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Childcare and Development of Paediatrics in Moravia (Czech Republic) in the Context of Palaeopathological Research Focusing on Congenital Malformations, Metabolic and Haematologic Diseases

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PÉČE O DĚTI A VÝVOJ PEDIATRIE NA MORAVĚ (ČESKÁ REPUBLIKA) V KONTEXTU PALEOPATOLOGICKÝCH VÝZKUMŮ SE ZAMĚŘENÍM NA VROZENÉ MALFORMACE, METABOLICKÁ A HEMATOLOGICKÁ ONEMOCNĚNÍ

ABSTRAKT Prezentovaná práce je součástí komplexní studie zaměřené na sledování původu a vývoje pediatrické péče na Moravě, jedné ze zemí dřívější Rakouské monarchie. Studie také bere v potaz sociální podmínky jako změny moravského zdravotnictví ve studovaném období v souvislosti s tereziánskými a josefínskými reformami. Novorozenecká úmrtnost byla v té době velmi vysoká, což souviselo i s nedostatkem péče o těhotné ženy. Studie sleduje zdravotní stav a příčiny úmrtí dětí od 13. do 19. století, na základě studia dostupných literárních zdrojů v kontextu paleopatologické analýzy dětských kosterních pozůstatků. Analýza koster dospělých jedinců sledované populace poskytuje důkaz vysoké úmrtnosti žen ve věku 20–30 let. Pozornost byla zaměřena na vrozené malformace, metabolická a hematologická onemocnění. Z vrozených malformací potvrdila paleopatologická analýza u dětské populace vývojovou dysplázii kyčelního kloubu a předčasnou obliteraci lebečních švů. Z hematologických a metabolických chorob byla nejčastěji zaznamenány známky anemie ve formě *cribra orbitalia* a stopy po kurdějích a křivici. Tyto choroby se nejčastěji vyskytovaly u dětí v chudobincích a sirotčincích. Podle literárních zdrojů jejich výskyt významně vzrůstal v závislosti na válečných událostech provázených hladomorem. Výsledky studie poskytují přímý důkaz výskytu sledovaných dětských nemocí na Moravě v období novověku.

KLÍČOVÁ SLOVA rakouská monarchie; vývoj pediatrie; péče o děti; Morava; vrozené malformace; metabolické choroby; hematologické choroby

ABSTRACT The presented study is a part of a complex study focused on monitoring the origin and development of paediatric care in Moravia, one of the countries of the former Austrian monarchy. The work also takes into account the social conditions, as changes in the Moravian healthcare sector occurred in the period under review in connection with the Theresian and Josephine reforms. Neonatal mortality was very high at the time, including, among other things, the lack of care for mothers-to-be. The study observes the state of health and the causes of paediatric mortality from the 13th to the 19th centuries, on the basis of the study of available literary sources within the context of palaeopathological analyses of children's skeletal remains. The analysis of adult skeletons of the study population provides evidence of high female mortality between 20-30 years of age. The attention was focused on congenital malformations, metabolic and hematogenic diseases. From congenital malformations, palaeopathological analysis confirmed the developmental dysplasia of the hip and the premature obliteration of cranial sutures in the examined child population. From the haematologic and metabolic diseases, the manifestations of *anemia* in the form of *cribra orbitalia*, signs of scurvy and rickets were most frequently reported. These diseases were reported mainly in children in foundling homes and orphanages. According to literary sources, their numbers grew significantly in connection with famine-related war incidents. Therefore, the results of the study provide direct evidence of the occurrence of observed childhood illnesses in Moravia during the period of modern times.

KEY WORDS the Austrian monarchy; development of paediatrics; child care; Moravia; congenital malformations; metabolic diseases; hematologic diseases

INTRODUCTION

The paediatric population represents an important part of each society. At the same time, however, it is society's most vulnerable group, because at the time of birth an infant is still psychomotorically immature and fully dependent on the care of others. The health status of children is therefore affected much more by social conditions than in adulthood. In the period of growth, the body experiences a number of significant changes, so children respond to the effects of pathogenic factors in a different way from adults. As a result, a separate medical field – Paediatrics – was set up in the 18th century. Modern Obstetrics came into being to provide care for women during pregnancy and childbirth. A number of authors have addressed the issue of childhood diseases in the Czech Lands and their treatment in the past. For example, the development of Obstetrics is described by Doležal et al. (2009), the history of Nursing by Tručková & Brabcová (2016), the history of children's treatment facilities by Čejka (2002a), childhood diseases by Brabcová (2002) and the history of paediatrics by Houštěk & Kubát (1982). However, a comprehensive study is still lacking. The presented study attempts to add some missing historical data from Moravia. It includes knowledge gained from the study of contemporary literary and iconographic sources and, at the same time, describes the direct palaeopathological findings of morbid changes in children's skeletons from archaeological researches in various modern-day localities.

HISTORICAL CONTEXT

After the death of the Bohemian and Hungarian King Louis Jagiellon in 1526, the Habsburgs acceded to the Bohemian throne. The Czech Lands then became part of the personal union under the Austrian branch of the Habsburg dynasty. In 1804, this unnamed state unit was officially named the Austrian Empire, later transformed into a union of two states with the designation of Austria-Hungary (Evans 2003). Many military conflicts significantly weakened the monarchy and caused considerable delay to Central European powers in the economic development of Western Europe. The only way out of the unfavourable situation was the realisation of significant changes in the economic, political, social, scientific and cultural spheres, which advanced the monarchy to among the more developed European states. This impossible task was taken on by Empress Maria Theresa (* 1717– † 1780) and continued by her son, Emperor Joseph II (* 1741– † 1790).

Moravia, as one of the crown countries of the Habsburg monarchy, was a separate administrative unit – administered by a Margrave. This establishment was preserved until 1918, when it became part of the independent state of Czechoslovakia. The Moravian metropolis at that time was the city of Brno which, under the reforms of Maria Theresa, recorded a significant economic boom in the second half of the 18th century. Therefore, in a short time, the Brno economy was transformed into the factory period thanks to the development of the textile industry. Brno became one of the most industrialised cities of the Habsburg monarchy and was referred to as the "Austrian or Central European Manchester". People living in nearby towns came to Brno to earn their livelihood and the number of inhabitants in Brno doubled over 50 years (from less than 50 000 inhabitants in 1850, the population increased to 100 000 in 1900).

As in other large industrial centres, a huge increase in the urban population caused complications in the social and health spheres. A typical feature of this period is the emergence of numerous Brno industrial suburbs, where the vast majority of poor workers lived under unfavourable hygienic conditions. There was, therefore, a considerable disproportion between the quality of living and the life of poor suburban workers and wealthy burghers residing in burgher houses. From a political point of view, the conditions in Moravia were mainly influenced by the Napoleonic Wars (the Battle of Austerlitz in 1805, the Battle of Wagram and Znojmo in 1809, The Vienna Congress, the Revolutionary Movement in Some Parts of the Monarchy and Metternich's Absolutism.

The reforms of Maria Theresa and then of Josef II were crucial for the development of Medicine in the Czech Lands. The General Health Regulations *(General–Medicinal Ordnung)* served from 1753 to ensure quality healthcare, which would operate in the whole empire on a unified principle. This order officially established the exact classification of health workers, their rights and obligations. In the Moravian environment, in the first period of validity of the new legal system, it was very difficult to adhere to the exact qualification requirements for the running of medical practices, because most of the requirements at that time were met only by doctors, who were university graduates. Due to the lack of educational medical facilities, the competence of lower health professionals, especially midwives, was often inadequate. In the subsequent period, the healthcare situation gradually improved.

During the 19th century, the original orders of Maria Theresa were amended by a number of Reich Laws. The most important of these was the *Reich Health Act* of 1870, which created the conditions for the formation of a nationwide public health network, which was maintained with minor modifications until 1950 (Vargová et al. 2010).

THE HISTORY OF CHILDCARE IN MORAVIA BASED ON ICONOGRAPHIC AND LITERARY SOURCES

In the old medical records, the number of reports on childhood specificities was generally insufficient, and the medical knowledge of childhood illnesses did not even reach the same level as that of the adult population. Even at the beginning of the modern era, professional healthcare in the Moravian countryside was practically inaccessible, and only rich burghers could afford it in the cities. Children from poor working-class suburban districts were reliant on local home care. This was inadequate, as can be seen, for example, in a home

treatment tract from the end of the 19th century (Vykoukal 1894). The least care was given to abandoned and orphaned children, whose number continually increased as a result of war events and natural disasters. Foundling homes and orphanages were established for these children, but they were more social and humanitarian facilities, where children suffered from malnutrition and infectious diseases. There was a high mortality rate in these institutions.

Foundling homes and orphanages were founded in Moravia, especially under the reign of Maria Theresa, who sought to establish homes for poor children, known as "*Arme Kinder Haüser*". The orphanage in Vienna, founded by the Empress in 1742 (Obršlík 1975), was used as a model.

Efforts to establish a genuine therapeutic institution exclusively for children and young people in Moravia date back to the Middle Ages. In 1471 at the parish school of St. Jacob, a hospital for sick pupils (Čejka 2002a) was founded, which did not differ from similar medieval hospitals. It was a small facility with insufficiently qualified staff and provided patients with asylum rather than medical treatment.

Emperor Joseph II abolished similar existing non-conforming facilities and established new regular hospitals in all major cities of the Austrian Habsburg hereditary lands, including Brno. In 1786, the United Imperial Royal General Assistance Institute for the Poor was established, with a branch in Olomouc, but there was no children's ward. If necessary, older children were hospitalised together with adults, while younger children were not accepted at all.

Brno doctor Karel Arnošt Rincolini (* 1786– † 1867) attempted to solve the unfortunate situation regarding the care of the youngest. In 1809, he founded a private institution in Brünn for sick children under the age of 7 years, called *Privat – Kinderkrankenarmenanstalt*. This facility provided free care to children from poor families. The running of this facility was covered by voluntary donations from more solvent citizens. Despite this support, however, the Rincolini Institute only operated for less than four years, although it was the first truly therapeutic paediatric institution in Moravia (Čejka 2002b).

The Children's Hospital of St. Cyril and Methodius was opened only in the autumn of 1846 in Cemetery Street, Brno. It provided free out-patient and in-patient medical treatment to the children of poor parents, without distinction of nationality or religion. Initially, the hospital had 28 beds, and an average of 100–120 children between one and twelve years of age were hospitalised there per year. The money needed for its running was paid to the Children's Hospital by subsidies, bequests, financial and material donations of all kinds. Most often, medical treatment was sought for diarrhoeal diseases and eye diseases, and then in order of frequency, for black cough, rickets, scrofula, scarlatina and cholera. Paediatric mortality was relatively high in the Hospital, ranging from 10–15 %. One of the causes of the high mortality were the large deficits in hygiene, which nevertheless could not be eliminated without sufficient funds.

A slight improvement of conditions occurred in 1889–1891, when the Hospital was rebuilt and extended, but not even these measures were sufficient. That is why the "Children's Hospital of Emperor Franz Joseph I" was built in Černá Pole, Brno to care for children from infancy up to 14 years of age (Mazal 1953). In this modern hospital, internal, infant, infectious and surgical departments were established. Throughout its existence (to the present time), this hospital has provided high quality healthcare to children, regardless of various changes in the political circumstances (1918 – origin of Czechoslovakia; 1939–1935 German occupation – *Protektorat Böhmen und Mähren*; 1993 – formation of the independent Czech Republic).

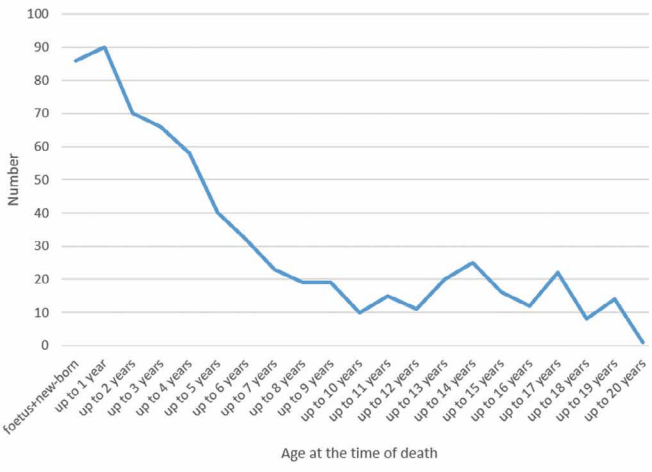
DIRECT PALAEOPATHOLOGICAL EVIDENCE OF THE OCCURRENCE OF CHILDHOOD DISEASES IN MORAVIA

The findings of pathological changes in skeletal remains from archaeological research provide direct evidence of childhood diseases.

MATERIALS AND METHOD

At the Department of Medical Anthropology of the Anatomical Institute of the Faculty of Medicine of Masaryk University in Brno, skeletal collections from four different Moravian archaeological sites have been studied in recent years (for age distribution, see Graph 1).

The oldest osteological collection originated in Brno from the Anenské Terasy site (hereinafter referred to as AT). On this site, from the 13th to the 17th centuries, a church was situated, around which there was a cemetery. It can therefore be assumed that the urban Brno population as well as inhabitants from nearby villages were buried in the cemetery, even from the period before the emergence of the textile factories. In the 2003 archaeological rescue research, a total of 132 graves were uncovered from this cemetery and several bones were collected from the grave fill. The skeletal remains were surveyed



Graph 1 An overview of the age at the time of death of the studied individuals

of a total of 267 individuals, including 125 adults (57 males, 53 females and 15 skeletons of undefined sex), and 121 children (16 premature or new-born infants, 62 children in the age category infans I, 43 children in the age category infans II) and 21 juvenile individuals (age category juvenis). However, most of the children's skeletal remains were preserved only in fragments. Severely damaged skeletons and isolated bones originated mainly from burial pits with several individuals and from grave fills (Vargová & Horáčková 2011).

Other skeletal remains were from Veselí nad Moravou (hereinafter referred to as V) and were dated between the 16th and the first half of the 17th century. In the past, small handcrafts and fish farming prevailed in the city. The rescue archaeological research revealed already partially destroyed graves with the skeletal remains of 185 individuals, of which 98 skeletons belonged to adults (50 males, 40 females, and 8 cases of undetermined sex), 82 children (11 newborn, 53 children in the age category infans I, 18 children in the age category infans II) and 5 juveniles (age category juvenis). The skeletal remains were incomplete and damaged, especially in eroded graves (Vargová et al. 2013).

The third studied skeletal collection originates from the cemetery at the Hospital of the Merciful Brothers in Brno (hereinafter referred to as M), which existed between 1759 and 1784. The Monastery Hospital was designed for old and sick males, but especially for Brothers of the Order, craftsmen, and the poor. In the graves from the modern period, skeletal remains of at least 87 individuals were found. Of these, 68 were adult (67 males, 1 female), 10 children (one child in the age category infant I, 9 in the age category infant II) and 9 juveniles. Most of the skeletons had been partially destroyed by building activities, therefore were incomplete and fractured (Vargová & Zapletalová 2007).

The largest osteological collection came from the central part of the former Municipal Cemetery in Malá Nová Street, Brno, currently Antonínská Street (hereinafter referred to as A). From 1785 to 1883, the cemetery served for the burial of the inhabitants of the five parishes in Brno, thus representing the typical urban population. In total, the skeletal remains of 1 083 individuals were collected, of which 663 were adults (238 males, 208 females, 217 of unreliably determined sex) and 420 children (92 foetuses or newborn, 233 in the age category infant I, 66 children in the age category - infans II) and 29 juveniles (age category juvenis). The grave pits were mostly used for repeated burials. The number of corpses buried in them differed and the degree of preservation of individual skeletons or their parts varied.

Standard anthropological and palaeopathological methods were used in the medical-anthropological study of children's skeletons. Anthropological analysis of skeletal remains was performed according to the procedures of Knussmann (1988), Martin and Saller (1957) and Stloukal et al. (1999). To determine the age in childhood, we used the knowledge of Baker et al. (2005), Čihák (1987), Fazekas & Kósa (1978), Scheuer & Black (2000) and Ubelaker (1987).

Individual children's skeletons have been divided according to the age estimation into the general age categories: foetus and newborn, infans I (until the eruption of permanent dentition, up to 6 years), infans II (7–14 years old), juvenis (15–20 years old). As the basic limit of adulthood, we considered ossification of the *synchondrosis sphenooccipitalis* in skulls.

Palaeopathological findings were assessed primarily according to the criteria of Aufderheide & Rodríguez-Martín (1998), Horáčková et al. (2004), Lewis (2018), Ortner (2003), Ortner & Putschar (1985), Steinbock (1976) and Vyhnánek et al. (1988). The basic examination method of palaeopathological diagnostics comprised in particular a detailed macroscopic analysis. For indicated cases, it was necessary to utilise X-ray examination, histological examination of the affected bone tissue. Within the differential diagnosis, some pathological lesions were compared with similar defects in recent skeletal material deposited in the Collection of Anatomical Pathology of the Natural History Museum in Vienna, where the diagnosis of the deposited pathologies was verified on the basis of current state-of-the-art clinical methods.

RESULTS

It was possible to record a number of diseases in children's skeletal remains. These included congenital skeletal developmental deviations, haematogenic and metabolic diseases, specific and non-specific inflammations. Post-traumatic traces also occurred rarely. The presented communication is focused on the monitoring of congenital, metabolic and haematogenic diseases.

Congenital bone anomalies are found in almost every large skeletal collection. Their origin is hereditary or embryonic damage during intrauterine development.

One of the most common congenital malformations of the locomotor apparatus is developmental dysplasia of the hip (DDH), whose worst form is luxation. An example of this type of disability are morphological changes in the left hip bone of a 9- to 12-year-old child (AT salvage No. 7). Above the upper edge of the acetabulum is an elongated oval pit of 27 x 15 mm, which can be considered as a vertical elongation of the articular surface. The pit is bordered on the dorsal side with a fine osteophytic rim of 1–2 mm in height. Its bottom is slightly bumpy in the lower part adjacent to the acetabulum, with small erosions; in the upper part it is deepened into a smooth notch which resembles the shape of *facies lunata* (Fig. 1). The acetabulum is damaged in the ventral portion, so its overall condition can not be objectively examined, nor the adjacent femoral head that is not preserved. However, when comparing the finding with current clinical cases, the described changes can be evaluated according to Tönnis (1987) as DDH with long-term 3rd degree dislocation of the head of femur.

Another congenital malformation was the finding of a prematurely obliterated left-sided squamous suture on the skull of a 14-year-old boy (M-No. 261). There is considerable individual variability in the obliteration of the cranial sutures, but closure of the squamous suture is only observed in the

Fig. 1 Left iliac bone of 9- to 12-year-old child with significant morphological changes in the acetabular region due to long-term dislocation of the femoral head (AT salvage No. 7)

age category of senilis (Meindl & Lovejoy 1985). The child's skull with an obliterated squamous suture is definitely a disease state.

In the analysis of children's skeletal remains, attention was also focused on changes caused by haematogenic and metabolic diseases. Among the blood diseases, it is possible to prove in particular manifestations of anaemia, in which red bone marrow hyperplasia occurs and thus the spongy bone formation increases. One of the manifestations of anaemia is porous changes in the roof of the orbit, known as *cribra orbitalia* (Moseley 1963), or possibly also *usura orbitae* (Møller-Christensen & Sandison 1963) or *hyperostosis spongiosa orbitae* (Hengen 1971). These represent bone destruction and new bone formation in front of the roof of the orbit in the form of small areas of porous or spongy structures. Hypertrophic diploe pushes the thin cortical layer of the roof of the orbit inward, into which the excess of the spongy bone protrudes. Depending on the morphological appearance, lesions on the roof of the orbit can be classified into three basic types, representing their different stages of development: I. porous, II. cribrotic and III. trabecular type (Horáčková et al. 2004).

In the studied children's osteology collections, *cribra orbitalia* was found in a total in 20.5 % (30 individuals, evaluable orbits n = 146.) In most cases, it occurred in both orbits, in the form of small perforations, porous type I (22 individuals, i.e. 73.5 %, n = 30). Less often these were larger and more numerous openings, cribrotic type II (5 individuals, i.e. 16.7 %, n = 30), or areas of hypertrophic exposed spongiosis, trabecular type III (3 individuals, i.e. 10.0 %; n = 30).

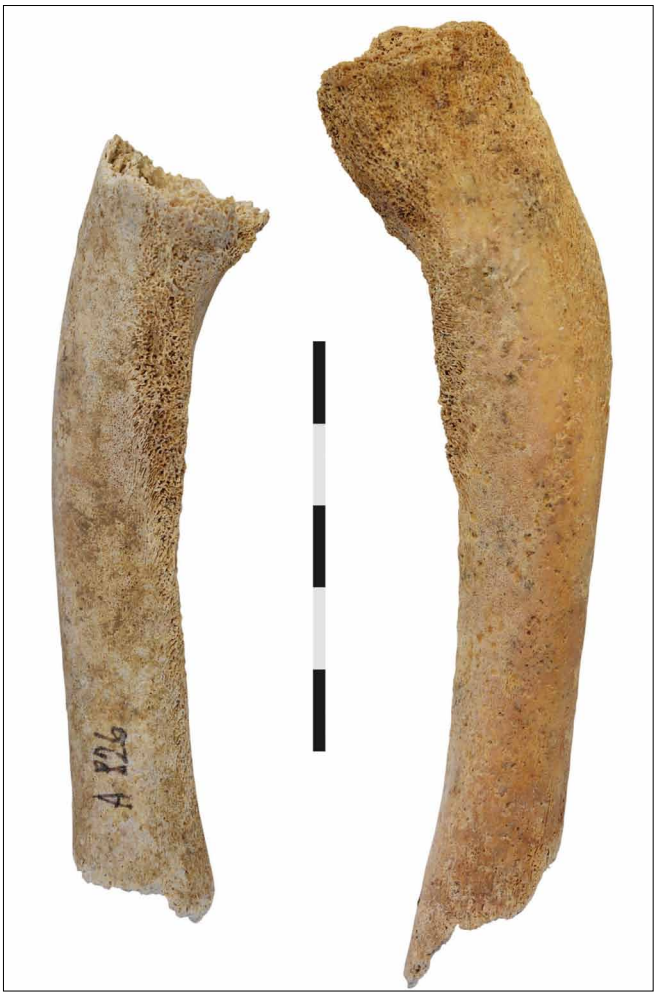


Fig. 2 Typical bending of diaphyses of both femurs of a 3-year -old child after normal physiological stress due to vitamin D deficiency-rickets (A 826)

In childhood, the metabolism is significantly influenced by the composition and amount of food consumed. Only sufficient nutrition rich in vitamins, essential nutrients, minerals and liquids is the main assumption for the healthy development of an infant. In the past, children often suffered from rickets caused by vitamin D deficiency. Its deficiency is reflected by a decreased blood calcium level, which results in a higher production of parathyroid hormone, which releases calcium and phosphorus from bone to blood. This results in both a failure of the enchondral ossification from the lack of inorganic substances in the intercellular mass and the weakening of the originally normally formed bone tissue. The final result is a severe loss of the strength of the skeleton.

In the studied collections, typical manifestations of rickets were observed in only three cases. A hypoplasia of enamel and dentin in the form of a dark coloured line of small holes and bumps on the crowns was recorded on the teeth of a 3-year-old child from Grave A 826. From the postcranial skeleton, diaphyses of both femurs without distal portions were preserved. The bones are significantly bent in the area of the proximal metaphyses, forming an arc with ventrally oriented convexity and with the proximal ends inclined dorsally (Fig. 2). The same

Fig. 3 On the right femur of a 6-year-old child, there is evidence of the significant bending of the body of the bone and maul-like extension of its distal metaphysis (known as Marfan's sign). These are the characteristic symptoms of rickets, with subsequent varus position of limbs (A 1857)

deformation can also be seen on the fragment of the proximal part of the right femur of a 2- to 4-year-old child (A 848). In this individual, both right forearm bones were also bent in the dorsolateral direction. The third case of rickets was diagnosed on the skeleton of approximately 6 years of age (A 1857). On both forearms there was a significant sag of the middle parts of the diaphysis in the medial direction. The right femur was also deformed; its distal metaphysis was significantly enlarged and club-shaped which, in the case of *rachitis*, is referred to as Marfan's sign (Fig. 3). According to the sag of the distal end of the affected bone in the lateral direction, it is evident that the child had a varus position of the limbs, known as *crura vara rachitica*.

Significant disease changes in the growing child's skeleton can also be caused by vitamin C deficiency. This vitamin is essential for the proper synthesis of collagen in connective tissues and its absence causes a disease called scurvy (*scorbut*). Pathological changes are manifested by a disorder of enchondral ossification, bleeding into the muscles, subcutaneous tissue and from the gums. This is a general disease, so there are multiple foci on the bones of the skeleton. On the surface of the bones, especially the lower limbs, numerous lodgements of newly formed bone tissue may occur, as a result of the ossified subperiosteal haematoma. In cases where haematoma resorption occurred, the bone remained weakened, especially in the area of the metaphyses. The exception, therefore, is not stress fractures, where the bone breaks out under normal physiological stress. During healing, a callus is created, in which there is thinned cortical bone and very thin trabeculae. During radiological examination, the bone tissue acquires the form of "cut glass". The overall gracility of the affected skeleton, as a result of inactive muscle atrophy, is also not exceptional. A typical finding is that of a scorbutic rosary, which is the enlargement of the ribs in the place of the costochondral joints. In the late stage of the disease, the infliction is manifested in the skull in the form of multiple porous hypertrophic bone lesions on the external surfaces of the frontal and parietal bones. *Cribra orbitalia* are usually observed. On the jaws, there are traces after *parodontitis* and dental diseases have been suffered – tooth loss, dental caries, enamel hypoplasia, eruption disorders (Ortner 2003; Zuckerman et al. 2014).

Possible signs of scurvy were found on three children's skeletons. In the first case, multiple, wide-ranging areas of newly formed bone tissue, with a slightly bumpy and finely perforated surface, were observed on the skeleton of a 4- to 5-year-old child (A 867). The lodgements were located on the fragments of most of the right ribs, on *facies costalis* of the left scapula, on the proximal two-thirds of the left humeral diaphysis, on the left hip bone's outer surface and the medial surface of the right tibia. The newly formed bone tissue was superficially localised on all affected bones and did not interfere with the compact bone. The skull was preserved only in fragments. The milk dentition was fully erupted. There was a sign of enamel hypoplasia only on the canines. The occurrence of *cribra orbitalia* could not be evaluated. A similar finding of *periostosis* was also recorded on the fragments of the diaphyses of both

femurs of a 1- to 1.5-year-old child (A 829). In this case, only two fragments of the middle parts of the humeri were preserved, along with the diaphyses of the femurs, so other possible symptoms of scurvy could not be assessed. The diagnosis of scurvy was also limited on the skeleton of a 1-year-old child (A 1835), from which only the fragments of the diaphyses of both tibiae and a fraction of the left hip bone with lodgements of newly formed bone tissue were preserved. The lesion surface was significantly porous and slightly bumpy.

DISCUSSION

The evaluation of pathological changes in children´s skeletons entails specific difficulties. The main one is the preservation of skeletal remains, as gracile children's skeletons are more easily subjected to natural decay processes and there is more often post-mortem damage. For this reason, it is to be assumed that the actual incidence of the monitored diseases in the population is always higher.

In children´s skeletons, the basic prerequisite of palaeopathological analysis is the detailed knowledge of the developmental stages of the individual bones. If specific growth patterns in childhood are disregarded, developmental changes could be confused with pathological manifestations. One of the relatively common congenital bone anomalies is the luxation of the hip joints. Hippocrates (* 460– † 370 BC) already mentioned this in his work "*De Articulis*", but considered it to be the result of an injury to the pregnant mother's abdomen. A more detailed description of pathological changes in bilateral luxation in the neonate was given by Giovanni Battista Paletta (* 1748– † 1832) in his book "*Exercitationes pathologicae*" in the second half of the 18th century. In addition, investigation into the treatment of the affected hip joint gradually evolved. The German surgeon Wilhelm Roser (* 1817- † 1888) considered hip instability as the precursor of dislocation and, as a precautionary measure, recommended that the lower limbs be maintained in a position of flexion and abduction. Italian physician Vittorio Putti (* 1880– † 1940) then designed an abduction pillow. Traction also began to be used to treat the luxation. This method of therapy was further refined and elaborated on by other doctors, but it was always a long and uncomfortable stay in bed for a handicapped child. With the discovery of anaesthesia, the introduction of antisepsis and the observance of aseptic principles, surgical therapy of hip luxation also developed. According to the written sources, Alfonso Poggi (* 1848– † 1930) carried out the first open surgical repositioning in 1880, and Albert Hoff (1859– † 1907) is particularly deserving of its improvement and popularisation. Operational procedures were criticised by Adolf Lorenz (* 1854– † 1946), who promoted closed reduction through manipulation under anaesthetic as instructed by Agostino Paci (* 1845– † 1902).

The systematic orthopaedic examination of newborn infants began in 1908, thanks to the French physician Pierre Le Damany (* 1870– † 1963), who used a special movement manoeuvre accompanied by a sound phenomenon to examine the hip joint. This diagnostic procedure was popularised by the Italian paediatrician, Mario Ortolani (* 1904– † 1983). It was named the "Ortolani Test" after him, and the sound in the case of a positive finding was named the "Ortolani Sign". Le Damany also introduced suspenders, which are similar to those used today (Peltier 1993; Poul 2009), for the treatment of dislocated hip joints.

A number of prominent surgeons also operated in the Czech Lands in the 19th and 20th centuries. Thanks to them, preventive general orthopaedic examination of the newborn was introduced and advanced methods of therapy were elaborated. The most famous method is credited to the Prague orthopaedic surgeon of German origin, Heinrich Hilgenreiner (*1870–†1953), who established precise X-ray criteria for the diagnosis of congenital dysplasia and dislocation of the hip joint. His abduction splint became the basis of all the abduction apparatus used. The improvement of surgical hip joint therapy in the beginning of the field was mainly due to Jan Zahradníček (*1882–†1958). Moravian physicians, Bedřich Frejk (*1890–†1972) and Arnold Pavlík (*1902–†1962), became world renowned for their orthopaedic aids – Frejka's pillow and Pavlík's suspenders – which are used up to the present time (Dungl et al. 2005).

Another congenital malformation was the premature, isolated adhesion of *sutura squamosa* on one of the children´s skulls (craniosynostosis). According to current epidemiological studies, the incidence of craniosynostosis is around 1: 2400 live births (Buchanan et al. 2014; Calandrelli et al. 2014; Fearon 2017). On the basis of literary sources, it is clear that craniosynostosis already occurred in the past. The formation of cranial sutures and their obliteration was already dealt with, for example, by Hippocrates (*460 BC–†377 BC) and Galén (*129–†200 or 216). One of the prominent personalities who dealt with this issue was the German physician, Rudolf Virchow (*1821–†1902). He accurately described the pathophysiology of the origin of skull deformities in craniosynostosis, which is now known as "Virchow's Law" (Greene et al., 2008). Under this law, in the case of premature ossification of the sutures, the growth of the skull stops in a direction perpendicular to this connection, but continues at the sites of the free sutures. According to the localisation of the disorder, gradually, depending on the additional maturation of the skeleton, the abnormal shape of the head develops. Premature adhesion may affect only one or multiple sutures. Of the isolated craniosynostoses, *sutura sagittalis* (scaphocephaly) is most frequently found to occur. Approximately at the same frequency then the *sutura coronalis* (frontal plagiocephaly or brachycephaly) and *sutura lambdoidea* (occipital plagiocephaly or brachycephaly) are prematurely obliterated. Less often, the adhesion of the *sutura metopica* (trigonocephaly) is recorded. Separate premature obliteration of the *sutura squamosa* is not common; it is only part of the multiple affection of cranial connections, such as oxycephaly. Therefore, each premature, isolated adhesion of the *sutura squamosa*, including the one described above, can be considered as a rare finding (Lewis 2018; Smartt et al. 2012).

In our case, however, it cannot be assessed whether it was a simple craniosynostosis without signs of intracranial overpressure or craniostenosis accompanied by central nervous system infliction by increased intracranial pressure. The aetiology of these conditions has not yet been fully elucidated. The premature adhesion of one of the cranial sutures is most often seen as one of the many symptoms of some rare genetically-engineered disease, such as Apert, Pfeiffer, Crouzon and Carpenter syndrome (Žižka 1994). Craniosynostoses are also sometimes described as manifestations of acquired syndromes (Cohen 1976) or may occur isolated from an unknown cause (Bennet 1967). No other pathological changes have been found on the studied skeleton. Therefore, the existence of a congenital or acquired syndrome cannot be confirmed, and not even explicitly excluded. However, it is assumed that the studied boy was apparently mentally handicapped because, after 1804 the monastery hospital was intended for the mentally ill (Vargová & Zapletalová 2007).

There are not many cases of craniosynostoses described in palaeopathological studies, especially in the Czech Lands. The exception are skulls from the ossuary in Broumov dating back from the 13th – 18th centuries (Pospíšilová et al. 2003; Pospíšilová & Procházková 2006), and from the crypt of the Pilgrimage Church of the Virgin Mary in Křtiny from the same period (Vargová & Horáčková 1996). The reasons for the small number of documented findings of craniosynostoses can only be speculated. One of these is poor skeleton preservation, as most children's skulls are in fragments. Furthermore, it is possible that a slight asymmetry in the partial obliteration of the sutures is not given much attention and only very noticeable cases of skull deformity, whose incidence in the population is not so high, are described.

In addition, the number of haematogenic and metabolic diseases recorded on skeletal remains cannot fully reflect their actual occurrence in the population. In exhumed bones, it is not possible to determine the exact calcium and phosphorus representation (the main criterion for bone formation and reduction of bone tissue), because, due to soil conditions, minerals are leached more or less out of the bones. For this reason, only typical cases with significant deformities of the skeleton can be diagnosed.

In the vast majority of palaeopathological studies, *cribra orbitalia* are regularly monitored, which are interpreted as one of the symptoms of anaemia. The frequency of these structures on the roof of the orbits is usually about 20 % (Hengen 1971). The average incidence of *cribra orbitalia* in children´s skeletons from our study groups (20.5 %) did not differ from these data. Anaemia is, however, only one of the symptoms of a wide range of different diseases, which cannot often be determined on bones. Other pathological changes were observed in some individuals with *cribra orbitalia*. These were, for example, foci in the *lamina interna* of the flat skull bones (V 61, V 69, V-Rc, V-Re), referred to in the literature as SES (*Serpens Endocrania Symmetrica*). This may be a symptom of many diseases, such as tuberculous or non-specific meningitis, traumatic lesions, tumours, scurvy or *rachitis* (Lewis 2004). In two individuals (M 261, M grave fill), dental hypoplasia, which is the result of long-term stress during the development of dentition, was recorded alongside the *cribra orbitalia*. Stress factors include, for example, infectious diseases of various aetiologies (tuberculosis, syphilis, etc.), lack of essential nutrients (especially calcium, phosphorus, and vitamins), diarrheal diseases associated with fluid loss, hormonal dysfunction (e.g. hypofunction of parathyroids), trauma, etc. (Goodman & Armelagos 1985). *Cribra orbitalia* was also observed in a teenage girl (AT 855), with signs of left hip joint infliction by aseptic necrosis of the femoral head (Perthes Disease).

Among the metabolic diseases, three cases of advanced stages of rickets with typical deformations of the shafts of the long bones of the limbs were diagnosed. From the osteological collections studied, rachitic changes were recorded only in the children's population from the Brno Municipal Cemetery in Malá Nová Street. The occurrence of rickets in the urban population in the 18th and 19th centuries, in the period of rapid development of industrial production, is not a surprise. At that time, Brno with its textile factories was among the most advanced industrial centres of the Austrian monarchy. A large number of working-class children lived in peripheral slums or right in the factories under unfavourable conditions. Poor nutrition and a lack of sunlight contributed to the formation of avitaminosis D. It is very probable that the three diagnosed cases of *rachitis* in the children studied (i.e. less than 0.5 %, n = 633) are far from being true to their occurrence. The palaeopathological literature generally refers to the industrialisation period in the 18th and 19th centuries as the era of the highest incidence of rickets in Europe, especially in northern regions with a lack of sunshine. Rickets was considered as a disease of civilisation. Its high incidence was recorded in industrial England at that time, so rickets was called the "English Disease". For example, Welch (2000) point out in their work that, at the end of the 19th century, signs of rickets in industrialised areas of developed countries were observed in up to 80 % of children under 2 years of age. The main reason for the low incidence of rickets on the examined skeletons is primarily the poor preservation of the skeletal remains. Only fragments of flat skull bones and parts of long bone shafts remain. As a rule, it was not possible to determine a number of important rachitic symptoms, such as the square shape of the skull, the rachitic rosary in the area of the sternocostal joints, scoliosis or pelvic deformity. Finally, only one symptom, which is not completely specific to this disease (for example, enamel hypoplasia) could be noticed, and therefore could not be interpreted as rickets. These facts are probably also the cause of the small number of previously documented rachitic skeletons from earlier historical periods. Rickets demonstrably occurred already in the Neolithic period, as evidenced, for example, by findings from Denmark (Benike 1985), Norway (Steinbock 1976) and Poland (Gladykowska-Rzeczycka 2001). In the other historical periods, described cases of skeletons with rachitic changes are increasing (Aufderheide & Rodríguez-Martín 1998; Mays et al. 2006).

The first accurate data on rickets were provided by the Greek

Age category Cause of death	Up to 1 year of age N=1011	1-5 N=81	6-15 N=64	Total N=1156	%
Complications of pregnancy and childbirth	765	0	0	**765**	**66.2**
Anencephalus	5	0	0	**5**	**0.4**
Hydrocephalus	8	0	0	**8**	**0.7**
Osteogenesis imperfecta	1	0	0	**1**	**0.1**
Bronchial atrophy	1	0	1	**2**	**0.2**
Dystrofia musculorum	0	0	1	**1**	**0.1**
Anemia excessiva	0	0	1	**1**	**0.1**
Insufficientia cordis	6	0	4	**10**	**0.9**
Diabetes mellitus	0	1	1	**2**	**0.2**
Rickets	6	2	1	**9**	**0.8**
Cachexia	2	1	1	**4**	**0.3**
Infectious diseases, tumours, traumas	217	77	54	**348**	**30.1**

Tab. 1 The causes of the death of children in the 1920s in Brno focusing on congenital malformations, metabolic and haematologic diseases

physician, Soranus of Ephesus (* 98 AD– † 138 AD). He mentions children with deformed bones and the cause of this disease is seen primarily in insufficient maternal care. Later, in his work "*De morborum Causis*", Galén (*129–†216) supplemented some of his previous knowledge of the disease, for example, extended symptoms of pigeon and funnel chest, varus and valgus deformity of the limbs (Aufderheide & Rodríguez-Martín 1998). Since the 16th century, records about rickets have appeared more frequently in medical literature. The first extensive monograph, written by English physician Daniel Wristler (*1619–†1684), dates back to 1645. In 1650 Francis Glisson (*1597–†1677) published practical experience with the disease. As industrialisation progressed, however, the number of rickets patients also increased, not only in England, but also in other industrialised countries.

In 1822, the Polish physician, Jedrzej Sniadecki (*1768–†1838), recognised the positive influence of sunlight on reducing the incidence of rickets, by comparing the number of affected urban and rural children. Two years later, the beneficial effect of fish oil use as an anti-rickets treatment was discovered by German physician, D. Schütte, who started to prescribe it. However, this therapy was appreciated much later throughout the European continent. Norwegian pharmacist Peter Joachim Möller (*1793–†1869), who in 1854 started the industrial production of fish oil and started exporting it abroad, contributed to this. Only in the early 20th century did British physician Edward Mellanby (*1884–†1955) scientifically prove that rickets is caused not only by a lack of sunlight but also by poor nutrition (Hawgood 2010). Based on Mellanby's study, American biochemist Elmer McCollum (*1879–†1967) isolated a substance from fish oil which he called vitamin D (Šíma & Turek, 2015). In the Czech Lands, after the anti–rickets effect of fish oil was published, this substance was preventively administered to children in schools. Paediatricians began to provide this prophylaxis to infants and toddlers.

Scurvy was another metabolic disease of the modern population. This disease, however, was already known to the Ancient Egyptians. Ebers' papyrus (probably from 1500 BC) mentions the mysterious disease suffered especially by sailors. Scurvy was also described by all renowned ancient physicians, such as Hippocrates. In Caesar's armies, scurvy was considered as the greatest enemy. Scurvy was also the greatest threat to European seafarers on long voyages in the 15th and 16th centuries. During this discovery period, about two million men died of scurvy. Scurvy was a typical disease of seafarers, but it also occurred in the Czech Lands in Central Europe. Literary sources evidence the existence of the epidemic occurrence of scurvy in the 18th and 19th centuries, especially in orphanages and foundling homes, as well as in adult prisoners and those in poorhouses, where the main cause was an insufficient amount of a quality vitamin C-rich diet. Less often, scurvy was recorded among children from poor urban districts. The rural population was the least affected. As the written report from the second half of the 19th century states, acidulous cabbage, herbal juice or sprouted peas were administered to the affected for the treatment of scurvy (Duchek 1873; Nopp 1926).

To date, in palaeopathological studies, scurvy is diagnosed relatively infrequently. Mays (2014) describes the overview of the findings in Europe. For this reason, it can be assumed that most cases have not yet been recognised.

Another part of the study was the comparison of the results of palaeopathological analysis with literary sources, of which the data from Parish Registers of the deceased in the Czech Lands were mainly used. Since 1784, when the Patent of Emperor Joseph II concerning the Parish Register began to pay dividends, the Registers also provided information on the causes of death. The oldest records are only indicative, because the medical level and inconsistent medical terminology did not allow precise diagnoses in many cases.

Brabcová (2002) studied the Parish Register of the deceased of St. Peter parish in Brno from 1785–1799. She found that the most common cause of infantile death (64.7 %) at that time was infantile convulsions. Next in descending order were tuberculosis (11.8 %), smallpox (6.5 %), emetic cough (6.3 %) and measles (1.1 %). Other diseases were rarely reported in the Parish Register.

The term "*infantile convulsions*" can conceal a number of diseases, with one of the symptoms being local or generalised convulsions. In the newborn, intracranial bleeding as a result of birth trauma is a common cause of convulsions. In addition, among the other causes are newborn haemorrhagic disease, dehydration, congenital malformations of the central nervous system and also calcium or magnesium deficiency, excess sodium or *hyperbilirubinaemia* (Houštěk et al. 1980; Kliková et al. 2017).

In the other age categories, the cause of death was mainly infectious diseases. The other diseases were rarely recorded.

Significantly more accurate information about the causes of death was obtained from the Registers of the deceased from the 1920s, where the records of four Brno parishes were studied - St. Jacob, St. Peter and Paul, St. John and St. Thomas. The findings of this part of the study are summarised in Table 1. This shows that most children (66.2 %, N = 1156) died due to complications in pregnancy and childbirth, such as *debilitas congenita* (weak children), *cephalohaematoma*, *icterus neonatorum* or *placenta praevia*. Postnatally, the infectious diseases played again a significant role in paediatric mortality.

CONCLUSIONS

The monitoring of the state of health and causes of mortality in children in Moravia in the period of the Modern Age summarises the information on the origin and development of paediatric care, based on the study of available literary sources within the context of the palaeopathological analysis of children´s skeletal remains. In the period under review, Moravia became part of the Austrian monarchy, and its healthcare underwent significant changes in connection with the Theresian and Josephine reforms. The childhood population was the population most at risk from the medical point of view at that time. Neonatal mortality was very high, related to the lack of care for mothers-to-be. The analysis of the adult skeletons of the studied collections evidenced a high female mortality between the 20th and 30th year of age, probably due to health problems associated with pregnancy and childbirth. Pregnant women gave birth with only the assistance of midwives, of which the overwhelming majority were illiterate without any medical education. Even after the entry into force of the Theresian Health Regulations, the situation only changed slowly. The development of Obstetrics was not as rapid as other fields of medicine. In addition, postnatal care for the newborn and infants was inadequate. Sick children were dependent solely on treatment by private practitioners, whose care was not easily accessible due to the lack of funding for poor families. A number of physicians in Brno provided medical care free of charge to the poor, but without funds it was not possible to provide the necessary medication. In the first public health facilities, children over the age of 10 years were hospitalised together with adults. Younger children were given institutional care only from 1846, after the establishment of the Children's Hospital of St. Cyril and Methodius in Brno.

In the 18th century and throughout the 19th century, Brno children suffered especially from infectious diseases, as evidenced by written documents. The incidence of congenital malformations was reported relatively rarely, metabolic diseases were more frequently observed. Children in foundling homes and orphanages often suffered from, among other things, an "epidemic" of scurvy and rickets. The incidence of these diseases also increased within the context of famine-related warfare.

However, this period of the modern age is also characterised by huge advances in individual medical disciplines, including Obstetrics and Paediatrics. A new era in paediatric care in Moravia was heralded by the opening of the largest and most modern treatment facility for children in Austria-Hungary in 1899 – the Children's Emergency Hospital of Emperor Franz Joseph in Černopolní Street in Brno – where doctors specialising exclusively in paediatric diseases started to work. There were infant, internal, ophthalmic, surgical and orthopaedic departments, and two wards for infectious diseases (Čejka 2002a).

The presented study has sought to supplement some of the findings on the history and occurrence congenital malformations, metabolic and hematologic diseases in children in Moravia, their treatment and healthcare possibilities. It focuses on the period of rapid industrial development (especially in the 18th –19th centuries), when there was a rise in scientific medical knowledge.

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CONFLICT OF INTEREST

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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