

ORIGINAL ARTICLE

Systematic review of health and disease in Ukrainian children highlights poor child health and challenges for those treating refugees

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Abstract

Aim: Millions of Ukrainian children have been internally displaced or fled to other countries because of the Russian war. This systematic review focused on their health needs and future challenges for clinicians.

Methods: A systematic literature search of the Medline, Embase and MedRxiv databases from 1 January 2010 to 31 March 2022 identified 1628 papers on the health of Ukrainian children and 112 were relevant to this review.

Results: In 2019, under-5 mortality was 8 per 1000 live births in Ukraine. Underweight and adverse childhood experiences, including child abuse, were frequent compared to other European countries, while childhood obesity seemed less common. Alcohol consumption was common in women of reproductive age, including during pregnancy, risking foetal alcohol syndrome. Neonatal screening programmes provided low coverage. Vaccine hesitancy was common and vaccination rates were low. Other concerns were measles, HIV, antibiotic resistance and multi-resistant tuberculosis. Many children are expected to suffer from psychological and physical trauma due to the war. Other healthcare challenges include low COVID-19 vaccination rates and a preference for secondary and tertiary care, rather than primary care. Many people cannot afford medication.

Conclusion: Ukrainian children often have poor health and host countries need to be aware of their needs.

KEYWORDS

antibiotic resistance, low vaccination rates, poor health, psychological trauma, Ukraine

1 | INTRODUCTION

Millions of people have fled Ukraine since the large-scale Russian invasion of the country on 24 February 2022. The war is a dramatic escalation of the conflict that has existed in the Eastern part of the

country since 2014. UNICEF has estimated that 4.3 million of the country's 7.5 million children were displaced just in the first month of the war. Of these, 1.8 million had crossed into other countries and 2.5 million had fled to other parts of Ukraine.¹ That figure has risen even further since then.

Abbreviations: AIDS, acquired immune deficiency syndrome; CDC, The American Centers for Disease Control and Prevention; HbsAg, surface antigen of the hepatitis B virus; HIV, human immunodeficiency virus; WHO, World Health Organization.

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We performed a systematic literature review to increase our understanding of the health needs of Ukrainian children, inside and outside their country. The main aims of this review were to describe the Ukrainian healthcare system and build up a picture of the health of Ukrainian children, with a particular focus on diseases and conditions that are more prevalent in their country. We hope that this will provide valuable information for healthcare organisations and professionals who are working with Ukrainian child refugees, as the health profiles of these children will differ from resident paediatric populations.

2 | METHODS

2.1 | Search process

A detailed search of the Medline, Embase and MedRxiv databases was carried out from 1 January 2010 to 31 March 2022 by an experienced librarian at the Karolinska Institutet, Stockholm, Sweden. The search terms are detailed in Appendix S1. The searches yielded 2267 papers from the three databases: 772 from Medline, 1436 from Embase and 59 from MedRxiv (Figure 1). After duplicates were removed, the titles and abstracts of 1,628 reports were reviewed by one of the authors (JFL), and 131 met the eligibility criteria (Figure 1). The current review was primarily based on 107 full papers,²⁻¹⁰⁸ but, due to the scarcity of data, we also chose to cite five relevant abstracts¹⁰⁹⁻¹¹³ for a more complete picture of child health in Ukraine. Our literature search was limited to papers published in English.

3 | RESULTS

The text below refers to the situation in Ukraine before the 2022 war with Russia, unless otherwise stated.

3.1 | Ukraine's history

The first Eastern Slavic state of Kyivan Rus was established in the 10th/11th century. For most of the next 1000 years, Ukraine was part of Russia or the Polish-Lithuanian commonwealth. The country has suffered from at least three major healthcare catastrophes in the last 100 years. The famines in 1921–1922 and 1932–1933 resulted in more than 8 million deaths and another 8 million people died in World War Two.¹¹⁴ Ukraine declared independence from the Soviet Union in 1991. After President Yanukovich was removed from office in 2014, Crimea was invaded by Russia and Russian-supported separatists declared independence for the two Ukrainian provinces of Donetsk and Luhansk.¹¹⁵ By early 2022, more than 14 000 civilians had been wounded or killed due to the persisting conflict in Eastern Ukraine¹¹⁴ and an estimated 1.5–2 million people had been internally displaced in Ukraine.⁸⁷ Before the Russian invasion on 24 February 2022, the total population of Ukraine was an estimated

Key Notes

- A systematic review from 1 January 2010 to 31 March 2022 identified 112 relevant papers on the health of Ukrainian children.
- Underweight and adverse childhood experiences, including child abuse, were frequent compared to other European countries, and medication was often unaffordable.
- Vaccine hesitancy was common, vaccination rates were low and other concerns were measles, HIV, antibiotic resistance, multi-resistant tuberculosis and psychological trauma from the war.

43 million. Of these, 78% were ethnic Ukrainians, 17% were ethnic Russians and the remaining 5% were other ethnicities. In 2022, 16.2% of the population were children aged 0–14 years. However, this review covered children aged 0–17 years of age.

3.2 | Healthcare system and population health

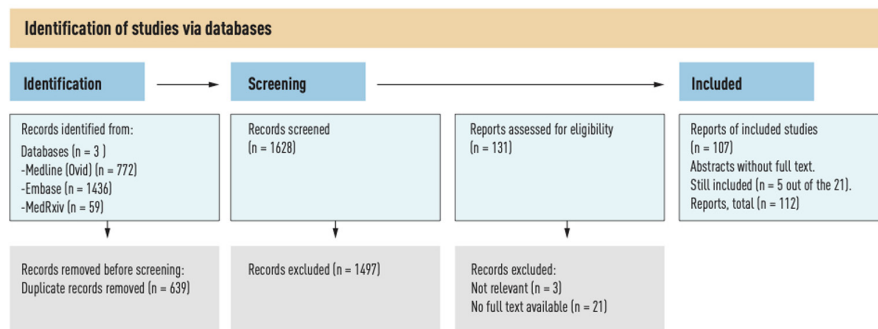
The healthcare system in Ukraine is divided into the national level, which is administered by the Ministry of Health, and several regional levels.⁷² Less than 1 in 20 Ukrainians are covered by voluntary private medical insurance.⁷²

In 2014, the Central Intelligence Agency World Factbook stated that there were 2.99 physicians and 7.5 hospital beds per 1000 residents in Ukraine.¹¹⁴ About 1% of the adult population in Ukraine had the human immunodeficiency virus (HIV) or acquired immune deficiency syndrome (AIDS) in 2020, which ranked it number 45 in the world.¹¹⁴ This corresponded to 260 000 individuals and resulted in 3100 deaths in 2020.¹¹⁴ Furthermore, 24.1% adults in Ukraine were classified as obese in 2016 and this was a world ranking of 61.¹¹⁴ Additional data on life expectancy and other health characteristics are presented in Table 1.

In spring 2022, Ukraine's healthcare system was already under stress from the ongoing war with Russia and from 2 years of the COVID-19 pandemic. By 19 April, 2022, there had been 5 million confirmed cases of COVID-19 in Ukraine and 112 000 deaths following COVID-19.¹¹⁶ Official Ukrainian figures for the number of COVID-19 cases have tended to be lower than international estimates.⁸⁶

The number of Ukrainians who have had to forego medication, due to the excessive costs, decreased from 69.6% in 2001 to 46.6% in 2010.³⁷ The 2010 figures were 35.7% for sometimes foregoing medication and 10.9% for always foregoing medication.³⁷ The Government has tried to limit this problem by introducing price controls and a drug reimbursement programme for patients with certain diseases, such as hypertension and diabetes mellitus (personal communication with Andrii Loboda, 5 April 2022). We have not been

FIGURE 1 Flowchart of papers included in the study



able to identify more recent data on the proportion of Ukrainians having to forego medication in 2022.

When Mackenbach and McKee compared the health policies of 43 European countries, Ukraine had the lowest health policy performance score of all countries, followed by Russia and Armenia.⁷⁴ A detailed review on health policy performance can be found in the supplementary index to their paper,⁷⁴ including a list of Ukraine's performance in areas such as tobacco use, alcohol use, hypertension, cancer screening, air pollution and healthy food.

Life expectancy tends to be 2 years shorter in Eastern and Southern Ukraine than the Western parts of the country. In young adults, the regional differences in life expectancy have been mostly due to accidents, infectious disease and tuberculosis,⁸⁴ which are discussed later. Data on regional differences in child life expectancy were not available.

3.3 | Child health

About half of the country's children are cared for by paediatricians, with the remainder by family doctors. Access to primary care services is limited,⁷² particularly for socially vulnerable groups and in rural areas.

Infant mortality and mortality under 5 years of age decreased from 17 and 19 per 1000 live births in 1990 to 7 and 8 per 1000 in 2019 (Table 2).¹¹⁷ Exclusive breastfeeding in the first 6 months was 54.9% in 2014,⁷² but was substantially lower in children born to internally displaced mothers in Ukraine.¹⁰⁰ Figure 2 provides an overview of child health concerns in Ukraine. These include adverse childhood experiences, vaccinations, stress and mental disorders, and specific events like the war with Russia. More details on the child healthcare system in Ukraine have previously been published.⁷²

A review funded by the World Health Organization (WHO) on adverse childhood experiences in 28 European countries found that they were more common in Ukraine than in any other country in the study.⁵⁴ These were measured by their impact on each country's gross domestic product. The paper, which was published in 2021, stated that 20.8% of Ukrainian children had at least two adverse childhood experiences from the following list: household substance abuse, household mental illness, parental separation or divorce, physical or sexual abuse, household member imprisoned

or a involved in criminality, domestic violence, parental death, child welfare intervention and serious illness and/or injury.⁵⁴

3.3.1 | Pregnancy, maternal health and newborn infants

The use of contraceptives by Ukrainian women is similar to Western countries and intrauterine devices are the most common methods.²⁸ A study published in 2013 stated that 1 in 12 pregnancies in Ukraine occurred in teenagers (8.7%).⁷⁴

Ukraine has a newborn screening programme and a 2020 paper by Loboda et al reported that neonates were tested for congenital hypothyroidism, phenylketonuria, congenital adrenal hyperplasia and cystic fibrosis.⁷² The coverage of this programme is unclear. Loboda et al reported that more than 122 000 newborn infants were screened in 2018, but the number of births that year was likely to have been around 400 000, according to the 2022 Central Intelligence Agency World Fact Book.¹¹⁴ This would suggest that only about 30% of newborn infants were screened.

3.3.2 | Alcohol and smoking

Alcohol consumption is common in women of reproductive age.²⁰ One study reported that about 46% of pregnant women had consumed alcohol at least once during the last month, with 9.3% reporting that they had consumed three or more drinks on at least 1 day during that period.²⁰ A study of 162 adopted children from Russian and Ukraine reported that about 50% fulfilled the criteria for foetal alcohol spectrum disorder.²⁶ However, this high figure was contradicted by a study that reported that none of the 18 Ukrainian orphans or adopted children that the authors studied had foetal alcohol spectrum disorder.¹¹⁸

A random sample of 445 adolescents (49.9% males) in the Ukrainian city of Dnipropetrovsk were asked about their alcohol habits at a mean age of 15.36 years. More than three-quarters (76%) reported consuming beer and wine regularly and 46% drank spirits.¹⁷

Smoking is prevalent in Ukrainian teenagers. In an anonymous survey of 437 adolescents aged 14–17 years old, 54.3% reported smoking and about 4.5% smoked at least 20 cigarettes a day.⁵⁹ Passive smoking and second-hand smoke was common.¹¹⁹ The

American Centers for Disease Control and Prevention (CDC) has estimated that in 2008–2010, 17.7% of Ukrainian women of reproductive age were smokers.¹⁹

Smoking cessation programmes are rare in Ukraine. The Global Adult Tobacco Survey³ reported that only 1.7% of people aged 15 years or over received support to quit smoking. This figure was low compared to low- to middle-income countries. We are not aware of any smoking cessation programmes for Ukrainian children.

3.3.3 | Other environmental exposures

In 2017, Hryhorenko et al cited a study, not published in English, which stated that 72% of the Ukrainian water supply did not meet the national sanitary standards and that 1 in 6 water supply systems did not have disinfecting facilities.⁵² Water problems were particularly common in rural areas, where up to three-quarters of areas used decentralised water sources, such as wells.

3.3.4 | Obesity, underweight and nutrition

Obesity seems to have been less common in Ukrainian children and adolescents than in many other Western countries²² and so has the metabolic syndrome.⁵³ A 2013 paper by Chaychenko et al reported that 15% of children aged 10–17 years had a body mass index that was above the 85th percentile.²² Another study by Deren et al reported the combined prevalence of overweight or obesity in Ukraine based on three different standards.²⁹ These were the International Obesity Taskforce (12.1%), WHO (17.6%) and the CDC (12.6%). The corresponding data just for obesity were 2.1%, 4.2% and 3.6% respectively.²⁹ Other data on trends³⁰ and regional variations of obesity³³ within Ukraine have also been published. It is also possible that the reportedly low prevalence of obesity is mainly relevant for older children aged 13–18 years. Data published in 2018 revealed a higher body mass index for Ukrainian children aged 7–13,⁸⁸ than the multi-ethnic WHO reference. One study reported that the diet of Ukrainian children seemed to be adequate, but unbalanced, as it provided too much energy and too few vitamins.⁸⁹

Being underweight may be a larger problem in Ukraine⁴³ than being overweight. A meta-analysis of 26 countries by Garrido-Miguel et al showed that Ukraine had the highest percentages of underweight children aged 2–13 years (14.7%) and adolescents aged 14–18 years.⁴³ This paper showed a strong correlation between being underweight and Ukraine's poor economy. Ukraine also had the lowest gross national income per capita of all 26 countries.⁴³

3.4 | Vaccinations and vaccine-preventable diseases

Both overall mortality and mortality from vaccine-preventable diseases have decreased dramatically in Ukraine since World War II.⁸³ Figure 3 presents the national vaccination schedule in Ukraine.

Vaccine hesitancy in Ukraine led to low childhood vaccination rates between 2008 and 2016. In 2016, only 19% of children received their third dose of the diphtheria-tetanus-pertussis vaccine, 31% their second dose of the measles, mumps and rubella vaccine and 56% received their third recommended dose of the oral polio vaccine.⁴⁷ Vaccination rates increased dramatically after that study, due to a large measles outbreak that resulted in a number of deaths.¹²⁰ Another study indicated that 34%–54% of Ukrainian children born in 2011–2015 had received appropriate diphtheria-tetanus vaccinations, but this meant that 46–66% were not fully vaccinated.⁶² It is notable that WHO data have suggested higher vaccination rates in recent years (Figure 4).¹²¹ Polio cases are extremely rare in Ukraine, but have occurred in the last decade.⁸⁰

COVID-19 vaccination rates also seem to be comparatively low in Ukraine.⁴⁹ By late February 2022, the Our World in Data website reported that only 36.3% of the Ukrainian population was completely vaccinated, having received two doses against COVID-19.¹²² The factors that have contributed to low COVID-19 vaccinations rates have been identified as slow vaccine delivery, high vaccine prices and not trusting the vaccine.⁴⁹

The Ukrainian vaccination schedule does not include the rotavirus (Figure 3), and this infection accounts for a large proportion of child gastroenteritis. One study reported that it accounted for 40%–50% of all gastroenteritis hospital admissions.²⁴ Children admitted to Ukrainian hospitals for the rotavirus infection tend to be older, with a median age of 101 weeks, compared to international data.⁴⁸ It has been speculated that this could be due to either underreporting younger children with the rotavirus or that older children in Eastern Europe have increased susceptibility to the rotavirus.⁴⁸

Hepatitis B vaccinations were introduced to Ukraine in 2002.⁶¹ Initial coverage was high (92%–98%) in 2004–2007, but then decreased to 21%–48% in 2010–2016. Despite low vaccination rates, the prevalence of Hepatitis B is low in Ukraine. A few areas of the country reported a surface antigen of the hepatitis B virus (HbsAg) seroprevalence of >0.5%.⁶¹

It is routine to test pregnant women in Ukraine for HbsAg, and one study reported that 0.72% tested positive.¹¹¹ Of note, Kravchuk et al reported that many women who were positive for HbsAg were not offered effective treatment or prophylaxis against vertical transmission. However, most newborn infants were vaccinated against Hepatitis B,¹¹¹ as shown in Figure 4.

A study by Ganczak et al, which was published in 2021, described how the researchers used focus groups to discuss vaccination attitudes of parents who had emigrated from Ukraine to Poland.⁴¹ The participants were generally positive about the Polish vaccination schedule for children, but several participants admitted they had obtained false immunisation certificates. There was low acceptance of the influenza vaccination, but it was unclear whether this related to the parents or the children receiving it.⁴¹

It is notable that the latest WHO data indicated that Ukraine had much higher child vaccination rates in 2019–2020 than earlier in that decade (Figure 4).¹²¹ However, we do not know to what extent children who were unvaccinated in the last decade have subsequently been vaccinated.

TABLE 1 National health characteristics of Ukraine and other selected countries, according to the Central Intelligence Agency 2022 World Fact Book¹¹⁴

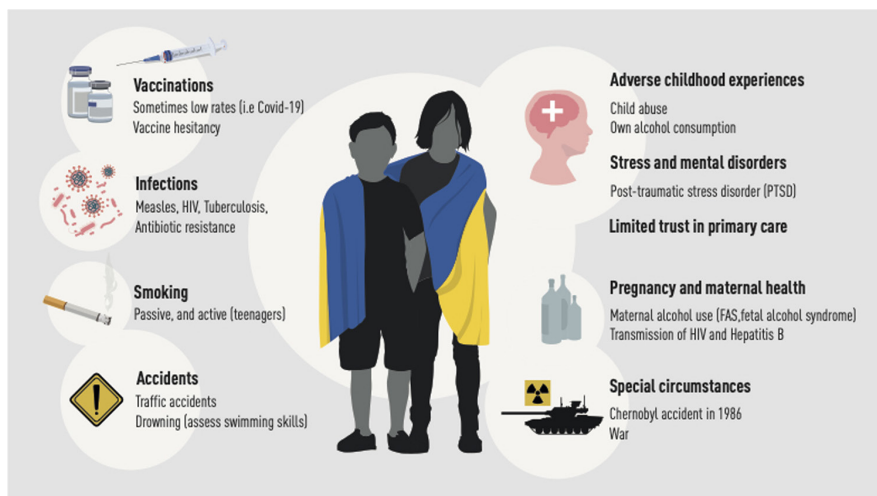
	Ukraine	Poland	Russia	Italy	Germany	France	UK	US	Sweden
Maternal age at first birth (mean), years	26.2	27.6	25.2	31.3	29.8	28.8	29.0	27.0	29.5
Life expectancy, years	73.18	78.53	72.16	82.67	81.30	82.39	81.30	80.43	82.60
Health expenditure, % of GDP	7.1	6.5	5.7	8.7	11.7	11.1	10.2	16.8	10.9

Abbreviations: GDP, Gross domestic product; Russia, the Russian Federation.

TABLE 2 Child health characteristics of Ukraine and neighbouring countries, according to 2021 UNICEF report¹¹⁷

	Ukraine	Belarus	Hungary	Poland	Republic of Moldova	Romania	Russia	Slovakia
Under-5 mortality (%)	8	3	4	4	14	7	6	6
Infant mortality (%)	7	2	3	4	12	6	5	2
Mortality rate, children 5-14 years (%)	2	1	1	1	3	2	2	1
Low birth weight <2500g (%)	6	5	9	6	5	8	6	8
Stunted (moderate or severe), children 0-4 years (%)	16	4	No data	2	5	10	No data	No data

^aMost data originate from 2019, Russia, the Russian Federation.

FIGURE 2 Health issues that affect Ukrainian children

3.5 | HIV and AIDS

HIV has always been a significant health problem in Ukraine.⁵⁵ The Central Intelligence Agency World Factbook estimated that about 1% of the adult Ukrainian population lived with HIV in 2020, with a world ranking of 45.¹¹⁴ This corresponded to 260 000 individuals and resulted in 3100 adult and child deaths in that year.¹¹⁴ The Global Burden of Disease HIV collaborators³⁹ provided a somewhat higher figures for 2017, with 5080 adult and child deaths in Ukraine. Most new cases of HIV are from injecting drug use.¹²³ HIV cases increased by 9.7% per year from 2007 to 2017, but deaths from HIV/AIDS fell by 5.9% per year.³⁹ Some 40% of Ukrainian people living

with HIV received anti-retroviral treatment, according to a 2019 paper, and the figure was 54% for HIV-positive children.⁶⁰

Naduta-Srynnyk et al also highlighted the need for social and psychological support for young people with HIV in Ukraine.⁸⁵

Ukrainian guidelines stipulate that mother-to-child HIV transmission should be prevented using anti-retroviral therapy² and interview data suggested that most pregnant women received this therapy.⁴ While vertical transmission occurs in HIV-positive pregnant women in Ukraine, with one model suggesting a rate of 17%,⁶⁰ a WHO assessment reported far lower mother-to-child-transmission rates of HIV in 2016. These were 1.9% at 2 months of age and 3.7% at 18 months of age.¹²⁴ Despite this, AIDS-related child deaths

National vaccination schedule in Ukraine (2018)

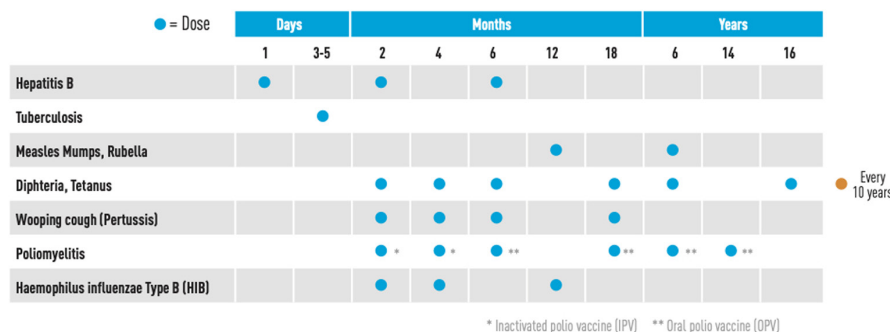


FIGURE 3 Ukraine's 2018 national vaccination schedule

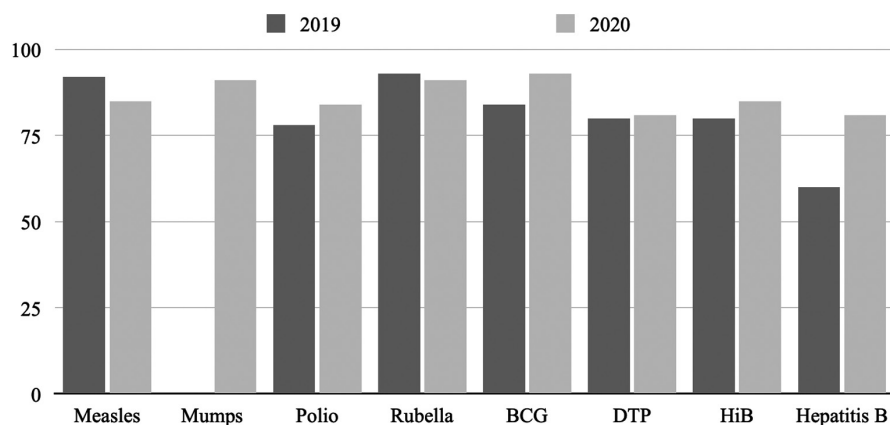


FIGURE 4 Vaccination rates (%) in children, based on WHO data. The figures refer to full vaccinations, such as the third dose of DTP and third dose of polio. No data for mumps in 2019. Data on rubella vaccinations may refer to an earlier year than 2019. Abbreviations: BCG, vaccination against Tuberculosis; DTP, Diphtheria-Tetanus-Pertussis; HiB, Haemophilus influenzae, type b

occur in Ukraine.^{60,117} Another study found that 1 in 10 pregnant women had not told their partners they were HIV-positive.⁴

Young people with unstable housing conditions, and orphans, face particularly high risks of HIV.^{50,51} One paper published after the 2022 invasion estimated that almost 100 000 children in Ukraine did not live with their parents and were housed in institutional care facilities and boarding schools.¹²⁵

3.6 | Other infections

Tuberculosis is one of the main reasons for differences in life expectancy, for all ages, between the East of Ukraine and the Southern and Western parts of the country.⁸⁴ One study reported rifampicin resistance in 16.9% of new tuberculosis cases and 29.7% of recurrent cases.²⁵ This study also reported that many HIV-positive adolescents who had tuberculosis were not on anti-retroviral therapy for their HIV.²⁵

Measles is a particularly important health issue.⁹⁷ According to the WHO, 53 218 (60%) of the 88 692 measles cases that were reported in Europe in 2018 were from Ukraine. Measles has vast implications for countries hosting refugee children from Ukraine because it is highly contagious. The high prevalence of measles is probably due to parental anxiety about vaccine safety, distrust in the Government and Ukraine's outdated health system.⁴⁷ These factors have all been shown to lower vaccination rates.¹¹³

In a large survey of 18 European countries, published in 2020, only 49% of the 372 Ukrainian parents who took part reported

confidence in childhood vaccinations.⁴⁷ This was on par with neighbouring Poland (45%), but lower than many other countries in Europe, such as Germany (63%).⁴⁷ Due to increasing vaccination rates, measles has recently decreased in Ukraine.

Diphtheria does occur in Ukrainian children, but the incidence seems to be declining.¹¹² A study of four large Ukrainian regions, namely Kyiv City and the Sumy, Odessa and Zakarpattya regions, showed that the seroprevalence for diphtheria antibodies was less than 80% in children and ranged from 50 to 79%.⁶² Protection against tetanus was deemed sufficient in three of the above regions, but not in the Zakarpattya region, where the seroprevalence for antibodies was 62%.⁶² Perinatal syphilis occurs in Ukraine,⁵⁶ but is very rare. It affected 0.07% of all pregnant women in Ukraine in 2016, with a more than 92% screening coverage and 100% treatment coverage of known cases.¹²⁶

One study reported that the most common agents for perinatal infections in newborn infants born in 2017–2019 in Ukraine were: *Escherichia coli*, *Streptococcus agalactiae*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Coagulase-negative staphylococci*, *Enterobacter* and *Pseudomonas aeruginosa*.⁹⁹

3.7 | Antibiotic resistance

Several sources have suggested extensive antibiotic resistance in Ukraine, but the research has been somewhat contradictory.³⁵ Feshchenko et al reported that in 2011–2013 amoxicillin plus clavulanic acid (amoxicillin), ceftriaxone and levofloxacin were all

fully active against *Streptococcus pneumoniae* and *Haemophilus influenzae* in Ukraine.³⁵ They also said that *Streptococcus pneumoniae* was sometimes resistant to trimethoprim plus sulfamethoxazole and that macrolides may have poor effects against *Haemophilus influenzae*.³⁵

One study showed that *Streptococcus pneumoniae* isolates that were collected in Ukraine in 2014–2016 showed susceptibility rates of 97% for amoxicillin, amoxicillin plus clavulanic acid, penicillin and fluoroquinolones. The rates were between 83% and 86% for oral penicillin, macrolides and cefaclor and 75% for trimethoprim plus sulfamethoxazole.¹⁰¹ A 90% susceptibility was recorded for *Haemophilus influenzae* to amoxicillin plus clavulanic acid, ceftriaxone, cefuroxime, azithromycin and fluoroquinolones when the Clinical and Laboratory Standards Institute criteria were used.¹⁰¹

A study carried out in the Kyiv region showed that about 28.2% of all *Staphylococcus Aureus* cases were methicillin-resistant and 14.2% of the *Enterococci* cases were resistant to vancomycin.⁹⁸ The most common hospital-associated infections in that study were *Escherichia Coli*, *Staphylococcus Aureus*, vancomycin-resistant *Enterococci*, *Pseudomonas aeruginosa* and *Klebsiella Pneumoniae*. Salmanov et al⁹⁸ provide further details on these and another study has pointed out that extensive antibiotic resistance is also seen in many other countries.¹⁰¹

Healthcare-associated infections have decreased in Ukraine in the last decade,⁶³ with most nosocomial infections originating from surgery, pregnancy, childbirth and the perinatal period.⁶³ A review by Konechnyi et al,⁶³ which mainly covered adults, reported that the most common multi-resistant species in Ukraine in 2017 were methicillin-resistant *Staphylococcus Aureus* (37.4%), *Pseudomonas Aeruginosa*, *Enterobacter*, *Klebsiella Pneumoniae*, *Escherichia Coli*, *Enterococci* and *Acinetobacter Baumannii*. The authors cite data from surgical interventions, where 26.3% of pathogens were resistant to at least four antibiotics: 41.0% to lincosamides, 40.4% to tetracyclines, 27.8% to macrolides, 35.4% to chloramphenicol, 34.5% to beta-lactams, 31.5% to aminoglycosides, 24.2% to fluoroquinolones, 21.2% to glycopeptides and 11.3% to oxazolidinones.⁶³ Extended spectrum *beta-lactamase*-producing bacteria were common.⁶³ Finally, a 2020 study isolated a large number of strains with multi-resistance to several antibiotics: 49.1% of *Klebsiella pneumoniae* isolates, 32.6% of *Staphylococcus haemolyticus* isolates, 36.9% of *Staphylococcus aureus* isolates and 30.6% of *Streptococcus pyogenes* isolates.¹²⁷

The factors that contributed to antibiotic resistance in children could have included lack of parental knowledge. Lugova et al⁷³ found that 60% of 159 parents who took part in a survey confused antibiotics with other medication used for the symptomatic treatment of upper respiratory tract infections.

3.8 | Chronic diseases

At least four papers suggested a low prevalence of asthma in Ukraine,^{11,34,58,67} but indicated that this was probably due to

under-diagnosis. One of these studies found a very low prevalence in 1.5% of children aged 5–15 years.⁶⁷ On the other hand, a 2018 international cross-sectional comparison found that 17.5% of Ukrainian children aged 6–13 years had some kind of respiratory allergy.¹²

Type 1 diabetes seems to be rising in Ukraine,¹⁰⁹ but potentially from a slightly lower level than in many Western countries. The Ukrainian Paediatric Diabetes Register reports that in 2012, 1 in 975 children had type 1 diabetes.¹¹⁰ This could be due to earlier under-recording.¹⁰⁹ Insulin pumps are available in Ukraine.⁴⁶ Complications seemed to be common in diabetic children in Ukraine, particularly peripheral neuropathy and liver steatosis, but we were unable to find any studies on complications after 2011.¹¹⁰

One paper reported a very high prevalence of epilepsy among Ukrainian children (3.2%).⁷⁰

3.9 | Psychological health, abuse and accidents

In 2011, Akmatov et al explored the attitudes towards child abuse in 28 developing and transitional countries.⁶ Ukrainians were more likely to agree with children receiving corporal punishment, with a median acceptance rate of 17.1%, than people living in other transitional countries, mostly the Balkans and former Soviet Union republics in Central Asia. The median acceptance rate for corporal punishment for all of the transitional countries was 7.7%.⁶ Child abuse has been linked to externalised behaviour in Ukrainian children,¹⁴ including aggression, delinquency and attention problems.⁷⁸ Burlaka et al reported that women in Ukraine experienced a high prevalence of intimate partner violence.^{15,16} Such violence is likely to increase in times of conflict and women in war zones are a particularly vulnerable group.¹⁸

One study found that tension-type headaches were common in adolescents in the Kharkiv region.⁶⁵

A 2021 paper said that traffic accidents were common in Ukraine⁹¹ and were the leading cause of death in adolescents and young adults aged 15–24 years.⁸

One study that compared 60 countries found that Ukraine had the eighth highest rate for adult and child deaths *per capita* from unintentional drowning.⁶⁹

3.10 | The Chernobyl disaster

The 1986 Chernobyl disaster was one of only two nuclear accidents to reach the maximum classification for severity. The other was the Fukushima Daiichi disaster in 2011. Many of the 1,628 papers we identified focused on the health consequences of the Chernobyl disaster, but few^{10,27,71} were relevant to the health needs of children in Ukraine today, apart from the stress experienced by parents and grandparents who survived the accident.

The WHO has determined that the concentrations of radioactive caesium in agricultural foods in Ukraine are generally below standards for action.¹²⁸ In the first decade after the Chernobyl

disaster, there was an increased incidence of thyroid cancer in children.²⁷ This excess risk was also seen in individuals exposed *in utero*,¹²⁹ but should not affect today's Ukrainian children. Having said that, we cannot fully rule out that the Chernobyl disaster may have had an impact on the health of Ukrainian children from the disaster area.

4 | DISCUSSION

This systematic literature review examined the Ukrainian healthcare system and the health of Ukrainian children. We specifically focused on the diseases and disorders that may differ between Ukraine and other countries, including those that may occur in child refugees.

Our study revealed concerns about measles, HIV and multi-resistant infections, including tuberculosis. Ukrainian parents have traditionally had low confidence in childhood vaccines, leading to low vaccination rates, but rates have started to increase after large measles outbreaks led to a number of deaths. Underweight^{29,30,43} and child abuse⁶ are also concerns. Adverse childhood experiences have been common.⁵⁴ While global reviews have shown that COVID-19 is generally mild in children,^{130,131} the low overall COVID-19 vaccination rates in Ukraine are cause for concern.

The Ukrainian healthcare system has lacked resources and underperformed.⁷⁴ However, it should be noted that healthcare has improved in a range of clinical areas in the last few years.¹³² Primary care, palliative care and emergency medical care are now 100% funded by the Ukrainian government¹³² and it has now begun to provide reimbursement for medicines for cardiovascular diseases, asthma and type 2 diabetes.¹³² An e-health system for tracking patients' health history was initiated in 2019, and more and more treatment protocols for children are evidence-based (personal communication, Andrii Loboda, 19 April, 2022).

The conflict in Eastern Ukraine has been going on since 2014 and this has included military attacks on schools. In a paper published before the February 2022 invasion, Loboda et al estimated that more than 400 000 children had psychological wounds from the conflict.⁷² The 2022 war has had a really negative effect on Ukrainian children. Explosives have a disproportionate effect on children, who often face more serious blast injuries than adults, not to mention the psychological trauma that follows.¹²⁵

The conflict will also have indirect effects, including children missing out on education, vaccinations and poor management of chronic conditions. UNICEF estimated that more than half of the country's children had left their homes in the first month of the conflict¹ and the number has risen even more since then.

Children without guardians face a particularly high risk of violence, human trafficking and abuse. The ongoing war threatens Ukraine's response to HIV.¹³³ The fighting will also lead to casualties.⁷⁶ The cost of the war will put increasing stress on the State's health budget and there is a risk that Ukrainian children will have less access to expensive drugs. Earlier research indicated that there was

already an issue with somatropin therapy for patients with growth hormone deficiencies⁴⁴ and other drugs are bound to be affected.

Refugee children are likely to suffer from psychological distress, poor diet and halted or delayed vaccinations.⁸⁷ Even before the current conflict, children in Ukraine may have suffered from unbalanced nutrition,⁸⁹ including rather low *per capita* fruit consumption.^{74,89} It is possible that during the transition period specific Ukrainian child growth charts may be valuable when estimating the growth of child refugees in countries outside Ukraine. These are available in the paper by Nyankovsky et al.⁸⁸

Ukrainian refugees may have low confidence in primary care services in host countries. A 2021 paper by Ganczak et al⁴¹ found that Ukrainians who had emigrated to Poland preferred seeing healthcare specialists rather than family doctors. Meanwhile, a 2017 paper by Madden et al⁷⁵ explored the primary care experiences of Eastern Europeans who had emigrated. These were mostly Polish people who had emigrated to the United Kingdom. The parents perceived that UK primary care doctors did not take their concerns about their children seriously and that they were often told that symptoms, such as fevers and coughs, would just go away. This meant that some parents chose to visit the emergency departments rather than primary healthcare centres.⁷⁵ The parents felt that family doctors blocked their access to hospital-based specialists and that they were recommended paracetamol and rest too often.⁷⁵

Healthcare personnel in countries hosting refugee children from Ukraine need to be very aware of the risk of measles, which may initially present with just fever and respiratory symptoms. Ukrainian children without proof of having had measles or measles vaccinations should preferably be examined in an isolation setting if they have a fever and cough, particularly in the first few months after they arrive from Ukraine. This is because they may have been exposed to measles in Ukraine or from travelling with others from Ukraine. Healthcare personnel in host countries need to make sure that they are personally protected against measles, to avoid further transmission. It must be emphasised that vaccination coverage for measles improved in Ukraine after the extensive outbreaks a few years ago. WHO data from 2019–2020 point towards child vaccination coverage of more than 80% for most diseases (Figure 4),¹²¹ although the rates are still below herd immunity for measles.

Ukrainian child refugees who are admitted to hospitals in other countries may be screened for multi-resistant bacteria and, when feasible, allocated a single room with a toilet. Multi-resistant bacteria are common in Ukraine, especially from carbapenem-resistant extended spectrum *beta-lactamase*-producing bacteria, *Pseudomonas*, *Acinetobacter*, methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant Enterococci.^{134,135}

4.1 | Strengths and limitations

This study had a number of strengths and limitations. The main strengths were that this was an extensive systematic literature review, which spanned a wide range of topics. We limited the search

to 2010–2022, to keep the number of papers to a manageable level and to ensure that the findings were relevant to current Ukrainian children. The limitations included our lack of data on the situation in Ukraine since the 2022 Russian invasion. Another limitation was that our literature search was limited to papers published in English and we may have been unable to identify relevant studies in other languages.

5 | CONCLUSION

This systematic literature review of health and disease in Ukrainian children raises concerns about their general health and the future challenges for clinicians treating them in Ukraine and in host countries. Ukraine's healthcare system was already poor before the Russian invasion in 2022 and many Ukrainians could not afford medication. Underweight and adverse childhood experiences, including child abuse, were frequent compared to other European countries, while childhood obesity seemed less common. Alcohol consumption was common in women of reproductive age, including during pregnancy, with a risk of foetal alcohol syndrome in offspring. Neonatal screening programmes provided low coverage. Vaccine hesitancy was common and vaccination rates were low. Other concerns were measles, HIV, antibiotic resistance and multi-resistant tuberculosis. Many children are expected to suffer from psychological trauma due to the war. Other healthcare challenges include low COVID-19 vaccination rates and a preference for secondary and tertiary care, rather than primary care.

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CONFLICT OF INTEREST

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