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Don´t Forget the Children! A review of the Consequences of Natural Disasters and Epidemics on Childhood Health and Mortality in the Past

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Abstract

Natural disasters, pandemics, and epidemics have devastating impacts on communities. Poverty, famine, ill health, social isolation, and death are some of the consequences of these adverse episodes. In addition, these catastrophes have led to transformations in culture, religion, political and economic stability, and other social aspects. Whilst such episodes have been well documented and studied, little attention has been given to their effect on children. Using osteoarchaeological and historical evidence, this review article explores how children appear to have been affected during, and in the aftermath of natural disasters and epidemics. A range of cases from Antiquity to the modern day is provided, alongside three focal case studies: 1. Famine in northwest England (A.D. 1622-1624), 2. The Spanish Civil War (A.D. 1936-1939), and 3. The Plague in Derbyshire, England (A.D. 1665-1666). These examples were chosen as population data prior, during, and after the event can be compared. This research demonstrates analogies with the present-day where countries have been facing disease outbreaks, droughts, floods, and earthquakes, amongst other disasters. Ultimately, the findings presented in this paper illustrate the extent to which these events shaped the lives and deaths of children in the past.

Keywords: Epidemic; Pandemic; Natural disasters; Childhood Health; Bioarchaeology

Introduction

Pandemics, epidemics, and other natural disasters such as earthquakes, fires or droughts have impacted populations throughout history (Torrence and Grattan, 2002; Kozák and Cermák,

2010). At the time of writing this article (July 2021), Covid-19 has affected the lives of millions of people worldwide, with almost four million deaths as a result of this virus (World Health Organization 2021a). This has led to global poverty due to a loss of income, physical isolation, and restrictions that have had an impact on physical and mental health (Dunn et al. 2020; United Nations 2020; Whitehead et al. 2021). In response to the Covid-19 crisis, it has been estimated that at least 138 countries closed their schools as a means of containing the virus (Van Lancker and Parolin 2020; Viner et al. 2020). However, authorities around the world were eager to open schools as soon as possible due to the harmful impacts non-attendance would have on student attainment (Bao et al. 2020; Eyles et al. 2020), mental health (Liu et al. 2020; Singh et al. 2020), and vulnerable children (Humphreys et al. 2020; Pereda and Díaz-Faes 2020). For children, living and surviving through pandemics can lead to long term health complications as some services, such as essential immunisation, may be disrupted (World Health Organization 2021b). Furthermore, the loss of family income can result in difficulties accessing adequate food (Santillán and Acosta 2021). In some areas, especially where there are high rates of low gross income per capita, children take on additional responsibilities within the household, and child labour occurs due to the death of family members and/or loss of employment (Risso-Gill and Finnegan 2015). This ultimately effects the overall well-being of children and puts them at greater risk of neglect and abuse (e.g. Morantz et al. 2013).

Droughts and floods can ruin communities, as livelihoods, homes, and agricultural land are destroyed, which ultimately result in food shortages, and individuals may be forced to drink contaminated water (Rodriguez-Llanes et al. 2011; Belesova et al. 2019). Undernutrition due to food scarcity during, and following, episodes of drought and flooding can contribute to stunted growth, anaemia, and vector-borne and diarrheal diseases in children (Bahru et al. 2019; Belesova et al. 2019; Cooper et al. 2019; Randell et al. 2020). These episodes also cause severe disruption to education, family life, and the potential loss of their homes. Whilst these episodes may improve resilience in children, they can also have detrimental effects on their mental health (Dean and Stain 2010; Arshad et al. 2020). Indeed, the increased prevalence of post-traumatic stress disorder (PTSD) has been recorded amongst children that have been affected by prolonged periods of drought and flooding (Bokszczanin 2007; Doostgharin 2009; Dyregrov et al. 2018; Amin et al. 2020). Initiatives to improve child well-being have been introduced (e.g. Carnie et al. 2011; Amin et al. 2020), though the ability to launch and run these schemes is largely dependent on the availability of funding, resources, security, and education.

A great deal of research has been conducted into epidemics and pandemics, and climatic events in the past (e.g. Torrence and Grattan 2002; Kozák and Cermák 2010; Gerrard et al. 2020). A number of plagues have been the focus of medical historians (e.g. Furtado 2021); the cause and expansion of these epidemics and pandemics have been further understood through bioarchaeological and biomolecular analyses of human remains from mass graves in particular (e.g. see Simmonds et al. 2008; Kacki et al. 2011; Feldman et al. 2016; Mordechai et al. 2019; Willmott et al. 2020). Geological and climatic events have also been studied from the point of view of sacrifice and human mortality (Toly 2005), for example in the case of Mexico (Durán 1867-1880; López Luján 1993, 2018; Guilliem Arroyo 1999; De la Cruz et al. 2008; Gerrard et al. 2020) and Peru (Prieto et al. 2019). The human remains from Pompeii and Herculaneum in Italy are also a famous example of death related to a natural disaster (Martyn et al. 2020), although at a more local rather than at a national or wider level. Yet, very little research considers how children in the past were affected by these catastrophic events, how it affected their mental and physical health, or how adults treated and cared for children, in both life and death, in response to these disasters.

The analysis of human remains to obtain data on age-at-death, biological sex, stature, and pathological conditions can shed light on mortality and morbidity in the past (Roberts 2019). Osteological research can be conducted to understand the physical health/health status of children, for instance by investigating skeletal development; whilst funerary contexts can provide evidence for the ways in which the living viewed and treated the dead. Where available, historical sources and medical records may provide a glimpse into the psychological effects of stressful events in the past (e.g. see Psota 2011; Harris 2013). Using osteoarchaeological data, historical documents, and other sources of information, this paper explores how epidemics, pandemics, and other natural disasters affected the well-being[1] of children in the past. The way in which adults treated children in life and death during such episodes is also explored through a variety of examples and three focal case studies.

[1] The United Nations Children's Fund (2007) states that there are six facets of child well-being, namely: educational well-being, health and safety, behaviors and risks, material well-being, relationships, and subjective well-being (the latter takes into account children's own sense of well-being, i.e. how they feel about health, education, and personal well-being). This definition relates to children living in the twenty-first century but many of these considerations can be applicable to children living in the past (e.g. Squires 2020). In this article, the different aspects that constitute child "well-being" are explored in variable amounts of detail in the context of catastrophic events.

At this point, it is worth acknowledging that the term "children" does not encompass the same age group in all societies (e.g. see Baxter 2008; Lewis 2009). For example, in seventh century A.D. England, a child was defined as any person under ten years of age (Squires 2019), whereas in Central Mexico during the same century, any person under twelve years of age was recognised as a child (Pérez Trejo 2016). Adulthood could also come at different ages if the individual had a business, undertook an apprenticeship, inherited land, entered the army, or got married, as in the cases of Ancient Rome (Rawson 2003), Late Antiquity (Perry 2005), or medieval England (Bailey et al. 2008). This can be problematic as it makes direct comparisons between populations difficult due to the disparate age ranges involved. Thus, given the breadth of geographical and temporal examples employed in this article, the term "child" will be used for any individual under the biological age of skeletal maturity (c. 18-20 years) or, where evidence is available, in line with what each of these populations deemed to be a child.

The Effect of Environmental Catastrophes and Epidemics on Children

Osteological, molecular, and documentary evidence have revealed that epidemics and pandemics have occurred around the world since prehistoric times (Rasmussen et al. 2015; Andam et al. 2016). The impact of these events would have affected children both in the short, medium, and long term, as observed amongst modern day populations that have experienced similar episodes (Kousky 2016; Lai and La Greca 2020).

The deaths, separation, or disappearance of parents and siblings would have impacted on any surviving children emotionally and economically, as seen in modern cases (e.g. Cas et al. 2014; Kousky 2016). In many instances it is not known what would have happened to these children, or who would have cared for them. However, there is some evidence to suggest that, on occasion, they may have received aid from charitable institutions or the Church (Fitzgerald 2016). Following the plague of A.D. 664 in Ireland, abbots took on the social responsibility of caring and feeding children that had no parents or guardians (Dooley 2007). The care of children in medieval England who became orphaned through disease or famine was orchestrated through the manorial court system (Hanawalt 1986). Any inheritance a child received, such as land or animals, could be placed at the disposal of a warden in return for providing care for the child until they came of age, although children without inheritances relied on the charity of the parish or institutions, such as hospitals, for their survival (Hanawalt 1986). The extent and duration of care provided for these children is difficult to establish, though it is likely that the degree of care varied with each unique situation and on a case-by-

case basis. Some children were taken into the households of close relatives whilst others may have experienced short-term wardships or were placed into a variety of boarding or servitude arrangements (Maddern 2010). Akin to the aforementioned abbots in seventh century Ireland, the Archbishop of Milan (Italy), Carlo Borromeo, organised aid for victims of famine and pestilence in A.D. 1578, appointing a prioress to oversee the care of children in order to create a sense of family (Snowden 2019). Neighbours came to the aid of orphaned children in Brabant (Belgium) following the death of their parents due to plague in A.D. 1631 (Curtis 2020). Local legislation required these children to enter isolation huts, however they refused, and would have been left vagrant if not for the act of mercy of their neighbours who took them in (Curtis 2020). Conversely, during the A.D. 1348 plague in Florence (Italy), historical documents indicate that parents feared the swift spread and rapid death caused by plague so much that they abandoned their children and left the urban centers for the countryside (Snowden 2019). Giovanni Boccaccio, an Italian author, who witnessed the A.D. 1348 plague in Florence wrote in his Decameron: "nay, what is more, and scarcely to be believed, fathers and mothers were found to abandon their own children, untended, unvisited, to their fate, as if they had been strangers" (Boccaccio 1348). In A.D. 1454-1457, the Gran Sequía (or 'Great Drought') resulted in food shortages and famine which affected those inhabiting Tenochtitlán (Mexico). The Dominican friar, Diego Durán who lived in the sixteenth century, recorded that King Motecuhzoma had ordered the importation of large quantities of maize from surrounding provinces that were not suffering from shortages (Durán 1867-1880). The maize was used to make tamales, which were distributed to both adults and children, though children were offered an additional large bowl of gruel (Durán 1867-1880). Many of these children were in dire need of assistance as many were abandoned by their parents who had left the city of Tenochtitlán when circumstances became much graver.

The loss of a mother would have been particularly detrimental to juvenile health if the child was breast feeding and the mother passed away, especially where there was no wet nurse to care for the baby (Reid 2005). In the present day, mothers who were suspected of having Covid-19 have been routinely separated from their new-born babies in some countries (World Health Organization 2021c). However, the lack of skin-to-skin contact and breast feeding has been found to be a greater risk of mortality for pre-terms and babies born with a low birth weight, than the risks associated with Covid-19 (Minckas et al. 2021). In the most severe of cases, children who lost their parents in the past also perished. For example, during the A.D. 1780-1789 epidemics in the Baja California Missions (USA), following an outbreak of smallpox at

the San Vicente mission, children were abandoned as their parents had died. These children were unable to care for themselves, there was no one to look after them, and they ultimately perished (Jackson 1981). The response to caring for children during periods of disease or following a natural disaster is variable and dependent on several factors. On the one hand, if adults were unable to support additional children during such episodes, they would be less likely to adopt an orphan. On the other hand, individuals belonging to religious institutions may have had social responsibilities to care for orphans and those in need (e.g. Dooley 2007; Fitzgerald 2016).

Violence towards children, such as infanticide or the unlawful killing of young children, has taken place during times of crisis throughout the past. In China, for example, during the 1935 Yellow River flood, mortality rates of refugee groups suggest that female infanticide may have been practiced (Li 1991). The sacrifice of children to appease deities when faced with crisis events has been observed in a number of societies (Andrushko et al. 2011; Domenici 2014; Killian Galván et al. 2020); and yet the debate around child sacrifice in certain contexts is still very much active as it is difficult to identify this practice both archaeologically and anthropologically (e.g. see the case of the Punic Tophet) (Schwartz et al. 2010, 2017; Xella et al. 2013). Excavations at the Peruvian site of Huanchaquito-Las Llamas has provided evidence for the sacrifice of 140 children and 200 camelids in a single event in c. 1450 A.D. (Prieto et al. 2019). Although the reasons for these mass killings is still debatable, one plausible hypothesis is that they were linked to a climatic event (e.g. extreme rainfall and floods) that had devastating effects on the community. A number of sites in Mexico, such as Templo Mayor in Mexico City (López Luján 1993, 2018) and Tlatelolco (Guilliem Arroyo 1999; De la Cruz et al. 2008), have revealed a number of graves related to human sacrifice, several of which contained the remains of children. These sites and the gods they venerated were related to water, rain, or the wind (Piña Chan 1991; Guilliem Arroyo 1999; Sahagún 2011; López Luján 2018). Thus, it has been interpreted that some of the child sacrifices may be related to the drought of A.D. 1454 which lasted for three years (Gill 2000). It is thought that the forty-one children found at Templo Mayor and thirty-seven at the site of Tlatelolco, may be linked to a request to the rain god, Tlaloc, for the long-awaited rain (Pérez Trejo 2020). These examples have shown that in several cases, natural disasters, epidemics, and pandemics prompted extreme reactions towards children, which resulted in the creation of unique burial contexts. Even today, some disasters, such as tsunamis, are seen as a Divine message and some of these cultural beliefs have impacts on the welfare of children (e.g. see Fanany and Fanany 2013).

Case Study 1: England's Final Famine

Between A.D. 1622-1624, northwest England, specifically Cumberland, Lancashire, and Westmorland, experienced severe famine due to poor harvests, high grain prices, and periods of economic depression within the textile industry (Appleby 1973; Laslett 2001; Healey 2015). The difficulty in estimating mortality rates from this historical event can be attributed to the absence of osteological and census data; instead, parish registers are used. Contemporary burial records do not provide age-at-death; this demographic attribute is thus estimated by means of cross-examining baptism and death records to provide an insight into child mortality rates (Healy 2015). Whilst the total number of individuals (or children) who died during this famine is unknown, it has been estimated that the famine killed around five percent of the population of Lancashire (Rodgers 1975). Penrith (Cumberland, now Cumbria) was badly affected as the average annual mortality rate during this catastrophe was five times greater than that of a non-famine year (Appleby 1980). A closer examination of the mortality rates of children from Penrith show increased mortality rates of one-year-olds and six- to fifteen-year-olds in 1622, the year after shortages commenced (**Figure 1**). Infant mortality rates peaked in 1623 which can be attributed to worsening shortages. Subsequently, mortality rates of the two youngest age groups fall, though the contrary is found for the two- to five-year-olds and six- to fifteen-year-olds which increases between 1623-1626, and 1627-1628. Scott et al. (1995) noted that elevated infant mortality (zero- to twelve-months-old) at Penrith was linked to maternal health and poor nutritional status of the mother during pregnancy (an observation also made by Geber (2016) when discussing the Great Irish Famine); while increased mortality of individuals over the age of one-year-old was the result of food supply shortages, affecting both weaning and lactation. The mortality peaks of the two youngest groupings quickly returned to pre-famine levels, possibly due to improved maternal nutrition and health, and preferential access to food during weaning. In contrast, the mortality rates of individuals over two-years-old increased in A.D. 1623. Here, older children may not have been offered the nutrition needed to sustain themselves during a period of stress. Prolonged undernutrition not only affects general health (e.g. metabolic conditions may emerge) and development, but increases an individual's susceptibility to infectious conditions (e.g. smallpox and influenza) which have implications on their survival (Morgan 2013).

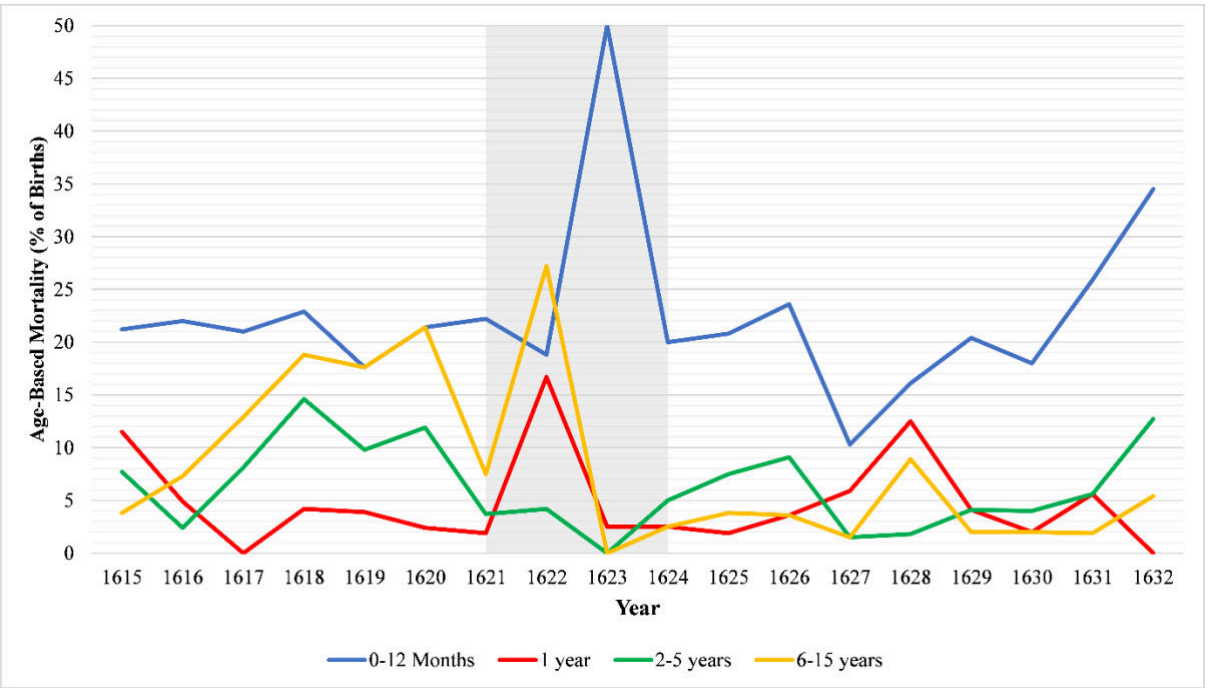

Figure 1: Line graph depicting age-based mortality for individuals born between A.D. 1615-1632 from Penrith, England. The grey area highlights the beginning of food shortages (1621) through to the end of the famine (1624) (source of data: Scott et al. 1995; Figure by Kirsty Squires).

Appleby (1973) suggests the increased mortality of children can be attributed to their inability to support and feed themselves during crisis episodes. The Poor Relief Act was passed in A.D. 1601. This legislation required the churchwarden of each parish to collect poor rates from the wealthy and redistribute this income to the needy, including children. However, an examination of the data presented here does not suggest this was particularly effective or enacted given the high mortality rates amongst children. This could potentially indicate a shift in attitudes towards the youngest members of society during crises. Unlike the medieval period, where there is some evidence to suggest that the church offered aid and care to destitute children (e.g. see Orme 2001), this was not the case in the present example. In part, this is the outcome of the Reformation whereby monastic institutions that offered alms closed, charity became more secular (e.g. introduction of Poor Law legislation), and perceptions of the poor changed, particularly amongst Puritans (Dubois 1988). The failure of the State to support children may have contributed to a high mortality rate amongst this section of the population. That being said, given the dire situation in northwest England during this period, it is probable that there was no aid left to offer in individual parishes due to the severity of food shortages in the region.

Temporary and Permanent Migration

Evidence for the movement and migration of children following catastrophic incidents have been reported from numerous historical contexts, many of which are evident in the archaeological record. Whilst many studies have focused on the reasons for migration in archaeology (Burmeister 2000; Van Dommelen 2014; Ames 2020; McSparron et al. 2020), the impact of child migration is often overlooked. During epidemics and, indeed, periods of war, children are frequently moved away from immediate sources of danger. For example, during the medieval period, children were temporarily sent away from their homes or schools to avoid plague outbreaks (Orme 2001). Colleges, such as those within the University of Oxford, would move their students to rural manors and families would send their children to relatives in parts of the country which were free of plague (Orme 2001). This enabled some children, predominantly those from wealthier families, to survive episodes of the epidemic. More recently, in times of conflict, children fled from their home country, for example during the Spanish Civil War (A.D. 1936-1939), thousands of children were sent on ships to Northern Europe and Mexico (Jump 2007).

Whilst some children moved back to their family unit or home following a crisis event, others faced a much bleaker fate. In the year following the Great Drought that affected households throughout Tenochtitlan (Mexico), all food reserves held in the royal storehouses had emptied. Families moved out of the city to towns inhabited by wealthier individuals. Sons and daughters were sold to noblemen and merchants in exchange for small containers of maize (Durán 1867-1880). Those who bought these children were responsible for their care; although some became slaves. The only way these children could be reunited with their families was if their parents could ransom their children after raising sufficient foodstuffs (Durán 1867-1880). Yet, regardless of the reasons for temporary or permanent migration, the impact of moving under these circumstances would have been stressful to children (e.g. Ataullahjan et al. 2020).

Contemporary studies have shown that children entering the care of strangers or extended kin they are not familiar with, as a result of crisis episodes, can find it difficult to readjust to their new surroundings (Young and Ansell 2003; Mathambo and Gibbs 2009). Such research has highlighted that these children can struggle to form new relationships, and the solace they once found within their friendship group is no longer available (Young and Ansell 2003; Mathambo and Gibbs 2009). In the present day, children manage their experiences of living through catastrophes in diverse ways, including play, education, and personal care (e.g. Mathambo and Gibbs 2009; Chatterjee 2018; Hunleth 2019). Children in the past are likely to have experienced

similar difficulties during crises and may have developed coping strategies to deal with the circumstances in which they found themselves, either alone or with other children. Indeed, coping strategies in the past show similarities to those noted in modern crises, particularly the use of play and recreational activities. During the Black Death (A.D. 1346-1352), for instance, one method of making sense of their experiences, was for children to create games and rhymes (Cantor 2001). Cantor (2001) suggests that the creation of rhymes, such as 'Ring Around the Rosie', was a result of children attempting to cope with their anxieties and fear of the Black Death. In other cases, particularly when dealing with natural disasters, distractions helped children when faced with extreme adversities. The Donner Party, which comprised a group of pioneers, experienced famine whilst travelling in a wagon caravan from Missouri to California (USA) in A.D. 1846-1847. In 1846, the party split in two and one group set up camp at Alder Creek. Individuals were stranded and starving at this site, and to pass the time children brushed their hair and were told Bible stories (Dixon et al. 2010). These minor activities would have resulted in short term distractions from the lack of food and the dire circumstances they faced.

Akin to the past, modern-day epidemics, pandemics, and natural disasters have shown that when crisis episodes occur, households can become displaced, which forces them to relocate, either temporarily or permanently (Booysen 2006; Dun 2011; Wilson et al. 2016). This is also true of war and conflict zones or when there is displacement due to political instability, violence, famine, and poverty. These migrants move to make a better life for themselves and their family (Donato and Perez 2017; Attinà 2018). Torrence and Grattan (2002) have noted that populations living in areas frequently hit by disasters may leave while others stay; this is largely attributable to the vulnerability of a group and their connection to the area in which they live. In some cases, children migrate alone without any adult supervision. The reasons for this can be far-reaching. Children may be required to work while other members of the household are unwell as a result of an epidemic or pandemic (Young and Ansell 2003), to care for sick relatives (Young and Ansell 2003), or have become orphaned due to a health condition or disease in which relatives are reluctant or not capable of supporting them (Evans 2005). In such instances, these children may rely on protection, shelter, and care from external organisations (Dun 2011) or members of their extended kin network (Mathambo and Gibbs 2009). However, in some cases these networks might not be available to children. In such instances, juveniles are vulnerable to potential violence, abuse, and neglect (e.g. Magqibelo et al. 2016; Digidiki and Bhabha 2018; Amnesty International 2021; Moayad et al. 2021). Furthermore, migration, be it accompanied or unaccompanied, from rural environments to

urban centres create physiological and mental stress, which ultimately have an impact on child survival (Brockerhoff 1994).

Case Study 2: The Spanish Civil War

The Spanish Civil War (A.D. 1936-1939) was the result of a military coup which led to a three year war between Nationalists and Republican force, which ultimately culminated in the Nationalist faction taking power in 1939. During this period, non-adult mortality rates increased, and in the spring of 1937 the first organised mass evacuations of children took place, with the aim of protecting them from the ongoing war (Gil Alonso and García Soler 2009: Save the Children 2019). It has been estimated that more than 33,000 children were sent to countries around the world, including Britain, France, Belgium, Australia, Mexico, and the USSR (Ramírez 2021). In the majority of cases, children were cared for by guardians they had never met before, for example being transported to holding centres (or colonies) specifically set up to care for children, or entered private foster care. This coupled with the trauma of leaving their families and experiences of war, of losing relatives who died as a result of executions or combat, and the lack of care led to physical and mental conditions. This is exemplified by a case in which eight groups of children were transported to a holding centre in Biarritz (France), whereby children had spent six months without washing and sleeping in whatever shelter was available (Damousi 2021). These children were not only physically affected (e.g. many were covered in scabies and suffered from bronchial coughs), but were nervous and unaccustomed to affection, struggled to communicate with their guardians, and became upset when asked about their background (Damousi 2021). In other cases, children had a positive experience, particularly of children placed in private foster homes. For example, some children that were fostered by families in France recalled how kind their guardians were and how foster parents treated them like their own children (Zahra 2011). Ultimately, it was hoped that following the war, these children would return to their families in Spain. However, this was not always the case. In some instances, children could not remember their birth name and family details, thus making it difficult to locate their parents, or their families had died, were missing, or imprisoned (Zahra 2011), while others were successfully repatriated but found it difficult to settle. In these instances, children returned to the countries that accepted them during the war or moved to a different country (Ramírez 2021).

While some children were able to escape the war, others remained in Spain with their families. Many of these children faced hardship; in particular the lack of food led to malnutrition and

unsanitary living conditions that resulted in various diseases (Asociación Española de Pediatría 2015; Tuneu et al. 2015; Ramírez 2021). In some instances, non-adults (in particular adolescents) were executed (Comes and Centeno 2011; Save the Children 2019). It has been estimated that there was an excess mortality of 138,000 children during this period as a result of the war (Salas Larrazábal 1977; Ramírez 2021). This is somewhat reflected in the mortality profiles observed between 1936-1940. Mortality rates among infants and children had started to decline following the Spanish Flu Pandemic (A.D. 1918-1920). However, an examination of mortality rates of individuals under five years of age shows an increased mortality rate during wartime years, which declines again following the end of the war (**Figure 2**). It is interesting to note that while there was an increase in infant mortality (0-12 months) during this period, there continued to be a decline in childhood mortality (1-4 years), though this had slowed down compared to previous years. Increased rates of infant mortality have been attributed to environmental and living conditions (Gamella and Carrasco-Muñoz 2017). Disease, lack of care (attention was diverted to the wounded), limited availability of food, and poor maternal health have been identified as contributing factors of stunted growth and illnesses in adulthood, as well as increased mortality rates (González Zapata et al. 2006; Gil Alonso and García Soler 2009; Asociación Española de Pediatría 2015; Puche et al. 2016). It is noteworthy that similar patterns have been found for children living during the Second World War (A.D. 1939-1945) (Daniele and Ghezzi 2019).

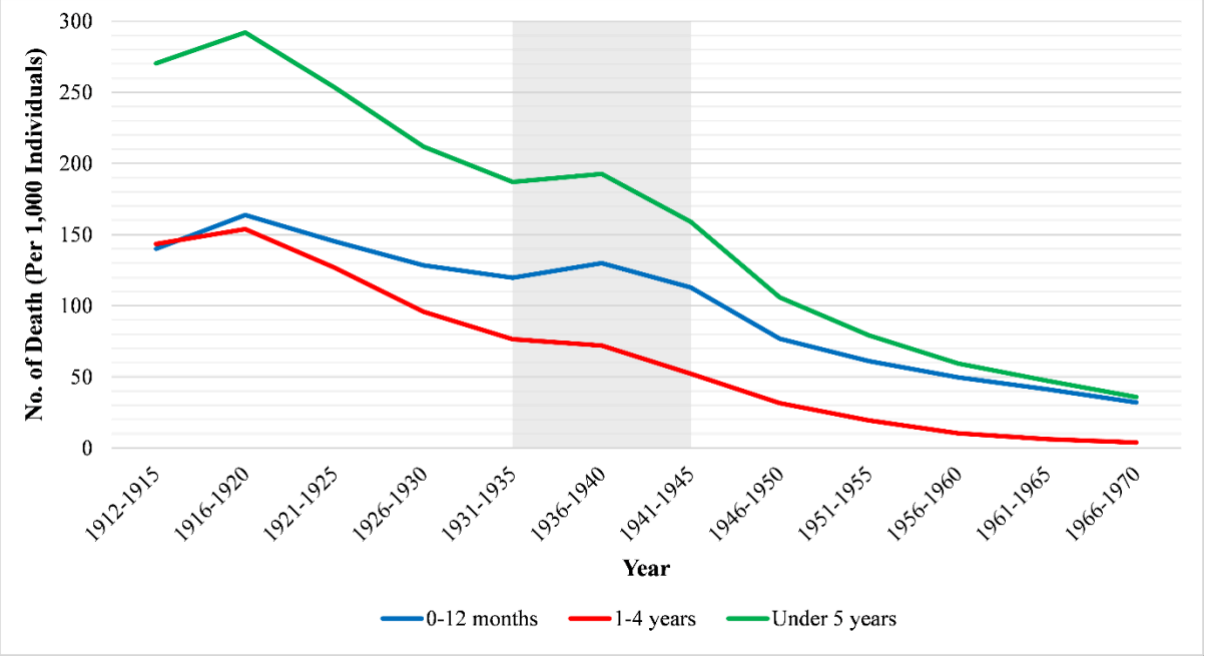

Figure 2: Line graph depicting mortality rates of infants (0-12 months), children (1-4 years), and both groups combined (under 5 years). The grey area highlights the period before and after the Spanish Civil War (A.D. 1936-1939) (source of data: Gamella and Carrasco-Muñoz 2017; Figure by Kirsty Squires).

Child Health and Mortality During Environmental Catastrophes

It is widely acknowledged that malnutrition, physical labour, socioeconomic status, biological sex and gender, and environmental pressures can result in stunted growth and delayed development (Waterlow 1988; Ulijaszek 2010; Horrell and Oxley 2016; Mays 2018); although the degree of influence by some of these factors is somewhat debatable (see Scheffler et al. 2020). As outlined in the introduction of this article, children living in areas that experience repeated floods, monsoons, and droughts are more susceptible to stunting than their counterparts inhabiting areas that are not affected by natural disasters (e.g. Cooper et al. 2019; Dimitrova and Muttarak 2020). The effect of famine was observed in children under the age of five years old living in rural China during the Great Chinese Famine (A.D. 1959-1961) (Morgan 2007). Gørgens et al. (2012) estimated that these children were 1–2 cm shorter than the "pre-famine" and "post-famine" control samples. Similar observations have been made from archaeological contexts with high child mortality and population migration, as in the case of the Irish potato famine between A.D. 1845 and 1852 (Geber 2015).

Alongside stunted growth and arrested development, the effects of epidemics, pandemics, and natural disasters can result in chronic health conditions, such as a number of metabolic conditions and infectious diseases, and high child mortality (e.g. Humphrey and King 2000; Mummert et al. 2011; DeWitte and Hughes-Morey 2012; Geber 2015; Brzobohatá et al. 2019). Foetuses and perinates uncovered from several mass graves, dating to the A.D. 13th-15th century, from St. Jakob in Tartu (Estonia) exhibited metabolic-related skeletal lesions, including rickets and scurvy, and infections; these are indicative of long-term malnutrition of their mothers (Morrone et al. 2021). Morrone et al. (2021) suggest that poor nutrition and the high number of perinatal deaths was the result of epidemics, political instability (whereby crops were damaged), and famines (e.g. see also Brzobohatá et al. 2019). Furthermore, medieval manorial accounts and recent osteological studies have demonstrated how The Great Famine (A.D. 1315-1317) and the subsequent Great Bovine Pestilence (A.D. 1319-1320) resulted in malnutrition of children growing up during those years in England (DeWitte and Slavin 2013). This is likely to have made individuals more susceptible to disease and increased their risk of

death during the Black Death outbreak (DeWitte and Slavin 2013). There are a number of possible reasons for this. After the age of five years, juveniles typically started to contribute more to family activities and chores, which may have exposed them to greater risks of catching infections due to increased interaction with others outside their household, as they were lacking the developed immune system of adults (Bing and McNeal 1997). Adolescents may also have been at greater risk of infection due to stresses of work activities, such as those involved in craft industries, for instance apprentice weavers, carpenters, or smiths, and roles often associated with lower socio-economic status (Watts 2015; Lewis 2016). From the age of twelve years old, adolescents would have taken on more work duties on behalf of their family, or would have migrated to urban areas to find menial work or placements as apprentices which would have increased their exposure to the risks of new urban environments and diseases (Orme 2001; Lewis 2016). In their study of the East Smithfield Black Death cemetery in London, Margerison and Knüsel (2002) reported a lower proportion of children under five years-of-age (14%) than expected, and a higher proportion of juveniles, five to fifteen years-of-age (23%), indicating older children in this sample were at greater risk of death due to plague in the urban centre of London. This finding is supported by Kacki's (2021) research on forty cemeteries in Western Europe associated with the Black Death and later plagues during the A.D. 14th-18th centuries. The demographics consistently revealed low proportions of children under five years-of-age, and a high frequency of juveniles, aged five to fourteen years old, and adolescents demonstrating these age groups were at particular risk (Kacki 2021). These findings are further supported by modern paediatric research which emphasises the need for emergency preparedness for paediatric casualties in disasters (Lozon and Bradin 2018). This is essential, as it has been highlighted that children are especially vulnerable during disasters due to their anatomy (e.g. smaller size makes them more predisposed to hypovolemic shock), physiology (e.g. higher respiratory frequency makes children more susceptible to the inhalation of noxious gases and toxins), and mental differences to adults (e.g. children are dependent on adults for safety, protection, shelter, and sustenance) (Parra Cotanda and Luaces Cubells 2010).

The mortuary rites afforded to children who died as a result of epidemics, pandemics, and environmental catastrophes is highly dependent too on the ideological beliefs of the living, and available resources (e.g. space for burial, labour, and time to dig graves). Where present day mass incidents receive the assistance of large international organisations, such as the International Commission of the Red Cross (ICRC), standardised protocols are followed which adhere to the culture and ideological beliefs of the living (e.g. Perera and Briggs 2008;

Ellingham et al. 2017; ICRC 2020a, 2020b). These guidelines particularly focus upon the management and burial of the dead (see e.g. Perera and Briggs 2008). In such documents there is no explicit reference to the differential treatment of children and as such, juveniles are to be treated akin to adults. The similar funerary treatment of children and adults was also seen in the past, whether in Roman times (Simmonds et al. 2008), during medieval European epidemics (Brzobohatá et al. 2019), or times of famine in the 19th century (Geber 2015). The Black Death plague of A.D. 1346-1352 resulted, proportionately, in a higher level of mortality than any other mass catastrophe (Green 2015) killing an estimated 30%-60% of the European population (DeWitte 2010; Kacki 2021). To effectively manage the burial of the dead, mass burial pits were utilised in existing cemeteries, and new cemeteries were created (Kacki 2021). However, other than the necessitated use of mass graves, burial practices remained consistent with the Christian practices of the time with both adults and children wrapped in shrouds prior to burial and placed supine, in an east-west orientation (Kacki 2021).

Case Study 3: Eyam, the Last English Plague

The Derbyshire village of Eyam experienced an outbreak of plague from September A.D. 1665 to October 1666 (Race 1995). Following the identification of plague, a decision was made, debatably by the villagers themselves or due to the influence of the Earl of Devonshire, to quarantine the village, effectively creating a closed community (Race 1995; Whittles and Didelot 2016). Prior to the plague, the population of Eyam was estimated to be between 700 and 1,000 people (Bradley 1977; Whittles and Didelot 2016). During the 14 months in which the plague took hold of the village, the deaths of 257 (26%-37%) village inhabitants were recorded in the parish registers (Clifford and Clifford 1993). Based on Bradley's (1977) method of detracting the date of baptism from the date of burial recorded in the parish registers, the numbers of non-adults who died during the plague and their age at death was established.

Figure 3 illustrates that a relatively consistent rate of mortality was found for 0-1 year olds throughout the A.D. 1660s. Although mortality increased during the plague years for 1.1-5 and 6-12 year olds, the greatest rise in mortality occurred among the 13-18 year olds. The higher rate of death for 6-18 year olds at Eyam corresponds with the demographic trends from Western European cemeteries dating to the A.D. 14th-18th century, as discussed above. However, Slack (1990) has argued that there was a lower number of births during the plague and asserts that, whilst the number of deaths per age group was higher in adolescents, the proportional mortality rate for infants only appears to be smaller because there were fewer of them than in non-plague

years (Slack 1990). This argument illustrates the complexities of understanding the impact of plagues on childhood mortality within the context of fluctuating population dynamics. Mortality rates returned to pre-plague norms in the years immediately following the end of the epidemic. It is worth highlighting that children from 34 households lost one parent during the outbreak and children from a further 20 families were left orphaned by the plague (Bradley 1977). Later parish registers indicate that extended family members moved into the parish after the plague had passed (Bradley 1977). It is therefore possible that relatives or guardians took care of these orphans, though this information was not recorded.

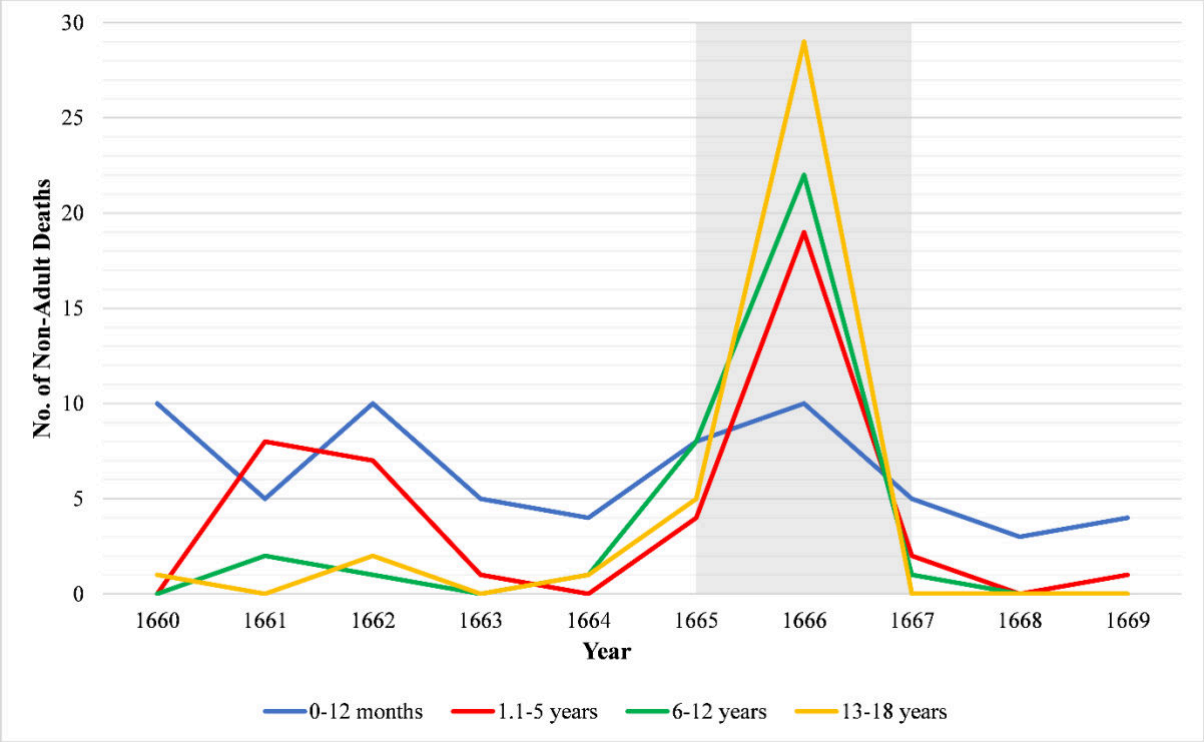

Figure 3: Line graph depicting age at death of non-adults from Eyam, Derbyshire, in the 1660s (source of data: Clifford and Clifford 1993. Figure by Esme Hookway).

Summary

Through the literature, this paper aimed to explore how epidemics, pandemics, and natural disasters affected the health and treatment of children in the past. It is clear that different societies responded to crises differently. Responses were largely based on available resources, ideological beliefs, and social and political structures at any one time, which resonates with the present day. Regardless, children would have been impacted in some way, whether this was a

change to household structure and personal relationships, or moving away from their loved ones. Not only are social relationships tested, but the mental and physical health and, indeed, the survival of children were affected by crises; those that survived may have developed lasting health issues leading into adulthood. The wide range of examples and focal case studies in this review article have also demonstrated how bioarchaeological and historical studies can be used to better understand contemporary issues. This is particularly pertinent at the time of writing, not only because of the impact Covid-19 has had on children around the world today, but also because of other crises that have taken place, including epidemics (e.g. United Nations Children's Fund 2021a), natural disasters (e.g. United Nations Children's Fund 2021b), and the withdrawal of U.S. and British soldiers from Afghanistan (United Nations High Commissioner for Refugees 2021). By examining how children and, indeed, their parents/carers reacted to catastrophic events in the past, we can better understand how children responded to these challenges, and what we can do to protect the most vulnerable that are enduring similar experiences in the present day. The authors felt this review was much needed as the way in which children coped in challenging environs is a much-understudied area within archaeology. There is great potential for further research exploring social relationships, child migration, and children's resilience and coping mechanisms to epidemics, pandemics, and natural disasters in the past, and how this can further our present-day understanding of the health and treatment of children during times of crisis.

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Don´t forget the children! a review of the consequences of natural disasters and epidemics on childhood health and mortality in the past

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