

MATEUSZ MIKOŁAJCZYK<sup>1</sup>

## Factors that Contributed to the Good Condition of Nicolaus Copernicus's Teeth

Czynniki, które przyczyniły się do dobrego stanu zębów Mikołaja Kopernika

<sup>1</sup> Student of Dentistry, Faculty of Dental Medicine, Medical University of Warsaw in Poland

### ABSTRACT

Nicolaus Copernicus was not only a world-famous astronomer but a physician as well. He was born on 19<sup>th</sup> February 1473 in Toruń and died on 24<sup>th</sup> May 1543 in Frombork. His remains were found in 2005 in Frombork Cathedral.

The aim of this work is to identify the reasons for mild tooth loss in the maxilla of 70-year-old Nicolaus Copernicus. This study analyzed the photos of the maxilla with the following teeth (according to the FDI notation): 22, 13, 23, 14, 24, 15, 25, and 26 from Copernicus's second funeral in 2010.

After analysis of the historical texts, it was confirmed that Copernicus had broad knowledge of various subjects, including medicine, which may have influenced his awareness of dental hygiene and healthy lifestyle. His diet and general health condition were also scrutinized.

The very good state of the teeth of 70-year-old Nicolaus Copernicus may be connected to his high education and social background, wide knowledge of medicine and oral hygiene, proper dietary and lifestyle habits, and good general health. It is probable that the above-mentioned factors had a major impact on Copernicus's longevity. This study is the first to find reasons for the good condition of Nicolaus Copernicus's teeth on the day of his death. The improvement of knowledge about Nicolaus Copernicus's prevention of dental disease may be important for the good condition and longevity of the current human population.

### ABSTRAKT

Mikołaj Kopernik był nie tylko światowej sławy astronomem, ale także lekarzem. Urodził się 19 lutego 1473 r. w Toruniu, zmarł 24 maja 1543 r. we Fromborku. Jego szczątki odnaleziono w 2005 r. w Katedrze we Fromborku. Celem niniejszej pracy było określenie potencjalnych przyczyn nieznacznej utraty zębów u Mikołaja Kopernika w chwili śmierci, mimo jego zaawansowanego wieku (70 lat). W pracy poddano analizie zdjęcia zębów szczęki (oznaczone według systemu FDI: 22, 13, 23, 14, 24, 15, 25, 26), które zostały wykonane podczas drugiego pogrzebu Kopernika w 2010 r. Informacje pozyskane ze źródeł historycznych pozwoliły potwierdzić, że Mikołaj Kopernik posiadał szeroką wiedzę z różnych dziedzin, w tym także z medycyny, co mogło mieć wpływ na jego świadomość w zakresie higieny jamy ustnej i zdrowego stylu życia. W opracowaniu zwrócono również uwagę na ogólny stan zdrowia astronoma oraz zwyczaje żywieniowe panujące w środowisku społecznym Kopernika. Ustalono, że bardzo dobry stan uzębienia 70-letniego Mikołaja Kopernika można wiązać z jego wykształceniem i pochodzeniem społecznym, szeroką wiedzą z zakresu medycyny i higieny jamy ustnej, prawidłowymi nawykami żywieniowymi i trybem życia oraz dobrym ogólnym stanem zdrowia. Jest prawdopodobne, że wymienione czynniki mogły mieć także wpływ na długowieczność Kopernika. Ustalenia te pozwoliły po raz pierwszy w literaturze na wskazanie czynników decydujących o dobrym stanie zębów Mikołaja

**Keywords:** Copernicus's teeth, prophylaxis of dental diseases, lifestyle, education, socioeconomic status, dietary habits

Kopernika w momencie jego śmierci. Pogłębianie wiedzy na temat profilaktyki chorób zębów w kontekście przypadku Kopernika może być ważne i mieć znaczenie dla współczesnej populacji.

**Słowa kluczowe:** zęby Kopernika, profilaktyka chorób zębów, styl życia, edukacja, status społeczno-ekonomiczny, nawyki żywieniowe

## I. BACKGROUND

In 2023, the 550<sup>th</sup> anniversary of the birth of Nicolaus Copernicus was celebrated. Nicolaus Copernicus – the world-famous scientist and astronomer who proposed that the sun was stationary in the center of the universe and the earth revolved around it – was born on 19<sup>th</sup> February 1473 in Toruń and died at the age of 70 on 24<sup>th</sup> May 1543 in Frombork [1]. Both Toruń and Frombork, which now are cities of the Republic of Poland, were ruled by Poland during Copernicus's time. Nicolaus Copernicus was not only a world-famous astronomer but also a physician. He was also active as a canon, jurist, diplomat, economist and even a military leader. Since the end of his education in 1503, when he obtained the degree of doctor of canon law, he spent all 40 years of his life (except for brief journeys) in the region called Warmia which belonged to The Crown of the Kingdom of Poland (Warmia is now a part of the Warmian-Masurian Voivodeship in the Republic of Poland). In Warmia in Lidzbark Warmiński he started his work as a physician and secretary of his maternal uncle, Bishop Lucas Watzenrode, who involved him in the political, economic, church, and administrative matters of the Chapter of the Warmia Bishopric. After his uncle's death in 1510, Copernicus moved to Frombork in Warmia. It was the place of his astronomical research and permanent residence, except for the journeys related to the tasks assigned to him by the chapter. These tasks were related not only to economic matters but also to the organization of the resistance movement against the Teutonic Order, including preparations for the defense of the Castle of Warmian Cathedral Chapter in Olsztyn. In 1521, Copernicus became the commissioner of Warmia and, in 1523, the general administrator of the Diocese of Warmia. During that time, apart from astronomical research, he worked on monetary affairs [2]. He spent most of his life working and living in Frombork in Warmia, where he died on 24<sup>th</sup> May 1543.

Nicolaus Copernicus was buried in the Archcathedral Basilica in Frombork. In 2005 archaeologists located his probable grave there. The discovery of the grave of Nicolaus Copernicus and his subsequent remains

was confirmed using forensic facial and skull reconstruction and genetic analyses [3,4]. The grave was in poor condition and not all of the remains of the skeleton were found. Among the missing bones, there was no mandible. Some of the teeth (upper second molars and upper first right molar) and parts of the femur and vertebrae were used as samples for DNA extraction and genotyping of the rest of the suspected remains of Nicolaus Copernicus. The DNA extraction from skeleton material was performed in three laboratories: the Institute of Forensic Research in Krakow (Poland), the Museum and Institute of Zoology of the Polish Academy of Sciences in Warsaw (Poland) and Rudbeck Laboratory at Uppsala University (Sweden) [3]. Swedish genetic experts compared DNA from vertebrae, the femur and a tooth with DNA from two hairs retrieved from a tome that Nicolaus Copernicus once owned (the book was kept in the library of Uppsala University in Sweden). The DNA from the skeleton found in the grave matched the DNA from the hair samples taken from the book owned by Copernicus.

Copernicus's remains were reburied in the same place in the Archcathedral Basilica in Frombork on 22 May 2010 which was five years after finding his grave. The pictures of his skeleton (Fig. 1) were made during the preparation for his second funeral. However, some researchers [5] suggest that the discovered teeth and bones could not belong to a person who died around the age of 70 because of the unexpectedly good condition of the teeth. It is known that tooth loss has been shown to correlate with multiple systemic comorbidities and is associated with disease-specific mortality. Therefore, this study sought to determine the hypothetical reasons for the good condition of the teeth of 70-year-old Nicolaus Copernicus.

## 2. TEETH PHOTOS FROM COPERNICUS'S SECOND FUNERAL

The photos (Fig. 1) show that during the second funeral in 2010 the maxilla contained the following teeth

(according to the FDI World Dental Federation (ISO) notation):

- tooth 22 (the left permanent upper lateral incisor),
- teeth 13 and 23 (the right and the left permanent upper canines),
- teeth 14 and 24 (the right and the left permanent upper first premolars),
- teeth 15 and 25 (the right and left permanent upper second premolars),
- tooth 26 (the left permanent upper first molar).

As illustrated in Figure 1: (A) – the photos showing Copernicus's skeleton and teeth; (B) – the photo was taken from the left side of the skull; (C) – the photo was

taken from the front left of the skull; (D) – the photo was taken from the right side of the skull; (E) – the photo was taken from the front side of the skull; (F) – the photo was taken from the top side of the skull.

Analysis of the photos from earlier publications [3,4,6] indicates that other three teeth were present during the discovery of the remains of Nicolaus Copernicus in 2005, i.e. tooth 16 (the right permanent upper first molar), teeth 17 and 27 (the right and the left permanent upper second molars). These three teeth (16, 17, 27) are absent in the pictures made in 2010 (Fig. 1) because they were submitted for DNA testing to three independent laboratories in Warsaw, Kraków, and Uppsala [3].



Fig. 1. The pictures of Copernicus's remains which were made during the preparation for his second funeral in 2010 (pictures copyright Rev. Prof. Dr. hab. Andrzej Kopiczko)

After-death estimation of adults' dental age is complicated because as age advances, the dentitions become influenced by numerous exogenous and endogenous factors which may lead to discrepancies between dental age and chronologic age. Age estimation in adults needs multidisciplinary and a combination of skeletal, biochemical, and molecular methods and various models including artificial intelligence (AI) models [7,8,9]. On the basis of photographs (Fig. 1), it can be demonstrated that the remaining teeth of Nicolaus Copernicus have physiological attrition as in an aging person, which is caused by tooth-tooth contact resulting in a loss of tooth tissue. Examples of physiological tooth wear are visible in the pictures (Fig. 1 B-D), e.g. worn incisal edge cusp in the canines and lost contact points of the teeth which became contact surfaces. Pathological tooth wear (pathological attrition, abrasion and erosion), which sometimes is followed by caries, may be caused by the consistency and type of consumed food, oral hygiene, the intensity of the chewing, saliva hyposecretion, genetic susceptibility of tooth tissues, missing teeth and parafunction e.g. bruxism, which can be associated with a stressful lifestyle [10,11]. Although it seems unlikely because there is no historical evidence of that matter, the situation in which Copernicus did not have teeth in his mandible because of an unknown reason cannot be excluded. This highly unlikely situation would prevent his upper teeth from physiological attrition as the teeth would not have their antagonists.

It is now widely known that barriers to maintaining healthy teeth are low socioeconomic status, lack of oral health education and lack of access to healthcare and prophylaxis. Preventive and health-promoting approaches based on common protective factors such as teeth brushing, healthy nutrition, reduction of sugar consumption, cessation of tobacco smoking and limitation of the consumption of alcohol apply to maintain good oral and general health. These factors probably played the same important role in the maintenance of healthy teeth in Copernicus's times.

### 3. EDUCATION, SOCIAL BACKGROUND AND SOCIOECONOMIC STATUS

It is known that current preventive dentistry prophylaxis was not relevant in the times of Nicolaus Copernicus, but it can be assumed that the condition of the oral cavity and teeth has always been related to education and socioeconomic status. Copernicus's medical education and his broadening of knowledge could potentially influence his maintenance of good-quality teeth. Young Nicolaus's education was provided to him by his maternal uncle Lucas Watzenrode who became

his guardian after his father died. He started his higher education at the Kraków Academy, where he studied liberal arts, including astronomy and astrology. However, his four-year studies in Kraków (1491-1495) did not result in obtaining a degree [12]. Despite the efforts of his wealthy and powerful uncle (Lucas Watzenrode was the Bishop of Warmia), he was not admitted to the group of Warmian canons. The first university where young Copernicus started his further studies was the University of Bologna in Italy (1496-1501). After four years of law study in Bologna, he moved to Padua (1501-1503). It is unclear when and where Copernicus completed his law studies, which began in Bologna, and when and where he began his medical studies, whether in Bologna or in Padua [13]. However, it is known that he continued his medical studies in Padua.

He was never awarded the degree of Doctor of Medicine, but he probably obtained a bachelor's degree, which allowed him to practice medicine and treat people in the future. Additionally, at that time, astronomy and astrology were closely related to medicine. Astrology was used as a tool for both the diagnosis and treatment of illnesses. Hence, Copernicus's knowledge of astronomy and astrology from earlier years of study in Kraków was useful and closely associated with the study of medicine at the University of Padua. In Padua, Copernicus also studied Greek philology. Copernicus's studies were eventually completed, and he obtained the degree of Doctor of Canon Law in 1503 at the University of Ferrara in Italy.

Copernicus's educational attainment was a very important determinant of his chances to become a well-paid official of the Diocese of Warmia. A position in the Warmian Cathedral chapter's canon secured a high standard of living. As noted above, Copernicus was a well-endowed person whose knowledge spanned a substantial number of subjects, including medicine, which may have influenced his awareness of caring for dental hygiene and leading a healthy lifestyle.

### 4. MEDICAL KNOWLEDGE AND ORAL HYGIENE

Thanks to his medical education, Nicolaus Copernicus became an authority in his environment. For many years he treated his uncle Lucas Watzenrode as well as other members of the Warmian Chapter. He also tried to treat his brother Andrzej who suffered from syphilis. However, Copernicus could not cure this then-incurable disease and Andrzej died in Rome at the age of 53 [14]. Due to his highly valued skills in the medical area, Copernicus was called on as a consultant for patients even outside the borders of Warmia, e.g. in Königsberg and Gdańsk. He also maintained contact

with other well-known physicians of that time, e.g. Jan Benedykt Solfa (the court physician of Sigismund I the Old), Wawrzyniec Wille / Wilde (the court physician of Albrecht Hohenzollern) and Jan Tresler (a doctor and Canon of Wrocław) [2,15]. Thanks to these connections he received advice on curing difficult medical cases.

In 1519, during the outbreak of a plague in Braniewo, Copernicus was also summoned for help there. Seeking a cure for the plague, he used Michał Sawonarola's book which he had had since his studies and made side notes in the margins of the chapter about plague prevention. It is worth emphasizing that Copernicus marked in the book a fragment that contained advice about rubbing the teeth with a small amount of tyriac (or 'alleo' for the poor) during the plague and eating some garlic, drinking some wine and dressing warmly before leaving the house in the morning. Tyriac, which was a commonly known medicine at that time, was made from aloe vera, valerian, licorice, rhubarb, fennel, turpentine, ginger, mustard, cinnamon, pepper, castoreum and opium. It is known that Copernicus used to rub his teeth with it almost every day [16]. Some of these plants are still used nowadays as the ingredients of herbal toothpaste [17].

Nicolaus Copernicus was relying on the methods and results of ancient Hellenic and Hellenistic science, and Medieval Arabic science. In the past, opium was mainly used as an analgesic, but in dentistry, small amounts of this narcotic substance combined with other ingredients might have had some other medicinal properties. For example, the Arabs used different plant-based substances, e.g. opium, in order to prevent caries and periodontitis. One of the greatest luminaries of medicine among the Arabs was Avicenna (Ebn Sina) [18]. Copernicus knew Avicenna's medical recommendations as many references to them were made in Savonarola's book, which Copernicus used. During a toothache, Avicenna suggested drilling a tooth cavity in order to remove accumulated pathogens and then filling the cavity with medicines. In order to cure periodontitis and relieve the pain caused by it, Arabian medics used opium, rose oil, pepper, ginger, and even castoreum [19]. Recommendations related to dealing with toothaches were also contained in the book entitled *Breviarium Practice* by Arnold de Villa Nova which was owned by Copernicus [16]. Except for these two mentioned books, Nicolaus Copernicus undoubtedly owned and used many other medical books in his work. Two of them were donated by the executors of his last will to canon Fabian Emerich who was a doctor. Some of his other books were given to the Bishop's Library in Lidzbark Warmiński. The rest of them were donated to the Chapter Library in Frombork. Subsequently, they were carried from Frombork to the Jesuit College

in Braniewo, and then due to a war with Sweden (1626-1629) these books were taken to Sweden [20]. Currently they are held in four Swedish libraries – the Royal State Library in Stockholm, the Library of the Astronomical Observatory in Uppsala, and the Chapter Libraries in Strängas and Linköping. In addition, some of the books from Frombork are nowadays placed in the town of Abo (Turku) in Finland [16]. Medical books which are known to have been owned and used by Nicolaus Copernicus include: Arnoldus de Villa Nova, *Breviarum practicae medicinae*, Pawia, 1485; Joannes Michael Savonarola, *Canonica de febris*, Bolonia, 1487; Hugo Seneasis, *Super IV Fen. I. Canonis Avicennae*, Venice, 1485; Joannes Michael Savonarola, *Opus medicinale seu practica de aegritudinibus*, Venice, 1486; Valascus de Tharenta, *Practica medicinae alias Philonium pharmaceuticum et chirurgicum dicitur*, Lyon, 1490; Montagnana Bartłomiej, *Consilia*, Venice, 1499; Hippocrates, *De praeparatione hominis*, Tübingen, 1512; Alexander Benedetti, *Anatomice et Aphorismi*, Paris, 1514; Galenus Klaudius, *De afeorum locorum notitia libri sex*, Paris, 1513; Dioskorides Pedanios, *De materia medica libri VI*, Florence, 1518-1532; Mesue, *Opus medicinale cum expositione Mondini super canones universales*, Venice, 1502; Paulus de Aegina, *Libri septem quibus dextra medendi ratio... continetur*, Basel, 1538; Hippocrates, *Praesagiorum libri tres*, Paris, 1511; Paulus de Aegina, *Praecepta salubria*, Paris, 1512; Johannes de Vigo, *Practica arte chirurgica*, Lyon, 1516; Johannes de Cuba, *Hortus Sanitatis*, Paris, 1497; Johannes de Ketham, *Fasciculus medicinae*, Venice, 1500; Antonius Guainerius, *Practica medica*, Venice, 1497/1498; Johannes Gaddesden, *Practica (...) rosa medicinae nuncupata*, Padua, 1492; Arnoldus de Villa Nova, *Breviarum practicae medicinae*, Venice, 1497; Petrus de Argellata, *Cirurgia*, Venice, 1499; and Mattheus Silvaticus, *Opus pandectarum medicinae. Questiones aliorum auctorum*, Venice, 1498 [12].

The number of medical books containing Copernicus's handwritten notes indicates that he was a person who had vast medical knowledge. His wisdom was based on information from various periods of time and different places including antiquity, the Arabian world and the Middle Ages. It is assumed that his extensive medical awareness along with continuous self-education allowed Copernicus to maintain the relatively good condition of his teeth. Not only did he know different methods of treatment, but he cared about oral cavity prophylaxis followed by a healthy lifestyle.

## 5. DIETARY HABITS AND LIFESTYLE

It is known that Copernicus had many duties as a canon, including mapmaking, collecting taxes and

managing the money, serving as a secretary, and practicing medicine. In the literature, there is little information about his lifestyle, including his dietary habits and leisure time. On the basis of possible similarity, an example of regulations arranging these elements of Copernicus's everyday life could be the ones used by the alumni of the Diocesan Seminary in Braniewo (located 10 km away from Frombork). In the Diocesan Seminary, for breakfast, the alumni ate beer soup or a piece of cheese and sometimes a piece of butter as well. For dinner, they were given boiled meat, beef tripe, pluck, hunter's stew (bigos), carrots or cabbage and other vegetables, and on fasting days, it was alternately fish cooked in broth, oat flour mash, salted fish, beer soup, fish with pepper, herring, smoked cod or dried fruit (plums or pears). For afternoon tea, the alumni ate white bread or drank a mug of beer. Suppers consisted of milk, roast, millet porridge with milk, dumplings or fish. Therefore, according to today's knowledge, the menu did not contain dishes that would have a bad effect on the health condition. Although the alumni drank beer, it was only a homemade special beer [21].

Of course, Nicolaus Copernicus, who was a wealthy canon, could afford better food than the alumni but moderation in eating and drinking was required among all members of the Frombork Chapter. During the day, the most important responsibilities were service of God, choir prayer and liturgical service. It should be pointed out that Copernicus was aware of the importance of a healthy diet, as he recommended it as a remedy for the intestinal illness of Bishop Maurice Ferber in 1536 [15]. Most likely, Nicolaus Copernicus's diet contributed to the good condition of his teeth. The food that he ate contained little or no amounts of sucrose and other sugars, which prevented him from developing carious cavities. Additionally, he did not eat coarse-grained food which significantly reduced the risk of developing abrasion and slowed down the process of attrition.

## 6. GENERAL HEALTH CONDITION

The kind of food can affect the health of the teeth and general health. The health of the oral cavity can significantly impact general health and vice versa. Maintenance of the number of teeth, increased oral function, having a good diet and maintaining nutritional status are all linked to general health. It should be pointed out that Copernicus was very rarely sick. Getting ill with 'fever' in 1538, which excluded him from one of the deliberations of the Chapter was noted as something extraordinary, although he was already elderly at that time [22]. Moreover, Copernicus's good condition of

the teeth can be connected to the fact that there is no information about him having any chronic diseases.

Among the male elite of the Kingdom of Poland and the Grand Duchy of Lithuania in the fifteenth and sixteenth centuries, the life expectancy was thirty-four and lifespans reached fifty to fifty-five, although some people lived on into their seventies like Nicolaus Copernicus, who lived on into the beginning of his seventy-first year [23,24]. Maybe the reason for his longevity was the good condition of the teeth. Today, we know that there is a relationship between the number of teeth, oral function, and longevity [25]. The health of the oral cavity can significantly impact general health and longevity. Future research may be able to explain the mechanisms and correlation between Nicolaus Copernicus's mild tooth loss and his healthy longevity.

## 7. CONCLUSION

In conclusion, the good condition of the teeth of the 70-year-old Nicolaus Copernicus can be connected to (1) high education, social background and socio-economic status, (2) wide knowledge about medicine and oral hygiene, (3) proper dietary and lifestyle habits, and (4) good general health. It is probable that the above-mentioned factors had a major impact on Copernicus's longevity. This study is the first to find reasons for the good condition of Nicolaus Copernicus's teeth on the day of his death. The improvement of knowledge about Nicolaus Copernicus's prevention of dental disease may be important for the good condition and longevity of the current human population.

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## REFERENCES

- [1] Birkenmajer L.A., *Stromata Copernicana*, Polish Academy of Arts and Sciences – PAU, Cracow (Poland) 1924.
- [2] Sikorski J., Mikołaj Kopernik na Warmii: chronologia życia i działalności. *Masuro-Warmian Bulletin*, 1966, 2, 309-338.
- [3] Bogdanowicz W., Allen M., Branicki W. et al., Genetic identification of putative remains of the famous astronomer Nicolaus Copernicus. *Proc Natl Acad Sci U S A*,

- 2009, 106(30), 12279-12282, <https://doi.org/10.1073/pnas.0901848106>.
- [4] Gąsowski J., *The Search for Nicolaus Copernicus's Tomb*, The Pułtusk Academy of Humanities Publisher, Pułtusk (Poland) 2006.
- [5] Kozłowski T., An Anthropologist's Reflections Over the Identification of the Bone Remains Discovered in Frombork Cathedral and Regarded as Belonging to Nicolaus Copernicus. An Attempt at Critical Evaluation, [in:] *The Nicolaus Copernicus grave mystery A dialogue of experts Kraków*, ed. Kokowski M., Polish Academy of Arts and Sciences – PAU, Cracow (Poland) 2012, 59-79.
- [6] Zajdel D., Czy tak wyglądał Kopernik?. *Issues of Forensic Science*, 2006, 251, 39-44.
- [7] Joo S., Jung W., Oh S.E., Variational Autoencoder-Based Estimation of Chronological Age and Changes in Morphological Features of Teeth. *Sci Rep*, 2023, 13(704), 1-11, <https://doi.org/10.1038/s41598-023-27950-4>.
- [8] Verma M., Verma N., Sharma R. et al., Dental Age Estimation Methods in Adult Dentitions: An Overview. *J Forensic Dent Sci*, 2019, 11(2), 57-63, [https://doi.org/10.4103/jfo.jfds\\_64\\_19](https://doi.org/10.4103/jfo.jfds_64_19).
- [9] Spalding K.L., Buchholz B.A., Bergman L.-E. et al., Age Written in Teeth by Nuclear Tests. *Nature*, 2005, 437, 333-334, <https://doi.org/10.1038/437333a>.
- [10] Jańczuk Z., Kaczmarek U., Lipski M., *Stomatologia zachowawcza z endodoncją. Zarys kliniczny*, Medical Publishing House PZWL, Warsaw (Poland) 2014.
- [11] Piątowska D., *Kariologia współczesna. Postępowanie kliniczne*, Med Tour Press International – MTP, Warsaw (Poland) 2009.
- [12] Jarzębowski L., *Biblioteka Mikołaja Kopernika*, Scientific Society in Toruń, Toruń (Poland) 1971.
- [13] Górski K., *Mikołaj Kopernik. Środowisko Społeczne i Samotność*, The Nicolaus Copernicus University Press, Toruń (Poland) 2012.
- [14] Borzyszkowski M., Mikołaj Kopernik i Tideman Gise. *The Studies of Warmia*, 1972, 9, 185-204.
- [15] Małek J., Mikołaj Kopernik jako lekarz i prawnik. *The Museum in Toruń Annual*, 2001, 10, 24-29.
- [16] Flis S., Kopernikowski inkunabuł medyczny w Olsztynie. *Masuro-Warmian Bulletin*, 1970, 4, 589-606.
- [17] Janakiram C., Venkitachalam R., Fontelo P. et al., Effectiveness of Herbal Oral Care Products in Reducing Dental Plaque & Gingivitis – a Systematic Review and Meta-Analysis. *BMC Complement Med Ther*, 2020, 20(43), 2-12, <https://doi.org/10.1186/s12906-020-2812-1>.
- [18] Hussain A., Khan F.A., History of Dentistry. *Arch Med Health Sci*, 2014, 2(1), 106-110.
- [19] Szpilczyński S., Kopernikowska wizja postępu w medycynie. *Quarterly J. His. Sci. Technol.*, 1968, 13(3), 580-581.
- [20] Czartoryski P., *The Library of Copernicus in Science and History: Studies in Honor of Edward Rosen, Studia Copernicana XVI*, eds Hilfstein E., Czartoryski P., Grande F. D., Ossolineum Publishing House – the National Institute of Ossoliński of the Polish Academy of Sciences, Wrocław (Poland) 1978, 355-396.
- [21] Makarczyk I., Menu kleryków seminariów braniewskich – diecezjalnego z 1595 roku i papieskiego z 1789 roku, [in:] *Między Barokiem a Oświeceniem. Radości i Troski Dnia Codziennego*, ed. Achremczyk S., Publisher of the Wojciech Kętrzyński Scientific Research Center, Olsztyn (Poland) 2006, 1, 452-468.
- [22] Biskup M., *Regesta Copernicana*, Ossolineum Publishing House – the National Institute of Ossoliński of the Polish Academy of Sciences, Wrocław (Poland) 1973.
- [23] Liedke M., Śmierć magnata, czyli co liczby mogą powiedzieć o konsekwencji śmierci mężczyzny w rodzinie magnackiej w Wielkim Księstwie Litewskim w XVI-XVIII w. (The Death of a Magnate, or What Figures Can Tell About the Consequences of a Man's Death in a Magnate Family in the Grand Duchy of Lithuania in the 16th-18th c.). *Kwartalnik Historii Kultury Materialnej (The Quarterly of the History of Material Culture)*, 2012, 60, 2, 271-282.
- [24] Liedke M., Demografia rodziny magnackiej w Wielkim Księstwie Litewskim na tle elit zachodnioeuropejskich. Wybrane problemy (The Demography of the Magnate Family in the Grand Duchy of Lithuania against the Background of the West European Elites. Selected Problems). *Przeszłość Demograficzna Polski (Poland's Demographic Past)*, 2015, 1, 37, 37-70, <https://doi.org/10.18276/pdp.2015.1.37-02>.
- [25] Watanabe Y., Okada K., Kondo M. et al., Oral Health for Achieving Longevity. *Geriatr Gerontol Int*, 2020, 20(6), 526-538, <https://doi.org/10.1111/ggi.13921>.