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EVIDENCES OF CHILDREN'S INFLAMMATORY DISEASES, TRAUMA AND TUMOURS FROM THE 13th TO THE 19th CENTURIES IN THE CZECH LANDS

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. It 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 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. Due to the lack of qualified medical staff, the development of Obstetrics and Pediatrics was much slower than other fields of medicine. Sick children were reliant only on the assistance of private doctors, whose care was unavailable to poor families. In the first public health facilities, only children older than 10 years of age were hospitalised 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 this part of the study, attention was focused on the occurrence of inflammatory diseases, trauma and tumours. According to literary sources, Moravian children were particularly afflicted with infectious diseases. These included diphtheria, black cough, sinusitis, bacterial inflammation of the lungs of various origins, dysentery, salmonellosis, icterus and other diseases. The palaeopathological study demonstrates the high incidence of tuberculous meningitis and congenital syphilis. Traumatic changes were recorded on bones in only a few cases. Unlike written data, the osteology study did not detect any malignant tumours in the examined children. The present communication therefore supplements information on the history and epidemiology of children's infectious diseases in Central Europe during the Modern Age.

KEY WORDS: The Austrian monarchy – Development of paediatrics – Child care – Inflammatory diseases – Moravia – Palaeopathology

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INTRODUCTION

The findings on the history of childhood illnesses in the Czech Lands are based primarily on the study of literary sources (e.g. Brabcová 2002, Čejka 2002a, b, Doležal *et al.* 2009). Written sources, however, do not match the number of documented findings of morbid changes in children's historical skeletons. For example, an exception to this is the work of Stloukal and Vyhnánek (1976) and Vymazalová *et al.* (2018). The presented paper describes direct evidence of inflammatory diseases, traumas and tumours in children's skeletal remains from four modern archaeological sites. The results of this analysis are complemented by some information on the history of the health status of the childhood population in Central Europe from the period of the Modern Age.

The presented paper is based on data contained in a dissertation of Vymazalová (2019) and follows up on the published article of Vargová *et al.* (2020).

HISTORICAL CONTEXT

From the last half of the 16th century, the Czech Lands (Bohemia, Moravia and Silesia) were part of the Habsburg Personal Union, first called the Austrian Empire, later Austria-Hungary (Evans 2003). The Austrian monarchy became the most advanced Central European superpower, based on the economic and cultural reforms under the reign of Maria Theresa (*1717–†1780) and her son, Emperor Joseph II. (*1741–†1790). The Theresian and Josephine reforms were also essential for the development of medicine in the Czech Lands. Since 1753, the General Health Regulations *(General-Medicinal Ordnung)* have been applied here, and were later amended by a number of other Reich laws. The most important of these is the Immigration Reform Act of 1870, on the basis of which conditions were created for the creation of a nationwide public healthcare network (Vargová *et al.* 2010). The presented paper is aimed at Moravia, one of the crown countries of the Habsburg monarchy. The Moravian metropolis was at that time the City of Brno which, in the second half of the 18th century, saw a rapid economic boom due to the development of the textile industry. At that time, the number of inhabitants in Brno doubled over fifty years. Numerous industrial suburbs in Brno were established, where the vast majority of poor workers lived under unfavourable hygienic conditions.

There are relatively few reports of childhood illnesses from this time. 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 first therapeutic institution in Moravia, intended exclusively for children, was a hospital for sick pupils at the parish school of St. Jacob founded in 1471. It provided patients with asylum rather than medical treatment (Čejka 2002a).

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 for sick children under the age of 7 years. The Rincolini Institute only operated for less than four years, due to a lack of finances (Čejka 2002b).

In the autumn of 1846, the Children's Hospital of St. Cyril and Methodius was opened in Cemetery Street in Brno. 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 %. The causes of the high mortality were especially the large deficits in hygiene and lack of finances.

A slight improvement of conditions occurred in 1899, when "Children's Hospital of Emperor Franz Joseph I" was opened in Černá pole, Brno. It cared for children from infancy up to 14 years of age and still serves this purpose to the present day (Mazal 1953).

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MATERIAL

In total, skeletal collections from four different Moravian archaeological sites have been studied in recent years (*Table 1*).

The oldest one originated from the Anenské Terasy site in Brno (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 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 newborn 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, 2014).

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 infans 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 (Vargová *et al.* 2007).

METHODS

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 and Kósa (1978),

TABLE 1: General overview of skeletons from the studied archaeological sites. AT, Anenské terasy (Brno); V, Veselí nad Moravou; M, Hospital of the Merciful Brothers in Brno; A, Malá Nová (Antonínská street, Brno); M, male; F, female; ?, undefined sex; N, newborn; Inf I, infans I; Inf II, infans II; J, juvenile individuals; Σ, total.

Sites	Century	Adult				Children					Total
		M	F	?	Σ	N	Inf I	Inf II	J	Σ	
AT	13–17	57	53	15	125	16	62	43	21	121	267
V	16–17	50	40	8	98	11	53	18	5	87	185
M	18	67	1	–	68	–	1	9	9	19	87
A	18–19	238	208	217	663	92	233	66	29	420	1083

Florkowski and Kozlowski (1994), Scheuer and Black (2000), Stloukal and Hanáková (1978) 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 sphenooccipitalis synchondrosis in skulls.

Palaeopathological findings were assessed primarily according to the criteria of Aufderheide and Rodríguez-Martín (1998), Horáčková *et al.* (2004), Lewis (2018), Ortner (2003), Ortner and Putschar (1985), Steinbock (1976) and Vyhnánek *et al.* (1998). 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 and 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 (Vargová *et al.* 2020), specific and non-specific inflammations. Post-traumatic traces also occurred rarely. The presented paper focuses on the monitoring of inflammatory diseases and trauma (*Table 2*).

In almost every large osteological collection, post-inflammatory traces are usually found on the bones. This is a manifestation of the defensive and reparative response of the organism to the action of a pathogenic agent. Among specific inflammatory diseases, tuberculosis culminated in the modern age in individual European children's populations, which in about 5–7% of tuberculosis patients also affected the skeleton (Steinbock, 1976).

Tuberculosis

Chronic tuberculous inflammation often affects the spine (*spondylitis tuberculosa* or *malum Potti*). The pathological process usually first destroys the spongy bone tissue within 2–4 vertebral bodies, producing casein, a yellow, cheesy matter. The affected vertebrae are unable to resist normal mechanical stress, resulting in compressed fractures. The cheesy matter usually flows along the musculus psoas major up to the iliac fossa, where it forms an abscess. The collapsed vertebral bodies have a wedge-shaped appearance and usually grow together in one block, which causes an angular curvature of the spine – a tuberculous gibbus.

Case 1:

A possible case of Pott's disease was recorded on the skeletal remains of a 2-year-old child (A 2824). The body of one of the thoracic vertebrae was wedge-shaped in the lateral view, with the tip facing ventrally. Other vertebrae either were not preserved or were in small fragments, so could not be evaluated objectively.

TABLE 2: General overview of the manifestations of inflammation on the studied skeletons. AT, Anenské terasy (Brno); V, Veselí nad Moravou; M, Hospital of the Merciful Brothers in Brno; A, Malá Nová (Antonínská street, Brno); TB, tuberculosis; Σ, total.

Sites	Number of specific inflammations		Number of non-specific inflmmations
	TB	syphilis	
AT	5	3	1
V	9	–	–
M	–	–	1
A	5	4	1
Σ	19	7	3

Case 2:

Further localisation of tuberculosis on the vertebral column was evident on a skeleton of a 12-to 14-year-old boy (V 55), where signs of *spondylitis anterior tuberculosa* were observed (*Figure 1*). On the ventral side of the bodies of the second and third lumbar vertebrae, a compact layer of bone was partially disrupted and spongy bone was exposed. The surface of the foci is porous with small areas of fine periosteal plates of newly formed bone tissue. On the L3 body, a raised ridge is formed around the lower edge of the defect. The intervertebral disc between the two affected vertebrae was probably not affected by the inflammatory process. Manifestations of chronic inflammation are evident both on the acetabulum and the head of the left femur. The acetabulum is partially eroded, with exposed spongy bone. Roughly in the middle, there is a circular hole with a diameter of about 18 mm, which leads to a subchondrally located hollow, about 15 mm deep, the walls of which have a rough surface. The edges of the hole are sharp, without macroscopically visible signs of repair. Throughout the circumference, the acetabulum is lined with a soft but wide plate of newly formed bone tissue. Its lodgement fills about half the *fossa iliaca*, on the outer surface of the *ala ossis ilii* reaching a distance of 50 mm from the acetabulum. The surface of the newly formed bone tissue is slightly wrinkled with a large number of small perforations. Inflammatory changes around the acetabulum show distinct traces of healing, similarly to the adjacent part of the neck of the left femur, where a large shallow depression (35 × 22 mm) is present on the ventral surface. The bottom of the bowl depression is largely smooth, proximal-laterally deepening into a circular hole (diameter about 5 × 5 mm). Throughout the circumference of the defect, there is a smaller rounded bulwark in the proximal part. On the *linea intertrochanterica femoris*, there is also an area of newly formed bone tissue.

Case 3:

Signs of tuberculous arthritis of the left hip joint were also observed on the skeleton of a 6- to 8-year-old child (A 843). The *facies lunata* is completely destroyed on the left iliac bone, and has an irregularly bumpy surface, with a series of erosions (*Figure 2*). The bone is perforated in several places throughout the

FIGURE 1: On the ventral side of the second and third lumbar vertebrae of the 12- to 14-year-old boy, signs of chronic tuberculosis – spondylitis anterior tuberculosa – are observed. The surface of the foci is porous with small areas of fine periosteal plates of newly formed bones (V 55).

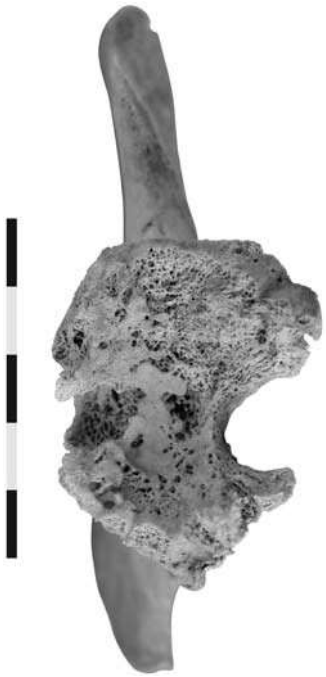

FIGURE 2: Significant traces of tuberculous arthritis can be observed in the acetabulum of the left pelvic bone of a 6- to 8-year-old child. Facies lunata is completely destroyed, has a bumpy surface with many perforations and erosions (A 843).

acetabulum. The largest of the fistulas (22 × 12 mm) has a form of a deep notch and opens into the pelvic cavity. A mark of chronicity of the inflammatory process are the smoothed fistula walls. A calcified lymph node found between the skeletal remains of a 13- to 15-year-old boy (AT 866) can be considered as evidence of a possible pulmonary form of tuberculosis. The structure is hollow, oval-shaped with a size of 14 × 17 mm. Its surface is slightly bumpy with some very small perforations. However, in the case of the described finding, the fact that it could possibly be a calcified cyst in *echinococcosis* can not be ruled out.

Case 4:

Traces of the tuberculosis process usually appear very rarely on the skull. One of the possible findings of cranial affliction with tuberculosis may be a lytic defect in the squama of the frontal bone of a 7- to 8-month-old infant (A890). The lytic focus is above the right orbit in the lamina externa; it is roughly circular in shape with a size of 14 × 11 mm, with sharp and crater-like undermined edges. Diploe is disturbed to a great extent by the lytic process. The least affected structure of flat bone is the *lamina interna*, where the lytic process formed an oval opening of 7 × 6 mm. The X-ray image showed a clarification with a double contour at the site of the osteolytic deposit, which corresponded to a different affection of the individual layers of the flat bone. The boundary of the defect and the normal bone is well marked, sometimes with a slight sign of the thin line of a sclerotic hem.

Cases of tuberculous meningitis

In the modern age, tuberculous meningitis was quite common among children. On the skeleton, this disorder manifests itself particularly on the endocranial surfaces of the skull bones and is usually seen on several cranial bones. It is an atypical formation of the *sulci arteriosi* of the meningeal arteries, which are richly bush-branched. In the *lamina interna*, they form a network of small, but deep channels and perforations, which coalesce together (*Figure 3*). Larger depressions such as *granulationes arachnoidales* may occur locally; in other cases, fine lodgements of newly formed bone tissue may be observed.

The symptoms described were found on the skulls of 14 children (A 838, A 887, AT 812, AT 1812, AT grave fill 9, V 31, V 61, V 69, disturbed graves VRb/1, V Rb/2, V Rc, V Re, V Rh). Only children aged from 6 months to 6 years were affected by tuberculous meningitis in the studied collections. In this age group, the number of cases described represents about 3.3 % (n = 467). In one-third, other signs of long-term stress in the form of *cribra orbitalia* or hypoplasia of dental enamel or dentin were also recorded on skeletons.

Syphilis

Syphilis was another widespread specific inflammation in the 18th to 19th centuries. The Czech Lands are located in the mild climatic zone of Central Europe, where only veneric syphilis is present from treponemal infections. In children, this is an inherited form of a disease in which the child's organism is infected transplacentally already during the period of intrauterine development. At this time, the immune system is not fully developed, so inflammatory changes on the skeleton are evident from the initial stage of the disease; they are extensive and persist until adulthood. Syphilis is characterised by multiple foci that can be on both the skull and the post-cranial skeleton. On the

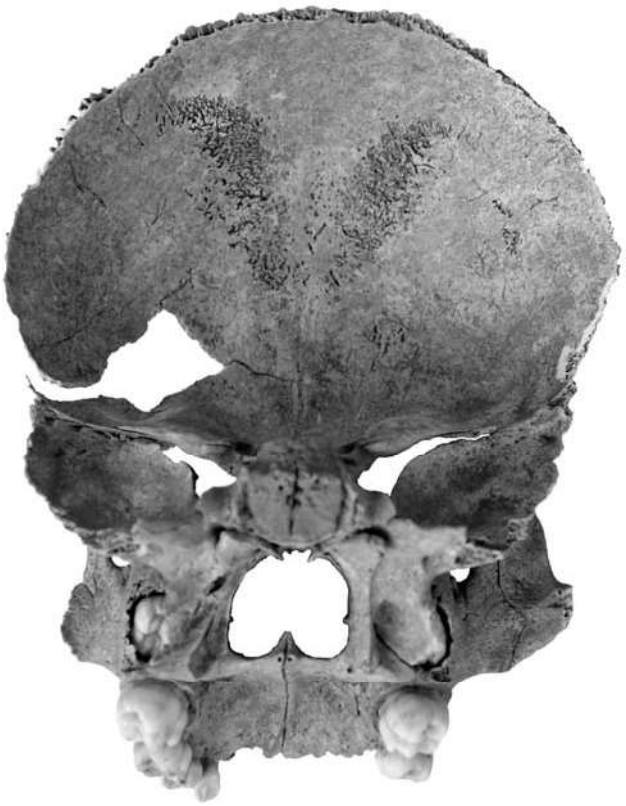

FIGURE 3: As a manifestation of chronic tuberculous meningitis can be considered an atypical formation of the sulcus arteriosus of the meningeal arteries in the lamina interna of the frontal bone of the 6- to 7-year-old child, where a network of deep canals and perforations are created (V 69).

flat bones of the cranial vault, the disease causes the local focal disintegration of bone tissue (syphilitic gummata), which Hackett (1978) designates as a dry caries (*caries sicca*). In the facial part of the skull, syphilis attacks the nasal and oral cavities (palatonasal destruction). The nasal bones are often affected as well, resulting in the total collapse of the external nose, which then acquires a typical saddle shape. Significant shape deformities of the skull (*hydrocephalus, caput natiforme, caput quadratum*) are also no exception. Other important symptoms of congenital syphilis include characteristic dental stigmas. The upper inner incisors which have barrel-shaped crowns and biting surfaces with crescent-like notches are known as Hutchinson's teeth. Fournier's tooth, or Moon's molar, denotes an atypical first molar whose crown has the shape of a rosebud or a mulberry (Ioannou *et al.* 2016). Syphilitic infliction of the long bones of the limbs is manifested by chronic periostitis or osteomyelitis, possibly with the presence of gummatous foci.

Case 1:

Among the studied skeletons, skeletal syphilis is likely on the skull of a child of about 1.5 to 2 years of age (A 889). The remains of syphilitic gumma are apparent in a circular lytic defect of about 10 mm in diameter, located just above the root of the nose on the squama of the frontal bone. The pathological process proceeded from the lamina externa towards the diploe. The defective surfaces and exposed trabeculae of spongy bone were rounded by a repair process. Several foci of chronic periosteal inflammation, with a slightly bumpy surface with numerous small perforations, were observed on the skull. One of these was located in the left orbit, the other on the cerebral surfaces of the greater wings of the sphenoid bone, where on the left side, the inflammatory process even deformed the foramen rotundum and partially the foramen ovale. The right zygomatic bone was slightly deformed by the inflammatory process and caused facial asymmetry in the affected child.

Case 2:

Syphilitic gumma was probably also the cause of a circular 5 mm diameter lytic focus on a fragment of parietal bone of a neonate (A 1833), where the lamina externa of the skull was affected in particular. Only small fragments of the skeleton were preserved, so the other bones could not be evaluated.

Case 3:

Also the skeleton of an 8- to 10-year-old child (A 1879) was in a fragmentary state, where the diaphysis of the right tibia with the periosteal plates of newly formed bone tissue was preserved on the anterolateral side of the distal half of the bone. In addition, a typical Moon's molar was recorded on a fragment of the mandible.

Case 4:

A similar finding was also a Moon's molar in the left upper jaw of a child of about 6 to 7 years of age (A 2811), in which signs of chronic inflammation on the inner surfaces of both mandibular rami were also found.

Case 5 and 6:

The findings of mulberry-like molars on the jaws of a 2- to 2.5-year-old child (AT 1806) and a 6- to 8-year-old child (AT, salvage 1, *Figure 4*) are also suspected cases of congenital syphilis. In addition to the manifestations of bone tuberculosis and syphilis, traces of non-specific inflammation were observed on the studied children's skeletons.

Case 7:

A similar finding was observed on the mandible of a 10- to 13-year-old boy (AT 193). On the edges of the dental alveoli of the right molars, there is evidence of a fine bone hem caused by chronic periodontitis on the buccal side. Periodontitis is probably related to the presence of an abnormal layer of dental calculus on the right side of the lower jaw. On the left, the dental calculus is not formed. Inflammatory changes are not present, and the crowns of the molars are abraded more heavily. Significant differences between the two sides in dental abrasion and the presence of dental calculus indicate that the affected boy only used the left side for chewing.

Case 8:

The rounded inflammatory focus (about 8 × 8 mm) on the right tuber maxillae of a 16- to 20-year-old male (grave fill M1) was also apparently of odontogenic origin. The surface of the lesion has a rough, irregular

FIGURE 4: Hypoplasia of the molars of a 6- to 8-year-old child in the mulberry form is known as Moon molars and is a typical manifestation of congenital syphilis (AT salvage No. 1).

structure with a number of minor perforations. The source of infection was probably a periapical abscess of one of the upper molars. A number of tooth caries on the preserved parts of the jaw was an indication of a bad state of dentition. Hypoplastic grooves on the incisors and *cribra orbitalia* in both orbits testify to the chronic disease of the affected individual.

Case 9:

Another manifestation of a non-specific inflammation is the finding on the skeleton of a 7- to 8-year-old child (A 846). On the medial surface of the middle part of the left tibial diaphysis there is a circular hole with a diameter of about 9 mm, leading to a pyogenic cavity whose walls and edges are smoothed by a repair process. In the surroundings of the fistula, there is an area of newly formed bone tissue, with a slightly bumpy surface and a number of perforations (*Figure 5*). The infection probably penetrated to the bone through an open wound on the leg, causing purulent osteomyelitis with an abscess within the bone. The pus from the pyogenic cavity flowed out of the fistula to the surface of the bone, causing a periostitic reaction.

Trauma

Trauma was also observed in the studied osteological collections. However, their number was lower than in adults, which is related to the greater elasticity of children's bones.

Case 1:

Traces of well-healed injury were observed in the distal part of the diaphysis of the right femur of a 16- to 18-year-old individual (AT 202). This was probably a cut (115 mm long), which was in the proximal-distal direction and partly separated the medial edge of the bone. A separate bone fragment has grown together with the bone, but in some sections there is still an evident slit on the dorsal side. Depending on the shape of the laceration, it can be assumed that the thigh was struck from behind. The rare periosteal foci on the long bones of the limbs may also be counted among traumatic changes. They are probably ossified subperiosteal haematomas after injuries.

Case 2:

A similar case is the well-defined plate of newly formed bone tissue (about 12 × 4 mm) on the medial surface of the right tibia of a 1.5- to 2-year-old child (AT salvage No.

FIGURE 5: The fragment of the left tibia of a 7- to 8-year-old child with a large pyogenic cavity inside could be evidence of pyogenic osteomyelitis (A 846).

FIGURE 6: A solitary boundary focus of newly formed bone tissue on the medial surface of the right tibial diaphysis of a 1.5- to 2-year-old child. It was probably an ossified subperiosteal haematoma (AT 19).

19). The surface of the focus is slightly bumpy, with a number of very fine perforations (*Figure 6*).

Case 3:

Traumatic origin could also not be ruled out in the 11- to 12-year-old child (A 2805) with marked pathological changes on the fragment of the proximal end of the left tibia. The affected bone has a prematurely connected deformed proximal epiphysis. The lateral condyle is markedly reduced in the distal direction in comparison with the medial one, which affected the axial position of the knee joint – *genua valga*. This was most likely damage to the proximal growth cartilage by an injury (known as *epiphysiolysis*), in which there was an infraction of the vascular supply of the epiphysis, followed by aseptic necrosis.

Aseptic necrosis

However, aseptic necrosis more often affects the femoral head (*morbus Perthes*), which is manifested by the deformity of the hip joint.

Case 1:

Symptoms of Perthes Disease having been suffered were observed on the left pelvic bone and the proximal end of the femur of a 14- to 18-year-old female (AT 855). On the preserved part of the *facies lunata*, a slightly bumpy surface with shallow, smoothed depressions is evident. The dorsal edge of the acetabulum is wavy, but rounded by the repair process. Above the acetabulum, the surface of the wing of the ilium is rough with a few small perforations. All these morphological deviations indicate the onset of arthrosis in the left hip joint. The most striking pathological finding is the side difference in the value of the colodiaphysar angle of the femurs, with the right side having a normal value of 120 degrees, while the left attains only 108 degrees. The greater trochanter exceeds the femoral head, so the bone length is 6 mm shorter than on the right side. The head of the affected femur is rather egg-shaped; its surface is bumpy in the ventral area with an extensive oval depression (32 × 20 mm). The floor of the defect is perforated, irregularly bumpy. However, the unevenness is rounded by the repair process (*Figure 7*). The stripe-like depression (30 mm × 10 mm) also has a similar pattern. It stretches from the fovea capitis femoris in a medial direction. The ventral edge of the head is lined with a fine osteophytic hem, which is a symptom of the onset of arthrosis. All these data are evidence of aseptic necrosis of the femoral head, which caused not only a change in its shape but also in the mechanical condition of the left hip joint.

DISCUSSION

Differencial diagnostics

Tuberculosis

The most common sign of inflammatory disease was tuberculosis on children's skeletons. The evaluation of the findings of tuberculous changes on the spine was not difficult. In differential diagnosis, especially juvenile kyphosis (morbus Scheuermann), a disease of unknown aetiology characterised by the wedge shape of the vertebrae and discopathy (Poul *et al.* 2009), had to be distinguished. However, this disease did not correspond to the age of the affected children in our collection, the absence of signs of intervertebral disc infliction and the presence of traces of chronic inflammation. Juvenile kyphosis occurs in adolescents during the growth acceleration period and is not an inflammatory disease. However, the diagnosis of tuberculous meningitis was

FIGURE 7: Symptoms of Perthes Disease were observed on the left pelvic bone and the proximal end of femur of the 14- to 18-year-old girl. The most striking pathological finding is the value of the colodiaphysar angle of the affected femur, which only reaches 108 degrees (AT 855).

particularly problematic, as pathological changes on the inner surface of the flat skull bones may be caused by other diseases. These include, in particular, traumatic lesions (ossified subperiosteal haematoma), tumours, scurvy, rickets, and non-specific chronic meningitis of another origin. However, an ossified epidural haematoma usually generates delimited, unifocal lesions and, unlike tuberculous meningitis, does not affect several cranial bones. In metabolic diseases, changes of the post-cranial skeleton are characteristic, except of the skull. In scurvy, these are mainly multiple ossified subperiosteal haematomas and, in rickets, deformation of the long bones of the limbs, especially the lower limbs. Tumorous osteolytic foci have sharp edges, pitting along the circumference of lesions, and with a different localisation. No signs of chronicity in the form of a repair process are visible macroscopically. It is very difficult to distinguish tuberculous meningitis from meningitis of another aetiology. Bacterial inflammations, whose causal agent is, for example, *Neisseria meningitidis* or *Streptococcus pneumoniae*, usually have an acute progression and cannot cache to leave traces on bones (Tyler 2010). Viral infections may also have a chronic progression, but their frequency was not as high as tuberculosis in the period under review. A number of leading palaeopathologists (e.g. Lorber 1958, Teschler-Nicola *et al.* 1998, Hershkovitz *et al.* 2002, Lewis 2004) consider that most endocranial lesions are caused by tuberculous meningitis, especially if the foci are similar to granulationes arachnoideales.

Despite the detection of *Mycobacterium tuberculosis* DNA being the only reliable possibility of verifying tuberculosis, its absence does not exclude tuberculosis. The pathogenic microorganism did not have to be preserved in the studied bone samples. These cases should only be considered as suspect.

A suspect case was also a calcified formation, which was an assessor of the calcified lymph node in tuberculosis of the lungs. In differential diagnosis, it was possible to exclude the calcification of tissue of certain organs in hypercalcaemia, because the calcified formations correspond to the shape and size of the affected organs. Both true and false stones are not hollow and mostly have irregular shapes. Calcified tumours, calcified newly formed connective tissue after inflammation or calcified thrombi, haematoma, etc. also have similar characteristics (Bednář *et al.* 1982, Stříteský 2001).

In differential diagnosis, the most problematic was differentiation of the found formation from the calcified cyst in echinococcosis. Echinococcosis is a disease caused by a cysticercus of *Echinococcus granulosus*. Localisation of the cysticercus may be different; most commonly the parenchymatous organs (liver, lungs) and brain are affected. The larvae form typical cystic formations with a semipermeable chitin membrane, which can calcify at a later stage of the disease. During X-ray imaging, the cysts therefore can be of different shape and size (up to 8 cm). In their walls, opacity caused by thin calcifications takes shape (Špaček *et al.* 1973, Vyhnánek *et al.* 1998). In older calcified echinococcal cysts, their parasitic origin can no longer be recognised (Bednář *et al.* 1982), as in our case. Palaeopathological findings and written sources, however, show that in the Czech Lands the incidence of tuberculosis in historical populations was much higher than echinococcosis, so the diagnosis of tuberculosis in this case is much more likely.

Syphilis

Another of the specific inflammatory diseases occurring in modern times was syphilis. The earliest written information about this disease in the Czech Lands dates back to 1493 (Hübschmann 1965). The prominent Moravian protomedicist, Tomáš Jordan of Klausenburk (*1539–†1585), in his writing "*Brunogallicus seu de lue nova in Moravia exorta*", describes a mass syphilis infection that spread in Brno from Adam's Spa and affected almost 200 inhabitants. The description of the disease fully corresponds to the findings of contemporary venerologists (Zapletal 1961). Due to this disease, the number of the population was considerably reduced, and its moral principles were significantly affected. The illness forced completely new legislation and resulted in the replacement of the original hospitals, which had been mostly social and humanitarian institutes for centuries, by medical health facilities (Zapletal 1952, Niklíček, Štejn 1985).

From this period, there are a number of palaeopathological findings, but the vast majority of them were observed on the skeletons of adult individuals (Vargová *et al.* 2019). The incidence of congenital syphilis with symptoms in children's bones is probably related to the diachronic development of the disease in the Czech Lands. From the palaeopathological point of view, Vlček (1975, 1984) divided the period of syphilis in the Czech Lands into several stages. In the first stage, until the second third of the 16th century, the disease had an acute progress and ended in death before a bone disorder could develop. After that, the population's defence against

treponemic infection gradually increased and the disease went into chronicity. For this reason, in the early 17th century, signs of syphilis also appear on bones. The number of bone syphilis findings increased considerably from the late 18th century, when not only the signs of the acquired but also its congenital forms appear. According to the mentioned data, it is not surprising that children's skeletons with syphilitic changes were not found, due to dating, in the osteological collections of Veselí nad Moravou and the cemetery at the Hospital of the Merciful Brothers, although the signs of syphilis on skeletal remains of adults have already been observed (Vargová, Zapletalová 2007, Vargová *et al.* 2014).

The relatively small number of recorded findings of congenital syphilis in children's skeletal remains are related to their poor preservation and to the limited possibilities of using conventional diagnostic procedures in paleopathology. In current clinical practice, the main diagnostic methods are serological tests and genetic methods demonstrating DNA pathogen in a tissue sample taken. In dry bones, however, *Treponema pallidum* and serum antibodies are not usually preserved, so classic procedures can only rarely be used (Kolman *et al.* 1999). Palaeopathological diagnosis of congenital syphilis was therefore mainly based on macroscopic and radiological examinations. The easiest evaluation was in the cases of the presence of characteristic dental stigmas (Hutchinson's teeth, Fournier's tooth or Moon's molar) with the simultaneous detection of periostitis and osteomyelitis in the bones of the post-cranial skeleton. Mainly osteolysis caused by malignant tumours and osteolysis of tuberculous origin had to be distinguished from syphilitic lytic lesions of the skull. Among tumours, the main diagnostic criterion was the absence of a macroscopically noticeable repair process. Although tuberculous lytic foci have a similar appearance to syphilitic ones, they tend to be lone, in contrast to multiple skeletal affections in syphilis.

Other diseases

In two cases, the manifestations of non-specific inflammation described in our collections were related to the poor dental status. In the first case, chronic periodontitis was induced by the presence of huge lodgements of dental calculus, which mechanically irritates the gums, pushes them away from the bone and thus supports the penetration of microorganisms into the periodontal tissues. A more serious affliction was an inflammatory process on the infra-temporal surface of the upper jaw. In the retromaxillary region, there is a risk of the spread of infection through the *plexus pterygoideus* into the orbit, and from there to the sinus cavernosus (Urban 1976).

Another non-specific inflammation was purulent osteomyelitis, found on the medial surface of one of the tibiae, which was probably post-traumatic. The unifocal deposit and localisation of the lesion corresponds to the transfer of an infection from an open injury (usually *Staphylococcus aureus*). The affected part of the tibia is not protected by the muscle, so it is very vulnerable. There is a bigger number of lesions in the endogenous form of osteomyelitis, where the infection is spread through the body by the bloodstream (Steinbock 1976).

Obvious traumatic changes were recorded in the studied bones in only two cases (salvage AT 19, AT 202). In particular, the cutting injury at the distal end of the femur (AT 202) was unusual. The healed notch resembled an ossified insertion of the thigh adductors *(myositis ossificans*), but the formation did not coincide with placement of their insertion on the *labium mediale linae asperae femoris*.

The cases of aseptic bone necrosis were interesting findings. In the case of the affected lateral condyle of the tibia (A 2805), it can be assumed that the cause of insufficient blood supply was a trauma that damaged the nutrition of the blood vessels. This part of the bone is usually well supplied with blood during development and it very rarely necrotises.

A more common finding in clinical practice is Perthes Disease. Its aetiology has not yet fully been elucidated. The main cause of this disease is probably the anomaly of the vascular supply to the proximal end of the femur in childhood, when the proportion of arteries supplying the proximal epiphysis gradually changes during growth. In the case described (AT 855), the deformation of caput femoris corresponds to the Type III ischaemic necrosis classification by Bucholz-Ogden (Bartoníček *et al.* 1991).

Tumour diseases were not diagnosed in the sample of the children's population. In the Czech Lands, only six cases of malignant tumours have been reliably described on skeletal remains from archaeological research. All findings, however, were exclusively in adults (Strouhal, Němečková 2008). One reason may be the relatively low number of malignant tumours with bone manifestations in childhood. Another reason is certainly the poor preservation of fragile children's bones, impaired in addition by the tumour process.

Comparison with literary sources

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. With the increase in medical knowledge in later years, their noticeable value is substantially higher.

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 metabolic diseases (for example, calcium or magnesium deficiency, excess sodium or *hyperbilirubinaemia*). In infancy, febrile convulsions occur in high temperature infections. Seizures of convulsions are also caused by epilepsy and can also accompany injury, inflammation, brain tumour, etc. (Houštěk *et al.* 1980).

In the younger children (1 to 4 years), the cause of death was mainly smallpox (25.3 %), tuberculosis (20.3 %), infantile convolutions (18.3 %), emetic cough (7.9 %), unspecified dropsy (anasarca) (3.9 %) and dysentery (3.5 %). Other diseases were rarely reported. In addition, death in older children (5–14 years) was most caused by smallpox (17.1 %) and tuberculosis (11.8 %), followed by anasarca (7.9 %) and abdominal typhus (7.9 %), further, emetic cough (5.3 %) and pneumonia of different aetiology (5.3 %).

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 3*. 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, bronchitis and pneumonia of various aetiology (9.3 %), gastritis and gastroenteritis (4.4 %) and tuberculosis (4.4 %) played a significant role in paediatric mortality.

The health situation in Moravia in the 19th century

The accumulation of a considerable part of the population in urban agglomerations, due to the expansion of industrialisation, contributed to the spread of this chronic infectious disease at the turn of the 19th century. At that time, the treatment of this disease was only dietary and climatic, which was ineffective and unaffordable for most of the inhabitants of Brno. Improvements in medical care were slow and gradual and depended on the implementation of the Theresian and Josephine healthcare reforms in practical life.

The childhood population was the group of inhabitants most at risk at this time. 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. Even in this facility, due to hygiene deficiencies and a lack of finances, treatment was problematic, especially of infectious diseases.

The first prophylactic measures were only considered with regard to vaccination against variola. In Brno, vaccination began in 1791, but initially it was only in rare cases. It was not until the discovery of the smallpox vaccine by British physician Edward Jenner (*1749–†1823) in 1796, that vaccination spread throughout the country. Moravia became the most forward-looking country in the whole Austrian monarchy concerning prophylactic vaccination against smallpox. In order to increase the motivation of the population to be vaccinated, large vaccination events were organised in Brno with music, singing, dancing and the distribution of financial bonuses from monetary donations gathered from collections. There were rewards for parents who allowed their children to be vaccinated. A severe outbreak of smallpox between 1799 and 1800, which killed about 7 000 inhabitants, contributed to the widespread use of vaccination in Brno (Kruta 1971).

In the 18th century and throughout the 19th century, Brno children suffered not only from tuberculosis, but also from other diseases, as evidenced by written

TABLE 3: The causes of the death of children in the 1920s in Brno focusing on inflamattory diseases, traumas and tumours based on the data from Parish Registers.

Age category / **Cause of death**	**> 1** **N=1011**	**1-5** **N=81**	**6-15** **N=64**	**Total** **N=1156**	**%**
Sepsis	8	1	1	**10**	**0.9**
Meningitis and encephalitis	16	6	6	**28**	**2.4**
Bronchitis and pneumonia	80	23	4	**107**	**9.3**
TB	11	16	24	**51**	**4.4**
Influenza	2	3	0	**5**	**0.4**
Diphtheritis	0	3	1	**4**	**0.3**
Pertussis	6	2	0	**8**	**0.7**
Scarlatina	1	7	2	**10**	**0.9**
Morbilli	1	0	0	**1**	**0.1**
Smallpox, chickenpox	0	2	0	**2**	**0.2**
Erysipelas	5	0	1	**6**	**0.5**
Syphilis	29	0	0	**29**	**2.5**
Gastroenteritis, peritonitis	45	5	1	**51**	**4.4**
Typhus	0	1	0	**1**	**0.1**
Dysentery	0	1	0	**1**	**0.1**
Hernia	2	0	0	**2**	**0.2**
Nephritis	1	0	4	**5**	**0.4**
Osteomyelitis	1	1	1	**3**	**0.3**
Tetanus	2	1	1	**4**	**0.3**
Malign tumours	1	0	2	**3**	**0.3**
Intoxication	2	1	2	**5**	**0.4**
Injuries	2	3	3	**8**	**0.7**
Murder	2	1	0	**3**	**0.3**
Others	794	4	11	**809**	**70.0**

documents. These were respiratory diseases, such as diphtheria, pertussis, scarlatina, and bacterial inflammation of the lungs of various origins, as well as alimentary infections including diarrhoea, salmonellosis, icterus, and others.

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.

Parish Registers of the deceased also indicate children's deaths due to unfortunate incidents, such as poisoning, burns or drowning. At that time, some of the children were even subjected to violence, which is evidenced by murders through suffocation,

strangulation, etc. It is interesting that the records also captured two cases of suicide committed by teenage girls.

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).

CONCLUSIONS

The presented paper forms part of a comprehensive study focused on monitoring the health status and causes of mortality of children in Moravia during the 13th to 19th centuries, within the context of a palaeopathological analysis of children's skeletal remains. This section is devoted to inflammatory diseases, traumatic changes and tumours. In this group of diseases, tuberculosis was most commonly reported on bones.

A palaeopathological study demonstrates the high incidence of tuberculous meningitis and congenital syphilis.

There were only a few cases of traumatic changes in children's skeletons, related to the considerable elasticity of children's bones containing higher amounts of organic substances.

The osteological study did not detect any malignant tumours in Moravian children, whereas the Parish Register of the deceased recorded three deaths from this type of illness. This is not a surprise, as the expansion of the textile industry resulted in environmental pollution and an increase of carcinogens.

The presented study has sought to supplement some of the findings on the history, development and epidemiology of children's illnesses 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. At that time, extensive state health reforms were introduced to help develop specialised medical disciplines including Obstetrics and Paediatrics. All these circumstances were essential for the gradual improvement in paediatric care.

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