

Digitally deprived children in Europe

DigiGen - working paper series



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The impact of technological transformations on the Digital Generation

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Abstract: The outbreak of the COVID-19 pandemic has completely changed the need for internet connection and technological devices across the population, but especially among school-aged children. For a large proportion of pupils, access to a connected computer nowadays makes the difference between being able to keep up with their educational development and falling badly behind. This paper provides a detailed account of the digitally deprived children in Europe, according to the latest available wave of the European Union - Statistics on Income and Living Conditions (EU-SILC). We find that 5.3% of school-aged children in Europe are digitally deprived and that differences are large across countries. Children that cohabit with low-educated parents, in poverty or in severe material deprivation are those most affected. We argue that digital deprivation should be considered part of the definition of material deprivation used by the European Commission to monitor the progress of European societies.

Key words: digital deprivation, computer, internet connection, vulnerable children, Europe, EU-SILC

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1. Introduction

The COVID-19 pandemic has completely changed the need for internet connectivity and for technological devices across the population, but particularly among children. In an attempt to halt the spread of the virus, many countries have moved part or all their teaching online.¹ Therefore, nowadays, for many children, having a computer connected to the internet makes the difference between being able to keep up with their education and falling badly behind. Issues of access are linked to the larger body of research surrounding digital exclusion, digital inequalities and the digital divide (Chen, 2013; van Deursen and van Dijk, 2010; DiMaggio et al., 2004; van Dijk, 2005; DiMaggio and Hargittai, 2001). Other aspects during the COVID-19 pandemic are also relevant — such as having the opportunity to stay socially connected with family, friends and peers at a time when physical distancing has been imposed in most countries (Ezpeleta et al., 2020; Ellis et al., 2020).

But not all children in Europe have either a computer or an internet connection. As a matter of fact, and according to the latest available wave of the European Union – Statistics on Income and Living Conditions (EU-SILC), on average, in 2019, 5.3% of children in Europe are digitally deprived: that is, they lived in a household that could not afford to have a computer and/or lived with adults who claimed they could not afford to have an internet connection for personal use at home. However, the differences across European countries are large. For example, in Iceland, only about 0.4% of children are digitally deprived, whereas in Romania and Bulgaria the figure soars to 23.1% and 20.8%, respectively.

In the current situation, having access to digital technologies is a prerequisite for children to be able to continue with their educational development. Yet, this access will be equally important once the pandemic is over, if we aim to have equal educational opportunities for all children. Much of the work on digital inequality — or, more specifically, the digital divide — has focused on access (the ‘first-level’ digital divide), which was assumed to be largely resolved (Paus-Hasebrink et al., 2019; van Deursen and Helsper, 2015). According to van Deursen et al. (2011), ‘the binary classification of access in terms of physical access (having a computer and an internet connection or not) is considered to have been superseded and replaced by a divide that is supposed to concentrate on a large number of more complex variables and relations’ (p. 126). This prompted a move to focus research on digital use and digital competencies, understood as ‘digital skills’ and often referred to as the ‘second-level’ digital divide (Hargittai, 2002; Ronchi and Robinson, 2019). The shift from access to skills and usage was seen as necessary in order to reflect changes in society, where digital skills were becoming more important (van Dijk, 2017). However, the pandemic has shown us that the assumption that ‘now everybody has access to and can use the internet’ (van Deursen et al., 2011, p. 126) is inaccurate; instead, it has served to demonstrate that children still face inequalities in access, leading to digital exclusion — or what we call ‘digital deprivation’.

This paper provides a detailed account of who the digitally deprived children in Europe are, where they live and what the associated risk factors of such deprivation are. We consider six vulnerable groups: (i) those who live in a lone-parent household; (ii) those who live in a poor family; (iii) those living in severe material deprivation; (iv) those with parents of non-European immigrant origin; (v) those with low-educated parents; and (vi) those in a large family. We find that digital deprivation affects particularly children in severe material deprivation, those that cohabit with low-educated parents and those who live in poverty. However, the characteristics that describe a digitally deprived child are heterogeneous across countries (as is the strength of

¹ UNESCO (2020) estimates that school closures in March 2020 affected 290.5 million students across the world.

the association). For instance, while cohabiting with parents of non-European immigrant origin is positively associated with digital deprivation in most contexts, this is not the case in Eastern Europe or the Baltic countries, where this characteristic is negatively associated with the probability of being a digitally deprived child.

Given the important consequences of digital deprivation in children's lives nowadays, we argue that lack of access to a connected computer should be considered part of the definition of material deprivation used by the European Commission to monitor the progress of European societies. Understanding who the digitally deprived children in Europe are is crucial if we are to design effective policies to combat the digital divide, and if we are to ensure equal educational opportunities for all children in Europe, irrespective of their socio-economic background.

The section that follows this introduction reviews the existing literature on digital exclusion. Section 3 introduces the data used and our definition of digital deprivation. Section 4 shows our results in terms of the big differences in the prevalence of digital deprivation across European countries. We also provide a detailed account of the individual and household socio-economic characteristics associated with children's digital deprivation. Section 5 highlights the importance of digital deprivation in the European context and proposes a new measure of material deprivation that takes accounts of it. Finally, Section 6 summarizes the main findings and proposes some policy recommendations.

2. Literature review

The development and increasing use of digital technologies has affected the lives of children and young people, and has, in turn, raised concerns about the emergence of new inequalities and the intensification of existing ones. These concerns have led to considerable work that has focused on digital exclusion or digital inequalities — often perceived in terms of a digital divide. The first report on the digital divide from the National Telecommunications and Information Administration (1999) focused on the ‘have nots’ in rural and urban America. This report served as a foundation for the initial work on the digital divide. That work was rather technical, pursuing a binary understanding of access, with a focus on demographics (van Deursen et al., 2011). According to Robinson et al. (2020), this techno-deterministic approach to access was seen as oversimplistic, assuming as it did that access alone led to a reduction in inequalities (Katz and Aspden, 1997). This promoted further work on the digital divide and led to a new understanding of the concept, to different definitions and to a focus on different levels of the digital divide (DiMaggio and Hargittai, 2001; Gunkel, 2003; Selwyn, 2004; van Dijk, 2005, 2006; Hilbert, 2011). Despite the heterogeneity of the definitions and levels of the digital divide, for the purposes of this article we adhere to the definition provided by the Organisation for Economic Co-operation and Development (OECD, 2001) which interprets the digital divide as ‘the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities’.² As van Dijk (2006) points out, the digital divide received growing attention; but from about 2005, interest began to wane, as the developed countries ensured that a large part of their population had access to electronic devices. However, the COVID-19 pandemic has shown that access issues are still important, and this has reignited the debate among scholars, who again focus attention on the access dimension of the digital divide. Some of this recent work includes research by Seifert (2020), Gibson et al. (2020) and Martins Van Jaarsveld (2020) all of whom study the effects of the digital divide in the COVID-19 crisis among the elderly population. Among school-aged children, Rodicio-García et al. (2020) find that 14.8% of students in Spain recognize that they do not have enough resources to follow online education, while Stelitano et al. (2020) explain that students of colour who live in great poverty or in rural areas in the US report having had less access to the internet at home during school closures. Furthermore, research by Kuc-Czarnecka (2020) indicates that there are areas of Poland that are especially vulnerable to digital deprivation.

Aside from the more recent academic research driven by the pandemic, earlier studies analysed several dimensions of the digital divide. For instance, the work of Longley and Singleton (2009) matched the 2004 Index of Multiple Deprivation (IMD) with a classification of ICT usage in the United Kingdom. They suggested that the lack of digital engagement was linked to high levels of material deprivation. In this respect, the authors developed a cross-classification of material deprivation and ICT usage. Yelland and Neal (2013) went beyond the classical digital-divide dichotomy between the ‘haves’ and the ‘have nots’ and looked at how the lives of families in low socio-economic areas of Australia improved as a result of their being given a computer and internet access. Students noted that they could complete school work and communicate with friends, while parents saw an increase in all family members’ confidence and active participation in their communities. Gordo (2003) found similar results and emphasized that closing the digital gap could benefit people who live in poverty. Harris et al. (2017) studied the information technology (IT) usage of 1,351 Australian children aged between 6 and 17 years. In their re-

² As we describe in the next section, the database used in the analysis is the European Union – Statistics on Income and Living Conditions (EU-SILC), so we calculate the digital divide according to the information available.

search, they found socio-economic status to be a determinant of how children use IT. In high socio-economic neighbourhoods, children were involved in IT activities, reading, playing musical instruments and engaging in physical activities. By contrast, in low socio-economic neighbourhoods, children were more exposed to TV, electronic games, mobile phones and non-academic computer use at home. However, they did not address the digital divide in terms of ICT access, as they considered that the digital divide lay in how (not whether) children used devices. On the other hand, Livingstone et al. (2005) and Livingstone and Helsper (2007) addressed that issue by examining the inequalities in internet access and usage among children aged 9–19, using the UK Children Go Online survey. They showed that more deprived regions had lower levels of internet access. The same was true of children with disabilities, who also had lower levels of internet access. Ting-Feng et al. (2014) explored the digital divide among students with learning disabilities, and found that while there was no disadvantage in terms of internet access, there was in terms of digital literacy. Similar results were reported by Vicente and López (2010) who showed that people with disabilities are less confident about their online activities and skills. Jackson et al. (2008) and Judge et al. (2006) found a positive relationship between closing the digital divide, ICT use and academic performance.

Finally, Chinn and Fairlie (2004) studied the determinants of computer and internet use in high-income and low-income countries, including a wide range of economic, demographic and policy factors. They found that the global digital divide was mainly explained by income disparities, communication infrastructures, access to electricity, the institutional environment and the demographic characteristics. However, few studies have approached the digital divide from a cross-country perspective, as we do in this paper.

Importantly, none of the literature reviewed on digital exclusion use up-to-date data to study the prevalence of digital deprivation across European countries and over time. Also, we have been unable to find any recent studies that tackle the socio-economic and demographic characteristics that define the phenomenon in Europe. Thus, we aim to fill this gap in the literature by providing a recent detailed account of who the digitally deprived children in Europe are and what socio-economic characteristics they share.

3. Data

The data set used in this paper is the EU-SILC in its cross-sectional form, provided to researchers by Eurostat. Most of the analysis focuses on the last wave of data available at the time of writing - i.e. the 2019 data.³ The EU-SILC has several advantages for the purposes of our research: (i) it allows a comparative analysis across Europe, with evidence for 32 countries; (ii) it provides very detailed information on the socio-economic background of children, as it includes data on household income, parental characteristics (such as labour market attachment), household structure, material deprivation, etc.; and (iii) it allows us to track changes over time, as it covers a relatively long period — most countries have participated since 2004.

The information relating to digital deprivation is contained in two variables.⁴ *HS090* collects, at the household level, the answers to the question ‘Does your household have a computer?’ Household respondents can answer ‘yes’ or ‘no’. If the answer is negative, the question continues as follows: ‘If you do not have a computer: (a) Would you like to have it but cannot afford it or, (b) Do you not have one for other reasons, e.g. you do not want or need it?’⁵ *PD080* collects, at the individual level, the answers to the question “Do you have an internet connection for personal use when needed?”. In this case, all adult members in the household can answer “yes” or “no”. And, again, if the answer is negative, they are asked whether it is because of unaffordability or because of other reasons. The data documentation clarifies that such internet access can be via smartphone, other wireless handheld device (e.g. a tablet), video games console, laptop, desktop computer or TV.⁶ We define as ‘digitally deprived’ those children that either live in a household that cannot afford to have a computer and/or live with adults that cannot afford internet connection.⁷

Importantly, there are other databases that collect a wider array of digital indicators; but in such cases we do not have as detailed information on the socio-economic background of children as the EU-SILC provides. Furthermore, this is the only data set that we know of that records enforced lack; thus, it is clearly stated that the members of the household would like to have a given item, but cannot afford it (Mack and Lansley, 1985; Marlier et al., 2007).⁸ Our sample considers children from above the age of 5 and below the age of 17, thus covering the period of compulsory education in the vast majority of countries analysed. We consider children who live with at least one parent.⁹ As Table 1 shows, the average age of the children was 11 years, and

³ The latest release of data that includes 2019 is from November 2020. Data for Iceland, Italy, Ireland and the UK is not provided, and so we use data relative to 2018 for these countries.

⁴ In Section 5 and in the conclusions of this paper, we argue in favour of adding more indicators related to ICT (information and communication technologies) in the EU-SILC and we plead for the inclusion of at least one indicator on digital deprivation in the list of items considered to define a household in ‘material deprivation’ by the European Commission and Eurostat.

⁵ According to the data documentation, ‘possessing the item does not necessarily imply ownership: the item may be rented, leased, provided on loan or shared with other households in (e.g.) a complex apartment and not necessarily owned. If the item is shared between households, the answer is YES if there is adequate/easy access (i.e. household can use the durable whenever it wants) and NO otherwise ... A computer includes a portable computer or a desktop computer, but does not include machines dedicated to video games that do not have any broader functionality. If a computer is provided ONLY for work purposes, this does not count as possessing the item’ (Eurostat, 2020, p. 196).

⁶ In the data documentation, more detail is provided: ‘Example of internet activities for personal use: social networking, sending/receiving emails, using services related to travel and accommodation, creating web pages, blogs, internet banking, reading or downloading online music, video, news, etc. looking for information, telephoning or making video calls, buying/selling goods or services, taking part in online consultations or voting on civic or political issues, etc. The household member is considered to have internet connection for personal use at home only if all the needs for personal use he/she are fully fulfilled by this connection.’ (Eurostat, 2020, p. 345).

⁷ Guio et al. (2012) considered that a household was deprived only if it lacked both a computer and an internet connection. Guio et al. (2017) only accounted for the lack of an internet connection under the argument that many individuals can now access the internet using other devices such as smartphones or tablets. While this is true, in this study, we want to consider both indicators given the large number of European children that now receive all their teaching online.

⁸ Such information allows us to disregard families that, because of their life style, they do not want to have an internet connection and/or a computer.

⁹ Only 0.91% of children in our sample live in a household where neither parent is present.

the parents were on average aged 42. Also, 48% of the sample were girls. Mean household size was 4.22 members, and 18.8% of children lived in a single-parent household.¹⁰ Furthermore, 20.1% of children in the sample were poor. Following the European Commission guidelines for the measurement of poverty in Europe, a household is defined as being in poverty if the equivalent household income is below 60% of the median of the same distribution. The modified OECD equivalence scale that gives a weight of 1 to the first adult, 0.5 to any other adults in the household and 0.3 to children below the age of 14 is used. Also, 6.1% of children live in 'severe material deprivation', according to the definition of the European Commission. That is, out of nine possible items, they lack at least four.¹¹ Finally, 15.1% of the children have at least one parent of non-European immigrant origin; 13.2% cohabit with parents who had not acquired education above the level of primary school or compulsory lower secondary school; and 24.3% live in a large family, with at least three children under the age of 18 in the household.^{12 13}

Table 1: Summary statistics, school-aged children, Europe, 2019

Variable	Mean	Std. Dev.	Min	Max
Age	10.972	3.129	6	16
Parents' average age	42.452	6.266	17	76
Female	.48	.5	0	1
Household size	4.223	1.19	2	22
Single-parent household	.188	.391	0	1
Poor	.201	.401	0	1
Materially deprived (severe)	.061	.24	0	1
Parents from non-European immigrant origin	.151	.358	0	1
Low-educated parents	.132	.339	0	1
Large family (3+ children)	.243	.429	0	1

Note: Data for the UK, Iceland, Italy and Ireland refers to 2018.

Source: Authors' computation using data from the European Union - Statistics on Income and Living Conditions (EU-SILC) (released November 2020).

10 The great majority of children in single-parent households live with the mother (83.4%).

11 The items that the European Commission considers to measure severe material deprivation include the impossibility to: (i) avoid arrears in rent, mortgage or utility bills; (ii) keep the home adequately heated; (iii) face unexpected expenses; (iv) eat meat or proteins regularly; (v) go on holiday; (vi) have a television set; (vii) have a washing machine; (viii) have a car; and (ix) have a telephone.

12 In single-parent households, we only consider the education of the mother or the father cohabiting with the child.

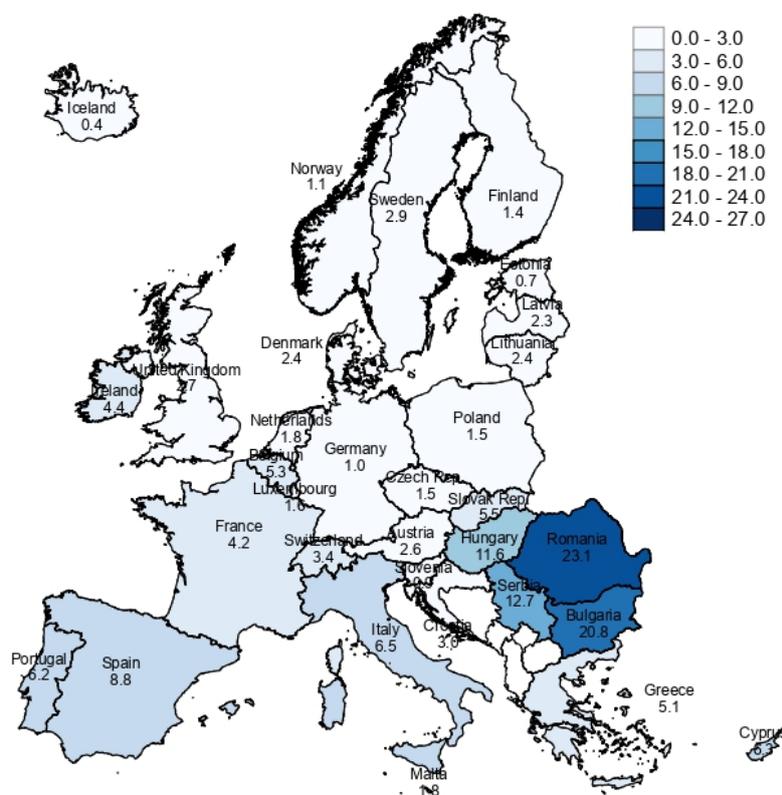
13 We do not distinguish between urban and rural areas, because the information is missing for 16.64% of the sample.

4. Digital deprivation in Europe

4.1 Children's digital deprivation across countries and over time

As mentioned above, 5.3% of school-aged children in Europe are digitally deprived, according to the latest data available — albeit the differences across countries are very large. Figure 1 shows the percentage of children who live in a household that cannot afford to have a computer and/or cohabit with adults who cannot afford to have an internet connection. The choropleth map shows two country clusters with a certain North–South divide. On the one hand, in Northern and Continental Europe, as well as in the Baltic countries and the UK, the percentages of digitally deprived children are very low — as low as 0.4% in Iceland, 0.7% in Estonia and 1.1% in Norway. None of the countries in this cluster have percentages above 3%. On the other hand, the prevalence of the phenomenon is much higher in the Mediterranean countries, and particularly in Eastern Europe (as indicated by darker colours on the map). In Romania, 23.1% of children are digitally deprived, and in Bulgaria 20.8%. The percentages are not as high in Hungary or Serbia, but more than 1 child in 10 is faced with the problem. Among the Mediterranean countries, it is in Spain that the percentage is highest (8.8%).

Figure 1: Percentage of digitally deprived school-aged children (6-16), Europe, 2019



Note: Data for the UK, Iceland, Italy and Ireland refers to 2018. In Austria, Denmark, Estonia, Finland, Germany, Iceland, Luxembourg, Malta, the Netherlands, Norway and Slovenia, fewer than 30 observations define the digitally deprived population, and therefore the results should be interpreted with caution.

Source: Authors' computation, using data from EU-SILC, 2019 (released November 2020).

Figures 2a and 2b show the relative importance of the two indicators used: Figure 2a refers to computer unaffordability and Figure 2b refers to internet connection unaffordability. The maps indicate that, of the two items, it is the inability to have a computer at home which mostly drives the overall results. In this case, it should be noted that again a certain North–South divide emerges, with a greater prevalence in Mediterranean and Eastern European countries. On the positive side, there are several countries where no household with children reports being unable to afford an internet connection at home — see, among others, Finland, Norway, Iceland and Austria.

Figure 2a: Percentage of school-aged children (6–16) who live in a household that cannot afford a computer, Europe, 2019

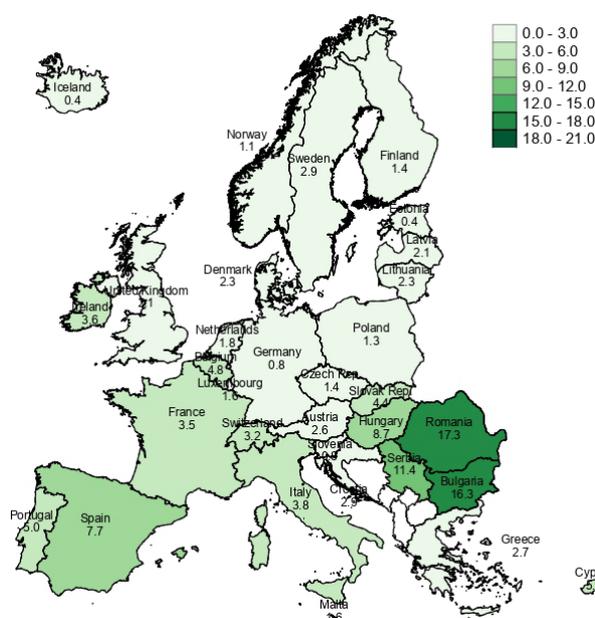
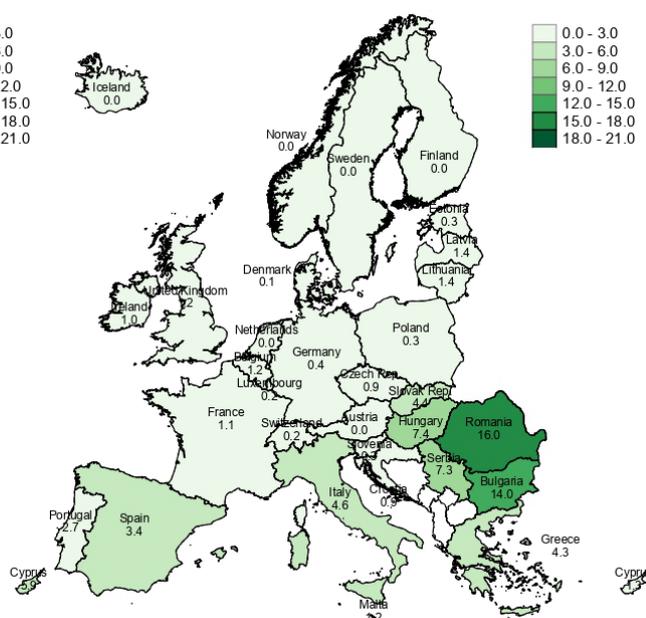


Figure 2b: Percentage of school-aged children (6–16) who live in a household that cannot afford an internet connection, Europe, 2019



Note: The data for the UK, Iceland, Italy and Ireland refers to 2018. In Austria, Denmark, Estonia, Finland, Germany, Iceland, Luxembourg, Malta, the Netherlands, Norway and Slovenia, fewer than 30 observations define the digitally deprived population; thus, the results should be interpreted with caution.

Source: Authors' computation, using data from EU-SILC, 2019 (released November 2020).

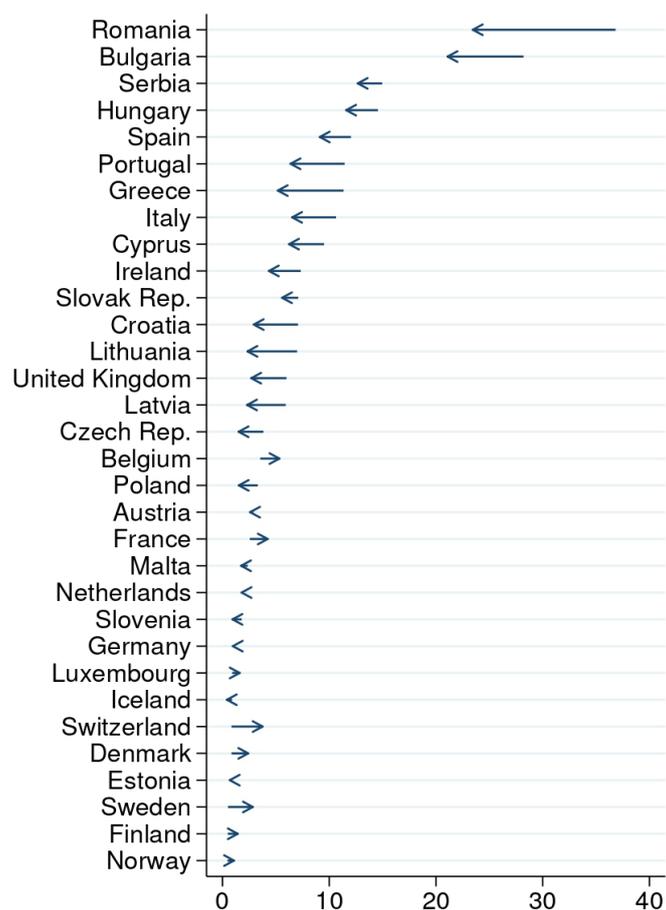
Despite the high figures for digital deprivation among school-aged children in Europe, according to the latest data available, an analysis of the trend over the past five years indicates that the great majority of countries — and particularly those most affected by the problem — have moved in the right direction. Figure 3 shows the percentage of children who were digitally deprived in 2015 and in 2019, with the arrow indicating the change in direction. For example, Romania has reduced the number of children affected by digital deprivation from 36.8% to 23.1% in this five-year period. In the case of Bulgaria, the change has been from 28.2% to 20.8%. Important advances have also taken place in Portugal, Greece and Italy, and to a smaller extent also in Serbia, Hungary and Spain. For the countries at the bottom of the figure, the change is not significant — largely because the problem was negligible in 2015.

4.2 Who are the digitally deprived children in Europe?

The previous section showed the great heterogeneity of digital deprivation prevalence among school-aged children in Europe, and how it has changed in the past five years. In this section, we aim to identify the socio-economic and demographic characteristics that define a digitally

deprived child in Europe. Is it parental education? The number of children in the household? Or the fact that the family receives income below the poverty line? In our analysis, we consider six household characteristics that could potentially be associated with digital deprivation: the child lives (1) in a single-parent household; (2) in a poor family; (3) in a severely materially deprived household; (4) with at least one parent of non-European origin; (5) with parents that have at most lower secondary education; and (6) with at least two other siblings under the age of 18.

Figure 3: Percentage of school-aged children (6-16) digitally deprived, Europe, 2015-2019



Note: Data for the UK, Iceland, Italy and Ireland refers to 2018 instead of 2019. In Austria, Denmark, Estonia, Finland, Germany, Iceland, Luxembourg, Malta, the Netherlands, Norway and Slovenia, fewer than 30 observations define the digitally deprived population in 2019 (or 2018); thus, the results should be interpreted with caution. Countries have been ranked according to the percentage of digitally deprived children in 2015.

Source: Authors' computation, using data from EU-SILC, 2015-2019.

In order to be able to work with a larger sample, and given that some characteristics relate to minorities, the results refer to the last five waves of data - that is, the period between 2015 and 2019.¹⁴ Furthermore, and on account of the small number of observations that define the digitally deprived population in some countries, as well as presenting the results at the European level, we show them by country cluster.¹⁵

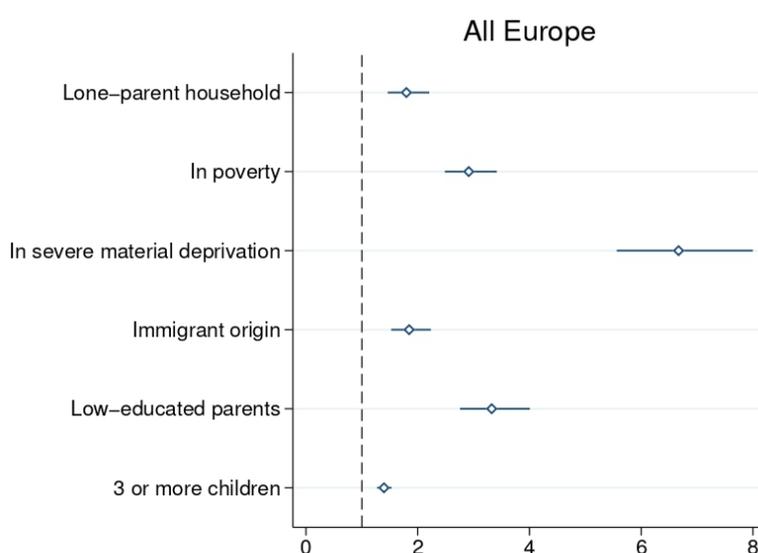
¹⁴ Table A.1 in the Appendix presents summary statistics for this five-year sample.

¹⁵ We consider six country clusters: Southern Europe (Spain, Greece, Italy, Portugal, Cyprus and Malta), Northern Europe (Finland, Sweden, Norway, Iceland and Denmark), Eastern Europe (Hungary, Poland, the Czech Republic, Romania, Serbia, Croatia, Slovenia, Slovakia and Bulgaria), Continental Europe (Belgium, Austria, Switzerland, Germany, France, Luxembourg and the Netherlands), the Anglophone countries (the United Kingdom and Ireland) and the Baltic area (Estonia, Lithuania and Latvia).

Our systematic exploration of the demographic and socio-economic characteristics associated with digital deprivation is based on logistic regressions, which we present in Table 2 and Figures 4 and 5 in the form of odds-ratios.¹⁶ Our dependent variable takes value 1 if the child is digitally deprived and 0 otherwise. Our parameters of interest are those associated with the six at-risk groups mentioned above. Control variables include individual characteristics of the child (gender, age and age squared), household size, parents' average age (and its square), year dummies (to control for changes over time) and country dummies (to control for time-invariant country characteristics).¹⁷ Standard errors are robust and clustered at the country level.

As shown in the first column of Table 2 and in Figure 5, at the European level one characteristic clearly stands out as being very closely linked to children's digital deprivation: living in severe material deprivation. On average across Europe, that increases the risk of suffering digital deprivation by a factor of 6.7 among school-aged children. Being poor and having low-educated parents are also relevant factors — these variables multiply the risk of being digitally deprived by a factor of 2.9 and 3.3, respectively. All other risk factors considered are positive (albeit at a lower level) and statistically significant at 99%. As for the control variables, we find no statistically significant differences between boys and girls, while the risk of being digitally deprived increases with age and decreases with parental age.

Figure 4: Probability of being digitally deprived, by socio-economic characteristics in school-aged children (6–16 years), Europe, 2015–2019



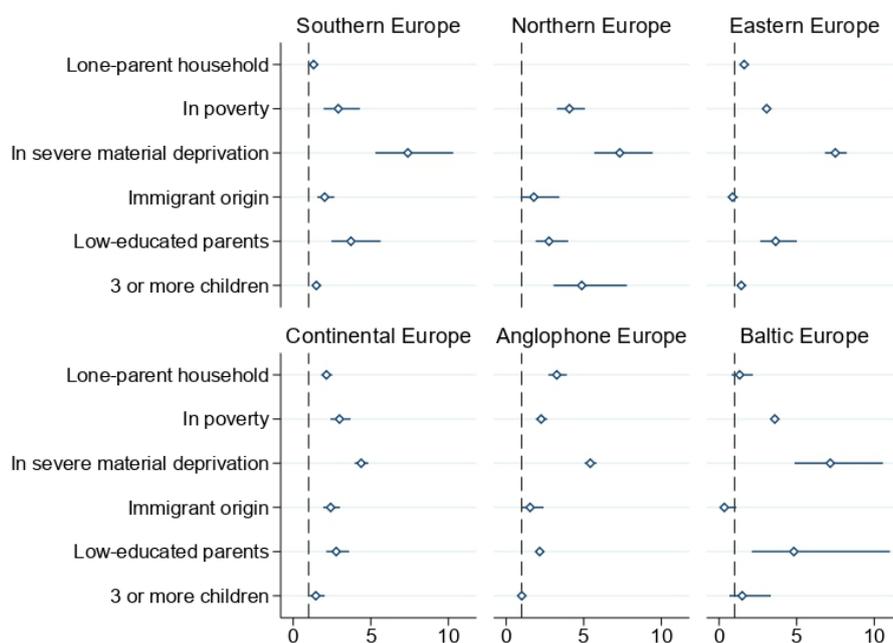
Note: Data for the UK, Iceland, Italy and Ireland refers to the period 2015–2018. The horizontal line indicates confidence intervals at 95%.

Source: Authors' computation, using data from EU-SILC, 2015–2019.

¹⁶ An odds ratio above the value of 1 implies that a given characteristic is positively associated with digital deprivation, while a value below 1 implies a negative association.

¹⁷ In single-parent households, average age refers to the age of the progenitor present in the household.

Figure 5: Probability of being digitally deprived, by socio-economic characteristics in school-aged children (6–16 years), European country clusters, 2015–2019



Note: Data for the UK, Iceland, Italy and Ireland refers to the period 2015–2018. The horizontal line indicates confidence intervals at 95%. The result for lone-parent households in Northern Europe is not shown given that it has a very large confidence interval.

Source: Authors' computation, using data from EU-SILC, 2015–2019.

Next, we move to the results by country cluster (see Figure 5). With very few exceptions (remarked on below), we find that the large bulk of the risk factors considered are positively linked to digital deprivation — though the strength of the association varies by context. In all groups of countries, the characteristic most strongly associated with digital deprivation is living in a household with severe material deprivation. For example, in Eastern Europe it multiplies the probability of being digitally deprived by 7.5; in the Baltic countries by 7.2 and in Continental Europe by 4.4. Cohabiting with low-educated parents is of particular importance in Eastern Europe, the Mediterranean countries and the Baltic area: in all those clusters, the probability of being digitally deprived increases by at least a factor of 3.5. Poverty is also a strong determinant of digital deprivation among school-aged children, though with a similar effect in all the country clusters analysed. With the sole exception of Northern Europe (which shows high risk), living in a large family has a more muted effect, and does not differ statistically from zero in the English-speaking countries. The same is true for living in a single-parent household, with relatively low risk in Southern and Eastern Europe and in the Baltic countries. In this last case, the associated odds ratio is not precisely estimated. Finally, and interestingly, having parents of non-European immigrant origin reduces the likelihood of digital deprivation in Eastern Europe and the Baltic area, while it increases the probability in all other contexts.

For the interested reader, Table A.2 in the Appendix presents qualitative results from similar regressions as those in Table 2, but at country level, with the objective of providing a more nuanced picture of the determinants of digital deprivation across Europe.¹⁸ In this case, we only consider countries where the digitally deprived sample of children is above 150 observations for the five-year period. The main takeaway from these results is that severe material deprivation, poverty and low parental education are positively associated with digital deprivation in all

18 Detailed results at country level are available from the authors on request.

the countries analysed, with the results statistically significant at 99% confidence level in all cases. The degree of association with digital deprivation for the rest of the characteristics varies much more, with the results less precisely estimated.

Table 2: Logistic regression (odds-ratios) for the probability of being digitally deprived at the European level and by country cluster

Variables	All Europe	Southern Europe	Northern Europe	Eastern Europe	Continental Europe	Anglophone Europe	Baltic Europe
Age	1.0403 (0.0549)	1.0543*** (0.0150)	1.0999 (0.1290)	0.9622 (0.0576)	1.3014*** (0.0998)	0.9643 (0.0427)	1.4605 (0.3685)
Age squared	0.9966 (0.0024)	0.9956*** (0.0007)	0.9937 (0.0054)	1.0006 (0.0025)	0.9857*** (0.0028)	1.0010 (0.0020)	0.9810* (0.0114)
Female	0.9580 (0.0339)	0.9509 (0.0540)	1.1885 (0.4069)	1.0618** (0.0318)	0.8743* (0.0707)	0.8567*** (0.0026)	0.9048** (0.0366)
Household size	1.0324 (0.0279)	0.9911 (0.0178)	0.9192 (0.1184)	1.1026*** (0.0168)	0.8815*** (0.0400)	1.0540 (0.0500)	0.9117 (0.0950)
Parents' average age	0.7985*** (0.0287)	0.8103*** (0.0522)	0.9941 (0.0592)	0.8235*** (0.0382)	0.7923*** (0.0167)	0.7472*** (0.0005)	0.9456 (0.0704)
Parents' average age squared	1.0024*** (0.0004)	1.0021*** (0.0007)	0.9994 (0.0005)	1.0023*** (0.0005)	1.0026*** (0.0003)	1.0028*** (0.0000)	1.0014*** (0.0005)
Lone-parent household	1.7972*** (0.1882)	1.3156*** (0.0737)	3.8559 (3.6356)	1.6199*** (0.1402)	2.1412*** (0.1750)	3.2654*** (0.3005)	1.3289 (0.3364)
In poverty	2.9134*** (0.2364)	2.9052*** (0.5803)	2.9844*** (0.8124)	3.0669*** (0.1121)	2.9818*** (0.3274)	2.2581*** (0.1866)	3.5931*** (0.0893)
Severe material deprivation	6.6693*** (0.6180)	7.3873*** (1.2556)	6.5861*** (0.3447)	7.4919*** (0.3580)	4.3787*** (0.2238)	5.4241*** (0.1961)	7.1662*** (1.4154)
Immigrant origin	1.8466*** (0.1802)	2.0282*** (0.2759)	2.0072*** (0.5057)	0.8652 (0.1533)	2.4151*** (0.2730)	1.5448* (0.3508)	0.3407* (0.2062)
Low-educated parents	3.3241*** (0.3170)	3.7217*** (0.7876)	2.2861*** (0.6097)	3.6469*** (0.5912)	2.7712*** (0.3722)	2.1637*** (0.0809)	4.8196*** (2.0303)
3 or more children	1.3960*** (0.0657)	1.4914*** (0.0699)	3.4932*** (0.5283)	1.4352*** (0.1455)	1.4578** (0.2452)	1.0083 (0.1188)	1.4904 (0.6129)
Observations	327,857	89,107	40,744	92,972	67,369	17,005	20,660
Year FE	Yes						
Country FE	Yes						

Note: Standard errors are in parenthesis. ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. Data for the UK, Iceland, Italy and Ireland refers to the period 2015–2018.

Source: Authors' computation, using data from EU-SILC, 2015–2019.

5. Towards a new definition of ‘material deprivation’

Given the increased importance of access to a computer and an internet connection for school-aged children during the coronavirus epidemic, in this section we consider the possibility of including our indicator of digital deprivation in the well-established definition of ‘material deprivation’ and ‘severe material deprivation’ used by the European Commission to monitor the progress of European societies. According to the Social Protection Committee and Eurostat, a household is in ‘material deprivation’ if it cannot afford three or more of the following nine items: (1) to avoid arrears in rent, mortgage or utility bills; (2) to keep the home adequately heated; (3) to face unexpected expenses; (4) to eat meat or proteins regularly; (5) to go on holiday; (6) to have a television set; (7) to have a washing machine; (8) to have a car; and (9) to have a telephone. A household is in ‘severe material deprivation’ if it cannot afford four or more from the same list of items. As with our indicator of digital deprivation, both measures distinguish between households that cannot afford a certain good or service (enforced lack) and those that do not have it for another reason (for example, because they do not want it or do not consider that they need it). Our proposal consists of adding a tenth item to the list: inability to afford a computer and/or internet connection.¹⁹

Figures 6a and 6b show material and severe material deprivation percentages across Europe among school-aged children in 2019. On average, 13.9% and 6.1% of Europe’s children live in material and severe material deprivation. Again, we find a certain North–South divide. On the one hand, in Northern and Continental Europe, the percentages of material and severe material deprivation are relatively low: for example, 3% and 0.5% in Iceland; 6.4% and 2.7% in Norway; and 6.4% and 2.4% in Finland. On the other hand, the prevalence of such phenomena is higher in the Mediterranean countries (as high as 16.9% and 8.3% in Italy; 14.5% and 5.4% in Spain; and 13.9% and 5.4% in Portugal) and particularly in Eastern Europe: Romania, Bulgaria, Serbia and Hungary have, on average, 3 children in 10 in material deprivation and 2 in 10 in severe material deprivation. Note that Greece is the European country with the worst figures: 33% of children live in material deprivation and 18.1% in severe material deprivation.

Table 3: Percentage of children in material deprivation, in severe material deprivation and digitally deprived, Europe, 2019

	Mean	Std. Dev.
Material deprivation	13.89	34.58
Severe material deprivation	6.12	23.97
Material and digital deprivation	14.78	35.50
Severe material and digital deprivation	7.37	26.12

Note: Data for the UK, Iceland, Italy and Ireland refers to 2018.

Source: Authors’ computation, using data from EU-SILC, 2019.

As expected, when we add the inability to afford a computer and/or internet connection to the definition of material and severe material deprivation, the figures worsen. Table 3 (for the whole of Europe) shows the percentages of children affected and Figures 6c and 6d (by country) show

¹⁹ As a matter of fact, one could easily substitute the digital deprivation indicator for the item that considers the impossibility of having a television set. Out of 73,094 children in our sample, only 160 were living in a household that claimed to be unable to afford a TV (i.e. 0.17% of the sample). Moreover, nowadays a connected computer can easily replace a television set.

the change (in percentage points). Thus, when accounting for digital deprivation, we find that 14.8% and 7.4% of school-aged children in Europe live in material and severe material deprivation, compared to 13.9% and 6.1% according to the standard definition. This means an increase of 0.9 percentage points (p.p.) in material deprivation and 1.3 p.p. in severe material deprivation. At country level, we observe important differences regarding such a change. While in some countries the change is negligible, in Romania we observe an increase of 3.7 p.p. in material deprivation that takes account of digital deprivation and 5.5 p.p. in the corresponding figure for severe material deprivation. Large increases are also to be found in Spain (2.1 p.p. and 2.7 p.p.) and in Bulgaria (1.5 p.p. and 2.9 p.p.). Finally, we also observe an increase of 2 p.p. or more in the prevalence of severe material deprivation with digital deprivation in Hungary and Portugal. Our results provide useful information for the design of social cohesion policies across Europe.



Figure 6a: Percentage of school-aged children (6-16) who live in material deprivation), Europe, 2019

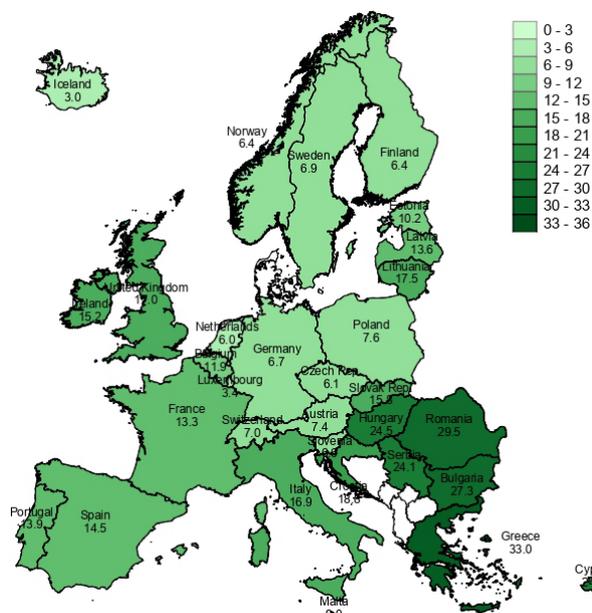


Figure 6b: Percentage of school-aged children (6-16) who live in severe material deprivation), Europe, 2019

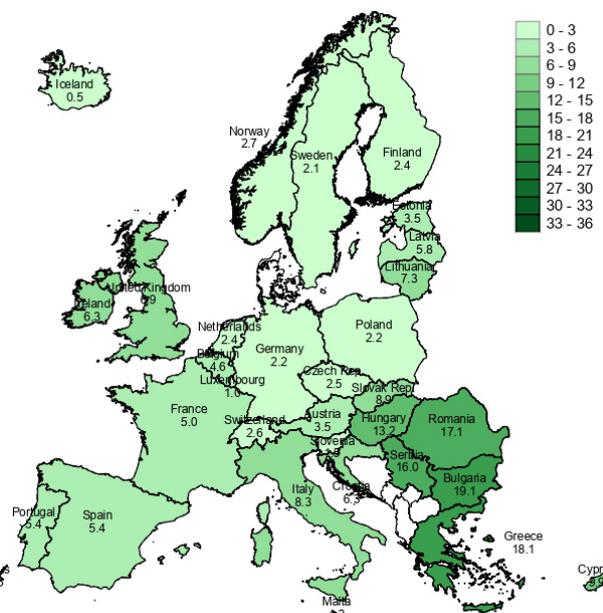


Figure 6c: Percentage point change in material deprivation (when including digital deprivation) of school-aged children (6-16), Europe, 2019

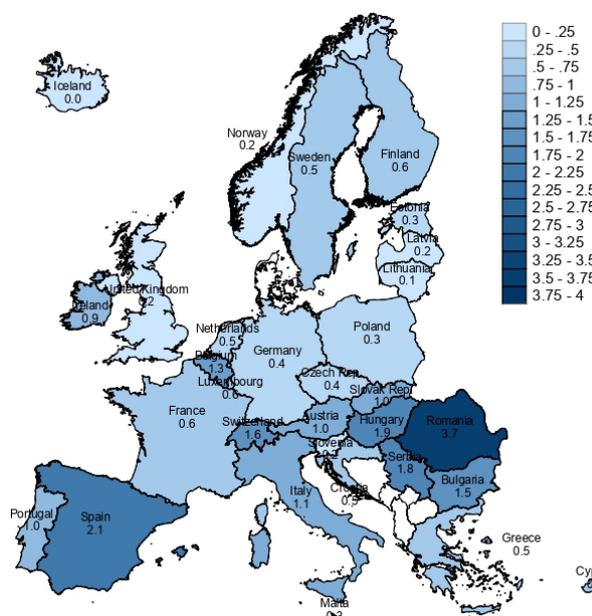
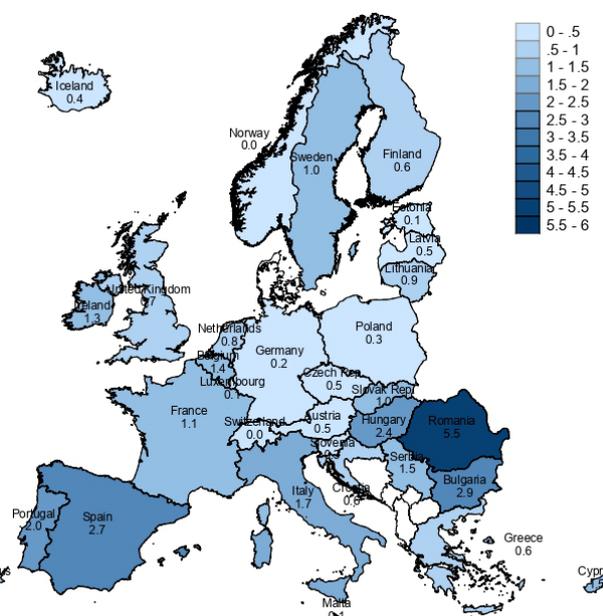


Figure 6d: Percentage point change in severe material deprivation (when including digital deprivation) of school-aged children (6-16), Europe, 2019



Note: Data for the UK, Iceland, Italy and Ireland refers to 2018. Denmark is excluded because of unavailability of material and severe material deprivation data.
 Source: Authors' computation, using data from EU-SILC, 2019.

6. Conclusions

This paper provides a detailed account of the digitally deprived children in Europe. We use the cross-sectional form of the latest wave available of the European Union – Statistics on Income and Living Conditions (EU-SILC), which refers to 2019. To the best of our knowledge, this is the only database that records enforced lack, and it allows us to identify households that are digitally deprived because of unaffordability. We consider lack of access to a computer and lack of access to an internet connection at home.

We find that 1 child in 20 in Europe is digitally deprived, with substantial differences from country to country. For example, in Romania, 3 children in 10 live in digital deprivation. In Bulgaria, the figure is 2 in 10. Thus, we document an important problem of access to the tools necessary for education in today's Europe: for many children, having a computer connected to the internet makes all the difference between keeping up with their education and falling badly behind. As a result, inequalities are likely to be exacerbated.

Of the two items considered (access to a computer and internet access), inability to afford a computer is far more prevalent than inability to afford an internet connection. The phenomenon is particularly widespread in Southern and Eastern European countries, and it particularly affects children who live with low-educated parents, in a poor household and/or in severe material deprivation. Nonetheless, the heterogeneity of the characteristics that describe a digitally deprived child across countries is worth noting. For example, in Eastern Europe, having parents of non-European immigrant origin is not associated with a higher probability of being a digitally deprived child, whereas in the remaining country clusters it is.

Despite its importance, digital deprivation is still not part of the European Union's definition of material deprivation or severe material deprivation; we argue that — particularly now — digital deprivation ought to be considered part of this indicator by the European Commission to monitor the progress of European societies. When we account for digital deprivation in the standard material deprivation definition, we find an increase of 0.9 p.p. in material deprivation and 1.3 p.p. in severe material deprivation among school-aged children — with important increases in such countries as Romania, Bulgaria and Hungary, but also Spain and Portugal.

Current and future policy efforts should target and support children who share the socio-economic characteristics associated with digital deprivation. If we want to achieve equality of opportunity in education, we should begin by providing equal access to education, which now implies having access to a computer and internet connection. Furthermore, schools, as a part of communities, carry an element of continuity; both in time of crisis and in the future, there exists the challenge of how to secure educational activities to support learning and continuity in children's lives. Therefore, it is crucial for children to have access not only to the internet, but also to the digital tools that are essential for their education and that can further the development of their digital skills.

Finally, our study is limited by the information included in EU-SILC regarding new technologies. To improve the monitoring of the situation of children, both during and after the COVID-19 pandemic, the database should incorporate more variables, including the use of other devices by children and children's satisfaction with them.



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Appendix

Table A1: Summary statistics, school-aged children, Europe, 2015–2019

	Mean	Std. Dev.	Min	Max
Age	10.948	3.159	6	16
Parents' average age	42.127	6.246	17	80
Female	.48	.5	0	1
Household size	4.254	1.219	2	22
Single-parent household	.187	.39	0	1
Poor	.209	.406	0	1
Materially deprived (severe)	.081	.272	0	1
Parents of immigrant origin	.141	.348	0	1
Low-educated parents	.141	.348	0	1
Large family (3+ children)	.246	.431	0	1

Note: Data for the UK, Iceland, Italy and Ireland refers to 2018 instead of 2019.

Source: Authors' computation, using data from EU-SILC, 2015–2019.

Table A2: Results of the logistic regressions (odds ratios) for the probability of being digitally deprived at country level, Europe, 2015–2019

	Lone-parent household	In poverty	In severe material deprivation	Immigrant origin	Low-educated parents	3 or more children
Austria		+ ***	+ ***	+ ***	+ ***	
Belgium	+ ***	+ ***	+ ***	+ ***	+ ***	
Bulgaria		+ ***	+ ***		+ ***	+ ***
Croatia		+ ***	+ ***		+ ***	
Cyprus	+ ***	+ ***	+ ***	+ ***	+ ***	
Czech Rep.	+ ***	+ ***	+ ***		+ **	
France	+ ***	+ ***	+ ***	+ ***	+ ***	+ ***
Greece	+ ***	+ ***	+ ***	+ ***	+ ***	
Hungary	+ ***	+ ***	+ ***		+ ***	+ ***
Ireland	+ ***	+ ***	+ ***	- ***	+ ***	- **
Italy		+ ***	+ ***	+ ***	+ ***	+ ***
Latvia	+ **	+ ***	+ ***		+ ***	
Lithuania		+ ***	+ ***	- ***	+ ***	+ ***
Poland	+ ***	+ ***	+ ***		+ ***	
Portugal	+ ***	+ ***	+ ***	- ***	+ ***	+ ***
Romania	+ ***	+ ***	+ ***		+ ***	+ ***
Serbia	+ ***	+ ***	+ ***	- **	+ ***	
Slovenia	+ ***	+ ***	+ ***	+ ***	+ ***	
Slovak Rep.	+ ***	+ ***	+ ***		+ ***	+ **
Spain	+ **	+ ***	+ ***	+ ***	+ ***	+ ***
UK	+ ***	+ ***	+ ***	+ ***	+ ***	

Note: ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. Data for the UK, Iceland, Italy and Ireland refers to the period 2015 to 2018. We do not consider countries with fewer than 150 observations for the sample of children in digital deprivation.

Source: Authors' computation, using data from EU-SILC, 2015–2019.



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