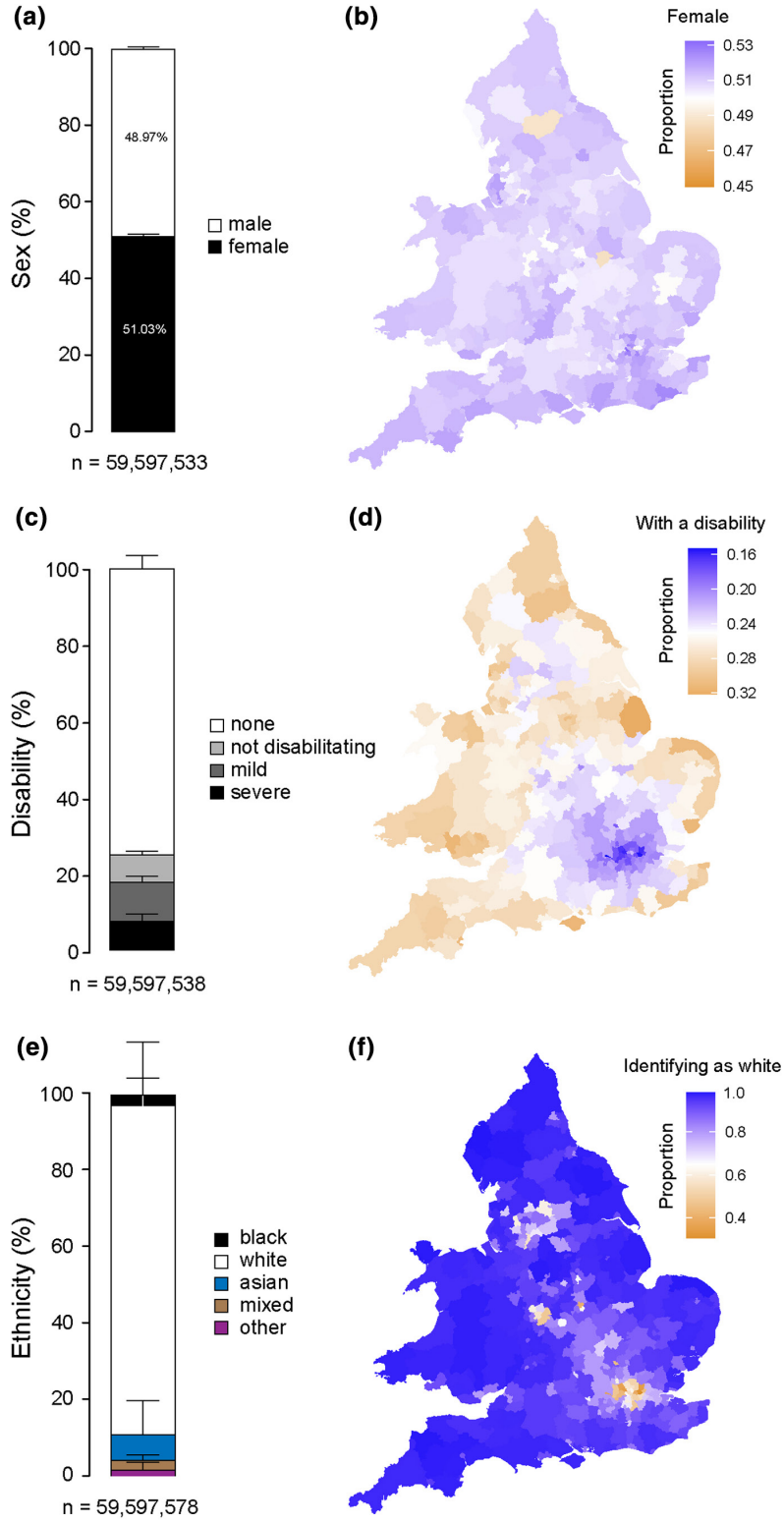

FIGURE 3 Sex, disability and ethnic distributions in England and Wales. Sex proportions in the dataset (a) based on geographical distributions (b). Disability type (c) and geographical distribution of respondents reporting at least one disability level (d). Ethnic groups in the dataset (e) and geographical distributions of respondents identifying as white (f).

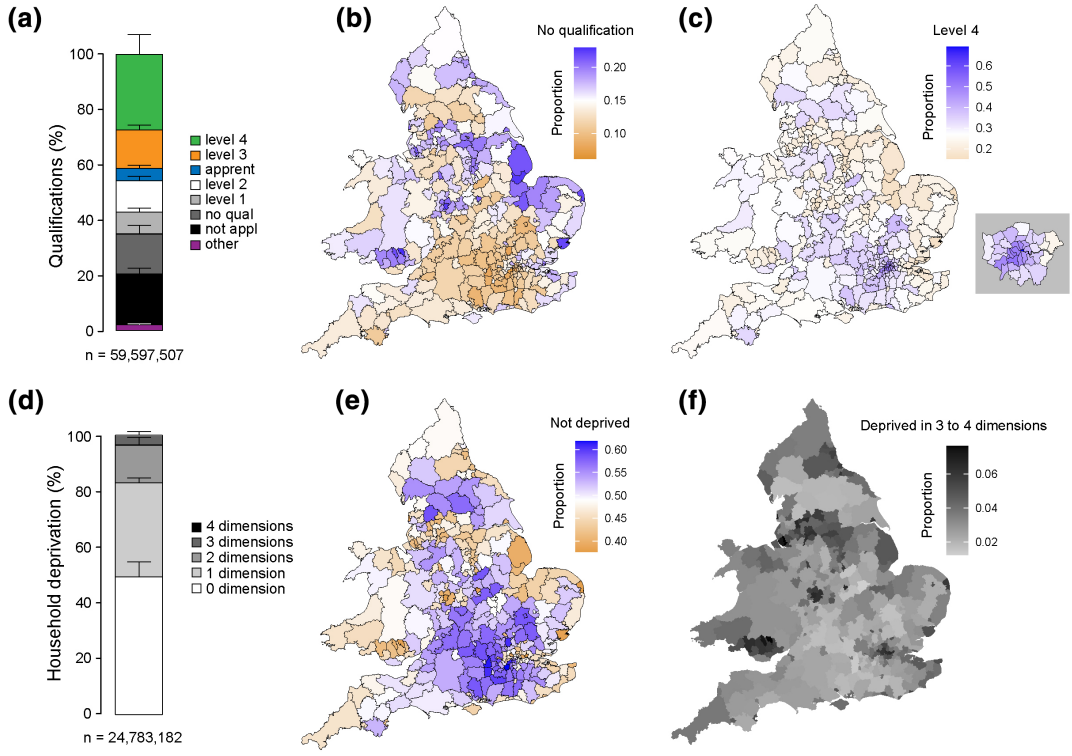

FIGURE 4 Qualifications and deprivation distributions in England and Wales. (a) Qualification types in the dataset. Geographical distribution of respondents with no qualifications (b) or with a level 4 qualification (c). Here, "level 4" corresponds to a degree, a higher degree, NVQ level 4 to 5, professional qualifications and other types of qualifications/degrees. See (Office for National Statistics, 2023b) for the full list. Inset: zoom on London area. (d) Distribution of household deprivation according to the number of deprivation dimensions. Geographical distribution of households without any dimension of deprivation (e) or reporting 3 to 4 dimensions of deprivation (f). apprent: apprenticeships, no qual: no qualification, not appl: not applicable.

correlation (rho = 0.71) was observed between deprivation and lack of qualification (Spearman correlation test, $p < 2.2e^{-16}$, Figure S2).

3.5 | Expected growth in student numbers

Next, we focused on student characteristics (UK-domiciled only). Since birth rates increased steadily from 2003 to 2012 (Figure 5a) and that undergraduates represented 2.588% of the total UK population in 2021 (Figure 5b), we calculated the potential surplus of students enrolling in HE institutions when reaching 18 years old. Our results suggest that each year from 2023 (18-year-old students born in 2004) to 2029 (18-year-old students born in 2011) will see a rise in enrollments, which will peak at 2170 additional students in 2029, when compared to enrollment in 2021 (Figure 5c). The observed rise in student numbers (versus enrollments in 2022) will remain until 2033 before dropping to lower levels starting in 2034. Such an increase in students will thus have to be taken into account by HE providers.

In the next sections below, we have gathered data from the Office for Students (OfS) regarding sex, ethnicity, age, deprivation, disability and suicide, in an attempt to contrast the population of students (from 2010 to 2020) with what was observed for these variables in the general population (2021), derived from reports published by the Office for National Statistics (OfNS).

3.6 | Strong sex bias in the subjects chosen by students and level of study

In the entire UK HE sector (dataset extracted from the OfS, Table S1), females represent the majority of students and this has been the case for the last 10 years (Figure 6a). These figures are significantly higher than what is found in the general population (binomial test vs. 51.03%, $p < 2.2e^{-16}$). Between 2010 and 2020, the proportion

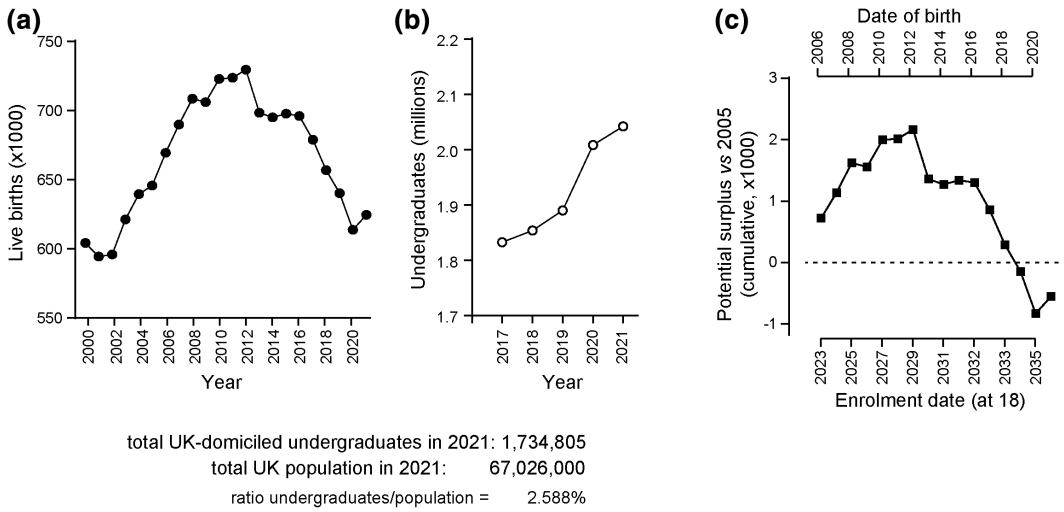

FIGURE 5 Predicted increase in student numbers. (a) Live births recorded from 2000 to 2021, based on the "vital statistics in the UK" dataset. (b) Undergraduates from 2017–2021. (c) Predicted surplus of students versus 2022. Here, enrolment date was calculated for 18 year olds based on date of birth (year).

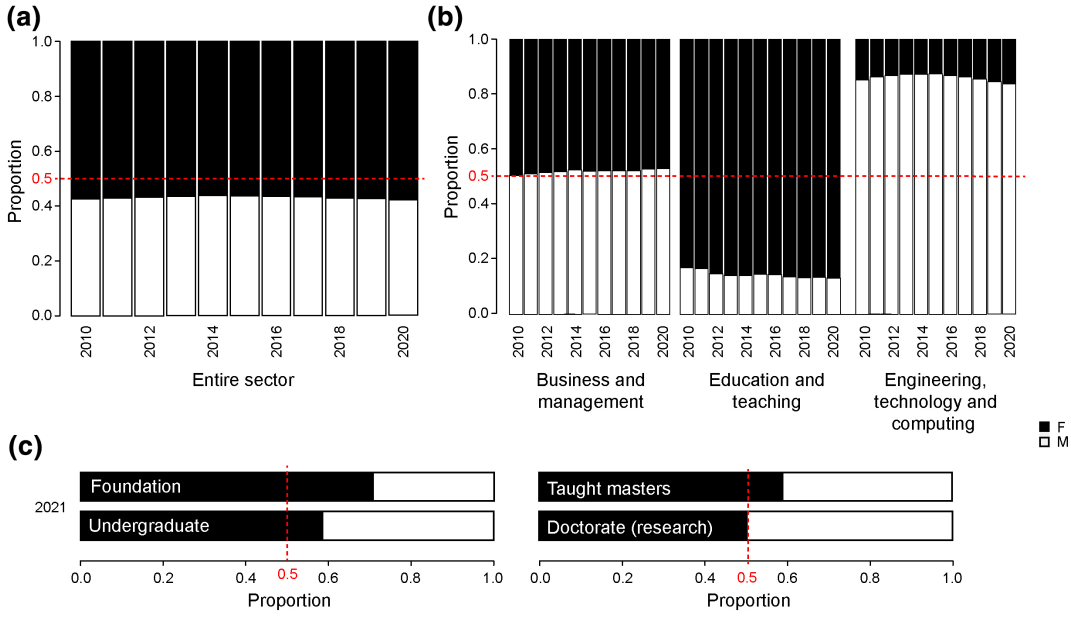

FIGURE 6 Analysis of sex in HE. (a) Proportion of males (M) or females (F) in the entire sector from 2010 to 2020. 'Entire sector' refers to all levels of study. (b) Sub-analysis highlighting subjects with high or poor sex diversity in undergraduates. (c) Proportions of males or females according to level of study. Dashed red lines indicate 50% for visual aid.

of females increased by 0.46%, reaching 57.85% in 2020 (compared to 57.39% in 2010), which represents a significant increase (binomial test, $p < 2.2e^{-16}$). When analysing different taught subjects, business and management were the subjects that were the closest to the figures found throughout the entire sector (Figure 6b). On the opposite side of the spectrum, education and teaching presented a strong bias towards females (86.8%), while engineering, technology and computing attracted more males than females (60.6%). In this database, we did not take into account students that identified as "other sex", which, in the entire sector, represented 0.19% of all students in 2020 (0.0058% in 2012, the year when such a possible answer was first introduced).

When comparing the 2020 results in the entire sector to those in the general population, HE seems attractive to females (51.03% of females in the general population versus 57.85% in HE). Thus, there may be some improvement needed to increase access to HE for male students. In addition to these observations, we also note strong sex disparities at different levels of study for UK-domiciled students. Indeed, in 2021, females represented 70.7% in foundation degrees, 58.6% of undergraduates, 58.9% of students in taught masters and 50.3% of all doctoral research students (Figure 6c). Thus, access to higher levels for females should be explored further to understand why progression for females towards higher levels of education is so asymmetric.

3.7 | Ethnic diversity across subjects

The entire sector was found to be increasingly diverse from 2010 to 2021 (Figure 7a). Indeed, students identifying as white represented 77.3% of the student cohort in 2010, which significantly decreased to 70.1% in 2020 (binomial test, $p < 2.2e^{-16}$). These figures are significantly lower than the average of 81.7% in England and Wales (2021 Census, binomial test versus 81.7%, $p < 2.2e^{-16}$), indicative of good access to HE by minorities. It is worth noting here that the answer 'gypsy or traveler' was first introduced in 2012, and that our quantification indicated that respondents identifying as belonging to such an ethnic group represented 0.034% of all students in 2020. The ethnic diversity in the whole student population was found to have significantly varied from 2010 to 2020 ($\chi^2 = 119355$, df = 140, $p < 2.2e^{-16}$).

When focusing on different subjects within the HE sector, business and management had increasing ethnic diversity from 2010 to 2016/2017, only to now be on the decline (Figure 7b). Very interestingly, since 2015, medicine, dentistry and veterinary sciences had increased their proportion of students from ethnic minorities, which are rising steadily. Humanities and languages were found to have the lowest proportion of ethnic minorities (81.2% of the students identified as white in 2020). However, we noted a steady rise in students from minorities since 2013 (85.3%, 84.4%, 83.8%, 83.6%, 83.1%, 82.6%, 81.9% and 81.2% of students identifying as white, respectively from 2013 to 2020, Figure 7b).

3.8 | Enrollment of mature students across disciplines

As expected, we found that the entire HE sector is mostly comprised of young students (Figure 8a). Here, 'young' is defined as strictly younger than 21 years old when entering HE. By contrast, 'mature' students are defined as students aged 21 years old or over when entering HE (Office for Students, 2020). In 2020, young students represented almost half of the undergraduate student cohort (49.3%). To note, students aged 51 years old or over represented 2.8% of all students in 2020, a decline from 3.3% in 2010.

As observed in Figure 8b, nursing, allied health and psychology has recently appealed to a younger population of students. In fact, young students represented only 39.1% of all students in 2010, which significantly increased to 51.2% in 2020 (binomial test, $p < 2.2e^{-16}$). The figures contrasted drastically with what was observed for design, creative and performing arts, which had the highest proportion of young students (79.7% in 2020)

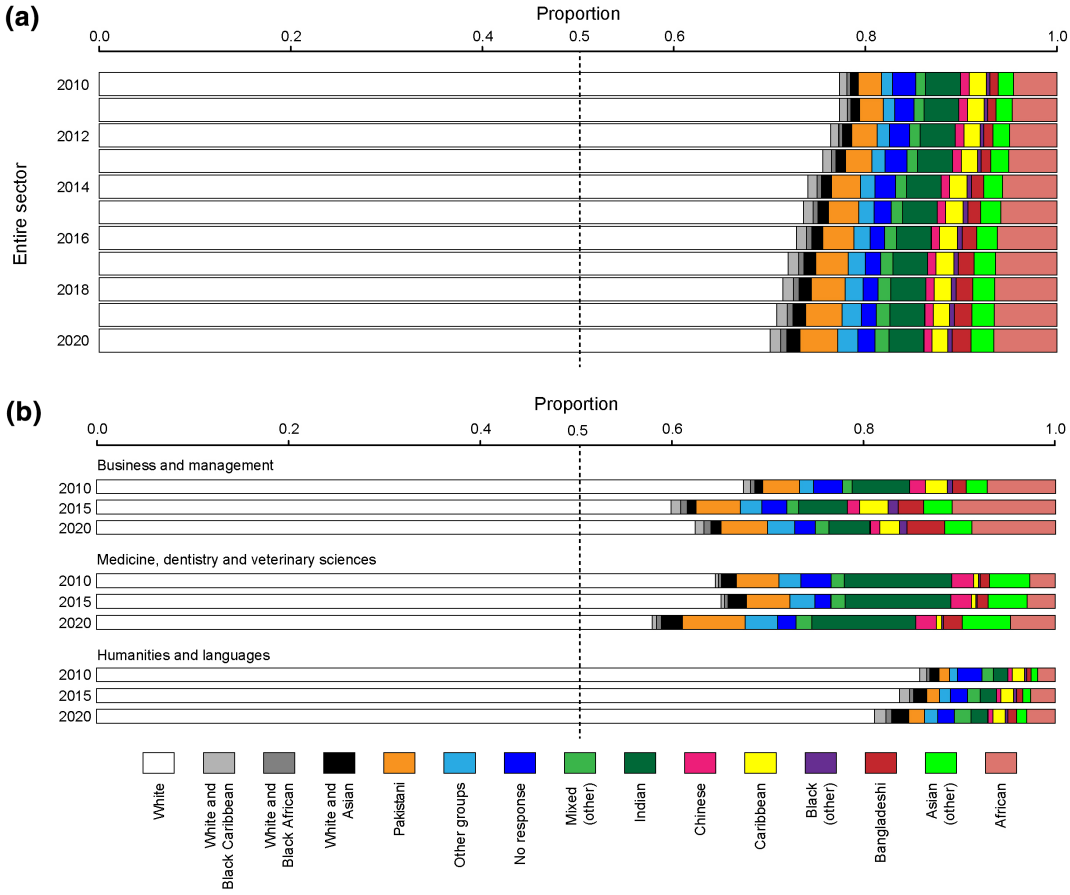

FIGURE 7 Ethnic diversity in HE. (a) Proportion of ethnic groups in the entire sector from 2010 to 2020. 'Entire sector' refers to all levels of study. (b) Sub-analysis highlighting undergraduate subjects with differences in ethnic diversity over time. Here, the dataset categorized students into 15 different ethnic groups. Note that the group "gypsy or traveler" was excluded here.

within all disciplines. This indicates that the HE sector presents great variation in terms of recruiting mature students. Efforts might be needed to increase access to HE for mature students, in light of recent societal events ('lockdown').

3.9 | Heterogeneity of the level of deprivation for students amongst disciplines

For UK-domiciled students in full-time education or apprenticeships, access to HE for deprived students has increased slightly from 2010 to 2020. Indeed, 14.7% of all students were categorized as most deprived in 2010 (1st quintile on the deprivation scale), which significantly increased to 19.0% in 2020 (binomial test, $p < 2.2e^{-16}$, Figure 9a). In parallel, students with the lowest index of deprivation (5th quintile) decreased from 2010 (24.6%) to 2020 (21.0%). This also implies that the proportions of students within quintile 3 and 4 also decreased from 2010 to 2020 (Figure 9a). In 2020, students not replying to that question or for which the question would not be applicable represented 3.4%.

When focusing on undergraduates, a strong increase amongst the most deprived students were observed in subjects allied to medicine, from 19.5% in 2010 to 25.3% in 2020, which is just short of a 6% increase (5.8%,

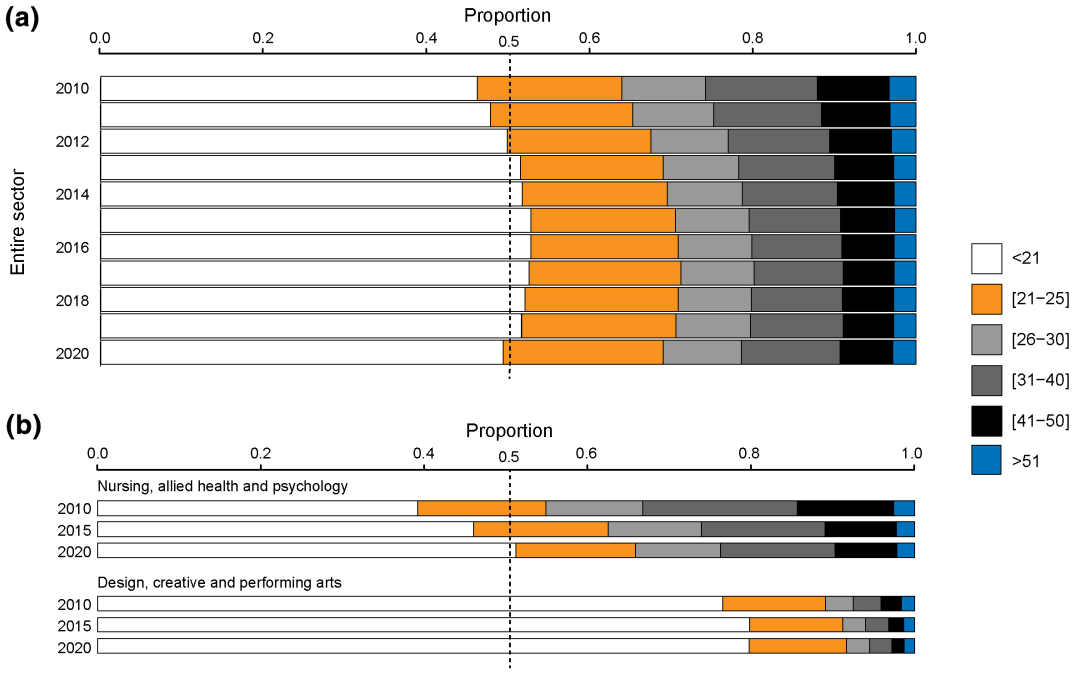

FIGURE 8 Age stratification in HE. (a) Proportion of age groups in the entire sector from 2010 to 2020. 'Entire sector' refers to all levels of study. (b) Undergraduate sub-analysis highlighting age diversity over time.

Figure 9b). Our analysis also indicated that the proportion of all other students (index of multiple deprivation 3 to 5, IMD) decreased, with a small increase of 1% for students in the IMD quintile 2 category. IMD quintiles are based on calculations by the OfS (Office for Students, 2019). In sharp contrast to these observations, the disciplines recruiting the lowest proportion of deprived student were geography and Earth/environmental studies, with rather consistent figures when comparing 2010 to 2020 (Figure 9b).

3.10 | Increased disabilities, increased mental health issues and suicide rates

From 2010 to 2020, the proportion of undergraduate students indicating disabilities steadily increased from 9.5% to 18.4% (Figure 10A), which represented a significant increase (binomial test, $p < 2.2e^{-16}$). Compared to the general population living with no disability (74.8%), the 2020 figures (81.6%) are not significantly different (binomial distribution, $p = .28$). This suggests that access to HE for students with disabilities is generally good across the sector. Very interestingly, we quantified the different disabilities disclosed by students and found that almost half (48.7%) of the disabilities were classified as cognitive/learning disabilities in 2010. Recent figures (2020) indicate that students report cognitive/learning (32.4%), mental health (29.0%), multiple/other (19.7%), sensory/medical/physical (14.5%) and social/communication (4.4%) impairments. Mental health impairments significantly increased from 2010 (0.008%) to 2020 (0.054%, binomial distribution, $p < 2.2e^{-16}$), which may warrant further investigation. However, we did not find significant differences in suicide rates amongst students from 2000 to 2019 (Figure 10B, left panel), as fluctuations were observed throughout. The median suicide rate from 2000 to 2019 was calculated at 3.85 per 100,000 students ($SD = 0.8$), which contrasts greatly with the 10.7 figure found in the general population in 2021 (Office for National Statistics, 2022f). Compared to female students, males presented significantly

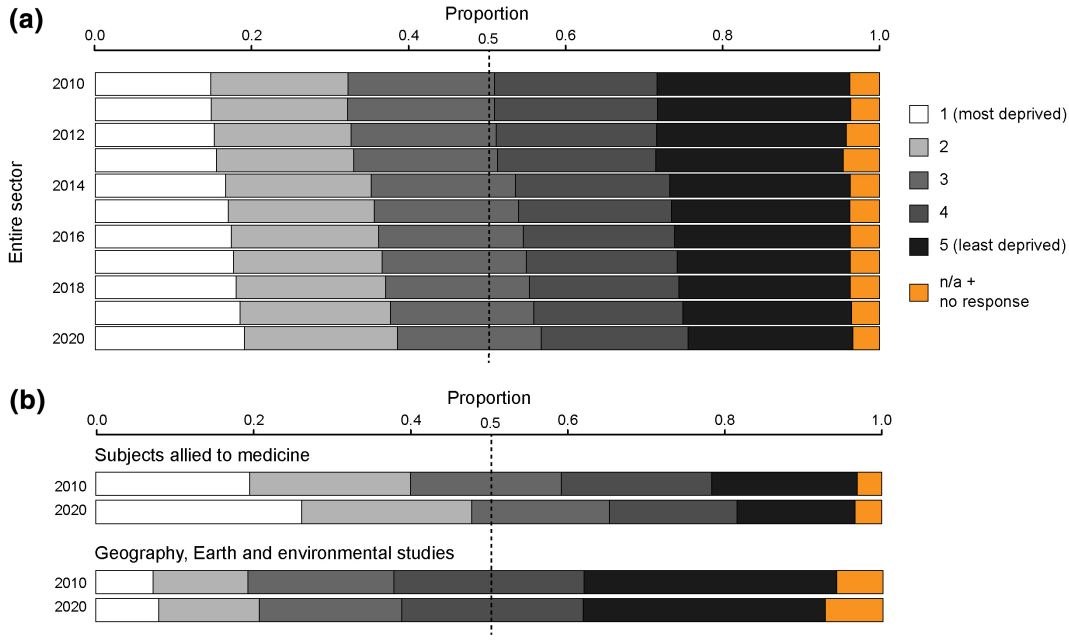

FIGURE 9 Deprivation stratification in HE. (a) Proportion of deprived students in the entire sector from 2010 to 2020, based on deprivation quintiles as in (Office for Students, 2019). 'Entire sector' refers to all levels of study. (b) Sub-analysis highlighting disparities between undergraduate subjects.

increased suicide rates (unpaired Welch *t*-test, $t = 8.005$, Figure 10B, right panel). Besides, the younger the students are, the lower the rates (Figure 10B, right panel).

4 | DISCUSSION

Access to HE for females was found to be high throughout the sector. We noted with interest that the proportion of females decreased with the level of study. Indeed, the proportion of females decreased when transitioning from taught masters to doctorate by research. Deciphering the cause of this has been attempted previously. Paralleling what we have reported here, a recent article found that STEM subjects (science, technology, engineering and mathematics) presented great gender inequalities (Bowman et al., 2022). Even when the proportion of doctoral degrees awarded to females is satisfactory in biology (52.5%), gaps in academic achievement are also reported, such as fewer academic appointments and lower citations of published work (Feldon et al., 2017; Ross et al., 2022). In a sample extracted from prestigious medical journals (more than 5600 articles), female authors are less likely to receive credit for published materials (Chatterjee & Werner, 2021). Furthermore, publications at senior authorship positions are fewer for females (Chatterjee & Werner, 2021). This was also corroborated by another study (Lerman et al., 2022). In psychology, a similar trend is observed, with fewer females in first or last authorships (Krebsbach, 2022). However, another study highlighted that these differences might be explained by confounding factors, such as self-citation and total number of authors, at least in medicine (Andersen et al., 2019).

HE providers are facing the huge challenge to increase enrollment of male students. This has been emphasized earlier (The Guardian, 2016; Weale, 2018) with the slogan: '*take (y)our son(s) to University day*', which seems to still be very current, in light of our present results. These inequalities appear to be grounded in secondary education. Indeed, a predictive study demonstrated that poorer proficiency in males, measured at 15 years old,

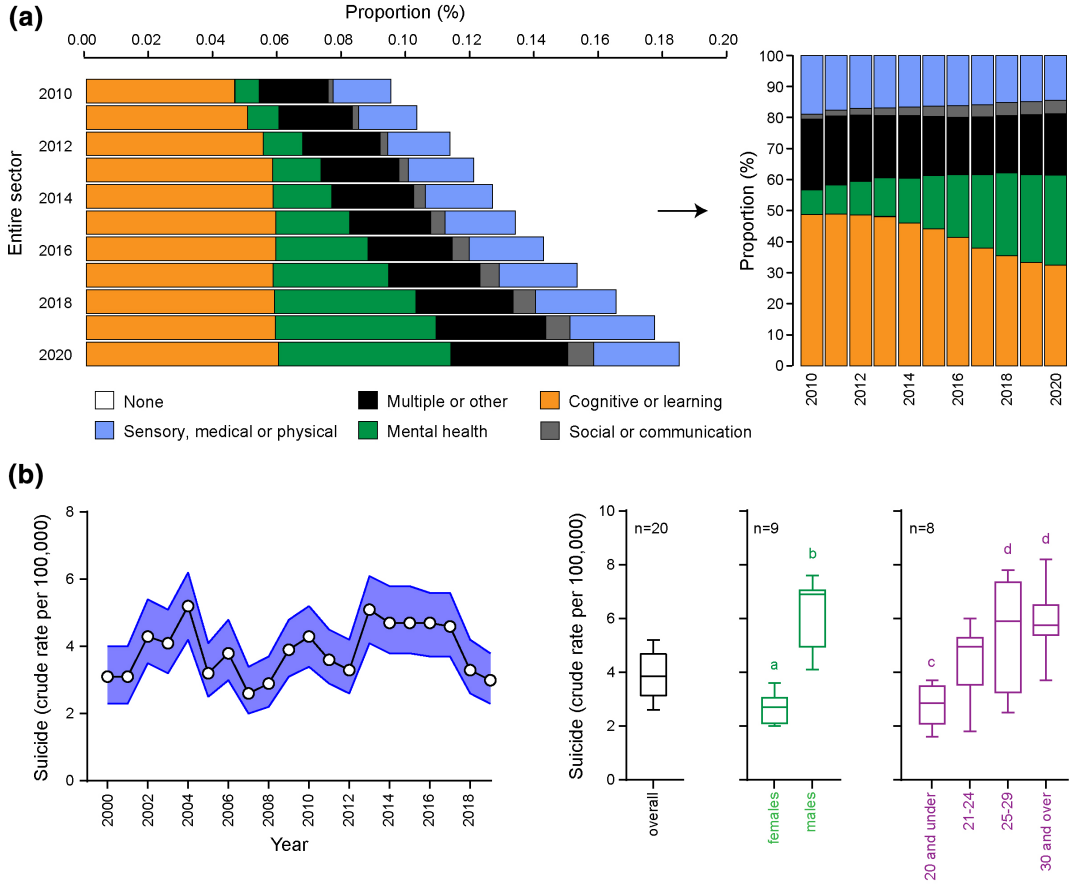

FIGURE 10 Disabilities in HE. (A) Proportion of students with different disabilities in the entire sector (all levels of study) from 2010 to 2020. (B) Crude suicide rates of all registered students (irrespective of domicile), from 2000 to 2019 or in different groups. Blue lines indicate the 95% confidence intervals (upper and lower limits). Statistical results are encoded as following: a versus b: $p < .0001$, unpaired *t*-test with Welch's correction, c versus d [20 and under vs. 25–29]: $p = .004$, c versus d [20 and under vs. 30 and over]: $p = .0009$, Tukey's post hoc tests after one-way ANOVA ($F_{3,28} = 7.52$, $p = .0008$).

can successfully predict tertiary enrollment 5 years later (Stoet & Geary, 2020). Interestingly, such a study added into the model a variable that accounts for societal attitude towards women in HE, which increases male representation (Stoet & Geary, 2020). Significantly higher grades are consistently reported in previous articles focused on high school female students (Dubuc et al., 2020), but results for University students can be heterogeneous (Crowther & Briant, 2022; Pirmohamed et al., 2017). To note, one of these two studies found that male and female students achieved similar grades overall (Pirmohamed et al., 2017), but females spend significantly more time studying, whilst having significantly higher achievement goals. Furthermore, conscientiousness was found to be higher in women than men (Verbree et al., 2022). In Germany, male adolescents seem to achieve significantly lower scores in German than females, but achieve significantly higher grades in mathematics (Weis et al., 2013). In the US, similar findings were observed in algebra, English and social studies, explained by better self-control and self-discipline in females (Duckworth & Seligman, 2006). Finally, an earlier study in Taiwan found that internet use for online exam preparation is linked to higher academic grades, while internet use for socializing or gaming predicts poorer grades (Chen & Fu, 2009). Thus, the question remains as to the cause of lower entry for males in HE. Indeed, whether the HE sector needs to correct gender discrepancies acquired during secondary

schooling remains a difficult question to address. The 'appeal factor' was also found to explain gender differences for specific subjects in different countries, such as mathematics, physics and computer sciences, but also non-science-based subjects such as psychology or politics (Huang et al., 2020). Governmental regulations may decide to implement new regulations within secondary education to tackle those issues. The causes of such differences between genders could be investigated further, whether societal, genetic or even environmental.

Our study found that the proportion of students with disabilities in HE is a true reflection of the figures from the general population. As such, HE providers can thus be deemed to provide a fair access for those students. However, some challenges accompany such figures. Our study found that almost 6% of all students reported a learning disability in 2016 (in England and Wales), which seems to parallel the self-reported figures at just short of 6% in another US study (McGregor et al., 2016). Indeed, appropriate housing is needed, especially for students reporting physical impairments. Furthermore, HE providers also need to ensure that academic adjustments can be implemented, to support learning. Most of these will relate to implementing measures for examinations or assessments, as found in a recent survey (Edwards et al., 2022). A great challenge faced by the HE sector is to provide the best support for visually impaired students (Hewett et al., 2017). Interestingly, students in need of such accommodations are often found to disclose 'hidden disabilities', which mainly encompass mental health issues or anxiety (Edwards et al., 2022). Another challenge for HE providers is to encourage disclosure of disabilities by students, who are often reluctant to do so, likely due to psychological factors (de Cesarei, 2015). Providing adequate academic support for disabled students might also prove difficult (Fossey et al., 2017), as the proportion of disabled students increases each new academic year. In the US, 32.9% of students reporting a learning disability receive academic adjustments (McGregor et al., 2016). Students recognize the efforts made by HE providers to support them in learning (Yssel et al., 2016), which is surely appreciated by HE institutions. University staff (faculty) also seem to have positive views about providing reasonable adjustments for students in need (Helena Martins et al., 2018; Lipka et al., 2020; Sandoval et al., 2021) and are generally aware of the different adjustments available (Sniatecki et al., 2015), although improvements might be deemed necessary (Papadakaki et al., 2022), especially via educational programs for educators (Valle-Flórez et al., 2021).

From 2010 to 2020, increased proportions of students with mental health impairments were observed. These results can partly be explained by assessments or examinations, which induce 'test anxiety' in more than half of the students (Hanfesa et al., 2020; Tsegay et al., 2019). An approach to reduce such an induced anxiety can be cognitive appraisal aimed at erasing perceived low self-efficacy (Krispenz et al., 2019). In the UK, a systematic review gathered evidence on factors influencing poor mental health. Such a study found childhood trauma, identifying as LGBTQIA+ and autistic impairments to be significantly associated with poorer mental health (Campbell et al., 2022). Efficient coping strategies were social support, self-control, self-efficacy (Campbell et al., 2022). Being male was also found to be a significant variable for better outcome (Campbell et al., 2022). Wellbeing can also be improved in University students by developing courses surrounding mindfulness, such as an 8-week long course based on group-lead cognitive therapy (Medlicott et al., 2021), which was adapted from an earlier study (Teasdale et al., 2000). We report here that suicides amongst HE students were consistent from 2010 to 2020, with an overall rate of around 4 deaths per 100,000 students, which are lower than what was found in the general population in 2021 (Office for National Statistics, 2022f). We also found significantly greater rates in male students, but lower rates in younger students. In England and Wales, suicide rates for men were also found to be almost three times those for women (Office for National Statistics, 2022f). In younger cohorts (adolescents aged 15–19), suicide rates varied throughout the World but were consistently higher in boys (Wasserman et al., 2005), although variations were recorded in some countries. Thus, being male and a mature student appear as risk factors, encouraging HE providers to target such groups for programs aimed at increasing awareness of students' mental health. The current study also found a steady trend (rise) in proportions of disabled students, which implies that HE providers will need to adjust staffing to best support students with disabilities. This includes academic staff, resources and support staff, the latter being paramount. These observations are not limited to HE and may be warranted on a national

level, as suggested in 2021 by the government (UK Government, 2022b). Finally, recent findings showed that 5% to 15% of school-aged children can present learning disabilities, such as comprehension, expression and reading (Grigorenko et al., 2020), as well as increased developmental disabilities (Zablotsky et al., 2019), thus confirming the need to provide support for future students.

Access to HE for ethnic minorities was found to be good in the UK. In the Netherlands, an older report found that students from non-western ethnic minorities (such as Turkish, Moroccan and Caribbean) achieved lower academic performance and presented higher dropout rates (Zorlu, 2013), although a more recent study found higher language-related test scores in ethnically diverse group of school students (Maestri, 2017). In a study performed on 2134 UK medical school students, white students achieved higher grades, while failing assessments in equal proportions (Mukherji et al., 2022). When focusing on degree classification for students that graduated in the 2020/2021 academic year, only 20% of students identifying as black achieved a first class degree, compared to 39.4% for those identifying as white (UK Government, 2022c). Asian, mixed and other ethnic groups respectively achieved first class degrees in 33.3%, 35.6% and 30.8% of cases. Upper second class degrees were achieved equally by all groups (UK Government, 2022c), emphasizing the need to reduce the gap for first class degree classification in students from black ethnic groups. Since 2014, the proportion of students achieving first class degree classification increased steadily for all groups (Asian, black, mixed, white and other) (UK Government, 2022c), which represented more than double the figures from 2010 (Office for Students, 2022a), which was criticized recently (BBC News, 2022). The present study observed a lower diversity index in Humanities, corroborated by another report (Pozniak, 2020), which seems to also be found in the arts and media industry (Thompson, 2023). A recent study found that academic retention of women from ethnic minorities in medicine is low, most likely due to higher attrition (Westring et al., 2021). Factors explaining such observations were ethnicity and relationship status. In light of these results, HE providers may need to provide additional support for students from black ethnic groups, although socio-economic factors, such as deprivation, might interfere here (Mukherji et al., 2022).

The current study reported adequate access to HE by disadvantaged students, although subject specific disparities were noted. Recent data recorded a surge of university applications from deprived students (UCAS, 2020; Weale, 2022), suggesting that efforts to increase HE access for deprived students have proven efficient. Scotland has been very successful at widening such an access, with figures indicating that 16.7% of students belong to the 20% most deprived communities in Scotland (Scottish Government, 2022). Interestingly, Scotland set the target for 2030 at 20% of students coming from deprived households (Weale, 2022). In England, a linear negative relationship was found between first/upper second class degree achievement and the deprivation index (HESA, 2023). In other words, the greater the deprivation, the lower the proportion of first/upper degree classifications. Again, additional support by HE providers might be warranted for deprived students. These observations were found to a lesser degree in Northern Ireland (HESA, 2023). Of note, measurements of deprivation in the UK can be achieved using three different indexes: IMD (index of multiple deprivation, used in the present study), POLAR (participation of local areas) or the model generated by HESA (2021).

Returning to education can be appealing for mature students. Because of other commitments, mature students prefer to enrol in online courses (Stone & O'Shea, 2019). In undergraduates from Australia and the UK, older students presented greater understanding (deep learning), especially women (Douglas et al., 2020). Furthermore, family support also seems to drive this population into HE, with, again, gender biases (Gill et al., 2015). Figures from 2019 suggest that mature students have better progression rates than young students when studying part-time, but have lower progression rates when studying full-time (Office for Students, 2021). Since 2012, each year has seen an increase in the numbers of full-time mature entrants, whilst the numbers for part-time mature entrants have decreased. Finally, mature entrants are more likely to enrol for medium tariff scores HE institutions, while younger students often enrol in high tariff scores institutions (Office for Students, 2021). The entire HE sector will need to address this issue to provide fair access to HE for all students, whether young or mature.

5 | LIMITATIONS OF THE CURRENT STUDY

Some caution is needed when interpreting our results, as a few potential biases and limitations were identified. First, we assumed that the student population does not differ from the general population, which can be erroneous for some variables analysed herein. This is the case with deprivation and disability.

Again, our current results must be interpreted with caution in regard to disability. Indeed, since we observed an age-related drive of disabilities in the general population, the proportion of reported disabilities are expected to be low, as our study population is young. Furthermore, potential biases might include better diagnosis or recognition of disabilities, encouraged by recent public policies.

In addition, the measurements of deprivation by the OfS (based on IMD quintiles) can be considered as categorical and aggregated data, which cannot be compared to different dimensions of deprivation, the latter used in Census data.

Furthermore, this study focused on proportion of students, as the total number of students in the entire HE sector varied in recent years (Figure S3). Several variables can account for such heterogeneous observations, such as societal (lockdown) or geo-political ('Brexit') contexts. Furthermore, the OfS publishes data on a yearly basis, which implies that the students will generally be included in the dataset for several years. Thus, depending on the status of the students (part-time, full-time, intercalated) or level of study (foundation, undergraduate, postgraduate, doctorate), some might be included in the datasets for just a single year (drop-outs, deaths), for up to 6 years (for example part-time undergraduate students) or possibly even more (from foundation to doctorate, part-time, with intercalation).

Finally, another limitation to the current study is the absence of data regarding UK citizens studying abroad. These students are not part of exchange programs (such as Erasmus), are not registered at UK institutions or partner institutions. To the best of our knowledge, these students are not captured in any statistics, likely due to local policies and regulations. As an example, it is illegal to gather information on ethnicity in France (Bleich, 2001). Complexity might also be an issue for capturing these students, as designing homogenized datasets that would be valid across different countries would be very challenging. Thus, the present study does not take into account this population, which is a limiting factor to the results obtained herein.

6 | CONCLUSION

To conclude, we found that access to HE needs to improve for males, although subject-specific biases were observed. Ethnic diversity remains high throughout the HE sector, although heterogeneous observations were observed in some disciplines. Students from the most deprived areas have been found in increased proportions since 2010, which presented strong variations across subjects. Finally, reported disabilities were on the rise, especially pertaining to mental health, warranting additional support for affected students. HE institutions will need to focus on suicide prevention, support for students reporting disabilities or from black ethnic groups.

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CONFLICT OF INTEREST STATEMENT

The author of the present study declares no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

PATIENT CONSENT STATEMENT AND CLINICAL TRIAL REGISTRATION

Not applicable.

PERMISSION TO REPRODUCE MATERIAL FROM OTHER SOURCES

Not applicable.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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