

Risk of CMV infection in nurses in Poland: Is it worth performing screening tests to estimate the prevalence of cytomegalovirus antibodies in Polish nurses?

Ryzyko zawodowe zakażenia wirusem CMV u pielęgniarek – czy warto wykonywać badania przesiewowe dotyczące określenia częstości występowania przeciwciał przeciw wirusowi cytomegalii wśród pielęgniarek w Polsce?

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Pielęgniarstwo i Zdrowie Publiczne, ISSN 2082-9876 (print), ISSN 2451-1870 (online)

Piel Zdr Publ. 2020;10(1):43–47

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Funding sources

None declared

Conflict of interest

None declared

Received on February 15, 2019

Reviewed on May 9, 2019

Accepted on September 9, 2019

Abstract

Nurses are an occupational group exposed to a number of adverse chemical, physical and psychosocial factors. A typical exposure in this group is chronic exposure to biological agent present in the work environment in connection with healthcare services provided by nurses and consisting primarily of direct contact with patients. Adverse biological agents are a substantial problem causing negative consequences of performing one's duties; they include contagious, allergic, toxic, irritant, and carcinogenic agents. Undoubtedly, specific of the nurse profession results in a risk of occupational exposure to cytomegalovirus (CMV) infection. Screening tests are therefore necessary in this occupational group, provided that CMV is still one of the most prevalent etiologic intrauterine factors of fetal infections. In case of primary infection of a pregnant woman, mother-to-fetus transmission occurs in 30–40% of cases. In addition, the CMV is suggested to contribute to several widespread cardiovascular, neoplastic or autoimmune diseases.

Key words: nurses, occupational exposure, biological agents, cytomegalovirus

This is a translated article.

Please cite the original

Polish-language version as

Zając P, Czarkowska-Pączek B. Ryzyko zawodowe zakażenia wirusem CMV u pielęgniarek – czy warto wykonywać badania przesiewowe dotyczące określenia częstości występowania przeciwciał przeciw wirusowi cytomegalii wśród pielęgniarek w Polsce? *Piel Zdr Publ.* 2020;10(1):42–47. doi:10.17219/pzp/112222

DOI

10.17219/pzp/112222

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Streszczenie

Pielęgniarki stanowią grupę zawodową narażoną na różnorodne niekorzystne czynniki chemiczne, fizyczne i psychospołeczne. Typowa dla tej grupy zawodowej jest chroniczna ekspozycja na obecne w środowisku pracy czynniki biologiczne w związku z realizacją przez pielęgniarkę świadczeń zdrowotnych, polegających przede wszystkim na bezpośrednim kontakcie z pacjentem. Szkodliwe czynniki biologiczne stanowią bardzo istotny problem w kontekście niekorzystnych skutków zdrowotnych nabytych w procesie pracy, mogących powodować wielokierunkowe następstwa zdrowotne o charakterze zakaźnym, alergicznym, toksycznym, drażniącym oraz rakotwórczym. Niewątpliwie specyfika pracy pielęgniarki sprawia, że ekspozycja zawodowa niesie za sobą ryzyko transmisji zakażenia cytomegalowirusem (CMV). Niezbędne są zatem badania w tej grupie zawodowej, tym bardziej że CMV wciąż pozostaje jednym z najczęstszych etiologicznych czynników wrodzonych zakażeń płodu. Podczas zakażenia pierwotnego ciężarnej transmisja wirusa od matki do płodu może sięgać nawet 30–40%. Ponadto sugeruje się udział CMV w rozwoju wielu szeroko rozpowszechnionych chorób sercowo-naczyniowych, nowotworowych czy autoimmunologicznych.

Słowa kluczowe: pielęgniarki, narażenie zawodowe, czynniki biologiczne, wirus cytomegalii

Background

By reason of their duties, healthcare workers constitute an occupational group exposed to a variety of adverse chemical, physical and psychophysical agents.¹ A typical exposure of the medical staff is chronic exposure to harmful biological agents present in the work environment, which trigger, among other things, infectious or invasive diseases caused by viruses, bacteria and fungi. The risk of exposure to biological agents among nurses is related to the scope and nature of their work. This is primarily due to the performance of health services, various medical procedures and care services (such as nutrition, satisfying physiological needs, personal hygiene) by a nurse, which involves mostly direct contact with the patient, his/her blood, body fluids, secretions, and excretions.^{2,3}

The specific nature of a nurse's work means that occupational exposure carries the risk of transmission of infection and, as a result, can even lead to the occurrence of an occupational disease.² The analysis of the data on the incidence of occupational diseases shows that infectious diseases, especially hepatitis B and C, are the most frequently detected among healthcare workers, with the number of cases being much higher among nurses in this occupational group.⁴ Therefore, the greatest attention to the issue of occupational exposure of healthcare workers is paid, in particular, to pathogens such as hepatitis B and C, as well as the immunodeficiency virus.³ Occupational exposure to human cytomegalovirus (CMV) is much less addressed. This stems from the fact that observing appropriate preventive measures and health and safety rules, wearing gloves, as well as washing and disinfecting hands seem to be recognized ways of preventing the transmission of CMV infections.⁵ Therefore, there is currently no routine diagnosis of healthcare workers for CMV infection. This may be due to the reduced awareness and underestimation of the existing risk of exposure to these pathogens in the work environment, especially as there are too few nurses per patient, the consequences of which may have a direct impact not only on the health, length of treatment and mortality of the patients, but may also contribute to

the acquisition of infections by the staff.⁶ The pressure of time and the intensity of work are not conducive to calm, thoughtful action during the performance of procedures. In addition, fatigue, circadian rhythm disorders, permanent stress, and overwork cause routine activities to be carried out in a hurry, thus reducing the quality of the medical care provided. It contributes, for instance, to the failure of the staff to maintain proper hand hygiene.^{7,8} These factors also have a significant impact on immune system disorders,⁹ which may render nurses more susceptible to infections. For this reason, the transmission of CMV infection during care and diagnostic activities, which are an integral part of a nurse's work, cannot be excluded.

The aim of this study was to analyze the current knowledge on the prevalence of antibodies against CMV among nurses, on the basis of selected literature.

Cytomegalovirus – characteristics

Cytomegalovirus, also known as the human herpes virus 5 (HHV-5), belongs to the *Herpesviridae* family and the *Betaherpesvirinae* subfamily. It is associated with characteristic abnormalities in infected cells, which are visible in microscopic examinations. These cells contain large nuclear inclusion bodies, which were first described by Ribbert in 1881. The human-specific virus was isolated in 1956–1957 in 3 independent studies by Weller et al., Smith, and Rowe et al. It was not until 1960 that it was called the Weller's CMV.^{10,11}

Cytomegalovirus is characterized by its ability to survive in the latent form – primary productive infection is followed by the reduction in gene expression.^{12,13} It should be noted that CMV may be periodically reactivated, which is when full viral replication and the subsequent production of viral infectious particles take place.¹³ The mechanisms that allow the virus to remain latent and lead to reactivation are unfortunately not fully understood. It is considered that the absence of immune response of the host, inflammatory processes or even stress can play a key role in reactivating the CMV infection.^{12,14,15}

Cytomegalovirus is widespread in the population, and the levels of seroprevalence vary greatly throughout the world, depending primarily on age, socioeconomic status and origin.^{16,17} It is estimated that specific anti-CMV immunoglobulin G (IgG) antibodies are present in 50–90% of the adult population. In developed countries, the percentage is 40–60%, while in developing countries it even reaches more than 80% of the population.^{13,18}

Cytomegalovirus infection can occur through direct contact with the infected person or material containing infectious particles of the virus such as saliva, blood, blood derivatives, vaginal discharge, urine, breast milk, or transplanted organs.^{17,19} Most frequently, the infection occurs in early childhood. The virus may be detected in children's saliva and urine up to 42 months after infection, which renders them important factors in the transmission of CMV.²⁰ It is worth mentioning that child care professionals may be a high risk group for CMV infection.²¹

Cytomegalovirus infection in patients with normal immunity is usually asymptomatic. It less commonly presents as mononucleosis, with weakness, fever, headache, pharyngitis, tonsillitis, enlarged liver and spleen, or as interstitial pneumonia.^{19,22} In transplantology, CMV is the most common infectious pathogen associated with morbidity and mortality in organ transplant recipients.²³ Cytomegalovirus is also one of the most common etiological factors in congenital infections, affecting 0.5–2% of live births.²⁴ Congenital CMV infection is a common cause of serious developmental disorders, blindness, hearing loss or deafness, symptoms of the central nervous system, and growth restriction. During primary infection of the pregnant woman, the transmission of the virus from the mother to the fetus reaches 30–40% and is associated with the occurrence of direct or long-term consequences of infection in the child (15–25%).²⁵ Moreover, CMV is suggested to be involved in the development of many widespread cardiovascular diseases (atherosclerosis, ischemic heart disease, coronary restenosis),^{26,27} cancers (gliomas, colorectal cancer)^{28,29} and autoimmune diseases (systemic lupus erythematosus, scleroderma, psoriasis).^{30,31}

Research on the incidence of CMV infections among nurses in Poland and abroad

Currently, there are no studies on the prevalence of CMV infection among nurses in Poland. However, already in 1983, in Poland, Szepietowski et al. conducted a study on the prevalence of antibodies against CMV among the staff of the dialysis and internist wards.³² Unfortunately, the study was of a general nature and did not include the division into occupational categories. It is therefore difficult to draw any conclusions about

the prevalence of CMV antibodies in the occupational group of nurses.

In foreign centers, these studies focus primarily on the risk of CMV transmission among nurses working in pediatric wards.^{17–26} However, it should be noted that such studies are often contradictory, and mainly from the 1980s. Many scientists indicate that there is no increased risk of CMV infection as a result of occupational exposure for nurses working in pediatric wards.^{33,34,36–39} Similar conclusions were reached by Lipscomb et al.,⁴¹ who did not demonstrate a link between seropositivity and exposure to “high risk” patients, such as children or immunocompromised patients, in nursing staff. Dworsky et al.³⁸ and Balcarek et al.³⁴ also found that people working in pediatric wards are not significantly more exposed to the risk of CMV infection than those who do not work with children professionally. Also, in the study by Stranzinger et al.³⁹ from 2016, no increased risk of CMV infection was observed in nurses, compared to other occupational groups employed in the same children's hospital.

In the same years, Haneberg et al.³⁵ and Friedman et al.³⁶ presented a contrasting phenomenon in their studies, showing that the prevalence of CMV antibodies among women working in children's hospitals is higher for those working in closer contact with the hospitalized children than for those with less or no contact with the patients. Similar results were also obtained by Sobaszek et al.⁴³ and Lepage et al.,⁴⁴ who observed that IgG CMV seropositivity is more frequent in persons working in pediatric wards as nursing aide rather than the nurses themselves. Therefore, work as a nursing aide in pediatric wards appears to be particularly high risk, connected with a more frequent detection of CMV antibodies in this group.

Abroad, differences in the work of a nurse and nursing aide can be seen, resulting from a different scope of responsibilities. Working as a nursing aide requires frequent and prolonged contact with the patient and his biological material due to the type of patient care provided by persons in this occupation. The work of a nurse mainly involves procedures such as collecting blood and administering injections, and thus requires strict hand hygiene. As a result, nurses wash and disinfect hands more often than nursing aides.

In Poland, nursing care (nutrition, satisfying physiological needs, maintaining personal hygiene), which constitutes a greater risk of contact with the patient's biological material, is mainly performed by nurses. Due to different working conditions of Polish nurses compared to nurses from other countries, foreign research cannot provide the basis for comparison and exclude this profession as a factor conducive to CMV infections. Therefore, the question remains whether the occupational group of nurses in Poland is significantly more exposed to CMV transmission in the course of their professional duties than the population not professionally connected with healthcare. With the above in mind, it is justified to undertake research

on the prevalence of CMV infection in Polish nurses, in order to study the knowledge on this subject and obtain an answer to the above question. In addition, the study will have practical and cognitive significance from an epidemiological point of view for the occupational group of nurses, who are heavily exposed to the pathogenic viral flora. The results of the study will allow supplementing the knowledge on occupational exposure of nurses, especially as the knowledge on working conditions and infections acquired in the working environment of this occupational group is still insufficient.

Conclusions

It is therefore necessary to carry out research in the occupational group of nurses, especially as CMV still remains one of the most common etiological factors of fetal congenital infections associated with direct or long-term consequences of infection in the child.^{24,25} This is of great social significance as the nursing profession is largely feminized. The lack of extensive screening for the determination of the prevalence of CMV antibodies among the occupational group of nurses also makes it impossible to estimate the real extent of the occurrence of pathogens, as well as the possible health effects of long-term exposure to the virus, especially since ensuring safe and hygienic working conditions should be the main element in occupational risk assessment. This study can therefore play an important role with regard to the occurrence of adverse health effects acquired in the course of performing professional duties.

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References

- Gorman T, Dropkin J, Kamen J, et al. Controlling health hazards to hospital workers. *New Solut.* 2013;23(Suppl 1):1–167. doi:10.2190/NS.23.Suppl
- Kowalczyk K, Krajewska-Kułak E, Ostapowicz-Vandame K, et al. Narażenie na czynniki niebezpieczne i szkodliwe w pracy pielęgniarów i położnych. *Probl Piel.* 2010;18(3):353–357. <https://www.termedia.pl/Narazenie-na-czynniki-niebezpieczne-i-szkodliwe-w-pracy-pielgniarow-i-polozonych,134,35155,0,0.html>. Accessed on November 28, 2019.
- Prażak Z, Kowalska M. Czynniki biologiczne w środowisku zawodowym pielęgniarów i możliwości zmniejszenia narażenia. *Hygeia Public Health.* 2017;52(2):111–118. <http://www.h-ph.pl/pdf/hyg-2017/hyg-2017-2-111.pdf>. Accessed on November 28, 2019.
- Wilczyńska U, Szeszenia-Dąbrowska N. Choroby zawodowe wśród pracowników ochrony zdrowia i pomocy społecznej w Polsce. *Med Pr.* 2010;61(6):597–605. http://www.imp.lodz.pl/upload/oficyna/artykuly/pdf/full/2010/%206-2010_uwilczyyska.pdf. Accessed on November 28, 2019.
- Bolyard EA, Tablan OC, Williams WW, Pearson ML, Shapiro CN, Deitchmann SD. Guideline for infection control in healthcare personnel, 1998: Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol.* 1998;19(6):407–463. doi:10.1086/647840
- Estabrooks CA, Midodzi WK, Cummings GG, Ricker KL, Giovannetti P. The impact of hospital nursing characteristics on 30-day mortality. *Nurs Res.* 2005;54(2):74–84. doi:10.1097/00006199-200503000-00002
- Potocka P, Rożkiewicz D, Ołdak D. Higiena rąk wśród personelu medycznego – co jeszcze można zrobić. *Forum Zakazeń.* 2016;7(4):289–293. doi:10.15374/FZ2016050
- Pittet D, Allegranzi B, Boyce J; World Alliance for Patient Safety First Global Patient Safety Challenge Core Group of Experts. The World Health Organization Guidelines on Hand Hygiene in Health Care and their consensus recommendations. *Infect Control Hosp Epidemiol.* 2009;30(7):611–622. doi:10.1086/600379
- Almeida CM, Malheiro A. Sleep, immunity and shift workers: A review. *Sleep Sci.* 2016;9(3):164–168. doi:10.1016/j.slsci.2016.10.007
- Fauquet CM, Mayo MA, Maniloff J. *Virus Taxonomy: VIIIth Report of the International Committee on Taxonomy of Viruses*. San Diego, CA: Elsevier Academic Press; 2005.
- Ho M. The history of cytomegalovirus and its diseases. *Med Microbiol Immunol.* 2008;197(2):65–73. doi:10.1007/s00430-007-0066-x
- Varani S, Landini MP. Cytomegalovirus-induced immunopathology and its clinical consequences. *Herpesviridae.* 2011;2(1):6. doi:10.1186/2042-4280-2-6
- Bulek K. Ludzki wirus cytomegalii (HCMV) – latencja i strategie ucieczki spod kontroli układu odpornościowego. *Post Biol Kom.* 2005;32(1):77–86. https://pbkom.eu/sites/default/files/artykulydo2012/32_1_77.pdf. Accessed on November 28, 2019.
- Wills MR, Poole E, Lau B, Krishna B, Sinclair JH. The immunology of human cytomegalovirus latency: Could latent infection be cleared by novel immunotherapeutic strategies? *Cell Mol Immunol.* 2015;12(2):128–138. doi:10.1038/cmi.2014.75
- Hummel M, Abecassis MM. A model for reactivation of CMV from latency. *J Clin Virol.* 2002;25(Suppl 2):123–136. doi:10.1016/S1386-6532(02)00088-4
- van Boven M, van de Kasstele J, Korndewal MJ, et al. Infectious reactivation of cytomegalovirus explaining age- and sex-specific patterns of seroprevalence. *PLoS Comput Biol.* 2017;13(9):e1005719. doi:10.1371/journal.pcbi.1005719
- Cannon MJ, Schmid DS, Hyde TB. Review of cytomegalovirus seroprevalence and demographic characteristics associated with infection. *Rev Med Virol.* 2010;20(4):202–213. doi:10.1002/rmv.655
- Nyholm JL, Schleiss MR. Prevention of maternal cytomegalovirus infection: Current status and future prospects. *Int J Womens Health.* 2010;2:23–35. doi:10.2147/ijwh.s5782
- Crough T, Khanna R. Immunobiology of human cytomegalovirus: From bench to bedside. *Clin Microbiol Rev.* 2009;22(1):76–98. doi:10.1128/CMR.00034-08
- Dunal M, Trzcińska A, Siennicka J. Wirus cytomegalii – problem zakażeń wrodzonych. *Post Mikrobiol.* 2013;52(1):17–28. <http://www.pm.microbiology.pl/web/archiwum/vol5212013017.pdf>. Accessed on November 28, 2019.
- Joseph SA, Béliveau C, Muecke CJ, et al. Cytomegalovirus as an occupational risk in daycare educators. *Paediatr Child Health.* 2006;11(7):401–407. doi:10.1093/pch/11.7.401
- Zuckerman AJ, Banatvala JE, Pattison JR, Griffiths PD, Schoub BD. *Principles and Practice of Clinical Virology: 5th Edition*. London, UK: John Wiley & Sons Ltd; 2004.
- Beam E, Razonable RR. Cytomegalovirus in solid organ transplantation: Epidemiology, prevention, and treatment. *Curr Infect Dis Rep.* 2012;14(6):633–641. doi:10.1093/pch/11.7.401
- Pokorska-Śpiwak M, Niezgoda A, Gołkowska M, et al. Rekomendacje postępowania w zakażeniach wirusem cytomegalii (CMV) – zalecenia Polskiego Towarzystwa Epidemiologów i Lekarzy Chorób Zakaźnych. *Prz Epidemiol.* 2016;71(1):297–310. http://www.pteilchz.org.pl/wp-content/uploads/2018/11/rekom_cmv_2016.pdf. Accessed on November 28, 2019.
- Ornoy A, Diav-Citrin O. Fetal effects of primary and secondary cytomegalovirus infection in pregnancy. *Reprod Toxicol.* 2006;21(4):399–409. doi:10.1016/j.reprotox.2005.02.002
- Gkrania-Klotsas E, Langenberg C, Sharp SJ, Luben R, Khaw KT, Wareham NJ. Higher immunoglobulin G antibody levels against cytomegalovirus are associated with incident ischemic heart disease in the population-based EPIC-Norfolk cohort. *J Infect Dis.* 2012;206(12):1897–1903. doi:10.1093/infdis/jis620

27. Sorlie PD, Nieto FJ, Adam E, Folsom AR, Shahar E, Massing M. A prospective study of cytomegalovirus, herpes simplex virus 1, and coronary heart disease: The atherosclerosis risk in communities (ARIC) study. *Arch Intern Med*. 2000;160(13):2027–2032. doi:10.1093/infdis/jis620
28. Fonseca RF, Kawamura MT, Oliveira JA, Teixeira A, Alves G, da Glória da Costa Carvalho M. The prevalence of human cytomegalovirus DNA in gliomas of Brazilian patients. *Mem Inst Oswaldo Cruz*. 2012;107(7):953–954. doi:10.1590/S0074-0276201200070002
29. Dimberg J, Hong TT, Skarstedt M, Löfgren S, Zar N, Matussek A. Detection of cytomegalovirus DNA in colorectal tissue from Swedish and Vietnamese patients with colorectal cancer. *Anticancer Res*. 2013;33(11):4947–4950. <http://ar.iiarjournals.org/content/33/11/4947.full>. Accessed on November 28, 2019.
30. Bilgin H, Kocabas H, Kesli R. The prevalence of infectious agents in patients with systemic sclerosis. *Turk J Med Sci*. 2015;45(6):1192–1197. doi:10.3906/sag-1404-150
31. Halenius A, Hengel H. Human cytomegalovirus and autoimmune disease. *Biomed Res Int*. 2014;2014:472978. doi:10.1155/2014/472978
32. Szepietowski T, Adamiec R, Imbs D. Cytomegalovirus antibodies in patients and personnel of a hemodialysis unit [in Polish]. *Pol Arch Med Wewn*. 1983;70(3):101–110.
33. Morgan MA, El-Ghany S, Khalifa NA, Sherif A, Rasslan LR. Prevalence of cytomegalovirus (CMV) infection among neonatal intensive care unit (NICU) and healthcare workers. *Egypt J Immunol*. 2003;10(2):1–8.
34. Balcarek KB, Bagley R, Cloud GA, Pass RF. Cytomegalovirus infection among employees of a children's hospital: No evidence for increased risk associated with patient care. *JAMA*. 1990;263(6):840–844. doi:10.1001/jama.1990.03440060086037
35. Haneberg B, Bertnes E, Haukenes G. Antibodies to cytomegalovirus among personnel at a children's hospital. *Acta Paediatr Scand*. 1980;69(3):407–409. doi:10.1111/j.1651-2227.1980.tb07101.x
36. Friedman HM, Lewis MR, Nemerofsky DM, Plotkin SA. Acquisition of cytomegalovirus infection among female employees at a pediatric hospital. *Pediatr Infect Dis*. 1984;3(3):233–235. doi:10.1097/00006454-198405000-00010
37. Balfour CL, Balfour HH. Cytomegalovirus is not an occupational risk for nurses in renal transplant and neonatal units: Results of a prospective surveillance study. *JAMA*. 1986;256(14):1909–1914. doi:10.1001/jama.1986.03380140079026
38. Dworsky ME, Welch K, Cassidy G, et al. Occupational risk for primary cytomegalovirus infection among pediatric health-care workers. *N Engl J Med*. 1983;309(16):950–953. doi:10.1056/NEJM198310203091604
39. Stranzinger J, Kindel J, Henning M, Wendeler D, Nienhaus A. Prevalence of CMV infection among staff in a metropolitan children's hospital: Occupational health screening findings. *GMS Hyg Infect Control*. 2016;11:Doc20. doi:10.3205/dgkh000280
40. Flowers RH, Torner JC, Farr BM. Primary cytomegalovirus infection in pediatric nurses: A meta-analysis. *Infect Control Hosp Epidemiol*. 1988;9(11):491–496. doi:10.1086/645758
41. Lipscomb JA, Linnemann CC, Hurst PF, et al. Prevalence of cytomegalovirus antibody in nursing personnel. *Infect Control*. 1984;5(11):513–518. doi:10.1017/s0195941700061026
42. Adler SP, Baggett J, Wilson M, Lawrence L, McVoy M. Molecular epidemiology of cytomegalovirus in a nursery: Lack of evidence for nosocomial transmission. *J Pediatr*. 1986;108(1):117–123. doi:10.1016/s0022-3476(86)80785-5
43. Sobaszek A, Fantoni-Quinton S, Frimat P, Leroyer A, Laynat A, Edme JL. Prevalence of cytomegalovirus infection among health care workers in pediatric and immunosuppressed adult units. *J Occup Environ Med*. 2000;42(11):1109–1114. doi:10.1097/00043764-200011000-00015
44. Lepage N, Leroyer A, Cherot-Kornobis N, et al. Cytomegalovirus seroprevalence in exposed and unexposed populations of hospital employees. *Eur J Clin Microbiol Infect Dis*. 2011;30(1):65–70. doi:10.1007/s10096-010-1054-4