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<https://doi.org/10.1057/s41599-022-01053-3>

OPEN

Experiences of food poverty among undocumented parents with children in three European countries: a multi-level research strategy

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A growing literature addresses undocumented migrants in different countries, with governmental exclusion from welfare and health services a common theme. However, little is known comparatively about the difference social context makes to the resources available to these migrants in different circumstances or how they manage and experience material deprivation and social exclusion. Adopting a realist approach, this paper draws on a comparative study that examined food poverty in low-income families with children aged 11–15 years in the UK, Portugal and Norway following the 2008 financial crisis. It shows the ways in which the study's multi-tiered research design enabled the analysis of the complex conditions in which parents sought to sustain and feed their families. Undocumented migrants living in extreme conditions constitute 'test cases' for examining the specific resources available (or not) to households in different layers of context and the consequences for the ways in which food and food poverty were experienced by children and parents in these contexts. The paper thus contributes to the methodological literature on comparative research, in particular to research design in the field of migration and to knowledge about an under-researched group in an increasingly hostile Europe.

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Introduction

Undocumented migrants, those who lack legal documents to enter or stay in a country,¹ are among the groups in Europe who are at greatest risk of extreme poverty, that is, living on very low incomes and experiencing multiple material deprivations (Bradshaw and Movshuk, 2019). However, they are largely invisible in international and national population surveys and, until recently, have generally been excluded from social research, further contributing to their social exclusion (Gaisbauer et al., 2019). Research in 2008 estimated the number of irregular immigrants in the 27 EU member states to be between 1.9 and 3.8 million (Kovacheva and Vogel, 2009: pp. 10–11), with more recent estimates putting the figure as between 3.9 and 4.8 million (Connor and Pasel, 2000).

Undocumented migrants are heavily constrained by public policy through limitations on entitlements to resources and opportunities. In Europe and North America they are often excluded from welfare services, and subject to the gatekeeping or 'bordering' practices of public officials, for example in relation to healthcare (Cuadra, 2010; Woodward et al., 2014; Jolly, 2018: p.197). Forbidden access to the formal labour market, undocumented migrants are also excluded from full entitlement to social assistance (Regioplan Policy Research, 2014) and, as a consequence, are dependent on a 'bricolage' of charity and informal sources (Phillimore et al., 2021). Excluded from cultural citizenship, they are denied a sense of belonging, as expressed in identities, practices and participation (Lister, 2007). Organisations supporting undocumented migrants report that the 2008 financial crisis and austerity measures have increased the hardship of undocumented migrants in many European countries (EAPN, 2015). The pandemic has heightened their financial, housing, and food difficulties (see Burton-Jeangros et al., 2020).

However, less is known comparatively about the difference social context makes to the resources available to undocumented migrant families in different circumstances, or the ways they negotiate and experience material deprivation and social exclusion in their everyday lives. We have adopted in the main a realist approach to explore the complex interplay between the societal, historical, and agentic actors (e.g., Bakewell, 2010; Iosifides, 2011) while also taking into account the ways in which actors interpret their experiences. The design of the study, *Families and Food in Hard Times*, that we discuss here is rare. Through its multi-tiered, mixed-methods research design, the paper analyses social context at the macro level of public policy, the meso level of local institutions and informal social networks and the micro level of household and individual practices. This strategy provides for the conceptualisation of entitlements to resources, food in particular, and addresses matters of explanation. It thereby demonstrates the specific conditions that make it harder (or easier) for particular undocumented parents to sustain their families and the differential effects of constraints and resources on experiences of food in particular times and places.

First, the paper sketches the colonial and migration histories of the three countries that formed the macro-level contexts (Hantrais, 2009) of the study. This is followed by a discussion of the research design. The next section takes a case approach. It selects and compares three families, one from each country, headed by a migrant parent with undocumented status. It examines the entitlements to resources available to the families at three levels—the nation, the locality and the household and individual practices. The discussion considers the aspects of social context that are consequential for families' abilities to sustain themselves and the conclusion reflects on the contribution of this study's design and analytic strategy to explaining similarities and differences in the experiences of food among undocumented migrant families living in different European countries.

Undocumented migrants in the UK, Portugal and Norway

Families and Food in Hard Times (European Research Council, grant agreement no. 337977) aimed to examine how low-income families with children aged 11–15 years managed to sustain and feed themselves in the wake of the 2008 financial crisis, a time when increasing evidence emerged in the UK and elsewhere of children going hungry and of families going to food banks (O'Connell and Brannen, 2021). To reflect countries differently impacted by so-called 'austerity' measures, we selected the UK, Portugal and Norway, providing a 'contrast of contexts' (Kohn, 1989). As discussed below, many of the low-income families studied in each country were first-generation migrants from outside Europe, including from the continent of Africa, including several families who were undocumented, with the largest group in the UK.

In the UK, according to Jolly (2018), there are no official data on the numbers of undocumented people; Gordon et al. (2009) estimated a figure of 725,000 people in 2007 and Jolly, Thomas and Staney (2020) more recently have updated the estimate to 674,000 undocumented individuals in the UK, including 215,000 children and 117,000 young people. The number living in Portugal is also unclear although it is noted that tens of thousands of predominantly Brazilian immigrants are 'irregular' (Fonseca and McGarrigle, 2014), that is, around 1.1 per cent of Portugal's population and a comparatively high proportion in the EU (Cuadra, 2010). In contrast, Norway has a small undocumented migrant population—approximately 15,000 out of a population of about 5 million—0.3 per cent of its population (Onarheim et al., 2018: p. 3).

Migration to the three study countries needs to be understood in the context of colonialism and racism that are central to European history (Jonsson, 2020). Immigration and asylum policies relate to the host countries' histories of colonisation, the demands of labour markets at different historical junctures, human rights policies, and the politics of discrimination and limitation of movement. Undocumented migrants' trajectories are also shaped by the social and economic conditions of the countries they come from as well as by the conditions in the countries of arrival. Thus, some groups of migrants are more likely to be undocumented than others. Black Africans are over-represented among the population of undocumented migrants in Europe and the parents in all three families discussed in this paper came from African countries that were experiencing or had experienced political instability or wars. There is evidence that in Europe black African migrants and their descendants are particularly affected by racism: in citizenship entitlements, employment opportunities, access to services including healthcare and daily encounters (EU-FRA, 2018).

The UK and Portugal have long histories of colonialism and immigration but have developed different relationships with their former colonies. As Mayblin (2014) has argued, UK policy has long been hostile to migrants and to granting refugee rights to non-European asylum seekers.² Immigration from Britain's former colonies started earlier than in other former European colonial powers and, therefore, became politicised early, with anti-discrimination legislation in place from 1965, not long after the 1963 Bristol Bus Boycott that protested against racial discrimination in employment and housing. However, anti-immigration sentiment and the curtailment of the citizenship rights of migrants from the Commonwealth persisted (Hansen 2003). In the aftermath of the 2008 financial crisis, the time of our research, the UK government made severe cuts to public expenditure. Cuts in support for migrants were the greatest in the EU (along with The Netherlands) including reduced funding for community cohesion programmes and the Refugee Council and

restrictions on eligibility for courses in English for Speakers of Other Languages (ESOL) programmes (Collett, 2011).

Under the UK's Immigration Act 2016 undocumented migrants are not permitted access to the labour market. Furthermore, they are among a larger group of migrants who are subject to a no recourse to public funds (NRPF) rule that denies entitlement to mainstream social security benefits, regardless of whether they have children in the household (Dexter et al., 2016; p. 16; Jolly et al., 2021). They lack rights to secondary NHS healthcare, Local Authority assistance and Council Housing. These and other measures, such as restrictions on opening bank accounts, are intended to deter immigration and create a 'hostile environment', creating extreme material hardship (Fitzpatrick et al., 2017; O'Connell et al., 2019). Under section 17 of the 1989 Children Act, Local Authorities in England are required to support 'children in need' by providing housing and subsistence from their budgets, which are not regarded as 'public funds'. In 2015, six out of ten families with NRPF who applied for Section 17 support were denied it (Dexter et al., 2016). As Jolly (2018) notes, thresholds have drastically reduced in line with budgets in the context of economic retrenchment, leaving social workers powerless. Schools are not funded to provide free school meals to children whose parents have NRPF and, if they choose to, costs are born by their own budgets. These policies have not changed regarding adults since the start of the pandemic. However, pressured by organisations and championed by footballer Marcus Rashford (O'Connell and Brannen, 2020), the UK government has been shamed into covering the costs of school meals for children in some families with NRPF, although this is temporary.

The break-up of Portugal's colonies was complete following the 1974 Carnation Revolution. Portugal's ties to its former African colonies shifted to 'an imagined community of descent' based on the Portuguese language and customs in which citizens of their former colonies (the 'Lusophone countries') were accorded special rights but also, via special labour agreements, were imported as temporary cheap labour in the context of Portugal's entry to the EU (Horta and White, 2008). In 2015, the Portuguese government declared that, under the newly approved Nationality Act, persons born abroad with at least one Portuguese ascendant in the second degree of the direct line who has retained their Portuguese citizenship, are Portuguese provided that they declare that they want to be Portuguese and have ties with the national community (EWSI, 2015). While fewer persons of African descent in Portugal and the UK report harassment on the grounds of race than in Nordic EU countries (EU-FRA, 2018) discrimination still exists, as expressed in recent protests about living conditions in Lisbon (de Sousa, 2019).

In the context of a low birth rate and an ageing population, the Portuguese labour market depends upon a large informal economy and cheap labour, principally in agriculture and construction (LeVoy et al., 2004) that has resulted in relatively easy access to employment by undocumented migrants. Yet the wages of undocumented migrants are much lower compared to legal migrants or resident workers (Oliveira and Gomes, 2016), particularly in the largely unregulated construction industry where wages are among the lowest in western Europe (LeVoy et al., 2004: pp. 48–9). Despite ILO and UN Conventions and EC demands for tougher control, contractors in industries relying on cheap labour have been difficult to monitor, whilst the Portuguese regulatory authorities have themselves been subject to irregularities (Corkill and Eaton, 1998: p. 163). Portugal also has an ongoing regularisation programme that facilitates migrants' inclusion into mainstream social and legal structures although these are difficult to navigate (LeVoy et al., 2004). It is also one of only four European countries that give undocumented migrants entitlement to access the same range of health services as

nationals, provided they meet certain pre-conditions, such as proof of identity or residence (Matlin et al., 2018).

Undocumented migrants in Portugal are ineligible for the (low) levels of social assistance in the context of an under-developed welfare state (Wall et al., 2001). All non-contributory means-tested benefits are reserved for Portuguese nationals, resident EU citizens and others where bilateral agreement exists (e.g., with Latin American countries) (Eardley et al., 1996, Table 3.1). However, despite the severe austerity policies imposed by the Troika in Portugal following the 2008 financial crisis, the Portuguese government is committed to a policy of integrating migrants, for example, basic literacy training, social assistance for those in extreme poverty regardless of residency status, allowing immigrants to request extensions of stay if unemployed or in unstable temporary employment (Collett, 2011). However, since the pandemic (March 2020) migrants with pending residency applications have been granted access to the same rights as Portuguese citizens, including use of the health system and social and financial support from the government. The decision also benefits those who have applied for asylum. Children of migrants are entitled to Portuguese nationality and social support including free school meals.³ In the pandemic, Portugal continues to provide school meals to the most disadvantaged children despite school closures, and the number of children accessing these meals has steadily increased (OECD, 2020).

Historically, Norway has been a country with more emigration than immigration. However, the trend has reversed in recent decades (Cappelen et al., 2010), with migrants admitted on humanitarian grounds because of wars and conflict in migrants' home countries. From the late 1990s, refugees came from Iraq, Somalia and Afghanistan under Norway's quota. In 2017, 41 per cent of migrants in Norway were from the EU/EEA, 32.4 per cent from Asia, Middle East and Turkey, 13.7 per cent from Africa and 12.7 per cent from other European countries, North America, South America and Australasia (ibid).

Norway's undocumented migrant population remains small (Onarheim et al., 2018). Except for citizens of other Nordic countries, under Norwegian immigration law, all 'foreigners' must apply for permanent residency. Grounds for residency include: to find employment, to pursue education, to seek protection and for family reunification. In 2016, most were permitted to stay on family reunification grounds. However, from 2006 those who arrived on tourist visas and then applied for family reunion were less likely to be granted residence (ibid.).

All entitlements to work, social security, housing and education are dependent on permanent residency. Undocumented migrants are not entitled to social assistance (Øien and Sønsterudbraten, 2011). They have the right to emergency healthcare only (Kvamme and Ytrehus, 2015). Those with residency are entitled to basic financial assistance. Before they can apply for work in Norway's highly regulated labour market (Pyrhönen and Martikainen, 2017: p. 6; Hernes et al., 2019: p. 20) they must complete a year-long integration programme under which municipalities offer education in the Norwegian language and culture, together with an employment internship and other work preparation measures. However, because the Norwegian labour market is geared towards high-level qualifications, migrants with residency are at great risk of unemployment, especially those from the African continent (Ekeland, 2011). During the pandemic unemployment has risen significantly among the foreign-born population compared with those born in Norway (OECD, 2020). Black migrants are particularly subject to racialised discrimination, including in the labour market (Midtbøen and Rogstad 2012). Children who have been resident in Norway for at least 12 months are entitled to child benefit in Norway (Table 1).

Table 1 Similarities and differences in the contexts that shape migrants' access to resources: UK, Portugal and Norway.

	UK	Portugal	Norway
History of colonisation and in-migration	Long	Long	Short
Legal restrictions on undocumented migrant adults	Strong	Weak	Strong
Access to benefits of children irrespective of parents' migration status	Poor	Medium/ variable	Good

The study: a multi-level research design and comparative case analysis

As noted above, in *Families and Food in Hard Times*, we set out to examine the difference that social context made to the extent and experience of food poverty among families with a child aged 11–15 years in three European countries. The samples in each country included parents who were first-generation migrants, with several who were undocumented.

In framing the study's research questions, we recognised that living on a low income and experiencing food insecurity is not only variable but specific to the social conditions in which families find themselves in terms of the resources to which they are entitled and the ways in which they manage poverty in their daily lives. We considered that, conceptually, migrants' daily practices and experiences of 'getting by' required an intersectional approach. As Horvath and Latcheva (2019: p. 128) suggest, migrants' practices 'crystallise at the intersection of individual biographies, family structures, economic developments, and a plethora of social institutions'. A gain or loss in one level or field may be accompanied by a loss or gain at other levels (Erel and Ryan, 2019: p. 250). The inter-relatedness of these levels becomes evident when change occurs, for example, when immigration policy is tightened, leading to the exclusion of undocumented migrants from entitlement to public resources, with consequences for the ways in which they seek resources from other fields, for example, charity.

In comparing the experiences of migrants, we therefore needed to examine migrants' multiple positionings across different fields (Olwig et al., 2012). These fields were operationalised as levels of analysis. At the macro level, we compared public policy (immigration law, welfare regimes and labour markets), charitable and other types of provision in each country relating to household food insecurity, including the discursive framing of food insecurity as a 'public issue'. At the meso level, we examined support from local institutions: schools and charities together with informal networks of friends and relatives that can be a burden as well as a resource for the poor (Offer, 2012). At the micro level of households, we explored the ways in which family members seek to access, manage, transform and share resources and the experiences of food poverty of children and parents.

The study adopted a realist ontological stance. While this stance is not wedded to any particular theory (Porpora, 2015), when combined with comparative analysis of cases, whether they be countries, households or individuals, it can produce a multi-layered understanding of the conditions and processes that shape outcomes and experiences (Brannen, 2019). Cross-national research lends itself to different types of data in order to capture multiple levels of reality which, as Pawson (1995) argues, should be fused in our thinking and brought together in data analysis. The choice of methods and datasets was closely allied to the research questions addressed (Brannen, 2005) concerning the multiple determinants of poverty and food poverty but also

concerning the experience of being income and food poor. This way of fleshing out social context helps to obviate the tendency, especially in qualitative research, to be overly reliant on research participants' perspectives in understanding causes. As Sayer (2000: p. 20) argues, 'Much of what happens does not depend on or correspond to actors' understandings; there are unintended consequences and unacknowledged conditions and things can happen to people regardless of their understandings'. The multi-level approach also redresses cross-national research's tendency to attribute difference only to the national level. In the field of migration, such concerns are reflected in research that draws on realist ontologies and mixed-methods approaches to account for both structure and agency in migration-related processes and practices (e.g., Bakewell, 2010; Iosifides, 2011; Phillimore et al., 2021).

In addition, working comparatively allows the researcher to move from understanding and interpretation towards explanation and generalisation (in a non-statistical sense). As in Ragin's (1994: p. 138) qualitative comparative approach, it affords the opportunity to see 'how different causes combine in complex and sometimes contradictory ways to produce different outcomes'. We may thereby identify instances of a social phenomenon and examine whether similar instances occur in similar contexts in different societies. As in all case-based research, it is important to be clear about the unit of comparison: a country, a household, an individual, a practice. A balance also has to be struck with being overly specific about what is being compared. As Sayer (2000: p. 27) suggests, how we 'carve up and define our dimensions of study tends to set the fate of any subsequent research', whilst Harvey (2014) argues for 'stretching' concepts in cross-national (food) research.

This comparative study was carried between 2014 and 2019. Its mixed-method, multi-level design (Yin, 2003) was modelled on earlier cross-national research carried out simultaneously in several European countries in which different layers of social context were investigated (Brannen and Nilsen, 2011). In order to identify the types of families most at risk of food poverty across the three countries, in the first phase of our study, we carried out secondary analysis of international and national datasets. We also took account of the different histories of the three countries and their welfare states, national policies and programmes concerning families, food and poverty and analysed newspaper reports on families, poverty and food (Knight et al., 2018).

To examine low-income households' food practices and experiences, we carried out intensive qualitative research, asking the same research questions and using a common analytic template, with 133 low-income households with children aged 11–15 years, distributed equally across the three countries. We recruited the households in broadly similar areas: both in capital cities and less urbanised areas in each country. A range of methods was employed with parents (mostly mothers) and children including semi-structured interviews, questionnaires and visual methods. Where possible, and subject to their informed consent, children were interviewed separately from parents.

The origins of the mothers in the study samples were diverse.⁴ Under half of the UK sample was a first-generation migrant (including eight from mainland Europe); just under a third of the Portuguese sample; and two thirds of the Norwegian sample (Table 2). In the UK sample, four of the nine mothers who were from former West African colonies were without leave to remain when interviewed. In the Portuguese sample, two parents (a father and a mother in different households) out of twelve migrants from former African colonies were undocumented, while in the Norwegian sample, one father out of twelve families from the Horn of Africa had no residency in Norway at the time.

Table 2 Origins of study mothers in the three countries' samples.

UK	Portugal	Norway
White British, black British and British Asian (second generation)	26 White Portuguese, black Portuguese (second generation)	31 White Norwegian
West African countries (former British colonies)	9 African countries (former Portuguese colonies)	12 Horn of Africa (Somalia, Eritrea, Ethiopia)
Eastern Europe	6 Brazil	2 Middle East (Turkey, Iraq, Syria, Afghanistan)
Other parts of Europe	2	Other (Caucuses and Central Asia)
North Africa and India	2	American continents
Total	45	45

In order to understand undocumented migrants' positionings in social context, and how levels of context combine to shape parents' capacities for food provisioning and experiences of food poverty, we have selected three cases for analysis in the paper, one from each sample. Given the small number to choose from, matching family characteristics was not possible. In accordance with the ethical procedures of the study (O'Connell and Brannen, 2021) participants' names and some other identifying details have been changed.

Morowa: extreme precarity and child hunger in London

Morowa migrated to London from a former West African British colony in 2005. She had been a lone parent for several years. She has four children: two teenage boys (both interviewed) and two younger children aged five and six. They live in a privately rented two-bedroom flat in an inner London borough.

The macro level. Morowa worked full-time as a domestic at the local hospital until her 'limited leave to remain' expired and she was no longer permitted to work. At interview, she was awaiting a decision from the Home Office regarding her application to stay in the UK. Morowa was no longer entitled to public funds, including Housing Benefit. She could not afford to pay the rent that has gone up from £1200 to £1500 a month, nor Council Tax. She had received a court summons because of arrears. She was also being pursued by debt agencies and by her bank for an overdraft and credit card payments. '... I don't know if they're coming to arrest me, I don't know'. Morowa had also lost her right to Child Tax Credit and Child Benefit.

The meso level. Morowa received no help from the Local Authority Social Services despite having children who are in need. As noted, Local Authorities in England have the legal responsibility to protect all children in their boroughs under section 17 of the 1989 Children Act. This means providing housing and subsistence from their budgets, which are not regarded as 'public funds'. Although a 'child in need assessment' had been conducted, Social Services decided that Morowa's children were not eligible. As the interviewer noted, '... the mother reported that the social worker had said to her that because she has a TV and the internet, the children are fine, and there are others far worse off than her, so there is nothing they can do'.

Because of the family's legal status, Morowa's teenage sons' secondary school had excluded them from free school meals (FSMs). The two teenagers had to endure the school day with empty stomachs. As one noted, 'So I need to have a good breakfast[...] Monday, yeah, I was doing an English test and all I could hear was my belly rumbling... it was not enough energy for me to, cos being a test yeah, I was half asleep. Even the tutor came up to me three times saying 'Do your test', yeah and I was so sleepy because ... it's difficult and stuff'. Hunger also brought feelings of

shame. One brother described being forced to watch his friends eating in the canteen, '... it's embarrassing yeah, you have no money on your card and then you just watch them eat'. He described trying to conceal his shame by going to the school library at lunchtime and trying to work. Asked if anyone enquired why he was not having school lunch he said that they thought he was fasting or disliked the school food. Morowa's two younger children were entitled to FSMs because primary schools are required by law to provide all children in Years 1 and 2 with a meal free of charge.

The family's lack of legal status had consequences for the boys' social participation outside school resulting in further social exclusion. Morowa could not afford the £10 required for the boys to join a local football club, something they desperately wanted to do. One brother described running to school instead of taking the bus and staying for sports after school despite suffering from hunger. He recalled an occasion when he had acute stomach pain, '...I was so hungry and that, so [...] all of a sudden yeah it was like[...] it was like [...] it was like I got hit on my belly. [...] when I don't eat yeah it comes. Yeah, so I'm scared that it might come back [...] it was like I got stabbed with a knife and it's still there.'

The boys were also excluded from taking part in peer-group activities, for example, buying something to eat on the way home from school. As one brother said, '[It] feels like I'm left out of the fun that happens and stuff. Like it just makes me feel empty...It makes me feel like what have I done like, what have I done?' In a poignant end to the interview one brother told us about his plan to buy food needed to take part in a school camping trip with the voucher given to the study participants. The boys kept quiet about their dire situation, adding to their social exclusion.

Morowa's ex-partner, from whom she separated some years ago because of domestic violence, paid some utility bills and brought food for the children. Unsurprisingly, Morowa was unwilling to ask him for help too often. The family was therefore largely dependent on charity. Morowa's GP had recently referred her to a food bank but the referral only permitted three visits. Morowa also mentioned support from a woman she called 'mother', whom she met through the church she used to belong to; the woman helps with the younger children and sometimes gives Morowa £10 to buy food.

The micro level. The consequences of Morowa's precarious legal status were manifest in the household's food practices. As research by the charity Joseph Rowntree Foundation (JRF, 2018) shows, the most common item lacked by those they refer to as 'destitute service users' is food. Morowa's family lacked not only enough to eat, the quality of their food was poor and they were excluded from food-related social participation that most families enjoy. Morowa's negligible food budget meant searching out cheap food locally, as she could not afford transport. She fed the children filling, customary West African foods such as cassava and beans, and took care not to waste food, '...when I haven't got

nothing I just make the rice and... and when you've finished you blend the pepper and tomatoes'. One of the teenagers commented on the monotony of their diet, '...just gets boring. ... We mostly eat rice.'

Morowa largely manages by going without food herself. She eats once a day and prioritises her children's meat intake, *'I'm not eating meat, only my children they eat meat'*. She takes some comfort in her belief in God and a conviction that, if she is granted permission to work, the family's future will be secured, *'I just pray to God what things are good for me. [...] and when things are good for me I just look for a job. Then I'll work hard so that I can take care of them, because things are difficult for them. That's how I pray to God.'*

Maria: survival and child sustenance in Lisbon

Maria is a lone parent with a 15-year-old son. In 2002 when she was 16, Maria migrated to Portugal with her family of origin from Angola, a former Portuguese colony. She became estranged from her family after she got pregnant and, without her parents' support, was unable to access the documentation needed for residency. At the time of interview, the family was living in one room in an apartment in Lisbon shared with a couple for which Maria pays two thirds of her wages.

The macro level. Maria works as a cleaner in the informal economy (300 euros a month in cash). Sometimes she also does 'odd jobs', earning between 10 and 50 euros extra. Although her son was born in Portugal Maria could not obtain documentation for him. However, unlike Morowa's children in the UK, Maria's son received some state support, *'Social Security in this aspect gives a special help to the kids who don't have documents.'* Her son's father who had migrated eventually sent the documentation and the son received his identification card aged 14.

The family's finances worsened when Maria began work for a cleaning company that promised to help her to become legal. However, the company tricked her and went bankrupt. Maria took the company to court, but the case is still unresolved. She applied for benefits but was unsuccessful. Yet Maria praised the Portuguese state, comparing it favourably with Angola, citing her son's schoolbooks provided by the Council.

The meso level. When her son was born, Maria went to Social Services who provided groceries, nappies and milk and also tried to help her obtain Portuguese citizenship, albeit unsuccessfully. Maria depends upon friends, the few relatives she is in touch with and local services. Maria secured her part-time cleaning job through her social network. Her son often sleeps and eats his meals at an aunt's who also gives him pocket money. As the aunt's financial situation is better than Maria's, she manages to offer Maria's son a better diet than Maria is able to provide, despite having five children. Sometimes, Maria eats at the aunt's house although she tries not to do this often because she is unable to reciprocate.

Unlike Morowa's teenagers, Maria's son is entitled to FSMs, free breakfast and snacks twice a day at school. Maria also approached a social worker in the local municipality and was referred to a charity to access food, *'[It is] the only help we had: food every day, we picked it up at the town council, they had at the cafeteria, where they made it...'*

At festivals such as Christmas, and when unforeseen expenses occur, Maria turns to her friends although she lacks money to take part in social activities with them. Having grown up in an Angolan family she enjoys Angolan food, but Maria only cooks it when ingredients are brought from Angola, *'I have to wait,*

sometimes a year, two years when someone comes and brings something more.'

The micro level. Maria spends 50 euros a month on food. Cooking is difficult as she shares a kitchen. Maria relies on staples like rice and pasta. She shops around for offers and economises by making enough food to cover dinner and lunch the next day. Snacks are bread and butter. Maria says that her son is a 'growing boy' and often hungry, complaining that he does not think about the need to reserve food for the next day. Their diet consists of the 'basics', the son said. However, he was reluctant to admit to hunger, perhaps because of shame. When Maria ran out of money at the end of the month she confessed she had stolen food on occasion. She fears that her legal status will not be resolved in the near future and feels socially excluded: *'I'm not sure it will improve, because when we live illegally in a country, you live imprisoned...[...] It greatly saddens me to think I might have to return to Angola 'like a zero'.*

Zeinab: feeding a large family in Oslo under a generous welfare state

Zeinab and her children migrated from Somalia to Norway in 2015. The family fled first to Saudi Arabia where some of the children were born. The family then returned to Somalia in order to migrate to Europe, but the father was arrested. Zeinab and her children travelled to several countries before being granted asylum in Norway and, eventually, residency. Three years later the father re-joined his family. He claimed residency on the grounds of family reunification but has been turned down three times.⁵ The couple has two teenage boys aged 17 and 18, a 12-year-old who was interviewed, a 7-year-old, and a baby. They live in a three-bedroom apartment in a suburb north of Oslo.

The macro level. Zeinab's husband is not entitled to state benefits. Zeinab completed the mandatory introductory programme but as a mother of a baby she is not employed. She and the younger children are entitled to basic financial subsistence. Her eldest son, aged 18, is unemployed and receives basic benefit. The next son, aged 17, is at high school and receives a scholarship to cover his keep. The social security agency, NAV, provides the family with 17,428 NOK a month including child benefits for the youngest three children, plus 4667 NOK towards the rent (9500 NOK monthly) and electricity costs. However, NAV has recently cut their benefits significantly for reasons the family does not understand.

The meso level. The family has only a small circle of family and friends in Norway. The eldest son who spoke (in Norwegian) on behalf of his mother reported several occasions when they had to borrow money from family and friends for food and hospital bills, *'Sometimes we just run out of bread and milk, and that's hard for the children, so mom has to borrow money to give us milk and bread'*. While Zeinab admits to using her credit card to buy food she tries not to build up debts. As meals are not provided in most Norwegian schools, the cost of packed lunch for all the children is very high. Recently Zeinab had to borrow money to buy fruit *'Because the children want food for school'*. The family had sought help from a food bank and used charities to find clothing and gifts. The children miss out on socialising with friends and cannot invite them home. For an occasional treat the children are bought hamburgers from McDonald's to eat at home.

The micro level. Zeinab finds feeding her large family hard, especially since NAV no longer pays her directly for the teenagers' upkeep and because of the cost of packed lunches. They

regularly eat cereals for both breakfast and supper. Dinner dishes are typically based on rice, spaghetti or potatoes. The 18-year-old described his mother making four pieces of chicken stretch to seven portions and purchasing products like rice in bulk. The men in the family make monthly trips to buy halal meat and other products in Sweden where food is cheaper and which they conserve in the freezer. The family's future depends on the father being granted legal status. The 18-year-old is pessimistic about the prospect, but insists that their father will continue to live with them even if denied residency, *'I think it's going to get worse if it continues like this'*.

Discussion and conclusion

This paper has drawn on cases from a comparative study of families and food poverty in three countries (O'Connell and Brannen, 2021) that included among its participants some undocumented migrants.

Undocumented migrants are not only extreme cases of poverty, they are currently at grave risk of heightened ethnic nationalism and economic austerity. The three households we have described are also 'test cases' in the sense that they allow us to identify the specific conditions that lead to poverty and food poverty and they demonstrate how particular families get by. To achieve this aim we examined the macro structural level of public policy, the meso level of local institutions and informal networks, and the micro level of individual and household strategies and experience. This methodological strategy generates understanding of the differential effects of resources (or lack thereof) in particular times and places. Its affordances are that it provides a nuanced understanding of the experiences of undocumented migrants. Each of the wider social contexts of these families encapsulates the legacies of time and place: the countries' particular histories of colonialism and immigration and the ways in which migrants have, or have not, been included into the developments in social welfare. The wider contemporary context also looms large, in particular the effects of the 2008 financial crisis and how this has played out at the local level in terms of existing services; the jurisdiction of local authorities and schools in providing access to food, other goods and services, the significance of family and friendship networks, and the role of charity. At the household level, it afforded a glimpse of the strategies that mothers employed to feed their families and how their lack of entitlement to resources intersected with other levels of context and the consequences for their own and children's experiences of food.

Morowa and Maria, both lone parents, lived in countries hit hard by national austerity policies imposed after the 2008 financial crisis. They were both negatively impacted by their countries' immigration policy; despite both living in the UK and Portugal respectively for many years they remained undocumented. In Morowa's case, the UK's punitive immigration legislation and restrictive rules concerning basic entitlements had deprived the family of income and, at the meso level, of Local Authority Social Services. Morowa's children were denied the right to protection and also to food by their school. Her referral to food banks, that in the UK are increasingly replacing the welfare state, was both limited and inadequate. At the micro level, this meant that Morowa lived on the edge despite her resourcefulness and cooking skills. She was forced to starve in order to prioritise her children's food intake. Even at school her teenage sons went hungry and felt shamed by food poverty.

Maria's situation in Portugal is similar but not the same: Maria continued to lack legal status despite many attempts to acquire it, demonstrating at the macro level the complexity and protractiveness of Portugal's 'regularisation' policy process (LeVoy et al., 2004). However, unlike the UK, Portugal applied immigration law

less stringently and Maria found work in the informal economy. Yet, even by Portuguese standards, Maria's income was exceptionally low. At the meso level, she had more informal contacts than Morowa, accessed support from local council services, charity and relatives. Importantly, free school food protected her son against food poverty and contributed significantly to his nutrition. Yet despite greater resources than Morowa, at the micro level, Maria admitted that, when she ran out of money, she had resorted to stealing food.

Zeinab's husband was undocumented and was not eligible for social security in Norway despite claiming family reunification. However, this family differs from the other two. Zeinab, a non employed mother, and her five children had residency. Because of Norway's generous welfare state, Zeinab's unemployed older son was able to claim basic financial assistance to cover his keep, housing and utilities. When at school he and currently his brother received scholarships. The younger children were entitled to child benefits. These financial resources allowed the family to get by and they had sufficient resources to buy food in bulk, despite having few informal contacts to call upon for assistance and no school meal provision (packed lunches were a heavy expense). In spite of their having a lot of mouths to feed, compared with Morowa and Maria, they were better off. However, like the other mothers, Zeinab relied on starchy foods, cooking meals that 'stretched', and shopping for food offers at cheaper shops.

The paper has drawn on cases from a comparative study of families and food poverty in three countries (O'Connell and Brannen, 2021). It has sketched the macro level of the different histories, economies and public policies of the countries that shape the experiences of undocumented parents trying to feed their children. At the meso or local level, it has examined the jurisdiction of local authorities and schools in providing access to food, other goods and services, the significance of family and friendship networks, and the role of charity. At the household level, it afforded a glimpse of the strategies that mothers employed to feed their families and how their lack of entitlement to resources intersected with other levels of context and the consequences for their own and children's experiences. There are some significant differences at national and meso levels, for example, in Portugal the less stringent rules concerning access to the informal labour market, free healthcare and the provision of free school meals, in contrast to lack of entitlement to public funds in the UK at national and local levels. This research design and analytic approach are important for understanding the complex processes that influence how families with children headed by an undocumented migrant manage to get by and their experiences of food poverty. They thereby address some of the methodological challenges that spatial figurations pose for comparison and afford explanatory value in identifying what makes a difference (Bauer et al., 2021).

The pandemic continues to exacerbate existing social inequality, especially in the UK (Crossley et al., 2020) and Portugal (Shaaban et al., 2020), making the lives of many parents and children even more precarious, especially those of undocumented migrants. Food poverty brings to the fore questions about governments' responsibility to ensure that all members of society, including children, have an entitlement to a level of income that enables them to obtain appropriate and adequate food as a basic human right. As the cases discussed in this paper document, the policies of some governments and local services deny these undocumented migrants this right. This leaves them and their children in highly precarious situations, reliant on charity and informal networks, neither of which suffice. Policies that meet the right to food need to be joined up; they need to address national legislation and local services and communities to protect parents and children from hunger and social exclusion.

Data availability

The datasets generated during and/or analysed during the current study are not publicly available. The UK data are in preparation for deposit with the UK Data Archive.

Received: 21 December 2020; Accepted: 21 December 2021;

Published online: 02 February 2022

Notes

- 1 Defined as those who lack legal documentation to enter a country but manage to enter clandestinely; who enter or stay using fraudulent documentation; or who, after entering using legal documentation, have stayed beyond the time authorised (IOM, 2011).
- 2 Refugees' exclusion from rights goes back to the Geneva Convention (Mayblin, 2014).
- 3 This is stated in the Portuguese constitution although it did not always work in practice <https://www.refworld.org/pdfid/5bc602314.pdf>.
- 4 We tried to avoid 'groupist' thinking (Brubacker, 2002).
- 5 A reason may be that family reunification requires an existing household member to have a job (Blom, 2010, OSF, 2013: p. 70).

References

- Bakewell O (2010) Some reflections on structure and agency in migration theory. *J Ethn Migr Stud* 36(10):1689–708
- Bauer N, Mennell S, Million A (2021) The Refiguration of Spaces and methodological challenges of cross-cultural comparison *FQS*, 22, 2 *FQS* <http://www.qualitative-research.net/>
- Blom S (2010) Sysselsetting Blant Innvandrere: Hvilken Betydning Har Individuelle Egenskaper og Tilpasningsstrategier? (Employment among immigrants: the relevance of individual characteristics and adaptation strategies?). *Søkelys på arbeidslivet* 27(1–2):59–75
- Bradshaw J, Movshuk O (2019) Measures of extreme poverty applied in the European Union. In: Gaisbauer H, Schweiger G, Sedmak C (eds.) *Absolute poverty in Europe: interdisciplinary perspectives on a hidden phenomenon*. Policy Press, Bristol, pp. 39–72
- Brannen, J (2005) NCRM methods review papers, NCRM/005. Mixed methods research: a discussion paper. Discussion Paper <http://eprints.ncrm.ac.uk>
- Brannen, J (2019) *Social Research Matters A life in family sociology*. Bristol: Bristol University Press
- Brannen J, Nilsen A (2011) Comparative biographies in case-based cross-national research: methodological considerations. *Sociology* 45(4):603–19
- Brubacker R (2002) Ethnicity without groups. *Eur J Sociol* 43:163–189
- Burton-Jeangros C, Duvoisin A, Lachat S, Consoli L, Fakhoury J, Yves Jackson Y (2020) The impact of the Covid-19 pandemic and the lockdown on the health and living conditions of undocumented migrants and migrants undergoing legal status regularization. *Front Public Health* <https://doi.org/10.3389/fpubh.2020.596887>
- Cappelen A, Ouren J, Skjerpén T (2010) Effects of immigration policies on immigration to Norway 1969–2010 Online: https://www.ssb.no/a/english/publikasjoner/pdf/rapp_201140_en/rapp_201140_en.pdf
- Collett E (2011) The future of immigrant integration in Europe in a time of austerity. Migration Policy Institute, Washington DC
- Connor P, Pasel J (2000) Europe's unauthorised immigrant population peaks in 2016, then levels off. Online: https://www.pewresearch.org/global/wp-content/uploads/sites/2/2019/11/PG_2019.11.13_EU-Unauthorised_FINAL.pdf
- Corkill D, Eaton M (1998) Multicultural Insertions in a Small Economy: Portugal's Immigrant Communities. *S Eur Soc Polit* 3(3):149–168
- Crossley T, Fisher P, Low H, Benzeval M, Burton J, Jäckle A, Read B (2020) 'Understanding Society COVID-19 survey, April briefing note: The economic effects', Working Paper No. 10/2020. ISER, University of Essex, Colchester
- Cuadra C (2010) Policies on health care for undocumented migrants in EU27. Country Report–Portugal. Health Care in NowHereland, Malmö
- de Sousa A (2019) 'Lisbon's bad week: police brutality reveals Portugal's urban reality'. *The Guardian*, 31 January. <https://www.theguardian.com/cities/2019/jan/31/lisbons-bad-week-police-brutality-reveals-portugals-urban-reality>
- Dexter Z, Capron L, Gregg L (2016) Making Life Impossible: How the needs of destitute migrant children are going unmet. *The Children's Society* <https://www.childrensociety.org.uk/sites/default/files/making-life-impossible.pdf>
- EAPN (2015) The European Anti-Poverty Network. Migrants in Europe's age of austerity. Report of the EAPN Task Force on Migration, April 2015. EAPN, Brussels
- Eardley T, Bradshaw J, Ditch J, Gough I (1996) Social assistance in OECD countries: synthesis report. Research report. Department of Social Security Research Report, No.46. HMSO, London
- Ekeland A (2011) [Stable workforce participation and unemployment rates]. *Statistics Norway*, Oslo
- Erel U, Ryan L (2019) Migrant capitals: Proposing a multi-level analytical spatio-temporal framework. *Sociology* 53:246–284
- European Union Agency for Fundamental Rights (EU-FRA) (2018) Second European Union Minorities and Discrimination Survey Being Black in the EU. Online: https://fra.europa.eu/sites/default/files/fra_uploads/fra-2018-being-black-in-the-eu_en.pdf
- EWSI European Website on Integration (2015) Portuguese Nationality Law-Organic Law no. 9/2015. Online: <https://ec.europa.eu/migrant-integration/librarydoc/portuguese-nationality-law---organic-law-no-9/2015>
- Fitzpatrick S, Bramley G, Sosenko F, Blenkinsopp J, Johnsen J, Littlewood M, Netto G, Watts B (2017) Destitution in the UK. *J Poverty Soc Justice* 25(1):95–97
- Fonseca M, McGarrigle, J (2014) Immigration and policy: new challenges after the economic crisis in Portugal edited by Levine E, Vereá M. Vereá, Coyoacán: Universidad Nacional Autónoma de México
- Gaisbauer H, Schweiger G, Sedmak C (eds.) (2019) *Absolute poverty in Europe: interdisciplinary perspectives on a hidden phenomenon*. Policy Press, Bristol
- Gordon I, Scanlon K, Travers T, Whitehead C (2009) *Economic impact on London and the UK of an earned regularisation of irregular migrants in the UK*. London School of Economics and Political Sciences, London
- Hansen R (2003) Migration to Europe since 1945: Its history and its lessons. *Polit Q* 74(s1):25–38
- Hantrais L (2009) *International comparative research. Theory, methods, and practice*. Palgrave Macmillan, Basingstoke
- Harvey M (2014) Comparing comparing: exercises in stretching concepts. *Anthropology of Food* S10: Explorations in cross-national comparison of food practices. Online: <https://journals.openedition.org/aoif/7689>
- Hernes V, Arendt J, Jooná P, Tronstad K (2019) Nordic integration and settlement policies for refugees A comparative analysis of labour market integration outcomes. Nordic Council of Ministers, Copenhagen
- Horta A, White P (2008) Post-colonial migration and citizenship regimes: a comparison of Portugal and the United Kingdom. *Revista Migrações*, n.º 4. ACIDI, Lisboa, pp. 33–57
- Horvath K, Latcheva R (2019) Mixing methods in the age of migration politics: a commentary on validity and reflexivity in current migration Res *J Mixed Methods* 13(2) <https://doi.org/10.1177/1558689818822445>
- IOM (2011) *International Migration Law No 25: Glossary on migration*. International Organisation of Migration, Geneva
- Iosifides T (2011) *Qualitative methods in migration studies: a critical realist perspective*. Ashgate, Farnham
- Jolly A (2018) No recourse to social work? Statutory neglect, social exclusion and undocumented migrant families in the UK. *Soc Incl* 6(3):190–200
- Jolly A, Thomas S, Stanyer J (2020) London's children and young people who are not British citizens: A profile. London: GLA. Online: https://wlv.openrepository.com/bitstream/handle/2436/623021/final_londons_children_and_young_people_who_are_not_british_citizens.pdf?sequence=2&isAllowed=y
- Jolly A, Dickson E, Garande K, Richard-Bishop I, Singh J (2021) *Immigration Policies: Enforcing Borders, Driving Hunger and Creating Destitution*. University of Wolverhampton. Online: https://wlv.openrepository.com/bitstream/handle/2436/624089/Jolly_et_al_Immigration_Policies_Working_Paper_2021.pdf?sequence=3&isAllowed=y
- Jonsson S (2020) A society which is not: political emergence and migrant agency. *Curr Sociol* 68(2):204–222
- Joseph Rowntree Foundation (2018) *Destitution in the UK*. York: Joseph Rowntree Foundation. Online: <https://www.jrf.org.uk/report/destitution-uk>
- Knight A, Brannen J, O'Connell R, Hamilton L (2018) How do children and their families experience food poverty according to UK newspaper media 2006–2015? *J Poverty Soc Justice* 26(2):207–233
- Kohn M (ed.) (1989) *Cross-national research in sociology*. Sage, London
- Kovacheva V, Vogel D (2009) The Size of the Irregular Foreign Resident Population in the European Union in 2002, 2005 and 2008: Aggregated Estimates, Hamburg Institute of International Economics. Online: https://www.researchgate.net/publication/270789231_The_Size_of_the_Irregular_Foreign_Resident_Population_in_the_European_Union_in_2002_2005_and_2008_Aggregated_Estimates_Hamburg_Institute_of_International_Economics
- Kvamme E, Ytrehus S (2015) Barriers to health care access among undocumented migrant women in Norway. *Soc Health Vulnerab* 6(1):28668. <https://doi.org/10.3402/shv.v6.28668>
- LeVoy M, Verbruggen N, Wets J (eds.) (2004) *Undocumented migrant workers in Europe*. PICOM and Hoger instituut voor de arbeid (HIVA), Brussels, Leuven, pp. 31–7
- Lister R (2007) Inclusive citizenship: realizing the potential. *Citizensh Stud* 11(1):49–61
- Midtbøen A, Rogstad J (2012) Diskriminerings Omfang og Årsaker. Etniske Minoriteters Tilgang til Norsk Arbeidsliv (The Extent and Causes of Discrimination. Ethnic Minorities' Access to Norwegian Working Life), Institute for Social Research Oslo: Institutt for samfunnsforskning

- Matlin S, Depoux A, Schütte S, Flahault A, Saso L (2018) Migrants' and refugees' health: towards an agenda of solutions. *Public Health Rev* 39:27
- Mayblin L (2014) Colonialism, decolonisation, and the right to be human: Britain and the 1951 Geneva Convention on the Status of Refugees. *J Hist Sociol.* <https://doi.org/10.1111/johs.12053>
- O'Connell R, Brannen J (2020) What food-insecure children want you to know about hunger. *The Conversation*, 14 September 2020. Online: <https://theconversation.com/what-food-insecure-children-want-you-to-know-about-hunger-146140>
- O'Connell R, Brannen J (2021) Families and food in hard times: European comparative research. UCL Press, London
- O'Connell R, Knight A, Brannen J (2019) Living hand to mouth: children and food in low-income families. Child Poverty Action Group, London
- OECD (2020) Initial education policy responses to the covid-19 pandemic: Portugal. Online: <https://www.oecd.org/education/policy-outlook/covid-snapshot-Portugal.pdf>
- Offer S (2012) The burden of reciprocity: Processes of exclusion and withdrawal from personal networks among low-income families. *Curr Sociol* 60(6):788–805
- Øien C, Sonsterudbraten S (2011) No way in, no way out? A study of living conditions of irregular migrants in Norway, Oslo: Fafo Information Office
- Oliveira C, Gomes N (2016) Indicadores de integracao do imigrantes. Relatorio Estatistico Anual 2016. Alto Commissariado para as migracoes, Lisboa
- Olwig K, Larsen B, Rytter M (2012) Migration, family and the welfare state: Integrating migrants and refugees in Scandinavia. Routledge, London
- Onarheim KH, Melberg A, Meier BM et al. (2018) Towards universal health coverage: including undocumented migrants. *BMJ Glob Health* 3:e001031
- OSF (2013) Somalis in Oslo. Open Society Foundation, New York, NY
- Pawson R (1995) Quality and quantity, agency and structure, mechanism and context: dons and cons. *Bull Methodol Sociol* 47(1):5–48
- Phillimore J, Bradby H, Brand T, Padilla B, Pemberton S (2021) Exploring Welfare Bricolage in Europe's Superdiverse Neighbourhoods. Routledge
- Porpora D (2015) Reconstructing sociology: a critical realist approach. Cambridge University Press, Cambridge
- Pyrhönen N, Martikainen T (2017) Nordic migration and integration research: overview and future prospects policy, paper 3. Nordforsk, Oslo
- Ragin C (1994) Constructing social research: the utility and diversity of method. Pine Forge Press, Thousand Oaks, CA
- Regioplan Policy Research (2014) Study on mobility, migration and destitution in the European Union Final Report. Directorate-General for Employment, Social Affairs and Inclusion European Community Programme for Employment and Social Solidarity-PROGRESS (2007-2013), Luxembourg
- Sayer A (2000) Realism and social science. Sage, London
- Shaaban A, Peleteiro B, Martins R (2020) COVID-19: What Is Next for Portugal? *Front Public Health*, 21 August <https://doi.org/10.3389/fpubh.2020.00392>
- Wall K, Aboim S, Cunha V, Vasconcelos P (2001) Families and informal support networks in Portugal: the reproduction of inequality. *J Eur Soc Policy* 11:213–233
- Woodward A, Howard N, Wolffers I (2014) Health and access to care for undocumented migrants living in the European Union: a scoping review. *Health Policy Plan* 29(7):818–830
- Yin R (2003) Case study research: design and methods, 3rd edn. Sage, London

Acknowledgements

This work was supported by the European Research Council (ERC) under the European Union's Seventh Framework Programme (FP7/ 2007–2013), ERC grant agreement number 337977. We also wish to thank the families who participated in the study and to thank and acknowledge the co-researchers with whom we carried out the research on which the article is based. The team included: in the UK, Laura Hamilton, Abigail Knight, Charlie Owen, Antonia Simon (Thomas Coram Research Unit, Institute of Education, UCL); in Portugal, Manuel Abrantes, Fabio Augusto, Sonia Cardoso, Vasco Ramos, Monica Truninger and Karin Wall (Instituto de Cincias Sociais da Universidade de Lisboa); in Norway, Silje Skuland and Anine Frisland (Consumption Research Norway, Oslo Metropolitan University).

Competing interests

The authors declare no competing interests.

Ethical approval

The study received ethical approval from committees in each of the three participating institutions (Institute of Education, UCL; University of Lisbon; Oslo Metropolitan University) and the European Research Council Executive Agency.

Informed consent

Informed consent was obtained from all participants and, where relevant, their legal guardians.

Additional information

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