lek. Paulina Maria Nowicka

Uwarunkowania wyszczepialności w Polsce na poziomie powiatów

Determinants of vaccination coverage in Poland at the poviat level

Rozprawa doktorska na stopień doktora
w dziedzinie nauk medycznych i nauk o zdrowiu
w dyscyplinie nauki o zdrowiu
przedkładana Radzie Dyscypliny Nauk o Zdrowiu
Warszawskiego Uniwersytetu Medycznego

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Warszawa, 2025

Słowa kluczowe: szczepienie, stan zaszczepienia, uwarunkowania społeczno-ekonomiczne

Key words: vaccination, vaccination coverage, socio-economic determinants

Szczególne podziękowania chciałabym złożyć mojemu Promotorowi
Panu Prof. dr hab. n. med. Mariuszowi Gujskiemu
za wszelkie wsparcie okazane w realizacji projektów badawczych
składających się na niniejszą rozprawę.

Bardzo dziękuję również
Panu Prof. dr hab. n. med. Bolesławowi Samolińskiemu
za możliwość rozwoju naukowego
oraz stworzenie warunków,
w których mogła powstać niniejsza rozprawa.

Serdecznie dziękuję
Panu Dr n. med. mgr mat. Zbigniewowi Lewandowskiemu
za cenne uwagi i okazane wsparcie podczas realizacji badań.

Wykaz publikacji stanowiących pracę doktorską

1. **Nowicka PM**, Socio-economic determinants of childhood vaccination coverage in high-income countries: a scoping review. Ann Agric Environ Med. 2025. doi:10.26444/aaem/211083.

   Impact Factor: 1,2

   MNSiW: 100

2. **Nowicka PM**, Lewandowski Z, Gujski M, Samoliński BK. Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014-2018. Ann Agric Environ Med. 2025. doi:10.26444/aaem/211389.

   Impact Factor: 1,2

   MNSiW: 100

3. **Nowicka PM**, Lewandowski Z, Gujski M, Samoliński BK. Socio-economic determinants of the second-dose measles vaccination coverage in Poland. Ann Agric Environ Med. 2025. doi: 10.26444/aaem/207725.

   Impact Factor: 1,2

   MNSiW: 100

4. Kłak A, Kuśmierska-Bucoń M, Grochal Z, Lisiecka-Biełanowicz M, Białoszewski A, **Nowicka PM**, Gujski M, Drop B, Drab A, Pinkas J, Attitudes towards vaccinations in selected medical groups in Poland. Curr. Issues Pharm. Med. Sci. 2025; 38(3):187-195. doi: 10.12923/cipms-2025-0030.

   Impact Factor: 0,7

   MNSiW: 70

Spis treści

Wykaz zastosowanych skrótów

DTP	Szczepionka przeciw błonicy, tężcowi, krztuścowi (ang. *diphtheria, tetanus, pertussis*)
Gavi	Gavi, Globalny Sojusz na rzecz Szczepionek i Szczepień (ang. *Gavi, The Vaccine Alliance*)
GUS	Główny Urząd Statystyczny
IA2030	Immunization Agenda 2030
MCV	Szczepionka przeciw odrze (ang. *measles-containing vaccine*)
MMR	Szczepionka przeciw odrze, śwince, różyczce (ang. *measles, mumps, rubella*)
MZ-54	Roczne sprawozdanie ze szczepień ochronnych
NIZP PZH-PIB	Narodowy Instytut Zdrowia Publicznego Państwowy Zakład Higieny – Państwowy Instytut Badawczy
PIS	Państwowa Inspekcja Sanitarna
POZ	Podstawowa Opieka Zdrowotna
PRISMA-ScR	Preferowane pozycje sprawozdawcze do przeglądów systematycznych i metaanaliz – rozszerzenie dla przeglądów zakresu literatury (ang. *Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews*)
PSO	Program Szczepień Ochronnych
PSSE	Powiatowa Stacja Sanitarno-Epidemiologiczna
ONZ	Organizacja Narodów Zjednoczonych
SDGs	Cele Zrównoważonego Rozwoju (ang. *Sustainable Development Goals*)
UNICEF	Fundusz Narodów Zjednoczonych na rzecz Dzieci (ang. *United Nations Children's Fund*)
VPD	Choroby, którym można zapobiec poprzez szczepienia (ang. *vaccine-preventable diseases*)
WHO	Światowa Organizacja Zdrowia (ang. *World Health Organization*)
WSSE	Wojewódzka Stacja Sanitarno-Epidemiologiczna

Streszczenie w języku polskim

W Europie historia praktyk zbliżonych do dzisiejszych szczepień zaczęła się w XVIII w., chociaż choroby zakaźne towarzyszyły ludzkości od zawsze. Rola szczepień ugruntowała się w XX w., czego dowodem była eradykacja ospy prawdziwej w 1980 r. Od tego czasu szczepienia uznawane są za jedną z najskuteczniejszych interwencji w obszarze zdrowia publicznego, przyczyniając się do znacznego zmniejszenia śmiertelności w skali globalnej. Niestety w trakcie pandemii COVID-19 doszło do pogłębienia nierówności w dostępie do szczepień. Instytucje międzynarodowe obecnie sygnalizują rosnące zagrożenia dla skuteczności programów szczepień, które wynikają m.in. z rozpowszechniania dezinformacji, kryzysów humanitarnych oraz ograniczenia wsparcia finansowego.

Celem niniejszej dysertacji było zbadanie stanu zaszczepienia populacji dzieci i jego dynamiki w Polsce na poziomie powiatów w latach 2014-2018, analiza występowania związków między czynnikami społecznymi i ekonomicznymi a stanem zaszczepienia na poziomie powiatów, pozyskanie wiedzy na temat społecznych i ekonomicznych uwarunkowań wyszczepialności oraz analiza postaw wobec szczepień wybranych grup społecznych. W ramach przeprowadzonych badań dokonano przeglądu literatury dotyczącej uwarunkowań wyszczepialności w krajach o wysokich dochodach, przeanalizowano dane dotyczące stanu zaszczepienia na poziomie powiatu i województwa, przedstawiono różnice mierzone na różnym poziomie szczegółowości raportowania, zidentyfikowano klastry o wystarczającym i niewystarczającym stanie zaszczepienia do osiągnięcia odporności populacyjnej. Przeprowadzono również analizę danych dotyczących stanu zaszczepienia na poziomie powiatu i ocenę związku między czynnikami społeczno-ekonomicznymi a stanem zaszczepienia. Badania uzupełniono o analizę postaw wobec szczepień pracowników ochrony zdrowia oraz studentów medycyny i pielęgniarstwa.

Wyniki przeprowadzonych badań pokazują jak istotny jest poziom raportowania danych do identyfikacji luk w stanie zaszczepienia, a także jakie informacje można uzyskać przy badaniu zależności pomiędzy danymi dotyczącymi szczepień a danymi dotyczącymi czynników społecznych i ekonomicznych. Poprawa stanu zaszczepienia populacji wymaga wieloaspektowego podejścia, począwszy od niwelowania barier w dostępie do szczepień, przez skuteczną komunikację z pacjentem, po prawidłowe raportowanie

danych dotyczących stanu zaszczepienia na wszystkich poziomach i ich analizę ułatwiającą planowanie celowanych interwencji.

Streszczenie w języku angielskim

The history of practices similar to modern vaccinations in Europe began in the 18th century, although infectious diseases have always accompanied humanity. The role of vaccinations became established in the 20th century, as evidenced by the eradication of smallpox in 1980. Since then, vaccinations have been recognized as one of the most effective public health interventions, contributing to a significant reduction in mortality globally. Unfortunately, the COVID-19 pandemic has deepened inequalities in access to vaccinations. International institutions are currently warning of growing threats to the effectiveness of vaccination programs, stemming from factors such as the spread of disinformation, humanitarian crises, and limited financial support. The aim of this dissertation was to examine the vaccination coverage of the child population and its dynamics in Poland at the poviat level between 2014 and 2018, to analyze the relationship between social and economic factors and vaccination coverage at the poviat level, to acquire knowledge on the social and economic determinants of vaccination coverage, and to analyze attitudes toward vaccination among selected social groups. The research included a review of the literature on the determinants of vaccination coverage in high-income countries, analyzed data on vaccination coverage at the poviat and voivodeship levels, presented differences measured at different granularity levels, and identified clusters with sufficient and insufficient vaccination coverage to achieve herd immunity. Data on vaccination coverage at the poviat level was also analyzed and the relationship between socioeconomic factors and vaccination coverage was assessed. The research was supplemented by an analysis of attitudes toward vaccination among healthcare workers, medical students, and nursing students.

The results demonstrate the importance of data reporting for identifying immunization gaps and the information that can be gained by examining the relationships between vaccination data and data on social and economic factors. Improving the vaccination status of the population requires a multifaceted approach, starting from eliminating barriers to vaccinations, through effective communication with patients, to correct reporting of data on vaccination uptake at all reporting levels and their analysis to facilitate the planning of targeted interventions.

1. Wstęp

Epidemie chorób zakaźnych towarzyszyły ludzkości od zawsze. Tukidydes opisał zarazę ateńską już w V w. p.n.e., Gajusz Swetoniusz Trankwillus wspominał o zarazie morowej o niebywałych rozmiarach, a Galen, lekarz Marka Aureliusza, opisał zarazę Antoninów rozprzestrzeniającą się na terytorium Imperium Rzymskiego w II w. n.e. [1-3]. Pierwsze wzmianki o zastosowaniu kwarantanny w Republice Wenecji pochodzą z czasów epidemii dżumy w XIV w., jednak nieznajomość innych skutecznych metod prewencji i leczenia chorób zakaźnych przyczyniły się do bardzo wysokiej śmiertelności, nie tylko na terenie Europy. W XVI w. konkwistadorzy zawlekli patogeny do Nowego Świata wywołując epidemie, które przyczyniły się do upadku cywilizacji Azteków i Inków [4,5]. Próby zapobiegania chorobom zakaźnym miały różne postaci. Pisemne źródła wskazują, że celowe narażenie na kontakt z chorobą jako sposób wytworzenia odporności miało miejsce już w I wieku w Chinach, choć inni autorzy sugerują, że prawdopodobnie odbywało się to znacznie wcześniej [6]. Nazywane wariolizacją (lub wariolacją) przybierało wiele postaci: mogło polegać na włożeniu kawałka bawełny nasączonej ropą pochodzącą od osoby chorej na ospę prawdziwą do nozdrza zdrowego dziecka, użyciu sproszkowanego strupa w ten sam sposób lub założeniu zdrowej osobie ubrań, które wcześniej nosiła osoba chora. Około 7 dni po takim zabiegu występowała gorączka i lekkie objawy choroby. Zanim wariolizacja dotarła do Europy w XVIII w. praktykowano ją w Azji, Afryce i na Bałkanach. Lady Mary Wortley Montagu, angielska arystokratka mieszkająca w Konstantynopolu, w 1717 r. opisała metodę inokulacji poprzez nakłucie, z którą spotkała się w imperium osmańskim. Zauważyła, że zabieg ten był niezwykle powszechny i nikt z chorujących na ospę prawdziwą nie umierał. Lady Wortley wykonała inokulację u swojego syna, a po powrocie do Anglii dzieliła się informacjami o tej niezwykłej procedurze [7]. Słowo „wakcynacja" zawdzięczamy Edwardowi Jennerowi, który w 1796 r. pobrał materiał z dłoni dojarki zakażonej krowianką i wprowadził go do nacięcia na ramieniu 8-letniego Jamesa Phippsa. U chłopca, poza zmianami skórnymi i obniżonym samopoczuciem, nie pojawiły się inne objawy choroby. Jenner opisał poczynione działania oraz obserwacje i opublikował w postaci doniesienia pod tytułem „*An inquiry into the causes and effects of the variola vaccinae: a disease discovered in some of the western counties of England, particularly Gloucestershire, and known by the name of cow pox."* [8,9].

Na ziemiach polskich pod zaborami pierwsze ustawodawstwo dotyczące szczepień przeciw ospie prawdziwej wiązało się z dekretem króla pruskiego Fryderyka Wilhelma III z lipca 1801 r. Dopuszczano w nim szczepienie dzieci przeciwko ospie (nie było ono obowiązkowe, a jedynie zalecane). W 1802 r. do wszystkich lekarzy w Galicji zostały rozesłane pisma zawierające informacje na temat szczepień i zachęcające do ich wykonywania. Dla lekarzy, którzy zaszczepili największą liczbę dzieci przewidziane były nagrody. Osoby duchowne pracujące na wsi zostały zobligowane do zachęcania do szczepień po każdym nabożeństwie [10].

XX wiek ugruntował rolę szczepień w profilaktyce chorób zakaźnych, czego dowodem była ogłoszona w 1980 r. przez Światową Organizację Zdrowia (WHO) eradykacja ospy prawdziwej, pierwszej choroby całkowicie wyeliminowanej dzięki programom szczepień [11,12]. Obecnie szczepienia stanowią jedną z najskuteczniejszych i najbardziej efektywnych kosztowo interwencji w obszarze zdrowia publicznego, przyczyniając się do znaczącego zmniejszenia śmiertelności w skali globalnej [13-20]. Prognozy wskazują, że w latach 2021–2030 działania związane z immunizacją mogą zapobiec około 51 milionom zgonów [20]. Jednak w trakcie pandemii COVID-19 doszło do pogłębienia systemowych nierówności w dostępie do szczepień, a obniżony stan zaszczepienia w wielu krajach nie wrócił do wartości sprzed pandemii [21,22]. W 2024 roku ponad 14 milionów dzieci nie otrzymało ani jednej dawki szczepienia (ang. *zero-dose children*) [23]. Instytucje międzynarodowe, takie jak WHO, UNICEF oraz Gavi, sygnalizują narastające zagrożenia dla skuteczności programów szczepień, wynikające m.in. z rozpowszechniania dezinformacji, wzrostu liczby ludności, kryzysów humanitarnych oraz ograniczenia wsparcia finansowego [24].

2. Cel pracy

Celem niniejszej pracy było zbadanie stanu zaszczepienia dzieci w Polsce, jego dynamiki na poziomie powiatów w latach 2014-2018, pozyskanie wiedzy na temat społecznych i ekonomicznych uwarunkowań wyszczepialności, a także analiza występowania związków między czynnikami społecznymi i ekonomicznymi a stanem zaszczepienia na poziomie powiatów oraz analiza postaw wobec szczepień wybranych grup społecznych.

Cel został zrealizowany poprzez:

- dokonanie przeglądu literatury dotyczącej uwarunkowań wyszczepialności w krajach o wysokich dochodach (**Publikacja I**)
- analizę danych dotyczących stanu zaszczepienia na poziomie powiatu i województwa, przedstawienie różnic mierzonych na różnym poziomie szczegółowości oraz zidentyfikowanie klastrów o wystarczającym i niewystarczającym stanie zaszczepienia do osiągnięcia odporności populacyjnej (**Publikacja II**)
- analizę danych dotyczących stanu zaszczepienia na poziomie powiatu i ocenę związku między czynnikami społeczno-ekonomicznymi a stanem zaszczepienia (**Publikacja III**)
- analizę postaw wobec szczepień pracowników ochrony zdrowia oraz studentów medycyny i pielęgniarstwa (**Publikacja IV**).

3. Podstawy teoretyczne cyklu prac stanowiącego rozprawę doktorską

3.1 Społeczno-ekonomiczne determinanty zdrowia

O wpływie „stosunków zewnętrznych na zdrowie i potrzebie ich znajomości" pisał już Hipokrates ok. 400 r. p.n.e., zwracając szczególną uwagę na czynniki środowiskowe [25]. Rudolf Virchow, nazywany ojcem medycyny społecznej, uważał, że medycyna musi wejść w życie polityczne i społeczne, żeby spełnić swoje zadanie. Pytał: „Czyż nie znajdujemy zawsze przyczyn chorób ludności w defektach społecznych?" [26]. W Polsce za jednego z pionierów medycyny społecznej można uznać założyciela Państwowego Centralnego Zakładu Epidemiologicznego w Warszawie (dzisiejszego Narodowego Instytutu Zdrowia Publicznego PZH-PIB), twórcę UNICEF, Ludwika Rajchmana, który angażował się w inicjatywy międzynarodowe mające na celu poprawę jakości życia [27,28].

W deklaracji z Ałma-Aty przyjętej na Światowym Zgromadzeniu Zdrowia w 1978 r. osiągnięcie najwyższego możliwego poziomu zdrowia uznano za najważniejszy światowy cel społeczny, którego realizacja wymaga działań wielu sektorów społecznych i ekonomicznych [29]. Osiem lat później w Karcie Ottawskiej na rzecz promocji zdrowia wymieniono fundamenty zdrowia, tj. pokój, schronienie, edukację, żywność, dochód, stabilny ekosystem, zrównoważone zasoby, sprawiedliwość społeczną i równość [30]. W 1991 roku Göran Dahlgren i Margaret Whitehead zaprezentowali wizualizację determinant zdrowia w postaci tzw. modelu tęczowego. W jego centrum znajdują się cechy indywidualne (wiek, płeć, cechy wrodzone), w kolejnych warstwach – czynniki dotyczące indywidualnego stylu życia, sieci społecznych, warunków życia i pracy (środowisko pracy, edukacja, bezrobocie, warunki sanitarne, świadczenia opieki zdrowotnej, warunki mieszkaniowe, produkcja żywności). Wszystkie wymienione cechy i czynniki otoczone są ogólnymi warunkami społeczno-ekonomicznymi, kulturowymi i środowiskowymi [31].

Obecnie WHO definiuje równość w zdrowiu (ang. *health equity*) jako brak niesprawiedliwych i możliwych do uniknięcia różnic w stanie zdrowia pomiędzy grupami populacji ze względu na uwarunkowania społeczne, ekonomiczne, demograficzne lub geograficzne. Warunki, w których ludzie rodzą się, żyją, pracują i starzeją się, a także dostęp do zasobów, jakim dysponują wywierają znaczący wpływ na

ich zdrowie. Osoby z ograniczonym dostępem do wysokiej jakości edukacji, miejsca zamieszkania, zabezpieczenia społecznego i możliwości zatrudnienia są bardziej narażone na choroby i zgon [32-34]. Uwarunkowania społeczno-ekonomiczne mogą mieć większy wpływ na zdrowie niż czynniki genetyczne czy dostęp do opieki zdrowotnej. Czynniki te często są modyfikowalne [35-37]. Działania organów rządowych, sektora prywatnego i społeczeństwa obywatelskiego skupione na społeczno-ekonomicznych uwarunkowaniach zdrowia mają fundamentalne znaczenie dla zmniejszenia nierówności w zdrowiu. Monitorowanie nierówności w zdrowiu rozpoczyna się od gromadzenia i analizy zdezagregowanych danych, by po raportowaniu wyników móc zastosować zdobytą wiedzę w celu wzmocnienia systemu opieki zdrowotnej i poprawy zdrowia [38]. Zmniejszanie i eliminowanie nierówności w zdrowiu jest kluczem do osiągnięcia Celów Zrównoważonego Rozwoju (SDGs) związanych ze zdrowiem: zapewnienia wszystkim ludziom w każdym wieku zdrowego życia i promowania dobrobytu (Cel 3) oraz zmniejszenia nierówności w obrębie krajów i między nimi (Cel 10) [39].

3.2 Nadzór nad wykonawstwem szczepień w Polsce

Ustawa z dnia 5 grudnia 2008 r. o zapobieganiu oraz zwalczaniu zakażeń i chorób zakaźnych u ludzi określa, że: „Główny Inspektor Sanitarny ogłasza w formie komunikatu, w dzienniku urzędowym ministra zdrowia, Program Szczepień Ochronnych na dany rok, ze szczególnymi wskazaniami dotyczącymi stosowania poszczególnych szczepionek, wynikającymi z aktualnej sytuacji epidemiologicznej, przepisów oraz zaleceń” [40]. Monitorowanie i analiza stanu zaszczepienia jest istotnym elementem pozwalającym na ocenę programu szczepień w danym kraju. W Polsce dokumentacja zaszczepienia obejmuje odnotowanie tego faktu w karcie uodpornienia oraz książeczce szczepień, która zakładana jest dla każdego nowonarodzonego dziecka. Karta uodpornienia przechowywana jest w podmiocie, w którym zrealizowano szczepienie [41]. Zgodnie z Programem Badań Statystycznych Statystyki Publicznej, podmioty wykonujące działalność leczniczą udzielające ambulatoryjnych i stacjonarnych świadczeń zdrowotnych biorące udział w szczepieniach ochronnych, w latach 2014-2018, raz w roku przekazywały dane dotyczące zrealizowanych szczepień do powiatowych stacji sanitarno-epidemiologicznych (PSSE), skąd zagregowane dane były następnie

przekazywane do wojewódzkich stacji sanitarno-epidemiologicznych (WSSE). WSSE agregowały dane z podlegających im terytoriów i przekazywały zbiór danych do Narodowego Instytutu Zdrowia Publicznego Państwowego Zakładu Higieny – Państwowego Instytutu Badawczego (NIZP PZH-PIB). Do sprawozdawania wykorzystywany był wzór formularza MZ-54 [42]. NIZP PZH-PIB raz w roku publikował dane ze szczegółowością raportowania na poziomie województwa [43]. W trakcie pandemii COVID-19 wprowadzono możliwość rejestracji szczepień w e-Karcie Szczepień. Najpierw były to jedynie szczepienia przeciw COVID-19, a następnie poszerzono tę możliwość również dla szczepień przeciw grypie oraz szczepień zalecanych. Obecnie trwa proces cyfryzacji dokumentowania realizacji programu szczepień, który docelowo obejmie wszystkie szczepienia [44,45].

4. Publikacje włączone do cyklu prac

4.1 Publikacja I

Nowicka PM, Socio-economic determinants of childhood vaccination coverage in high-income countries: a scoping review. Ann Agric Environ Med. 2025. doi:10.26444/aaem/211083.

Wstęp

Obserwowane w ostatnich latach rozprzestrzenianie się nieprawdziwych wiadomości na temat szczepionek, spadek zaufania do szczepień, stan zaszczepienia niewystarczający do osiągnięcia odporności populacyjnej, a w konsekwencji wzrost zapadalności na choroby, którym można zapobiec dzięki szczepieniom (VPD), wskazują na kruchość istniejących programów szczepień. W tym kontekście identyfikacja czynników społecznych i ekonomicznych wpływających na stan zaszczepienia ma kluczowe znaczenie. Te determinanty obejmują warunki życia, pracy, środowisko społeczno-kulturowe oraz struktury polityczne i gospodarcze, które kształtują dostępność i postawy wpływające na akceptację szczepień.

Cel

Celem dokonanego przeglądu literatury było zidentyfikowanie i syntetyczne zestawienie społecznych i ekonomicznych czynników związanych ze stanem zaszczepienia dzieci w krajach o wysokich dochodach w latach 2016-2025.

Materiał i metody

Przeprowadzona analiza literatury ujawniła brak systematycznych przeglądów dotyczących społeczno-ekonomicznych uwarunkowań szczepień w krajach o wysokich dochodach w latach 2016-2025. Przy użyciu wytycznych *Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews* (PRISMA-ScR) przygotowano przegląd anglojęzycznych artykułów opisujących badania na temat społeczno-ekonomicznych uwarunkowań stanu zaszczepienia w krajach o wysokich dochodach w latach 2016-2025.

Do przeglądu włączono publikacje dostępne w bazach PubMed, Scopus, Embase i Web of Science Core Collection.

Wyniki

Po przeprowadzeniu analizy 931 publikacji do przeglądu włączono 39 artykułów. Ponad połowa badań uwzględnionych w niniejszym przeglądzie pochodziła z 3 krajów: Stanów Zjednoczonych, Włoch i Kanady. Kluczowymi determinantami szczepień były: położenie geograficzne, wykształcenie, pochodzenie etniczne, wielkość gospodarstwa domowego, samotne rodzicielstwo, dochód gospodarstwa domowego, ubezpieczenie, deprywacja, korzystanie z pomocy społecznej i status społeczno-ekonomiczny oraz interakcja z podmiotem świadczącym opiekę zdrowotną. Wyższe wykształcenie rodzica, dochód, korzystanie z pomocy społecznej, zamieszkiwanie w mieście były w większości badań związane z wyższym stanem zaszczepienia dziecka, chociaż postawy nieprzychylne szczepieniom również występowały wśród osób o wyższym wykształceniu i dochodach. Niższy stan zaszczepienia był związany z większą liczbą osób w gospodarstwie domowym, statusem mniejszości etnicznej, samotnym rodzicielstwem, brakiem ubezpieczenia, deprywacją, brakiem zaufania do instytucji i określonymi indywidualnymi cechami rodzica.

Podsumowanie

Przegląd literatury wskazuje, że stan zaszczepienia dzieci stanowi odzwierciedlenie szerszych uwarunkowań społeczno-ekonomicznych, takich jak stabilność ekonomiczna, dostępność i jakość infrastruktury opieki zdrowotnej, kontekst kulturowy oraz poziom zaufania do instytucji publicznych. Determinanty stanu zaszczepienia mogą różnić się nawet pomiędzy krajami o wysokich dochodach i w zależności od rodzaju szczepienia. Dalsze badania powinny koncentrować się na analizie współzależności między tymi czynnikami oraz uwzględniać standaryzowane porównania międzynarodowe w celu identyfikacji źródeł nierówności. Niezbędne są również pogłębione badania jakościowe uwzględniające lokalny kontekst w celu lepszego zrozumienia przyczyn niższego niż oczekiwany stanu zaszczepienia, mechanizmów podejmowania decyzji przez rodziców oraz projektowania precyzyjnych interwencji.

4.2 Publikacja II

Nowicka PM, Lewandowski Z, Gujski M, Samoliński BK. Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014-2018. Ann Agric Environ Med. 2025. doi:10.26444/aaem/211389.

Wstęp

W ostatnich latach zaobserwowano spadek wyszczepialności wraz ze wzrostem liczby przypadków chorób, którym można zapobiegać poprzez szczepienia. Według szacunków Światowej Organizacji Zdrowia w 2020 r., w związku z pandemią COVID-19, aż 23 mln dzieci nie otrzymało szczepień odpowiednich do ich wieku. Wiarygodne obliczenie stanu zaszczepienia ma zasadnicze znaczenie dla oceny powodzenia programu szczepień oraz identyfikacji populacji, do której należy kierować dalsze interwencje. Raportowanie danych dotyczących szczepień dzieci w Polsce nie pozwala na łatwą identyfikację małych obszarów terytorialnych w celu ukierunkowania działań organów zdrowia publicznego w przypadku niższego niż oczekiwano stanu zaszczepienia na ich terenie.

Cel

Celem pracy było: 1) przedstawienie różnic w osiągnięciu wystarczającego stanu zaszczepienia (≥95%) pierwszą (MCV1) i drugą (MCV2) dawką szczepionki przeciw odrze, mierzonym na różnym poziomie szczegółowości raportowania (poziom wojewódzki vs. poziom powiatowy), 2) zidentyfikowanie klastrów o wystarczającym/niewystarczającym stanie zaszczepienia MCV1 i MCV2.

Materiał i metody

Dane dotyczące stanu zaszczepienia wykorzystane w badaniu zebrano z dokładnością raportowania na poziomie powiatu ze stacji sanitarno-epidemiologicznych w Polsce. Jako wskaźniki wybrano stan zaszczepienia przeciw odrze: MCV1 odnotowany w 3. roku życia oraz MCV2 w 11. roku życia. Próg został określony na poziomie 95%, aby podzielić jednostki terytorialne na te, w których odnotowano wystarczający (≥95%) i niewystarczający (<95%) stan zaszczepienia przeciw odrze. Statystyka opisowa posłużyła do przedstawienia stanu zaszczepienia MCV1 i MCV2 w podziale na poziom województwa i

powiatu. Analizę przestrzenną z wykorzystaniem lokalnego współczynnika autokorelacji Morana przeprowadzono w celu zidentyfikowania sąsiednich powiatów o podobnym stanie zaszczepienia oraz obszarów odstających o wyraźnie odmiennych wartościach. Bliskość powiatów została określona przy pomocy kryterium sąsiedztwa na podstawie posiadania wspólnej granicy.

Wyniki

W latach 2014-2018 stan zaszczepienia MCV1 wahał się od 89% do 99% na poziomie województwa i od 80% do 100% na poziomie powiatu, podczas gdy stan zaszczepienia MCV2 w tym samym okresie wahał się od 84% do 99% na poziomie województwa i od 32,3% do 100% na poziomie powiatu. Powiaty o największych odnotowanych różnicach w stanie zaszczepienia MCV1 znajdujące się na obszarze jednego województwa, znajdowały się w następujących województwach: w 2014 r. - w mazowieckim, łódzkim i małopolskim; w 2015 r. - w mazowieckim, łódzkim i pomorskim; w 2016 roku - w łódzkim, pomorskim i mazowieckim; w 2017 r. - w mazowieckim, małopolskim i podlaskim, a w 2018 - w lubelskim, mazowieckim i łódzkim. Województwa, w których w 2014 r. odnotowano największe dysproporcje w stanie zaszczepienia MCV2 między powiatami na ich obszarze to: warmińsko-mazurskie, mazowieckie i lubuskie; w 2015 r.: podkarpackie, mazowieckie i pomorskie; w 2016 r.: mazowieckie, podkarpackie i łódzkie; w 2017 r.: podkarpackie, mazowieckie i małopolskie oraz mazowieckie, małopolski i podkarpackie w 2018 r. Największe różnice pomiędzy stanem zaszczepienia raportowanym na poziomie województwa i powiatu w przypadku każdej z dawek szczepionki przeciw odrze odnotowano w województwie mazowieckim w każdym z analizowanych lat, oprócz 2015 roku dla MCV1. Dla MCV1 istotną statystycznie lokalną autokorelację przestrzenną (na podstawie lokalnego współczynnika autokorelacji Morana) zaobserwowano dla 14 powiatów w 2014 r., 26 w 2015 r., 27 w 2016 r., 44 w 2017 r. i 47 w 2018 r. Odsetek powiatów tworzących klastry przestrzenne o podobnym stanie zaszczepienia MCV1 zwiększył się w czasie, wynosił 4,1% w 2014 r., 7,5% w 2015 r., 7,2% w 2016 r., 11,9% w 2017 r. i 13,4% w 2018 r. Ponadto dla kilku powiatów stwierdzono istotną statystycznie ujemną lokalną autokorelację przestrzenną, wskazującą na przestrzenne wartości

odstające (ang. *outliers*). Dla MCV2 istotną statystycznie lokalną autokorelację przestrzenną zaobserwowano dla 23 powiatów w 2014 r., 27 w 2015 r., 22 w 2016 r., 16 w 2017 r. i 25 w 2018 r. Odsetek powiatów tworzących klastry przestrzenne o podobnym stanie zaszczepienia MCV2 wynosił 5,9% w 2014 r., 7,8% w 2015 r., 6,6% w 2016 r., 4,7% w 2017 r. i 7,2% w 2018 r. Istotną statystycznie ujemną lokalną autokorelację przestrzenną stwierdzono dla kilku powiatów.

Podsumowanie

Badanie to podkreśla wartość szczegółowej, przestrzennej analizy w ujawnianiu różnic w stanie zaszczepienia w Polsce. Podczas gdy dane na poziomie województw pokazują ogólny stan zaszczepienia, wyniki na poziomie powiatu ujawniają luki – szczególnie w przypadku MCV2, który w niektórych obszarach spada poniżej 70%. Duże ośrodki miejskie, takie jak Warszawa, Łódź i Kraków, często pojawiają się w klastrach grupujących powiaty o niewystarczającym stanie zaszczepienia. Analiza danych o wyższej szczegółowości pozwala na wczesną identyfikację obszarów wrażliwych i umożliwia wdrażanie bardziej precyzyjnych interwencji mających na celu zwiększenie stanu zaszczepienia wśród mieszkańców tego obszaru.

4.3 Publikacja III

Nowicka PM, Lewandowski Z, Gujski M, Samoliński BK. Socio-economic determinants of the second-dose measles vaccination coverage in Poland. Ann Agric Environ Med. 2025. doi: 10.26444/aaem/207725.

Wstęp

Uwarunkowania społeczno-ekonomiczne istotnie wpływają na stan zaszczepienia populacji. Szczególnie ważne jest ich monitorowanie w kontekście odry – jednej z najbardziej zaraźliwych chorób wirusowych, której występowanie może sygnalizować luki w odporności populacyjnej. W różnych krajach obserwuje się zróżnicowane zależności między poziomem uprzywilejowania społeczno-ekonomicznego a stanem zaszczepienia dzieci przeciwko odrze, co wskazuje na potrzebę lokalnych analiz. Chociaż od wprowadzenia w Polsce obowiązkowego szczepienia przeciwko odrze minęło już 50 lat, Polska pozostaje jednym z nielicznych krajów Regionu Europejskiego WHO, gdzie odra występuje endemicznie. Regionalna Komisja Weryfikacyjna zaleca osiągnięcie stanu zaszczepienia dwiema dawkami szczepionki MMR na poziomie co najmniej 95% w celu zachowania odporności populacyjnej. Kluczowe jest zidentyfikowanie obszarów o niższym stanie zaszczepienia oraz analiza uwarunkowań społeczno-ekonomicznych, co umożliwi skuteczne, oparte na danych działania interwencyjne.

Cel

Celem pracy była ocena związku między czynnikami społeczno-ekonomicznymi a wystarczającym stanem zaszczepienia (≥95%) drugą dawką szczepienia przeciwko odrze, śwince, różyczce (MMR2) na poziomie powiatów w Polsce w latach 2014-2018.

Materiał i metody

W badaniu wykorzystano dane pozyskane z rocznych raportów powiatowych stacji sanitarno-epidemiologicznych za lata 2014-2018, dotyczące drugiej dawki szczepionki MMR (MMR2) podawanej dzieciom w wieku 10 lat.

Stan zaszczepienia obliczono jako odsetek dzieci zaszczepionych w danym roku kalendarzowym w odniesieniu do odpowiedniej kohorty urodzeniowej. Z zasobów Głównego Urzędu Statystycznego pozyskano zmienne społeczno-ekonomiczne na poziomie powiatu. Do analizy statystycznej zastosowano wieloczynnikową regresję logistyczną, skorygowaną o populację oraz liczbę lekarzy i pielęgniarek, w celu identyfikacji predyktorów wystarczającego poziomu zaszczepienia.

Wyniki

Prawdopodobieństwo osiągnięcia wystarczającego stanu zaszczepienia MMR2 było wyższe w powiatach o większej liczbie: dzieci uczęszczających do placówek wychowania przedszkolnego, beneficjentów środowiskowej pomocy społecznej, gospodarstw domowych korzystających ze świadczeń środowiskowej pomocy społecznej, rodzin otrzymujących zasiłek rodzinny na dzieci, porad lekarskich udzielanych w podstawowej opiece zdrowotnej (POZ). Nie stwierdzono istotnego związku między wystarczającym poziomem zaszczepienia a przeciętnym miesięcznym wynagrodzeniem brutto, liczbą osób pracujących, ani liczbą rodzin zastępczych w żadnym z badanych lat.

Ani liczba rodzin zastępczych w powiecie, ani liczba osób pracujących, ani wynagrodzenie nie były zmiennymi, które niezależnie określały stan zaszczepienia MMR2. Natomiast na przestrzeni lat jako niezależne zmienne determinujące stan zaszczepienia MMR2 ujawniły się: liczba porad udzielanych w POZ, liczba gospodarstw domowych korzystających ze świadczeń środowiskowej pomocy społecznej, liczba beneficjentów środowiskowej pomocy społecznej, liczba rodzin otrzymujących zasiłek rodzinny, a także liczba dzieci uczęszczających do placówek wychowania przedszkolnego. Zmienne te były niezależne od wielkości powiatu oraz od liczby lekarzy i pielęgniarek w powiecie. Niezależnymi predyktorami osiągnięcia wystarczającego stanu zaszczepienia MMR2, które wystąpiły w więcej niż jednym z badanych lat, były: liczba gospodarstw domowych korzystających ze świadczeń środowiskowej pomocy społecznej, liczba porad udzielanych w POZ, liczba rodzin otrzymujących zasiłek rodzinny na dzieci.

Podsumowanie

Stan zaszczepienia MMR2 na poziomie powiatu jest przewidywalny na podstawie wybranych zmiennych społeczno-ekonomicznych, niezależnie od wielkości powiatu, liczby lekarzy i pielęgniarek na jego obszarze. Istnieją zmienne, które pozwalają przewidzieć, czy nastąpi wzrost, czy spadek stanu zaszczepienia. Szczególnie istotna wydaje się rola instytucjonalnego wsparcia rodzin oraz kontaktu z podstawową opieką zdrowotną. Choć analiza oparta na danych powiatowych nie pozwala na pełną ocenę motywacji jednostkowych, może stanowić cenne narzędzie dla decydentów w zakresie planowania interwencji ukierunkowanych na zwiększenie akceptacji szczepień.

4.4 Publikacja IV

Kłak A, Kuśmierska-Bucoń M, Grochal Z, Lisiecka-Biełanowicz M, Białoszewski A, Nowicka PM, Gujski M, Drop B, Drab A, Pinkas J, Attitudes towards vaccinations in selected medical groups in Poland. Curr. Issues Pharm. Med. Sci. doi:10.12923/cipms-2025-0030.

Wstęp

Sukces szczepień nie zależy wyłącznie od ich dostępności i skuteczności, ale również od poziomu akceptacji społecznej. Szczególną rolę odgrywają tutaj przedstawiciele zawodów o wysokim zaufaniu społecznym. Wiedza pracowników ochrony zdrowia na temat szczepień, ich prywatne poglądy, jak również stres czy wypalenie zawodowe wpływają na postawy i decyzje podejmowane przez pacjentów. Niechęć i odmowa szczepień pojawiające się w niektórych grupach zawodowych mogą stwarzać zagrożenie dla zdrowia publicznego w skali globalnej.

Cel

Celem pracy było określenie postaw wobec szczepień wśród pracowników ochrony zdrowia oraz studentów medycyny i pielęgniarstwa oraz określenie ich potrzeb i oczekiwań w zakresie upowszechniania szczepień w populacji.

Materiał i metody

W okresie od kwietnia do września 2021 roku, na podstawie trzech scenariuszy rozmowy, przeprowadzono online 40 częściowo ustrukturyzowanych indywidualnych wywiadów pogłębionych w dwóch grupach: 1) pracowników ochrony zdrowia (20 osób; lekarze, pielęgniarki, położne); 2) studentów medycyny i pielęgniarstwa (20 osób). Każdy wywiad trwał 45-60 minut. Przy rekrutacji uczestników zastosowano dobór próby metodą kuli śnieżnej. Z każdego wywiadu przygotowano transkrypcję, na podstawie której sporządzono szczegółowy raport.

Wyniki

Wypowiedzi pracowników ochrony zdrowia wskazują na istotne trudności w komunikacji dotyczącej szczepień, wynikające z niedostatecznej wiedzy pacjentów, ich nieufności oraz korzystania z nierzetelnych źródeł informacji. Personel medyczny często unikał rozmów z osobami o poglądach antyszczepionkowych. W środowisku zawodowym podkreślono braki w aktualnej wiedzy, trudności w odróżnianiu faktów od mitów oraz ograniczoną promocję szczepień, zwłaszcza przeciw grypie. Część pracowników medycznych nie szczepiła własnych dzieci, a decyzje o rezygnacji z immunizacji wynikały m.in. z obaw przed niepożądanymi odczynami i absencją w pracy.

Wypowiedzi studentów medycyny i pielęgniarstwa wskazują na ograniczoną obecność tematyki szczepień w programach nauczania. Część studentów deklarowała brak zaufania do skuteczności szczepień przeciw grypie. Wiedza na temat szczepień była fragmentaryczna, ograniczona głównie do zajęć z immunologii i pediatrii, bez praktycznego przygotowania do rozmów z pacjentami. Studenci postulowali wprowadzenie obowiązkowych zajęć poświęconych szczepieniom oraz większy nacisk na edukację praktyczną. W kontaktach z najbliższym otoczeniem studenci spotykali się z ambiwalentnymi postawami wobec szczepień, szczególnie przeciwko grypie i COVID-19, oraz z rozpowszechnionymi fake newsami. Studenci podkreślali konieczność zwiększenia zaufania społecznego do szczepień poprzez edukację, kampanie informacyjne oraz zaangażowanie lekarzy i ekspertów jako wiarygodnych źródeł wiedzy. Zwracali uwagę na deficyty wiedzy w zakresie znajomości mechanizmów działania szczepionek, profilaktyki chorób zakaźnych oraz brak umiejętności praktycznych w zakresie komunikacji z pacjentem.

Podsumowanie

Wypowiedzi pracowników ochrony zdrowia i studentów medycyny oraz pielęgniarstwa wskazują na istotne braki w wiedzy, umiejętności komunikacji oraz na niedostateczną promocję szczepień w środowiskach ich pracy i nauki. Personel medyczny często spotyka się z nieufnością pacjentów, a sam nie zawsze posiada aktualną wiedzę i odpowiednie przygotowanie do jej skutecznego

przekazania. Studenci medycyny i pielęgniarstwa krytycznie oceniali programy nauczania, wskazując na niedostatek praktyki i edukacji w zakresie szczepień. W obu grupach zauważono potrzebę intensyfikacji działań edukacyjnych, poprawy jakości komunikacji oraz zwiększenia zaufania społecznego do szczepień.

5. Podsumowanie

Niniejszy cykl publikacji składa się z przeglądu literatury i trzech prac oryginalnych: dwóch opartych na badaniach ilościowych i jednej opartej na badaniu jakościowym.

Przegląd literatury pokazał, że poziom zaszczepienia w dzieciństwie zależy od złożonej interakcji czynników społeczno-ekonomicznych, środowiskowych i związanych z opieką zdrowotną. Kluczowymi determinantami były: położenie geograficzne, wykształcenie rodziców, pochodzenie etniczne, wielkość gospodarstwa domowego i samotne rodzicielstwo; dochody gospodarstw domowych, ubezpieczenie, deprywacja, korzystanie z pomocy społecznej oraz interakcja z podmiotem świadczącym opiekę zdrowotną. Zależnie od kraju i kontekstu dany czynnik może korelować pozytywnie lub negatywnie ze stanem zaszczepienia. Za przykład może posłużyć otrzymywanie świadczeń socjalnych – w Polsce i w Japonii związane było z wyższym stanem zaszczepienia, a w Wielkiej Brytanii – z niższym. Zidentyfikowane zmienne podzielono na 7 kategorii tematycznych, a włączone badania przedstawiono w tabeli z wyszczególnieniem kraju, rodzaju badania i jego celu, aby móc dokonać szybkiej oceny przy planowaniu akcji związanej z promocją szczepień.

Praca oryginalna dotycząca poziomu szczegółowości raportowania danych dotyczących szczepień przeciw odrze pokazała korzyści ze spojrzenia na stan zaszczepienia w Polsce z poziomu powiatu. Przy obecnym systemie raportowania do decydentów na poziomie krajowym trafiają informacje o stanie zaszczepienia na poziomie województw. Luki w stanie zaszczepienia na poziomie powiatów nie są przekazywane do informacji publicznej, a w niektórych powiatach stan zaszczepienia przeciw odrze (MCV2) spadł poniżej 70%. Wykorzystanie analizy przestrzennej pozwala na ocenę tworzących się klastrów o podobnym stanie zaszczepienia oraz obszarów znacząco odbiegających od sąsiadujących z nimi.

Druga praca oryginalna udowodniła, że niektóre czynniki społeczno-ekonomiczne mogą być predyktorami osiągnięcia wystarczającego stanu zaszczepienia przeciw odrze na poziomie powiatów. Są to powszechnie dostępne, publikowane przez Główny Urząd Statystyczny dane: liczba gospodarstw domowych korzystających ze świadczeń środowiskowej pomocy społecznej, liczba porad udzielanych w POZ, liczba rodzin

otrzymujących zasiłek rodzinny na dzieci. Łatwość dostępu do tych danych może pozwolić instytucjom zaangażowanym w raportowanie danych na temat stanu zaszczepienia populacji w Polsce na włączenie ich do przyszłych analiz.

Badanie jakościowe, które służy za podstawę trzeciej pracy oryginalnej, było przeprowadzane w trakcie pandemii COVID-19 i uchwyciło wzrost zainteresowania tematyką szczepień wśród pracowników ochrony zdrowia i studentów. Wypowiedzi respondentów wskazały na istotne trudności w komunikacji dotyczącej szczepień, unikanie konfrontacji z osobami o innych poglądach oraz problemy z krytyczną oceną źródeł informacji. Studenci postulowali o zwiększenie ilości godzin zajęć poświęconych szczepieniom, a potrzeba szkoleń na ten temat była wyrażona zarówno przez lekarzy, pielęgniarki, jak i położne.

Z punktu widzenia bezpieczeństwa zdrowotnego państwa analiza danych dotyczących stanu zaszczepienia dzieci w Polsce i jego uwarunkowań powinna być ciągłym procesem, szerzej wpisanym w działalność instytucji krajowych.

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7. Kopie prac wchodzących w skład rozprawy

REVIEW ARTICLE

Annals of Agricultural and Environmental Medicine
www.aaem.pl

Socio-economic determinants of childhood vaccination coverage in high-income countries – a scoping review

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Nowicka PM. Socio-economic determinants of childhood vaccination coverage in high-income countries: a scoping review. Ann Agric Environ Med. doi:10.26444/aaem/211083

Abstract

Introduction and Objective. Vaccination remains a cornerstone of global public health, projected to prevent 51 million deaths between 2021–2030. Recent surges in vaccine-preventable diseases, including record measles cases in the USA, a rising number of pertussis outbreaks in Europe and the Americas, increased pneumococcal infections in Australia, signal deteriorating vaccination coverage in high-income countries. These emerging threats highlight the urgent need to examine the socio-economic variables associated with routine childhood immunization. The aim of this scoping review is to identify the socio-economic determinants of childhood vaccine coverage in high-income countries.

Review Method. Four databases: PubMed, Scopus, Embase and the Web of Science Core Collection were searched for relevant studies published between January 2016 – July 2025.

Brief description of the state of knowledge. Thirty-nine studies met the inclusion criteria. Childhood vaccination was associated with a variety of socio-economic factors. Key determinants of childhood vaccination coverage were: parental education, geographic location, ethnicity, household size and household income and insurance. While higher education, income, institutional support and living in an urban area were generally associated with higher coverage, hesitancy among educated and affluent groups also appeared. Lower vaccination coverage was associated with larger families, minority status, single parenthood, lack of insurance, deprivation, institutional distrust, and certain individual factors.

Summary. The review underscores that vaccination coverage reflects broader societal systems, economic security, healthcare infrastructure, cultural context, and trust in institutions. Structural advantages in high-income countries may mask underlying inequities. Addressing these dimensions is essential for closing immunization gaps.

Key words

vaccination coverage, childhood immunization, socio-economic determinants, vaccination

INTRODUCTION

Vaccination stands among the most impactful and economically efficient public health interventions. It is estimated that between 2021–2030, global immunization efforts will avert approximately 51 million deaths [1]. The World Health Organization (WHO), United Nations Children's Emergency Fund (UNICEF) and the Vaccine Alliance (Gavi) warn that these efforts face escalating challenges due to widespread misinformation, population growth, humanitarian emergencies, and reductions in financial support.

Re-emergence of vaccine-preventable diseases (VPDs) highlights the fragility of current vaccination coverage [2]. In 2025, the United States of America (USA) has recorded the highest number of measles cases since the disease was declared eliminated nationally in 2000 [3]. Cases of diphtheria, previously rare in Europe, had risen to 320 in 2022 [4]. A surge of pertussis outbreaks was observed globally: since 2022 across European countries and since 2024 in the Americas and Japan [5, 6, 7]. Rates of invasive pneumococcal disease in Australia have not been higher since 2004 [8]. Compared to other continents, vaccination confidence is lower in Europe, while Japan ranks among the countries with the lowest vaccine confidence worldwide [9]. As the outbreaks of VPDs continue to emerge across regions and populations, it is vital to understand the socio-economic determinants of childhood vaccination coverage. These determinants encompass an array of factors that influence health outcomes, including the environmental, economic, and societal conditions under which individuals are born, live, work and age. They are shaped by broader structural forces, such as public policies, economic systems and socio-cultural norms [10].

The bibliographic search found a lack of reviews designed to present the socio-economic determinants of the routine childhood vaccination coverage in high-income countries covering the period 2016–2025. Therefore, a scoping review was performed to identify and synthesize literature examining social and economic variables associated with childhood vaccination coverage.

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Received: 30.07.2025; accepted: 17.09.2025; first published: 25.09.2025

MATERIALS AND METHOD

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR) checklist [11].

Search strategy. Four databases: PubMed, Scopus, Embase and the Web of Science Core Collection were searched for relevant studies published between January 2016-July 2025 on socio-economic determinants of childhood vaccination coverage in high-income countries. The only identified review of quantitative studies found on the topic of socio-economic differences in childhood vaccination in developed countries encompassed the period from 1 January 2000–12 April 2016 [12]. Consequently, the current review was designed to examine the literature published from 2016 onward.

Search strategy included the terms 'socio-economic determinants', 'socioeconomic determinants', 'childhood vaccination coverage', and 'childhood vaccine uptake'. A data chart was created in Microsoft Excel to extract the following information from the publications: authors, title, year of publication, study design, aim, study location, type of vaccination, determinants of immunization.

The database search generated 931 results (Fig. 1). After removing duplicates, 913 titles and/or abstracts were screened, 238 full-text articles were assessed for eligibility. Studies which did not focus on socio-economic determinants, childhood routine vaccinations, high-income countries (according to the World Bank Group classification for 2024–2025), were not published in English, studies which focused on HPV vaccination, on specific vulnerable populations or were historical studies – were excluded. Finally, 39 articles were selected for inclusion.

RESULTS

Study characteristics. Of the 39 included articles (Tab. 1), 17 investigated populations and areas in Europe (Italy – 7, United Kingdom – 4, France – 2, Denmark – 1, The Netherlands – 1, Poland – 1, multi-country – 1), 14 in North America (United States – 8, Canada – 5, multi-country – 1), 4 in Asia (Israel – 3, Japan – 1), 2 in New Zealand, 1 in Australia, and 1 had a global scope. 14 studies focused specifically on 1 vaccine: 8 on measles-containing vaccine (MCV), 3 – rotavirus vaccine (RV), 1 – vaccine against diphtheria, tetanus, pertussis (DTP), 1 – hepatitis B vaccine (HBV), 1 – polio vaccine (OPV), 1 study focused on 2 vaccines (MCV and DTP).

The methodological designs included: cohort studies (n=12) [15, 20, 25, 33, 37, 38, 40, 43, 45, 46, 47, 48], survey-based studies (n=11) [17, 19, 21, 22, 29, 32, 35, 42, 44, 49, 50], ecological studies (n=10) [14, 18, 23, 26, 27, 28, 36, 39, 41, 51], retrospective observational studies (n=3) [30, 31, 34], mix-methods studies (n=2) [13, 24], and a descriptive study (n=1) [16]. 23 studies used data at the national level, 10 at the regional level and 6 at the city level.

Table 2 outlines the determinants of vaccine uptake identified according to study design. Identified variables were classified into 7 thematic categories: social, socio-economic, economic, healthcare-related/economic, healthcare-related, environmental, and individual.

SOCIAL DETERMINANTS

Parental education. In 13 studies higher parental education was associated with higher vaccination coverage/uptake, higher compliance with the vaccination reminder, higher vaccine confidence or lower risk of vaccination exemption. In one study, higher parental education was associated with higher vaccination coverage only in earlier cohorts (children born between 1995–2000), while in later cohorts (children born between 2006–2019) higher education was associated with lower vaccination coverage [47].

Ethnicity, race, citizenship. Authors of 13 studies explored the association of ethnicity, race and/or citizenship with immunization. Foreign childbirth was associated with lower coverage in 3 studies conducted in Canada, Japan, and the United Kingdom (UK) [23, 36, 49]. In the Italian context, cohort analysis revealed a shift in the association between citizenship status and vaccine uptake: in the earlier cohort foreign citizenship was associated with lower uptake, while in later cohorts, lower uptake was associated with Italian citizenship [47]. In The Netherlands, lower MCV uptake was observed in infants whose parents' country of birth was unknown [46]. A study from the UK described that white British children were less likely to be fully immunized if their mother was born outside the UK; however in case of Pakistani children, the chance of being fully immunized was higher if their mother was born outside the UK [33]. Another UK-based study reported that individuals of white ethnicity were significantly more likely to have received at least one MCV dose than those from all other ethnic groups combined [16].

In Canada and the USA, lower vaccination coverage was recorded among children from black, indigenous backgrounds [13]. Infants in the USA had higher odds of being vaccinated against HBV during the birth hospitalization if they were Hispanic, non-Hispanic black or Asian compared to non-Hispanic white [40]. In New Zealand, the highest immunization coverage was noted in areas with a high proportion of the population that were of European ethnicity [31]. A study from Israel showed that delayed vaccination was more common among the Jewish vs. Arab population, and delayed first dose was predictive of future delays [48]. Two studies from the USA examined vaccination exemptions. Among predictors of high risk of total vaccination exemptions was a high percentage of the Hispanic population, while a predictor of high risk of non-medical vaccination exemptions was high percentage of the white population [28]. Conscientious USA vaccination exemption rates were positively correlated with the percentages of students that self-report as of two or more races, Pacific Islander, and White [34].

Household size/birth order. In the studies from the UK and Israel, high birth order was associated with lower vaccination uptake and timeliness [23, 48]. In France, the presence of older siblings was independently associated with incomplete vaccination [20]. Larger household size correlated with reduced vaccination completion. Families with more children in the USA, UK and Canada, particularly those with four or more [22, 37], demonstrated lower odds of completing immunization schedules [33]. In Canada, delays were notably pronounced among later-born children at key vaccination milestones [42].

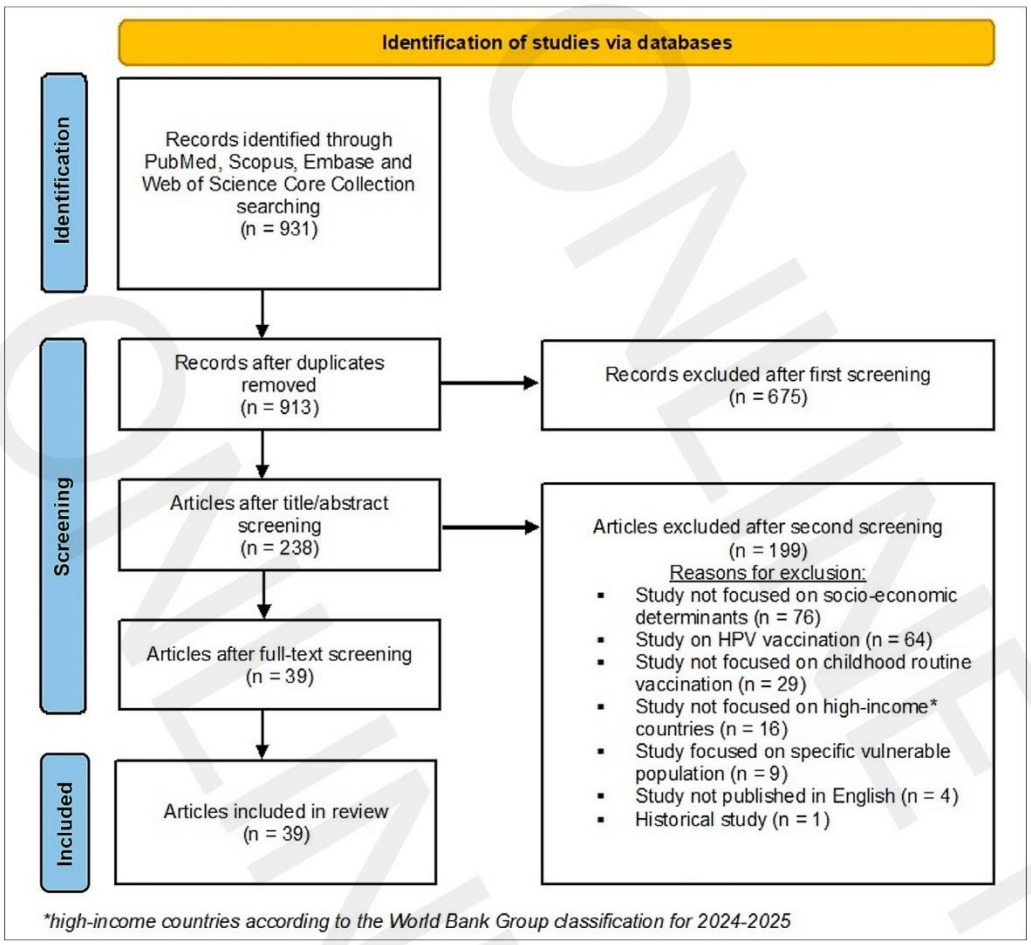

Figure 1. Flow diagram for literature search and study selection

Single parenthood/mother's marital status. Children from single-parent families were more likely to experience partial immunization in the UK [33], delayed [42] or non-vaccination in Canada [49]. Canadian and Italian studies found that mother's marital status (unmarried) was negatively associated with vaccine uptake [37, 47].

Other social determinants. Gender inequality at the national level was predictive of childhood immunization coverage. Higher gender inequality was significantly associated with increased zero-dose DTP prevalence and lower DTP3 coverage. A study from Italy showed that the social network composition also played a role, with the presence of anti-vaccine individuals linked to reduced uptake [19]. In Canada, children who were not attending daycare were more likely to experience delays in vaccination [42].

SOCIO-ECONOMIC DETERMINANTS

Receiving welfare/social assistance/child benefits. A higher number of households receiving welfare benefits was correlated with higher MCV vaccination coverage in Japan [36], and with the higher chance of sufficient MCV vaccination coverage in Poland [14]. In the UK, lower MCV coverage was associated with eligibility for free school meals [23]. Families receiving means-tested benefits, particularly within Pakistani communities, had increased risk of partial immunization [33].

Socio-economic status. In 4 studies (from Israel, The Netherlands and the USA) socio-economic status (SES) was associated with vaccine uptake [22, 39, 46, 48]. Lower SES was associated with reduced vaccine uptake or vaccination delays in two studies [22, 48]. In one study from Israel, the higher SES level of the municipality where health facility was located was associated with lower OPV vaccination uptake [39]. In a study from The Netherlands, high SES had significantly lower early MMR uptake, compared with very high SES [46].

Table 1. Studies included in the review

Ref. no.	Authors	Year	Country/ area	Study title	Study design	Aim
13.	Gellert FR, et al.	2025	United States, Canada	Bridging the gap: A mixed-methods analysis of Canadian and U.S. immunization programs for enhancing racial equity in childhood vaccinations	mix-methods	to compare racial disparities in childhood immunization between Canada and the United States over the past decade to identify resilient, cross-context interventions that promote racial equity and strengthen public health practices
14.	Nowicka PM, et al.	2025	Poland	Socio-economic determinants of the second-dose measles vaccination coverage in Poland	ecological	to assess the relationship between socio-economic factors and sufficient coverage (≥95%) with the second dose of vaccination against measles at the poviat level in Poland from 2014 – 2018
15.	Scronias D,et al.	2025	France	Persistence of major socio-economic inequalities in childhood measles-mumps-rubella vaccination coverage and timeliness under vaccination mandates, France, 2015 to 2024	retrospective cohort	to evaluate whether the 2018 expansion of France's childhood vaccination mandates improved the timeliness of MMR vaccine administration and reduced socio-economic inequalities in vaccination coverage among children
16.	Jary H, et al.	2025	United Kingdom, England	Sociodemographic inequalities in the epidemiology and vaccine uptake within a large outbreak of measles in Birmingham, England, 2023 to 2024	retrospective descriptive	to investigate sociodemographic disparities in measles epidemiology and vaccine uptake during a large outbreak in Birmingham, United Kingdom
17.	Anzà D, et al.	2025	Italy	Determinants of Rotavirus Vaccine Acceptance in an Area of Southern Italy with Low Vaccination Coverage: A Case-Control Study by the Health Belief Model Questionnaire	survey-based case-control	to identify key determinants influencing parental acceptance of the rotavirus vaccine (RVV) in a region of Southern Italy (Palermo, Sicily) with historically low vaccination coverage
18.	Mercogliano M, et al.	2024	Italy	An ecological analysis of socio-economic determinants associated with paediatric vaccination coverage in the Campania Region: A population-based study, years 2003-2017	ecological	to assess the association between socio-economic factors and paediatric vaccination coverage at the municipal level
19.	La Fauci G, et al.	2024	Italy	Rates and determinants of Rotavirus vaccine uptake among children in Italy: a cross-sectional study within the 2022 OBVIOUS* project	cross-sectional survey-based	to assess national rotavirus vaccine uptake among Italian children and identify sociodemographic and behavioral factors influencing parental decisions
20.	Jacques M, et al.	2023	France	Determinants of incomplete vaccination in children at age two in France: results from the nationwide ELFE birth cohort	observational cohort study	to identify factors associated with incomplete vaccination in two-year-old children in France, in order to inform targeted public health interventions.
21.	Arzilli G, et al.	2023	Italy	Assessing vaccine hesitancy and health literacy using a new Italian vaccine confidence index and a modified Italian medical term recognition test: A cross-sectional survey on Italian parents	cross-sectional survey-based	to evaluate vaccine hesitancy and health literacy among Italian parents using two newly developed tools: the Vaccine Confidence Index and a modified Italian Medical Term Recognition Test
22.	Michels SY, et al.	2023	United States	Failure to Complete Multidose Vaccine Series in Early Childhood	cross-sectional survey-based	to identify demographic and socioeconomic factors associated with initiating but not completing multidose vaccine series among children aged 19–35 months
23.	Perry M, et al.	2023	United Kingdom, Wales	Determinants of Equity in Coverage of Measles-Containing Vaccines in Wales, UK, during the Elimination Era	ecological	to identify demographic and socioeconomic factors associated with inequities in measles-containing vaccine coverage in Wales
24.	Ilesanmi MM, et al.	2022	Canada	Trends, barriers and enablers to measles immunisation coverage in Saskatchewan, Canada: A mixed methods study	mix-methods	to assess measles immunization trends and explore barriers/enablers from healthcare providers' perspectives
25.	Shen AK, et al.	2022	United States	Trends in Vaccine Refusal and Acceptance Using Electronic Health Records from a Large Pediatric Hospital Network, 2013-2020: Strategies for Change	cohort	to characterize trends in vaccine refusal and acceptance across pediatric practices and identify associated demographic and systemic factors
26.	Varbanova V, et al.	2022	Europe	Determinants of basic childhood vaccination coverage in European and OECD countries	ecological	to identify national-level determinants of DTP3 and MCV1 coverage across 61 countries from 1990–2019
27.	Vidal Fuertes C, et al.	2022	World	The Association between Childhood Immunization and Gender Inequality: A Multi-Country Ecological Analysis of Zero-Dose DTP Prevalence and DTP3 Immunization Coverage	ecological	to assess the relationship between gender inequality and childhood immunization coverage globally
28.	Tandy CB, et al.	2022	United States	Geographic disparities and predictors of vaccination exemptions in Florida: a retrospective study	ecological	to identify geographic disparities and sociodemographic predictors of vaccination exemptions in Florida
29.	Tal O, et al.	2021	Israel	Parents' attitudes toward children's vaccination as a marker of trust in health systems	cross-sectional survey-based	to assess how trust in health system stakeholders influences parental adherence to childhood vaccination
30.	Marek L., et al.	2021	New Zealand	Spatial-temporal patterns of childhood immunization in New Zealand (2006-2017): An improving pattern but not for all?	retrospective observational	to identify geographic and temporal trends in immunization coverage
31.	Marek L.; et al.	2020	New Zealand	Investigating spatial variation and change (2006–2017) in childhood immunisation coverage in New Zealand	retrospective observational	to assess socioeconomic and demographic factors influencing immunization coverage

Ref. no.	Authors	Year	Country/ area	Study title	Study design	Aim
32.	Bertoncello C, et al.	2020	Italy	Socioeconomic Determinants in Vaccine Hesitancy and Vaccine Refusal in Italy	cross-sectional survey-based	to explore socioeconomic inequalities in vaccine hesitancy and refusal
33.	Santorelli G, et al.	2020	United Kingdom	Factors associated with the uptake of the UK routine childhood immunization schedule in a bi-ethnic population	longitudinal cohort	to assess vaccine uptake and associated factors in White British and Pakistani children
34.	Morrison M, et al.	2020	United States	Conscientious vaccination exemptions in kindergarten to eighth-grade children across Texas schools from 2012 to 2018: A regression analysis	retrospective observational	to examine geographic trends and predictors of nonmedical vaccine exemptions
35.	Carpiano RM, et al	2019	Canada	Socioeconomic status differences in parental immunization attitudes and child immunization in Canada: Findings from the 2013 Childhood National Immunization Coverage Survey (CNICS)	cross-sectional survey-based	to explore the influence of socio-economic status (SES) on vaccine attitudes and coverage
36.	Sugishita Y, et al.	2019	Japan	Determinants of Vaccination Coverage for the Second Dose of Measles-Rubella Vaccine in Tokyo, Japan	ecological	to identify municipal-level factors associated with MR2 coverage
37.	Rafferty E, et al.	2019	Canada	Measurement of coverage, compliance and determinants of uptake in a publicly funded rotavirus vaccination programme: a retrospective cohort study	retrospective cohort	to assess rotavirus vaccine coverage, schedule compliance, and determinants of uptake following the introduction of a publicly funded programme
38.	Haider EA, et al.	2019	United Kingdom, Scotland	Identifying inequalities in childhood immunisation uptake and timeliness in southeast Scotland, 2008-2018: A retrospective cohort study	retrospective cohort	to examine the relationship between deprivation, vaccine uptake, and timeliness for four routine childhood vaccine
39.	Tur-Sinai A, et al.	2019	Israel	Vaccination uptake and income inequalities within a mass vaccination campaign	ecological	to assess OPV uptake and its association with socioeconomic status and income inequality during a national campaign
40.	Oster NV, et al.	2019	United States	Sociodemographic, clinical and birth hospitalization characteristics and infant Hepatitis B vaccination in Washington State	retrospective cohort	to identify sociodemographic and clinical factors associated with timely HepB vaccination during birth hospitalization
41.	Toffolutti V, et al.	2019	Italy	Austerity, measles and mandatory vaccination: cross-regional analysis of vaccination in Italy 2000-14	ecological	to assess the impact of public health expenditure cuts on MMR vaccination coverage
42.	Kiely M, et al.	2018	Canada	Impact of vaccine delays at the 2, 4, 6 and 12 month visits on incomplete vaccination status by 24 months of age in Quebec, Canada	cross-sectional survey-based	to quantify the impact of vaccine delays at 2, 4, 6, and 12 months on incomplete vaccination status by 24 months
43.	Suppli CH, et al.	2018	Denmark	Sociodemographic predictors are associated with compliance to a vaccination-reminder in 9692 girls age 14, Denmark 2014-2015	cohort	to identify sociodemographic predictors of compliance with vaccination reminders for MMR and HPV
44.	Lu PJ, et al.	2018	United States	Association of Health Insurance Status and Vaccination Coverage among Adolescents 13-17 Years of Age	cross-sectional survey-based	to assess vaccination coverage disparities by insurance status among adolescents
45.	Danchin MH, et al.	2018	Australia	Vaccine decision-making begins in pregnancy: Correlation between vaccine concerns, intentions and maternal vaccination with subsequent childhood vaccine uptake	prospective cohort	to assess how maternal vaccine concerns, intentions, and uptake during pregnancy correlate with subsequent childhood vaccine uptake
46.	Nic Lochlainn LM, et al.	2017	Netherlands	A novel measles outbreak control strategy in the Netherlands in 2013-2014 using a national electronic immunization register: A study of early MMR uptake and its determinants	retrospective cohort	to evaluate uptake and determinants of early MMR vaccination during a targeted outbreak intervention
47.	Anello P, et al.	2017	Italy	Socioeconomic factors influencing childhood vaccination in two northern Italian regions	retrospective cohort	to identify sociodemographic factors associated with non-vaccination and trends over time
48.	Stein-Zamir C, et al.	2017	Israel	Age-appropriate versus up-to-date coverage of routine childhood vaccinations among young children in Israel	retrospective cohort	to compare age-appropriate and up-to-date vaccination coverage and identify factors associated with delays
49.	Gilbert NL, et al.	2017	Canada	Determinants of non-vaccination and incomplete vaccination in Canadian toddlers	cross-sectional survey-based	to identify sociodemographic factors associated with total non-vaccination, measles non-vaccination, and incomplete pertussis vaccination
50.	Hill HA, et al.	2016	United States	Vaccination Coverage Among Children Aged 19-35 Months - United States, 2015	cross-sectional survey-based	to assess national and subgroup vaccination coverage and disparities
51.	Bernstein S, et al.	2016	United States	State-Level Voting Patterns and Adolescent Vaccination Coverage in the United States, 2014	ecological	to examine whether state-level political affiliation is associated with adolescent vaccination coverage for HPV, Tdap, and meningococcal vaccination

Table 2. Determinants of vaccine uptake identified according to study design

		Study design						Sum
Category	Determinant	Ecological	Cohort	Survey-based	Mixed-methods	Retrospective observational	Descriptive	
Social	Parental education	**4** [18, 23, 27, 28]	**2** [43, 47]	**8** [17, 21, 29, 32, 35, 42, 44, 49]				14
	Ethnicity[a]	**3** [23, 28, 36]	**5** [33, 40, 46, 47, 48]	**1** [49]	**1** [13]	**2** [31, 34]	**1** [16]	13
	Household size[b]	**1** [23]	**4** [20, 33, 37, 48]	**2** [22, 42]				7
	Single parenthood[c]		**3** [33, 37, 47]	**2** [42, 49]				5
	Gender[d]	**1** [27]		**1** [19]				2
	Social circle[e]			**1** [19]				1
	Daycare attendance			**1** [42]				1
Socio-economic	Welfare[f]	**3** [14, 23, 36]	**1** [33]					4
	Socio-economic status (SES)	**1** [39]	**2** [46, 48]	**1** [22]				4
Economic	Household income	**3** [18, 28, 39]	**2** [15, 37]	**2** [35, 49]				7
	Deprivation	**2** [18, 23]	**1** [38]		**1** [24]	**1** [31]		5
	Gross Domestic Product per capita	**1** [26]						1
	Unemployment rate	**1** [18]						1
	Poverty status			**1** [50]				1
	Perceived economic hardship			**1** [32]				1
Healthcare-related/ economic	Insurance		**3** [15, 25, 40]	**3** [22, 44, 50]				6
	Health expenditure	**1** [41]						1
Healthcare-related	Interaction with healthcare provider[g]	**1** [36]	**2** [20, 25]	**2** [17, 29]				5
	Trust in health authorities			**2** [21, 29]				2
	Access to healthcare			**1** [44]	**1** [13]			2
	Adherence to health recommendations		**1** [20]	**1** [29]				2
	Medical treatment approach[h]		**1** [20]	**1** [29]				2
	Gestational age at birth		**1** [37]	**1** [42]				2
	Density of healthcare workers[i]	**2** [26, 28]						2
	Access to vaccine information			**1** [17]				1
	Delayed first dose of a vaccine		**1** [48]					1
	Number of medical consultations in primary healthcare	**1** [14]						1
	Length of the hospital stay		**1** [40]					1
	Under-five mortality	**1** [26]						1
Environmental	Geographical location[j]	**3** [18, 26, 28]	**4** [20, 25, 37, 43]	**4** [17, 19, 22, 50]	**1** [24]	**2** [30, 34]		14
Individual	Political views	**1** [51]	**1** [46]					2
	Age		**1** [37]	**1** [29]				2
	Diet			**1** [29]				1
	Parity		**1** [45]					1
	Religious affiliation		**1** [46]					1
	Season of birth		**1** [48]					1

a ethnicity, race, citizenship, mother's birthplace, child's birthplace
b household size, birth order
c single parenthood, mother's marital status
d parental gender, gender inequality
e having friends/relatives opposed to vaccination
f families receiving welfare, social assistance, state subsidies, child benefits
g receiving recommendation/notification/visit from healthcare provider
h using alternative/conservative medicines
i density of primary care providers, nurses and midwives (per 1,000 people), physicians (per 1,000 people)
j geographical location, region, city, area, health facility location, geographical mobility

ECONOMIC DETERMINANTS

Household income. Higher household income was positively associated with improved vaccine uptake in Italy and France [15, 18], while in the USA, high median income at the community level was paradoxically associated with an increased risk of total vaccination exemptions [28]. In Israel, maternal clinic areas characterized by greater income inequality showed significantly lower vaccination uptake [39]. Similarly, in Canada, income interacted with residential location: children in lower-income rural areas had decreased odds of rotavius vaccination, whereas income had no apparent effect in urban settings [37]. Moreover, lower household income was associated with increased gaps in immunization [49]. Parents in middle-income group were more likely to express strong concerns regarding MCV vaccine side-effects, while parents from the lowest income groups had higher safety concerns regarding DTP vaccine [35].

Deprivation. Across five studies (from Italy, UK, Canada and New Zealand) deprivation has been shown to exert a negative impact on childhood vaccination coverage [18, 23, 24, 31, 38]. In Italy, area-level deprivation correlated with lower coverage, especially for MCV and OPV vaccines [18]. In the UK, association between deprivation, uptake, and timeliness was found: delay was pronounced for 40% of the most deprived population [38].

Other economic determinants. In European countries, higher gross domestic product *per capita* was positively associated with increased DTP and MCV vaccination coverage [26], while elevated unemployment rates were negatively associated with DTP coverage [18]. In the USA, poverty status was associated with reduced vaccination [50]. Additionally, rising levels of perceived economic hardship were associated with increase vaccine hesitancy in Italy [32].

HEALTHCARE-RELATED AND HEALTHCARE-RELATED / ECONOMIC DETERMINANTS

Insurance. In France, children from households eligible for State-subsidized health insurance had delayed and incomplete MCV vaccination [15]. In the USA, eligibility for the Vaccines for Children programme corresponded with higher vaccine refusal odds [25], in contrast, public insurance was positively associated with timely hepatitis B vaccination [40], though the vaccine coverage was lower for most vaccines among uninsured children and those insured by Medicaid, compared with those having private health insurance [44, 50]. Lack of insurance was strongly associated with failure to complete vaccination series [22]. Reductions in public health expenditure were associated with a decrease in MCV coverage in Italy [41].

Interaction with healthcare provider. Provider engagement improved coverage through repeated vaccine invitations [25], reminder letters [36], and postnatal follow-up. Higher incomplete vaccination rate was associated with the child's medical follow-up by a general practitioner, compared to a follow-up by a paediatrician in France [20]. Compliance with other child screening examinations was associated with the higher acceptance of the national vaccination programme in Israel [29].

Other healthcare-related determinants. Trust in health authorities positively correlated with vaccine confidence in two studies [21, 29]. Institutional distrust and poor access to healthcare were mentioned as barriers undermining vaccine equity in confidence in the USA [13]. Low reliance on alternative medicine was associated with greater adherence to the national vaccination programme in Israel [29], whereas social media use was linked to lower vaccine confidence in Italy [21]. In areas with greater number of medical consultations, the chance of sufficient vaccination coverage was higher in Poland [14], while in the USA high density of primary care providers was a predictor of high risk of total vaccination exemptions [28].

Preterm birth increased odds of delayed or incomplete vaccination [37, 42], while high under-five mortality correlated with reduced DTP and MCV coverage [26]. Additionally, findings from the USA indicated that shorter durations of postnatal hospitalization were inversely associated with timely administration of the first dose of the HBV [40]. Delayed initiation of the vaccination against diphtheria, tetanus, acellular pertussis, polio and Haemophilus influenzae type b (DTaP-IPV-Hib) series was positively correlated with overall vaccination delays, as reported in a study conducted in Israel [48].

ENVIRONMENTAL DETERMINANTS

Geographical location. Factors related to geographical location (urban/rural area, health facility location, geographical mobility) and their association with vaccination coverage were mentioned in 14 studies. Urban settings were associated with higher vaccination coverage in four studies [17–19, 26]. However, some urban areas with concentrated deprivation exhibited poorer outcomes than rural counterparts with active local health services [18].

Although spatial clustering revealed that suburban outskirts in New Zealand exhibited higher immunization coverage compared to urban areas [30], living in rural or isolated area was linked to lower vaccine uptake in three studies [20, 37, 50]. A study focused on Florida, USA, showed that populations living in a rural area showed lower risks of non-medical exemptions [28], while a study conducted in Pennsylvania, USA, showed that the location of the suburban clinic was associated with higher refusal odds [25]. In a study conducted in Texas, USA, schools with the top 10 highest reported conscientious vaccination exemption percentages were located in three of the four most populous metropolitan areas in this state [34]. In Denmark, girls only lacking the MCV-vaccination, were less likely to be vaccinated when living in non-capital regions [43].

Geographic mobility – moving across state lines – was described as being associated with higher odds of incomplete vaccination series in one study [22]. Geographic and logistical barriers negatively impacted vaccine uptake in Canada [24].

INDIVIDUAL DETERMINANTS

Political views. In The Netherlands, municipalities with a higher proportion of the conservative Reformed Political Party voters were associated with lower MCV uptake [46]. Similarly, in the USA, adolescent vaccination coverage was

higher in states with Democratic majorities compared to those with Republican majorities [51].

Age. In Israel, older age was positively associated with favourable attitudes toward the national vaccination programme and higher adherence [29]. In Canada, when compared with mothers over 40 years of age, those aged 31–35 and 36–40 had significantly lower odds of not completing the rotavirus vaccine series, while mothers 21–25 years of age and under 21 years of age, had significantly greater odds of not having their children fully vaccinated [37].

Diet. In Israel, vegetarian parents were more likely to partially vaccinate their children, whereas vegan parents demonstrated a tendency not to vaccine their children [29].

Parity status. In Australia, women pregnant with their first child exhibited greater vaccine hesitancy, compared with mothers with more children [45].

Religious affiliation. Religious objections towards vaccination were found to be associated with lower MCV uptake in The Netherlands [46].

Season of birth. Authors of a study from Israel found that vaccination delay was associated with a particular birth season – winter [48].

SUMMARY

More than half of the studies included in this review originated from three countries: USA, Italy, and Canada. The key determinants of immunization were identified as being geographic location for environmental characteristics; parental education, ethnicity, household size and single parenthood for social characteristics; household income, insurance, deprivation of economic characteristics, benefitting from social assistance and SES status from socio-economic category, and interaction with health provider among healthcare-related variables.

Childhood vaccination uptake is governed by a complex interaction of socio-economic, environmental and healthcare-related factors. Across diverse countries and contexts, parental education is associated with higher vaccine coverage, confidence, and compliance. However, shifting trends in later birth cohorts suggest rising scepticism among highly educated parents, warranting longitudinal examination. Ethnicity, race, and citizenship status influence immunization patterns, with foreign-born and minority populations often experiencing lower coverage, although notable exceptions exist across different national settings. Family structure plays a critical role: larger household, higher birth order, and single parenthood consistently predict incomplete or delayed immunization. Socio-economic disadvantage, including low income and deprivation, has a well-documented negative effect on vaccination, although some evidence points to mitigating effects of social assistance in certain countries. Counter-intuitively, some affluent communities show increased exemption rates, highlighting ideological hesitancy as a distinct phenomenon.

Institutional support, including pediatric follow-up and reminder systems, improve adherence. Trust in medical authorities, preference for conventional care, and consistent child screening support vaccine uptake. Conversely, social media use and institutional distrust undermine vaccine confidence.

Environmental factors, particularly rural residence, further exacerbate disparities. Geographic determinants reveal that urban settings often outperform rural ones, yet intra-urban deprivation and suburban exemption hotspots complicate this narrative. Maternal age, primiparity, religious or political affiliations and lifestyle choices, such as vegetarianism or veganism, have been associated with vaccine hesitancy or refusal.

Limitations of the study. All studies included in this review were published in peer-reviewed journals; however, the quality of the included studies and the quantitative strength of identified determinants were not formally assessed, as the primary objective of this review was to map the current landscape of socio-economic determinants influencing vaccination coverage in high-income countries. Consequently, the relevance of the reported determinants may be limited, if underlying evidence was compromised by methodological bias or insufficient study rigour. This review was restricted to studies published in English, which may have introduced selection or publication bias by omitting pertinent research available in other languages.

CONCLUSIONS

The review reinforces that childhood vaccination coverage reflects broader societal systems – economic security, healthcare infrastructure, socio-cultural context, and trust in institutions. The socio-economic determinants of childhood vaccination coverage are not uniform across countries. This variability highlights the need not only to unravel the intersectionality among these determinants in future studies, but also to prioritize standardized cross-national comparisons to identify structural drivers of inequity. Context-sensitive qualitative studies are needed to better understand the declining uptake, parental decision-making, and plan-targeted interventions to close immunization gaps.

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ORIGINAL ARTICLE

Annals of Agricultural and Environmental Medicine
www.aaem.pl

Granularity matters – measles first- and second-dose vaccination coverage in Poland, 2014–2018

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Nowicka PM, Lewandowski Z, Gujski M, Samoliński BK. Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014–2018. Ann Agric Environ Med. doi:10.26444/aaem/211389

Abstract

Introduction and Objective. Vaccination coverage of ≥95% is essential to interrupt measles transmission. Accurate measurement of vaccine uptake is critical for identifying vulnerable populations and guiding public health interventions. The aim of the study is to: present differences in the sufficient measles vaccination (MCV) coverage in Poland, measured at different granularity level, and to identify clusters with sufficient/insufficient MCV coverage.

Materials and Method. Data on MCV coverage was extracted from annual reports collected by sanitary-epidemiological stations in Poland between 2014–2018. Spatial analysis using Local Moran's I was performed to identify neighbouring poviats with similar MCV rates and outlier areas with markedly dissimilar values.

Results. MCV coverage in Poland exhibited substantial spatial and temporal variability. The first dose of measles vaccination (MCV1) coverage ranged from 89% – 99% at the voivodeship level and from 80% to 100% at the poviat level, while the second dose measles vaccination (MCV2) coverage ranged from 84% – 99% and from 32.3% – 100%, respectively. Spatial disparities were particularly pronounced in several voivodeships, with Mazowieckie consistently demonstrating both the highest positive and negative deviations between poviat-level and voivodeship-level coverage. Statistically significant local spatial autocorrelation was observed in an increasing number of poviats for MCV1, rising from 14 in 2014 to 47 in 2018. For MCV2, the number of poviats with significant clustering fluctuated, peaking at 27 in 2015.

Conclusions. The use of fine-grained poviat-level data revealed disparities in MCV coverage and localized gaps that would be obscured at the voivodeship level, underscoring the importance of high-resolution spatial analysis for guiding targeted vaccination efforts and improving public health equity.

Key words

vaccination coverage, MMR vaccine, childhood immunization, measles, vaccine uptake.

INTRODUCTION

Achieving high vaccination coverage remains one of the most effective strategies for mitigating both the spread and impact of infectious diseases [1–3]. As a commonly available method of preventing infectious diseases, vaccinations contribute to shaping not only individual but also collective prevention [4–6]. A decline in vaccination coverage along with an increased number of vaccine-preventable disease cases have been observed in recent years [7, 8]. According to estimates of the World Health Organization (WHO), 23 million children did not receive the complete age-appropriate vaccination course in 2020 due to the COVID-19 pandemic, and associated disruptions. Global estimates of coverage with the first dose of measles-containing vaccine (MCV1) dropped from 86% in 2019 to 81% in 2021 [8].

Due to the highly contagious nature of the measles virus, a very high level of herd immunity is required, with vaccination coverage of at least 95% needed to interrupt transmission [9]. As of July 2025, surveillance data from the WHO reported 239,816 suspected measles cases and 108,074 confirmed cases across all WHO regions. The Eastern Mediterranean Region accounted for the largest proportion (35%), followed by the African (21%) and the European Region (21%) [10]. From 1 July 2024 – 30 June 2025, 30 EU/EEA Member States reported a total of 14,401 cases of measles and 8 deaths. 84.3% of cases with a known age and vaccination status were unvaccinated [11]. Reliable calculation of the vaccination uptake is vital in assessing the success of the vaccination program, identifying susceptible populations for further interventions, and informing future health policy decisions [12, 13]. Following significant outbreaks that underscored gaps in vaccine coverage, in recent years, several European countries (e.g. Italy, France and Germany) have introduced mandatory measles vaccination, while in Poland, measles vaccination has been a compulsory component of the national immunization program since 1975 [14 – 16].

The childhood immunization data reporting in Poland (described below) does not allow for easy identification of smaller territorial areas (such as poviats) to target actions of public health authorities in the case of lower than expected

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Received: 19.08.2025; accepted: 25.09.2025; first published: 09.10.2025

vaccination coverage on their territory. The analysis of data at the poviat level will allow to identify areas with insufficient vaccination coverage to achieve herd immunity and direct targeted public health activities aimed at increasing the vaccination uptake. This study aimed to: 1) present the differences in the sufficient MCV1 and MCV2 coverage measured at different granularity levels (voivodeship vs. poviat), and 2) identify clusters with sufficient/insufficient MCV1 and MCV2 coverage.

MATERIALS AND METHOD

Childhood immunization data reporting in Poland. Data on childhood routine vaccines administered in Poland in the studied period was recorded by the entities conducting medical activity providing outpatient and stationary health services participating in preventive vaccinations, which were obliged to send the individual data in a paper form to the poviat sanitary-epidemiological stations (PSSE) once a year (since 2024 the data is sent quarterly in an electronic form) [17,18]. PSSE sent the aggregated data using MZ-54 form to respective voivodeship sanitary-epidemiological stations (WSSE). There are 318 PSSE and 16 WSSE in Poland [19]. Aggregated data from WSSE is sent to the Chief Sanitary Inspectorate and the National Institute of Public Health National Institute of Hygiene-National Research Institute [20]. Each year, both institutions publish a document entitled *Vaccination in Poland*, in which the voivodeship is the smallest territorial unit assessed [21].

Data collection. Measles vaccination coverage data used in the study was collected with granularity at the poviat level. Data was collected from 2014–2018 when the second dose of the MCV vaccine was administered to children at age 10. This analysis does not cover the period following the 2019 revision of the immunization schedule, which moved MCV2 administration to age 6 [22]. Due to the aggregated nature of the data received from sanitary-epidemiological stations, it was not possible to identify individual patients who received the vaccination. The vaccination coverage rate for each calendar year was calculated as the proportion of the vaccinated children in a birth cohort targeted for immunization. The numerator represented the number of children who received the specific vaccine during the observed calendar year. The measles-containing vaccines (MCV1 in the 3rd year of life, MCV2 in the 11th year of life) were chosen as indicators. The threshold was defined at 95% to divide territory units into those with sufficient (≥95%) and insufficient (<95%) measles vaccination coverage. Data from the voivodeship level was compared with the data from the poviat level.

Data integration and analysis. Microsoft Excel and SAS programme version 9.4 were used for data integration and analysis. Descriptive statistics was used to present the MCV1 and MCV2 coverage at the voivodeship and at the poviat levels. Spatial analysis using Local Moran's I was performed to identify neighbouring poviats with similar MCV (MCV1 and MCV2) rates and outlier areas with markedly dissimilar values. The level of significance was set at .05. Poviats with sufficient MCV vaccination coverage surrounded by poviats with similarly high values were in category called 'high-high' (HH). Poviats with insufficient MCV vaccination coverage surrounded by poviats with similar values were included in the 'low-low' (LL) category. An outlier 'high-low' (HL) area described a poviat with sufficient MCV vaccination coverage surrounded by poviats with insufficient MCV vaccination coverage. An outlier 'low-high' (LH) area described a poviat with insufficient MCV vaccination coverage surrounded by poviats with sufficient MCV vaccination coverage. The proximity of poviats was determined using the shared boundary criterion.

RESULTS

Between 2014–2018, MCV1 coverage ranged from 89% – 99% on the voivodeship level, and from 80% – 100% on the poviat level (Tab. 1), while MCV2 coverage in the same period ranged from 84% – 99% on the voivodeship level, and from 32.3% – 100% on the poviat level (Tab. 2). Figures 1 and 2 depict differences in the areas of Poland with sufficient (≥95%) and insufficient MCV1 (Fig. 1) and MCV2 (Fig. 2) vaccination coverage measured at the poviat and at the voivodeship levels. The voivodeships exhibiting the greatest variation in MCV1 coverage across constituent poviats were as follows: Mazowieckie, Łódzkie, and Małopolskie in 2014; Mazowieckie, Łódzkie, and Pomorskie in 2015; Łódzkie, Pomorskie, and Mazowieckie in 2016; Mazowieckie, Małopolskie, and Podlaskie in 2017; and Lubelskie, Mazowieckie, and Łódzkie in 2018. The voivodeships demonstrating the highest levels of disparity in MCV2 coverage across poviats in their area were as follows: Warmińsko-Mazurskie, Mazowieckie, and Lubuskie in 2014; Podkarpackie, Mazowieckie, and Pomorskie in 2015; Mazowieckie, Podkarpackie, and Łódzkie in 2016; Podkarpackie, Mazowieckie, and Małopolskie in 2017; and Mazowieckie, Małopolskie, and Podkarpackie in 2018.

The greatest positive deviation between the poviat with the highest MCV1 coverage and the corresponding voivodeship-level coverage was observed in the Mazowieckie voivodeship in 2014, 2016, 2017, and 2018, and in the Małopolskie Voivodeship in 2015. Conversely, the largest negative deviation between the poviat with the lowest MCV1 and the voivodeship-level coverage was recorded in Mazowieckie in 2014, in Łódzkie during the period 2015–2017, and in Lubelskie in 2018. The greatest positive deviation between MCV2 coverage in the poviat with the highest coverage and the corresponding voivodeship-level coverage was consistently observed in Mazowieckie Voivodeship across all years analyzed. In contrast, the largest negative deviation between the poviat with the lowest MCV2 coverage and the voivodeship-level coverage was recorded in Warmińsko-Mazurskie in 2014, in Podkarpackie in 2015 and 2017, and in Mazowieckie in 2016 and 2018.

For MCV1, statistically significant local spatial autocorrelation (based on Local Moran's I) was observed for 14 poviats in 2014 year, 26 in 2015, 27 in 2016, 44 in 2017 and 47 in 2018. The proportion of poviats forming spatial clusters with similar MCV1 coverage increased over time, accounting for 4.1% in 2014, 7.5% in 2015, 7.2% in 2016, 11.9% in 2017, and 13.4% in 2018. Additionally, a subset of poviats exhibited statistically significant negative local spatial autocorrelation, indicating spatial outliers: 1 poviat in 2014, 2 in 2015, 4 in 2016, 6 in 2017, and 4 in 2018 (Tab. 3).

Table 1. MCV1 vaccination coverage at the voivodeship and the poviat level 2014–2018

	MCV1																			
	2014				2015				2016				2017				2018			
Voivodeship	Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.		
DOLN[a]	97.7	93.6	-	99.8	96.5	93.9	-	100	96.1	93.4	-	99.6	95.1	91.5	-	100	92.9	88.3	-	99.3
KUJA[b]	99	98.3	-	100	98.7	97.6	-	99.7	98.3	96.7	-	99.7	97.5	95.2	-	100	96.6	94	-	99.7
ŁÓDŹ[c]	96.8	91.6	-	100	95.1	90	-	99.7	94.6	81	-	99.7	93.9	86	-	100	92.0	83.6	-	98.7
LUBU[d]	98.8	97.2	-	99.8	97	94.7	-	99.5	96.6	94.3	-	99.1	95.8	93	-	99.2	94.4	90.3	-	97.8
LUBE[e]	97	93.3	-	100	96.4	93.5	-	99.5	95.3	90.7	-	99.7	93.1	86.7	-	97.9	91.3	80.1	-	97.1
MAŁO[f]	96.2	91.6	-	100	94.9	93.8	-	99.9	93.9	88.4	-	98.7	92.7	86.7	-	98.9	92.2	86	-	99.6
MAZO[g]	94.5	83	-	99.9	93.0	88.5	-	100	91.6	88.3	-	99.7	89.6	83.9	-	99.5	89.7	82.9	-	99.7
OPOL[h]	98.1	97.1	-	100	97.3	94.9	-	100	97.1	95.6	-	99.7	96.4	94.4	-	98.9	95.6	93.3	-	98.7
PODK[i]	97.7	93.9	-	99.7	97.2	94.3	-	99.7	96.3	89.1	-	100	94.5	88.8	-	99.1	93.5	88.9	-	99.5
PODL[j]	96.4	94.4	-	99.5	95.5	92.7	-	98.5	93.6	90.3	-	98.5	91.9	85.8	-	97.9	89.0	83.4	-	98
POMO[k]	96.6	93.9	-	99.4	96.4	92.3	-	99.9	94.9	82.8	-	99.3	94.4	90.3	-	99.4	93.5	88.7	-	99.1
ŚLĄSK[l]	96.6	95.2	-	98.9	96.0	93.7	-	98.8	95.4	92.3	-	98.3	93.8	89.9	-	97	92.4	88.8	-	96.4
ŚWIĘ[m]	98.4	94.9	-	99.8	98.1	94.3	-	99.8	99	97.9	-	100	97.1	95	-	99.5	96.2	94	-	99.1
WARM[n]	95.7	99.1	-	100	99	98	-	100	98.7	97.3	-	100	98.3	95.9	-	100	98.2	96.3	-	99.8
WIEL[o]	97.9	95.7	-	100	97.4	95	-	99.7	96.5	92.9	-	100	95.9	92.6	-	99.1	94.5	90.9	-	99
ZACH[p]	98.2	98.16	-	100	98	95.1	-	100	97.5	92.7	-	100	97.1	94.7	-	99.8	95.4	91.9	-	99.5

[#]MCV1 (measles-containing vaccine, 1st dose) vaccination coverage at the voivodeship level [%]; [§]range (min.-max.) of MCV1 vaccination coverage at the poviat level [%]; [a] Dolnośląskie; [b] Kujawsko-Pomorskie; [c] Łódzkie; [d] Lubuskie; [e] Lubelskie; [f] Małopolskie; [g] Mazowieckie [h] Opolskie; [i] Podkarpackie; [j] Podlaskie; [k] Pomorskie; [l] Śląskie; [m] Świętokrzyskie; [n] Warmińsko-Mazurskie; [o] Wielkopolskie; [p] Zachodniopomorskie

Table 2. MCV2 vaccination coverage at the voivodeship and the poviat level 2014–2018

	MCV2																			
	2014				2015				2016				2017				2018			
Voivodeship	Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.			Voi[#]	Pov[§] min. – max.		
DOLN[a]	95.4	89.8	-	99.8	94.3	85.9	-	99.8	93.5	83.5	-	100	94.1	89.0	-	100	92.3	85.5	-	99.4
KUJA[b]	99.3	98.8	-	100	99.1	98.4	-	100	99.0	97.9	-	100	98.7	97.7	-	99.8	98.2	95.9	-	100
ŁÓDŹ[c]	94.4	85.1	-	99.3	93.4	82.0	-	99.4	92.8	79.6	-	99.5	92.7	83.6	-	99.5	92.9	84.1	-	99.7
LUBU[d]	97.2	82.7	-	99.6	96.9	92.8	-	100	96.8	90.1	-	99.4	95.3	88.0	-	99.1	95.7	91.4	-	99.2
LUBE[e]	97.3	94.0	-	100	96.5	89.2	-	100	96.0	86.9	-	100	95.8	89.6	-	99.8	94.3	88.4	-	99.8
MAŁO[f]	95.1	88.0	-	99.8	94.4	87.6	-	98.8	92.8	82.8	-	98.8	92.3	82.1	-	98.4	91.5	80.8	-	98.4
MAZO[g]	86.4	72.4	-	99.7	85.9	72.6	-	99.5	83.7	67.3	-	99.5	85.4	72.4	-	100	84.7	65.2	-	100
OPOL[h]	95.9	91.0	-	99.5	96.6	91.4	-	99.1	96.7	91.2	-	99.5	95.7	93.9	-	99.2	95.2	93.2	-	99
PODK[i]	92.0	82.4	-	99.1	90.1	71.2	-	99.5	89.7	75.8	-	98.8	85.1	32.3	-	98.7	89.2	82.3	-	98.8
PODL[j]	96.5	94.2	-	99.8	96.6	94.3	-	99.4	95.4	89.8	-	99.7	93.6	86.5	-	99.7	93.4	89.2	-	99.1
POMO[k]	94.0	93.4	-	99.3	93.3	81.5	-	99.8	92.0	80.7	-	99.2	92.8	84.6	-	99.6	91.5	84.4	-	99.1
ŚLĄS[l]	95.1	83.7	-	98.7	95.1	84.5	-	98.9	94.6	84.3	-	99.6	93.8	82.6	-	98.6	92.9	85.5	-	97.4
ŚWIĘ[m]	97.4	94.7	-	100	96.6	93.1	-	99.6	96.2	88.9	-	99.7	96.5	92.8	-	99.9	96.0	92.5	-	99.4
WARM[n]	97.4	46.3	-	100	99.4	98.8	-	100	99.3	98.7	-	100	99.1	97.9	-	100	98.8	97.1	-	100
WIEL[o]	98.0	95.9	-	100	97.4	95.1	-	100	96.3	92.4	-	99.8	95.4	88.3	-	99.5	95.2	91.1	-	99.5
ZACH[p]	96.7	91.3	-	100	96.3	90.0	-	100	95.4	89.4	-	99.8	95.4	87.6	-	99.6	95.1	88.1	-	99.8

[#]MCV2 (measles-containing vaccine, 2nd dose) vaccination coverage at the voivodeship level [%]; [§]range (min.-max.) of MCV2 vaccination coverage at the poviat level [%]; [a] Dolnośląskie; [b] Kujawsko-Pomorskie; [c] Łódzkie; [d] Lubuskie; [e] Lubelskie; [f] Małopolskie; [g] Mazowieckie; [h] Opolskie; [i] Podkarpackie; [j] Podlaskie; [k] Pomorskie; [l] Śląskie; [m] Świętokrzyskie; [n] Warmińsko-Mazurskie; [o] Wielkopolskie; [p] Zachodniopomorskie

For MCV2, statistically significant local spatial autocorrelation was observed for 23 poviats in 2014, 27 in 2015, 22 in 2016, 16 in 2017 and 25 in 2018. The percentage of poviats forming spatial clusters with similar MCV2 coverage was 5.9% in 2014, 7.8% in 2015, 6.6% in 2016, 4.7% in 2017, and 7.2% in 2018. Statistically significant negative local spatial autocorrelation was identified for 4 poviats in 2014, 2 in 2015, 1 in 2016, 1 in 2017, and 2 in 2018 (Tab. 4).

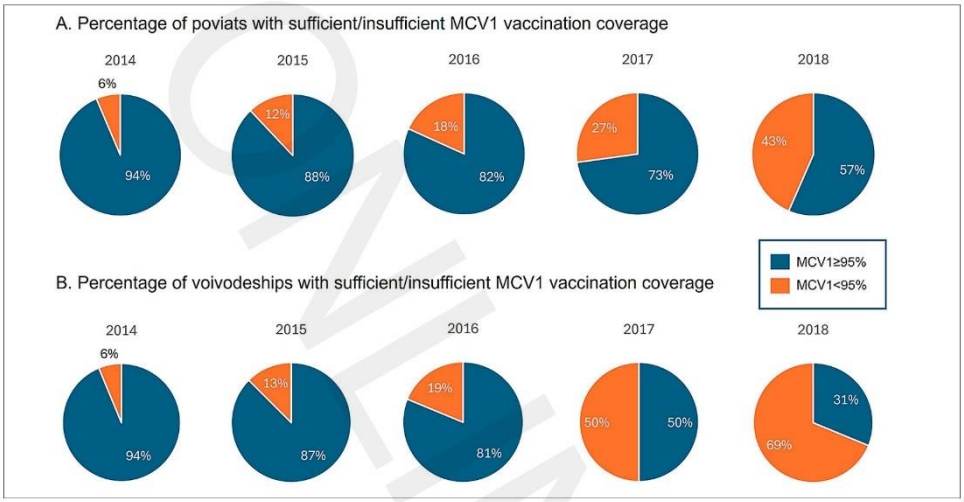

Figure 1. Areas of Poland with sufficient (≥95%) and insufficient (<95%) MCV1 vaccination coverage, poviat and voivodeship perspective (2014-2018)

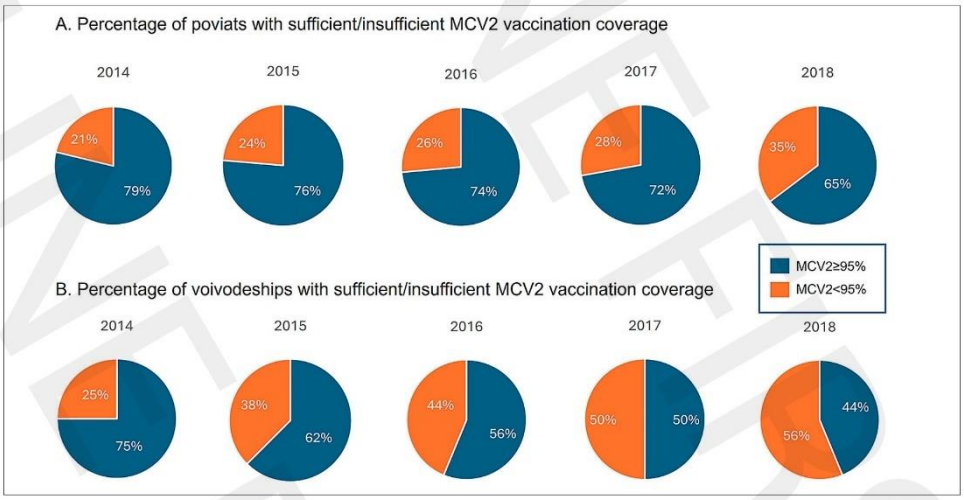

Figure 2. Areas of Poland with sufficient (≥95%) and insufficient (<95%) MCV2 vaccination coverage, poviat and voivodeship perspective (2014-2018)

DISCUSSION

The European Immunization Agenda 2030, a strategic framework developed by the WHO Regional Office for Europe, seeks to reduce disparities in immunization coverage through the local-level interventions, based on a comprehensive monitoring systems at regional, national, and subnational levels. One of the strategic priorities is to enhance subnational capacity to interpret and analyze immunization surveillance data in order to identify critical gaps and populations at elevated risk of VPD outbreaks [23]. Previous studies have shown that the under-immunization and vaccine refusal cluster geographically [24 – 28]. Masters et al. found that, when non-vaccination was locally clustered, reporting aggregated data at the state- or county-level could result in substantial underestimates of outbreak risk. The authors suggested collecting vaccination data of higher granularity to prevent a return to endemic measles transmission in the USA

[28]. Leveraging digital technologies and data triangulation is needed to improve immunization monitoring and VPD surveillance and strengthen the quality of the reported data [23].

Main findings and analysis of results. The comparison of MCV1 and MCV2 vaccination coverage across voivodeship and poviat levels between 2014 – 2018 reveals important insights into the spatial dynamics of immunization in Poland. At the voivodeship level, 5 regions: Kujawsko-Pomorskie, Opolskie, Świętokrzyskie, Warmińsko-Mazurskie and Zachodniopomorskie, consistently achieved sufficient coverage for both MCV doses. Lubuskie and Wielkopolskie voivodeships also demonstrated stable and generally sufficient coverage, though in 2018 both fell marginally (less than 1%) below the 95% threshold. However, when examining the data at the poviat level, substantial internal disparities become evident. While MCV1 coverage remained relatively stable, with minimum values generally above 80%, MCV2 coverage exhibited significantly greater variability. In some poviats, coverage for the second dose dropped below 70%. The divergence between MCV1 and MCV2 coverage at the poviat level suggests challenges in ensuring both doses completion. This pattern may reflect insufficient reporting systems, logistical barriers to follow-up, or localized vaccine hesitancy. The Mazowieckie voivodeship consistently exhibited the greatest internal variability in both MCV1 and MCV2 coverage, appearing repeatedly among the regions with the largest differences between poviats. This may reflect the socio-economic and demographic heterogeneity within the voivodeship, which encompasses both the metropolitan area of the capital of Poland and more rural districts. Similar patterns are observed in eastern and southeastern regions, including Lubelskie and Podkarpackie, where broader coverage ranges and lower minimums highlight barriers to full immunization.

Both MCV1 and MCV2 show recurring LL clusters in central and eastern Poland, especially in the poviats of Łódź, Pabianice, Zgierz, Pruszków, Warsaw and Warsaw West. These areas consistently exhibit insufficient coverage surrounded by similarly underperforming neighbours.

Studies performed in OECD and European countries show that urban settings are associated with higher vaccination coverage [29–31]. Surprisingly, urban and peri-urban areas, such as Kraków, Warsaw and Łódź, frequently appear in LL clusters for both MCV doses, suggesting systemic issues in vaccine uptake even in well-resourced regions. LL clusters identified in Mazowieckie, Łódzkie, and Małopolskie voivodeships warrant focused investigation by sanitary inspection authorities to elucidate the underlying determinants of persistently insufficient MCV coverage.

Furthermore, HL and LH outliers offer valuable case studies to understand what drives success or failure in specific contexts. These areas could inform best practices or reveal structural weaknesses. Communication strategies and operational practices employed by PSSE in HL outlier areas (e.g. Piaseczno, Sanok, Grójec), where high coverage was achieved despite being surrounded by LL areas, should be systematically evaluated and considered for adaptation in LL and LH areas to enhance immunization uptake.

In conclusion, while vaccination coverage reported at the national and regional level presents general immunization performance, local-level analysis reveals significant disparities that must be addressed to achieve comprehensive and equitable vaccine coverage. Granular surveillance is therefore indispensable for guiding effective public health strategies and ensuring that no population is left behind in the pursuit of measles elimination. These observations underscore the critical importance of data granularity in vaccination reporting.

Limitations of the study. While the study had several strengths, including using data from the territory of the entire country on the lowest available granularity, some limitations must be acknowledged when evaluating these findings. Firstly, vaccination coverage data was provided by sanitary-epidemiological stations in multiple formats, including handwritten documents, scanned images, and digital files. To enable standardized analysis, one of the authors manually digitized the data, ensuring consistency and interoperability across all formats. Secondly, the data was provided in a pre-aggregated format, which precluded analysis of vaccine uptake at the individual level. Thirdly, the analysis did not cover the period following the 2019 revision of the immunization schedule, which moved MCV2 administration to age 6.

Future research. Lack of the access to the individual level vaccination data should not be viewed as a barrier to conducting more granular research. It is imperative to maximize the utility of existing data sources and to develop more robust data collection and analytical frameworks capable of accurately monitoring and improving vaccine coverage at both the voivodeship and poviat levels. The use of cluster analysis proves effective in identifying priority regions. Future surveillance should integrate spatial methods to dynamically monitor and respond to emerging immunization patterns. Urban centres should not be assumed to have high coverage, data shows they may be hotspots of insufficient immunization. Future studies should also investigate barriers to completing the vaccination schedule, from the perspective of both the health system and the parent.

CONCLUSIONS

This study underscores the value of granular, spatial analysis in revealing disparities in measles vaccination coverage across Poland. While voivodeship-level data presents general immunization, poviat-level findings expose significant gaps – particularly in MCV2 uptake, with some areas falling below 70%. Notably, urban centres like Warsaw, Łódź, and Kraków frequently appear in low-coverage clusters, challenging assumptions about urban vaccine performance. Analysis of higher-granularity data with early identification of vulnerable areas enables local public health and medical professionals to design and implement more precise interventions aimed at enhancing vaccine uptake within their communities, supporting a shift from reactive to pro-active public health strategies. Recognizing and addressing spatial disparities in vaccine coverage is essential for achieving equitable immunization.

Table 3. Neighbouring poviats with similar MCV1 coverage rates (HH, LL) and outlier areas with dissimilar MCV coverage rates (LH, HL) with significant Local Moran's I values (p<0.05), 2014–2018

2014				2015				2016				2017				2018			
Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]
Kraków	LL	91.6	3.46	Łódź	LL	92.3	3.24	Łódź	LL	91.7	2.87	Łódź	LL	89	1.46	Środa Śląska	LL	88.6	0.91
Pruszków	LL	83	16.52	Pabianice	LL	90.3	3.48	Pabianice	LL	81	1.73	Luków	LL	86.7	2.42	Łódź	LL	88.2	1.92
Warsaw West	LL	89.1	14.11	Zgierz	LL	90	3.18	Luków	LL	90.7	1.11	Wieliczka	LL	93.4	1.20	Pabianice	LL	83.6	1.93
Wołomin	LL	92.6	2.47	Łuków	LL	93.5	1.35	Wieliczka	LL	93.8	1.88	Kraków	LL	86.7	3.00	Zgierz	LL	87.2	1.52
Warsaw	LL	92.9	7.48	Wieliczka	LL	94	2.03	Kraków	LL	88.4	4.25	Garwolin	LL	94.3	0.87	Łuków	LL	80.1	3.24
Łomza	LL	94.7	0.79	Kraków	LL	89.2	6.03	Mińsk Mazowiecki	LL	94.5	1.53	Łosice	LL	90.9	2.20	Ryki	LL	89.9	1.35
Gdynia	LL	94.2	1.92	Otwock	LL	89.4	1.63	Otwock	LL	88.8	1.05	Mińsk Mazowiecki	LL	94.5	1.18	Garwolin	LL	91.8	1.18
Sopot	LL	93.9	3.78	Pruszków	LL	89.3	5.46	Pruszków	LL	89.3	4.31	Ostrów Mazowiecka	LL	91.6	0.91	Łosice	LL	87.8	3.09
Rybnik	HH	95.3	1.18	Siedlce	LL	93.3	1.13	Siedlce	LL	93	1.06	Otwock	LL	83.9	2.26	Mińsk Mazowiecki	LL	93	0.83
Ruda Śląska	HH	95	1.36	Warsaw West	LL	91.3	5.39	Warsaw West	LL	88.3	5.16	Pruszków	LL	90	3.55	Ostrów Mazowiecka	LL	89.1	1.20
Giżycko	HH	100	0.88	Wołomin	LL	93	2.10	Wołomin	LL	89.9	2.28	Siedlce	LL	86.8	2.66	Pruszków	LL	86	2.35
Sochaczew	HH	95.2	0.79	Warsaw	LL	92.4	5.20	Warsaw	LL	90.8	4.49	Warsaw West	LL	88.2	3.72	Siedlce	LL	82.9	4.20
Gdańsk	HH	95	1.35	Gdańsk	LL	93.8	1.32	Białystok	LL	90.8	1.03	Wołomin	LL	86.1	3.78	Sochaczew	LL	91.2	0.86
Piaseczno	HL	99.9	-3.28	Gdynia	LL	92.3	2.12	Bielsk Podlaski	LL	91.3	1.03	Warsaw	LL	84.4	7.31	Warsaw Zachodnia	LL	85.8	3.34
				Sopot	LL	93.3	4.24	Lomza	LL	90.3	1.11	Białystok	LL	89.1	0.94	Wołomin	LL	85	2.23
				Rybnik	LL	94	1.15	Gdańsk	LL	92.3	1.03	Łomża	LL	85.8	2.07	Warsaw	LL	88.4	2.41
				Ruda Śląska	HH	95.4	0.90	Gdynia	LL	92.2	1.00	Gdańsk	LL	91.1	0.93	Białystok	LL	85.2	1.52
				Bartoszyce	HH	99.5	0.97	Sopot	LL	94.6	1.53	Gdynia	LL	90.3	1.31	Łomża	LL	83.4	2.55
				Braniewo	HH	100	1.26	Jaworzno	LL	92.3	0.95	Sopot	LL	91.2	2.84	Siemiatycze	LL	91.4	1.00
				Kętrzyn	HH	100	0.88	Kielce	HH	99.4	0.64	Lubliniec	LL	92.4	0.74	Sopot	LL	90	1.92
				Lidzbark Warmiński	HH	100	0.99	Działdowo	HH	99.2	0.83	Rybnik	LL	92.1	0.87	Rybnik	LL	88.8	0.98
				Sochaczew	HH	95.8	0.80	Brodnica	HH	99.5	0.81	Jaworzno	LL	89.9	1.34	Wodzisław Śląski	LL	89.2	0.99
				Garwolin	HH	96.1	0.87	Zgierz	HH	95.4	0.80	Bartoszyce	HH	99	1.05	Bartoszyce	HH	98.8	1.25
				Mińsk Mazowiecki	HH	95.1	2.11	Poznań	HL	92.9	-0.65	Braniewo	HH	99.7	1.38	Braniewo	HH	99.4	1.36
				Żielona Góra	HL	94.7	-0.80	Piaseczno	HL	99.7	-2.13	Działdowo	HH	99.8	1.22	Działdowo	HH	99.8	1.21
				Piaseczno	HL	100	-3.13	Tarnobrzeg	LH	91.9	-1.52	Elbląg	HH	98.8	0.95	Elbląg	HH	98	0.86
								Kwidzyń	LH	82.8	-2.08	Iława	HH	99.4	0.92	Giżycko	HH	99.6	1.15
												Kętrzyn	HH	99.8	0.97	Iława	HH	98.4	0.81
												Lidzbark Warmiński	HH	100	1.18	Kętrzyn	HH	99.8	1.29
												Nowe Miasto Lubawskie	HH	99.3	0.97	Lidzbark Warmiński	HH	99	1.17
												Ostroda	HH	98.7	0.85	Nidzica	HH	98.6	0.99
												Piła	HH	99.1	1.02	Nowe Miasto Lubawskie	HH	99.4	1.14

2014				2015				2016				2017				2018			
Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV1[c]	LM[d]
												Złotów	HH	98.9	0.94	Ostroda	HH	98.6	0.98
												Walcz	HH	99.1	0.82	Piła	HH	99	1.08
												Gołub Dobrzyn	HH	99	0.83	Drawsko Pomorskie	HH	98.8	0.97
												Nakło-nad- Notecia	HH	99.1	0.84	Swidwin	HH	99.5	1.17
												Rypin	HH	100	1.18	Wałcz	HH	98.9	0.85
												Sepolno Krajeńskie	HH	99.4	0.82	Gołub Dobrzyn	HH	99.7	1.02
												Zgierz	HL	99.2	-1.03	Nakło-nad- Notecia	HH	98.4	0.89
												Żielona Góra	HL	93	-0.73	Rypin	HH	99.5	1.02
												Nowy Dwór Mazowiecki	LH	98.1	-1.02	Sepolno Krajenskie	HH	99.5	1.07
												Piaseczno	HL	99.5	-2.86	Tuchola	HH	99.6	0.87
												Węgrów	HL	97.8	-1.12	Człuchów	HH	99.1	0.89
												Tarnobrzeg	LH	88.8	-1.40	Piaseczno	HL	99.7	-1.72
																Radom	LH	85.7	-1.77
																Tarnobrzeg	LH	89.9	-0.93
																Wysokie Mazowieckie	HL	98	-1.18

[a] reporting area covered by the Poviat Sanitary-Epidemiological Station; [b] cluster or outlier type: HH – high-high. poviats with sufficient MCV1 coverage. surrounded by poviats with sufficient vaccination coverage; LL – low-low. poviats with insufficient MCV1 coverage. surrounded by poviats with insufficient vaccination coverage; HL – high-low. poviats with sufficient MCV1 coverage. surrounded by poviats with insufficient vaccination coverage; LH – low-high. poviats with insufficient MCV1 coverage. surrounded by poviats with sufficient vaccination coverage; [c] MCV1 (measles-containing vaccine. 1st dose) vaccination coverage at the poviat level [%]; [d] Local Moran's I (p<0.05)

Table 4. Neighbouring poviats with similar MCV2 coverage rates (HH, LL) and outlier areas with dissimilar MCV2 coverage rates (LH, HL) with significant Local Moran's I values (p<0.05), 2014–2018

2014				2015				2016				2017				2018			
Poviat[a]	Cluster/ Outlier Type[b]	MCV2[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV2[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV2[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV2[c]	LM[d]	Poviat[a]	Cluster/ Outlier Type[b]	MCV2[c]	LM[d]
Łódź	LL	90.4	0.82	Łódź	LL	88.8	1.76	Łódź	LL	87.5	1.80	Łódź	LL	87	0.97	Łódź	LL	87.9	1.19
Zgierz	LL	85.1	0.76	Pabianice	LL	91.9	0.75	Pabianice	LL	87	1.12	Kraków	LL	82.1	1.96	Zgierz	LL	87.6	0.91
Nowy Dwór Mazowiecki	LL	89.8	1.32	Zgierz	LL	82	1.67	Zgierz	LL	79.6	1.57	Piaseczno	LL	86.8	2.56	Kraków	LL	80.8	3.12
Otwock	LL	91.1	1.10	Kraków	LL	87.6	1.61	Kraków	LL	82.8	2.41	Pruszków	LL	76.7	8.41	Garwolin	LL	92	0.73
Piaseczno	LL	89.1	3.18	Garwolin	LL	89.7	0.93	Otwock	LL	89.4	1.90	Warsaw West	LL	84.1	4.59	Otwock	LL	66.7	5.74
Pruszków	LL	83.5	8.02	Nowy Dwór Mazowiecki	LL	92.8	1.36	Piaseczno	LL	79.8	7.27		LL	80.1	2.45	Piaseczno	LL	88.5	4.63
Warsaw West	LL	84.4	6.15	Otwock	LL	90.5	2.05	Pruszków	LL	80	11.73	Warsaw	LL	72.4	6.37	Pruszków	LL	76	11.46
Wołomin	LL	86.3	2.30	Piaseczno	LL	87.4	5.24	Sochaczew	LL	88.6	1.19	Brzozów	LL	89.8	3.17	Sochaczew	LL	86.4	1.69
Warsaw	LL	72.4	8.10	Pruszków	LL	80.3	14.83	Warsaw West	LL	82.8	6.63	Dębica	LL	88.7	0.89	Warsaw West	LL	80.9	7.95
Brzozów	LL	89.9	1.48	Sochaczew	LL	89.4	1.41	Wołomin	LL	82.9	2.91	Krosno	LL	32.3	3.47	Wołomin	LL	81.7	2.69
Dębica	LL	89.5	0.78	Warsaw West	LL	77.6	12.71	Warsaw	LL	73.1	10.46	Mielec	LL	82	1.54	Warsaw	LL	73.2	12.61
Przemyśl	LL	82.4	1.85	Wołomin	LL	85.8	2.76	Brzozów	LL	92.3	0.95	Przemyśl	LL	83.4	1.07	Brzozów	LL	87.4	1.84
Przeworsk	LL	88.6	1.22	Warsaw	LL	72.6	12.68	Dębica	LL	83.5	2.56	Ropczyce	LL	87.9	1.78	Dębica	LL	90.1	1.02
Rzeszów	LL	89.8	1.14	Brzozów	LL	91.6	1.81	Łancut	LL	86.1	1.20	Rzeszów	LL	84.4	1.39	Łańcut	LL	85.2	1.83
Strzyżów	LL	90.7	0.822	Dębica	LL	87.6	1.58	Mielec	LL	75.8	2.95	Strzyżów	LL	89.4	2.90	Mielec	LL	82.3	1.51
Pruszcz Gdański	LL	83.4	0.988	Jaroslaw	LL	91.5	2.23	Przemyśl	LL	85.1	0.96	Sanok	HL	98.7	-2.01	Przemyśl	LL	85.6	1.13
Tczew	LL	87.9	0.862	Mielec	LL	80.1	2.31	Rzeszów	LL	85.9	1.58					Ropczyce	LL	88.8	1.77
Lubliniec	LL	83.7	1.26	Przemyśl	LL	71.2	3.80	Strzyżów	LL	85.1	2.21					Rzeszów	LL	83.4	2.05
Myszków	LL	84.5	1.766	Rzeszów	LL	87.2	2.07	Tarnobrzeg	LL	80	1.96					Strzyżów	LL	89	1.45
Bartoszyce	LH	46.3	-6.745	Tarnobrzeg	LL	82.3	1.25	Tczew	LL	81.5	1.19					Gdańsk	LL	84.4	2.02
Braniewo	HL	99.4	-1.774	Pruszcz Gdański	LL	89.6	0.82	Gdańsk	LL	88.4	0.89					Gdynia	LL	86.6	1.56
Kętrzyn	HL	100	-1.147	Tczew	LL	81.5	1.26	Grójec	HL	98.6	-0.65					Sopot	LL	86.7	3.38
Lidzbark Warmiński	HL	100	-1.144		LL	90	0.98									Giżycko	LL	99.5	0.73
				Sopot	LL	89.7	1.93									Skierniewice	HL	98.9	-0.91
				Lubliniec	LL	84.5	0.88									Grójec	HL	97.7	-0.68
				Wrocław	LH	85.9	-0.72												
				Sanok	HL	99.5	-1.40												

[a] reporting area covered by the Poviat Sanitary-Epidemiological Station. [b] cluster or outlier type: HH – high-high. poviats with sufficient MCV2 coverage. surrounded by poviats with sufficient vaccination coverage; LL – low-low. poviats with insufficient MCV2 coverage. surrounded by poviats with insufficient vaccination coverage; HL – high-low. poviats with sufficient MCV2 coverage. surrounded by poviats with insufficient vaccination coverage; LH – low-high. poviats with insufficient MCV2 coverage. surrounded by poviats with sufficient vaccination coverage. [c] MCV2 (measles-containing vaccine. 2[nd] dose) vaccination coverage at the poviat level [%]. [d] Local Moran's I (p<0.05)

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ORIGINAL ARTICLE

Annals of Agricultural and Environmental Medicine
www.aaem.pl

Socio-economic determinants of the second-dose measles vaccination coverage in Poland

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Nowicka PM, Lewandowski Z, Gujski M, Samoliński BK. Socio-economic determinants of the second-dose measles vaccination coverage in Poland. Ann Agric Environ Med. doi: 10.26444/aaem/207725

Abstract

Introduction and Objective. Measles is one of the most contagious human viruses and serves as an early indicator of gaps in population immunity. Despite the introduction of measles vaccination 50 years ago, Poland remains one of nine endemic countries in the WHO European Region. The aim of the study is to assess the relationship between socio-economic factors and sufficient coverage (≥95%) with the second dose of vaccination against measles (MMR2) at the poviat level in Poland from 2014 – 2018.

Materials and Method. Data on MMR2 coverage was extracted from annual reports collected by sanitary-epidemiological stations in Poland. Socio-economic data was obtained from Statistics Poland. A multivariate logistic regression analysis, adjusted for population size and the number of physicians and nurses, was performed to identify predictors of sufficient MMR2 coverage.

Results. Three socio-economic variables were found to be significant independent predictors of sufficient MMR2 coverage across years: the number of households receiving community-based social assistance, families receiving child benefits, and the number of medical consultations in primary health care. Poviats with higher values for these variables had increased odds of achieving sufficient MMR2 coverage. In contrast, no significant association was observed between MMR2 coverage and the average monthly salary, employment rates, or the number of foster families.

Conclusions. MMR2 coverage at the poviat level in Poland is predictable using selected socio-economic variables. The findings suggest that benefitting from social assistance positively influences vaccination uptake. While individual-level data would provide greater insight, poviat-level data can still guide public health interventions to improve MMR2 coverage and reduce the risk of measles outbreaks.

Key words

measles, childhood immunization, vaccination coverage

INTRODUCTION

Socio-economic status is one of the key determinants of health [1]. The Constitution of the World Health Organization (WHO) acknowledges the importance of co-operation with other sectors, allowing for the improvement of social and economic conditions to achieve health gain [2]. One of the most successful tools in achieving health gain is immunization [3, 4]. The uptake of vaccines among children is subject to diverse factors that vary based on the particular vaccine and the distinct national context [5–10]. In Australia, the lowest vaccination rates in the highest socio-economic advantaged geographic areas demonstrated what is known as the 'privilege paradox' [6]. In the United Kingdom and Germany, for the MMR (measles, mumps, rubella) vaccines, evidence of an inverse relation (lower vaccine uptake among children from a higher socio-economic group) was found [7]. However, a longitudinal ecological study, also from the United Kingdom, showed the lowest MMR uptake among children from the most socio-economically deprived communities [8]. A relationship between adverse socio-economic factors and increased MMR vaccination coverage was also identified in Spain [9]. In the USA, MMR vaccine hesitancy has socio-cultural and geographical clustering elements [11]. In a Canadian city, significant disparities were found at the neighbourhood level, with areas of social and economic disadvantage having lower rates of total, complete, and up-to-date MMR uptake, compared to areas of greater social and economic wealth [12].

Given the critical role of vaccination in public health, it remains essential to systematically evaluate the country-specific determinants that most significantly impact childhood vaccination coverage.

Measles is one of the most contagious human viruses which is preventable through vaccination. According to the World

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Received: 22.04.2025; accepted: 30.06.2025; first published: 18.07.2025

Health Organization, because of its high transmissibility, measles acts as an early warning system, quickly exposing any immunity gaps in the population [13].

One of the strategic priorities outlined in the European Immunization Agenda 2030 includes achieving high and equitable coverage throughout the life course, and utilizing data to reduce the number of un- and under-vaccinated individuals in every country [14].

Even though 50 years have passed since the introduction of measles vaccinations in Poland and the incidence of measles cases per 100,000 population has decreased from 588 to 0.12 [15, 16], Poland is still among 9 of the 53 Member States from the WHO European Region considered to be endemic for measles by the Regional Verification Commission (RVC) in 2023. The RVC expressed concerns that the decrease in routine immunization coverage with both MMR doses at the national and sub-national level presented an additional risk of outbreaks. Poland was urged to ensure high routine immunization coverage (of at least 95%) with both doses of MMR. The RVC also called for continued efforts to ensure high coverage in groups with suboptimal immunization. One of the general recommendations was to gather the latest immunization coverage data at both: national and subnations levels [17]. Coverage of 95% or greater of two doses of measles-containing vaccine is needed to create herd immunity in order to protect communities and achieve and maintain measles elimination [18]. Locating areas where the vaccination coverage is lower than needed is crucial. Identifying these areas may be possible through examining the correlation between the vaccination coverage and socio-economic variables, as their impact leads to the differentiation of health status between social groups, and also territorially between areas of the country with different levels of economic development. Finding a territorial unit with accessible vaccination coverage and socio-economic data is essential for facilitating evidence-based interventions by local government authorities and sanitary-epidemiological institutions within the respective areas.

The aim of this study is to assess the relationship between socio-economic factors and sufficient coverage (≥95%) with the second dose of vaccination against measles, mumps, rubella (MMR2) at the poviat[1] level in Poland from 2014 – 2018.

MATERIALS AND METHOD

Data collection. Data on mandatory vaccination uptake in Poland was registered in paper form by the medical entity where the vaccination was performed. According to the Statistical Research Programme on Public Statistics, entities performing medical activities providing outpatient and inpatient health services participating in vaccination, provided annually individual data in paper form to the poviat sanitary-epidemiological stations. This data was later aggregated and sent to the voivodeship sanitary-epidemiological stations (VSES). VSES further aggregated the data from its territory and sent it to the National Institute of Public Health – National Institute of Hygiene – National Research Institute [19].

Data to calculate the MMR2 coverage in this study was extracted from annual reports on mandatory vaccinations from 2014–2018 collected from sanitary-epidemiological stations in Poland with granularity at the poviat level. The coverage rate for each calendar year was calculated as the proportion of the vaccinated children in a birth cohort targeted for immunization. The numerator represented the number of children who received the second dose of vaccination against measles, mumps, rubella (MMR2) during the observed calendar year. In the study period, the MMR2 was administered to children aged 10. This study does not extend to the period following the change in the immunization schedule which, beginning in 2019, shifted MMR2 administration to children aged six [21]. The aggregated format of received data prevented any identification of a patient receiving the vaccination.

The following socio-economic variables of interest were extracted from Statistics Poland public database at the poviat level: population, number of nurses per 10,000 population, number of physicians per 10,000 population, average monthly gross salary (PLN), number of people working, number of foster families per 10,000 population, number of children aged 3–5 in pre-school education institutions, number of beneficiaries of environmental social assistance, number of households that have benefitted from community-based social assistance benefits for 10,000 population, number of families receiving child benefit per 10,000 population, number of medical consultations in primary health care per 10,000 population.

Statistical analysis of the results was performed with the SAS programme version 9.4. A multi-variate logistic regression adjusted for population, the number of medical doctors and nurses, was computed to identify determinants of sufficient MMR2 vaccination coverage at the poviat level.

RESULTS

Table 1 contains descriptive statistics of the socio-economic variables included in the study.

The number of voivodeships and the number of poviats with sufficient MMR2 coverage decreased over time. The percentage of poviats without sufficient MMR2 coverage, across the years in the voivodeships, was the highest in the Subcarpathian, Silesian and Mazovian voivodeships. In the Subcarpathian Voivodeship, the MMR2 coverage was not sufficient in more than 50% of the poviats in each of the years studied. Nationally, MMR2 coverage shows an unequal uptake across poviats, with almost 67 percentage point difference in MMR2 coverage between poviats with the lowest and highest vaccination coverage.

From 2014 – 2018, the percentage of counties with sufficient MMR2 coverage decreased by 14.5%. For all socio-economic parameters, a unit was selected (see: footer of Tab. 2), which was used to estimate the odds of the sufficient MMR2 coverage at poviat level. It is expressed using the odds ratio additionally adjusted for the number of healthcare workers (physicians, nurses) and population. The units were selected so that the odds ratios had similar values.

Poviats with higher number of following variables: children in preschool education institutions (abbr. *preschool children*),

[1] poviat – local self-government community (all residents) and the relevant territory, i.e. a unit of basic territorial division covering an area from several to a dozen or so communes (gminas) or the entire area of a city with poviat rights (i.e. a commune with the status of a city that has been granted poviat rights) [20].

Table 1. Quantitative characteristics (median, interquartile range, range) of the socio-economic variables of interest by years (units explained in the footer)

		Calendar Year						
		2014	2015	2016	2017	2018	Trends[#]	P[$]
Population[a] (thous.)	med(IQR) range	79 (56–123) 21–1,735	79 (56–123) 21–1,744	79 (55–123) 20–1,754	79 (55–124) 20–1,765	79 (55–125) 20–1,778	–	.80
Nurses[b]	med(IQR) range	46 (33–59) 6–169	45 (33–60) 6–153	45 (33–60) 5–153	47 (35–63) 4–162	48 (35–65) 7–171	+	.058
Physicians[c]	med(IQR) range	31 (24–42) 10–139	32 (24–41) 7–142	31 (25–43) 8–150	33 (25–44) 3–162	33 (25–44) 5–167	+	.021
Salary[d]	med(IQR) range	3,350 (3,155–3,832) 2,544–14,128	3,453 (3,250–3,919) 2,569–14,698	3,575 (3,387–4,062) 2,659–15,153	3,781 (3,582–4,321) 2,960–15,912	4,062 (3,815–4,581) 3,183–17,155	+	.0001
Workers[e]	med(IQR) range	2,639 (2,245–3,039) 1,595–5,054	2,668 (2,268–3,056) 1,603–5,307	2,709 (2,333–3,131) 1,664–5,395	2,762 (2,372–3,157) 1,645–5,416	2,792 (2,407–3,211) 1,669–5,476	+	.0001
Foster fam[f]	med(IQR) range	10 (8–13) 3–23	10 (8–12) 3–23	10 (7–13) 2–22	10 (7–12) 2–23	9 (7–12) 2–24	–	.063
Preschool children[g]	med(IQR) range	761 (690–851) 514–3,423	808 (739–888) 548–3,614	771 (692–860) 533–3,417	808 (734–886) 577–3,584	834 (761–908) 602–3,651	+	.0001
Beneficiaries[H]	med(IQR) range	999 (729–1,295) 287–2,967	914 (657–1,216) 275–2,739	835 (585–1,109) 269–2,559	729 (519–983) 236–2,367	657 (461–896) 203–2,165	–	.0001
Households[i]	med(IQR) range	336 (257–404) 134–855	319 (247–389) 121–796	298 (233–369) 118–769	276 (219–346) 112–736	256 (201–319) 102–682	–	.0001
Benefit fam[j]	med(IQR) range	364 (269–432) 67–625	336 (246–405) 64–627	364 (270–430) 72–657	363 (269–426) 75–608	354 (272–409) 84–565	+	.96
Advice[k] (thous.)	med(IQR) range	42 (39–45) 28–56	44 (40–47) 29–65	44 (41–47) 27–58	45 (41–48) 29–59	46 (42–49) 31–58	+	.0001

[#] direction of correlation with calendar year (sign of correlation coefficient)
[$] refers to significance of correlations
[a] population in poviats
[b] number of nurses per 10,000 population
[c] number of physicians per 10,000 population
[d] average monthly gross salary (PLN)
[e] number of people working in poviats
[f] number of foster families per 10,000 population
[g] number of children aged 3-5 in preschool education institutions
[h] number of beneficiaries of environmental social assistance
[i] number of households that have benefited from community-based social assistance benefits per 10,000 population
[j] number of families receiving child benefit per 10,000 population
[k] number of medical consultations in primary health care per 10,000 population

Table 2. Odds of achieving sufficient MMR2 vaccination coverage across the years depending on socio-economic variables (all ORs were adjusted for population size and the number of physicians and nurses)

Year		2014		2015		2016		2017		2018	
	Units	OR	P	OR	P	OR	P	OR	P	OR	P
Salary	a	0.95	.65	1.05	.67	1.13	.26	0.99	.92	1.01	.901
Workers	b	1.03	.26	1.00	.86	0.99	.83	1.01	.63	1.03	.26
Foster fam	c	0.98	.63	1.04	.37	1.03	.39	0.99	.78	1.00	.97
Preschool children	d	1.11	.025	1.09	.027	1.13	.01	1.04	.313	1.11	.008
Beneficiaries	e	1.10	.001	1.10	.001	1.13	.001	1.10	.002	1.15	.001
Households	f	1.05	.005	1.07	.001	1.06	.001	1.06	.003	1.07	.001
Benefit fam	g	1.06	.001	1.04	.029	1.04	.014	1.04	.009	1.04	.02
Advice	h	3.52	.0001	3.18	.001	1.66	.07	1.57	.109	1.98	.011

[a] average monthly gross salary (PLN)
[b] number of people working in poviats per 100 people
[c] number of foster families per 10,000 population
[d] number of children in preschool education institutions aged 3-5 per 1,000 population
[e] number of beneficiaries of environmental social assistance per 1,000 population
[f] number of households that have benefited from community-based social assistance benefits per 1,000 population
[g] number of families receiving child benefit per 1,000 population
[h] number of medical consultations in primary health care per person

beneficiaries of environmental social assistance (abbr. *beneficiaries*), households that benefited from community-based social assistance benefits (abbr. *households*), families receiving child benefit (abbr. *benefit fam*), medical advice provided in primary healthcare (abbr. *advice*) were more likely to achieve sufficient MMR2 coverage. No significant association was noted between the average monthly gross salary (abbr. *salary*), number of people working in poviats (abbr. *workers*), nor the number of foster families (abbr. *foster fam*) and sufficient vaccination coverage in any of the years studied.

Odds ratios of ≥95% MMR2 vaccination coverage in poviats for the number of *preschool children, beneficiaries, households, benefit fam, advise* were within the ranges: 1.04–1.13, 1.10–1.15, 1.05–1.07, 1.04–1.06, 1.57–3.52, respectively (Tab. 2).

In 2018, the odds to achieve sufficient MMR2 coverage adjusted for the number of healthcare workers (physicians, nurses) and population increased by 98% with each *advice*, by 15% with each *beneficiary*, by 7% with each *household*, by 4% with each family receiving child benefit. In 2014, the set of independent predictors consisted of two: *advice, benefit*

Table A1. Correlations between the variables of interest in 2014

	Workers[e]	Foster fam[f]	Preschool children[g]	Beneficiaries[h]	Households[i]	Benefit fam[j]	Advice[k]
Population[a]	0.17	-0.04	0.58	-0.11	-0.44	-0.47	-0.08
	.002	.46	.001	.052	.001	.001	.14
Nurses[b]	0.24	0.00	0.35	0.12	-0.07	-0.23	0.05
	.001	.96	.001	.028	.23	.001	.35
Physicians[c]	0.17	0.14	0.52	-0.09	-0.29	-0.45	0.14
	.002	.010	.001	.09	.001	.001	.012
Salary[d]	0.18	0.14	0.61	0.02	-0.30	-0.57	-0.05
	.001	.014	.001	.79	.001	.001	.37
Workers[e]	1.00	-0.49	0.27	-0.04	-0.31	0.05	-0.06
		.001	.001	.53	.001	.35	.29
Foster fam[f]		1.00	0.05	0.03	0.21	-0.37	0.24
			.40	.61	.001	.001	.001
Preschool children[g]			1.00	-0.20	-0.55	-0.63	0.04
				.001	.001	.001	.51
Beneficiaries[h]				1.00	0.75	0.51	0.12
					.001	.001	.034
Households[i]					1.00	0.55	0.21
						.001	.001
Benefit fam[j]						1.00	-0.02
							.67
Advice[k]							1.00

[a] population in poviats
[b] number of nurses per 10,000 population
[c] number of medical doctors per 10,000 population
[d] average monthly gross salary (PLN)
[e] number of people working in poviats
[f] number of foster families per 10,000 population
[g] number of children aged 3-5 in preschool education institutions
[h] number of beneficiaries of environmental social assistance
[i] number of households that have benefited from community-based social assistance benefits per 10,000 population
[j] number of families receiving child benefit per 10,000 population
[k] number of medical consultations in primary health care per 10,000 population

Table A2. Correlations between the variables of interest in 2015

	Workers[e]	Foster fam[f]	Preschool children[g]	Beneficiaries[h]	Households[i]	Benefit fam[j]	Advice[k]
Population[a]	0.16	-0.03	0.61	-0.11	-0.44	-0.45	-0.08
	.003	.55	.001	.053	.001	.001	.14
Nurses[b]	0.20	-0.01	0.35	0.12	-0.07	-0.24	0.00
	.001	.82	.001	.037	.18	.001	.98
Physicians[c]	0.17	0.09	0.53	-0.09	-0.30	-0.44	0.11
	.002	.09	.001	.10	.001	.001	.053
Salary[d]	0.16	0.15	0.65	-0.03	-0.33	-0.59	-0.05
	.005	.006	.001	.62	.001	.001	.40
Workers[e]	1.00	-0.48	0.28	-0.02	-0.29	0.08	-0.07
		.001	.001	.71	.001	.17	.23
Foster fam[f]		1.00	0.05	0.01	0.19	-0.37	0.26
			.42	.81	.001	.001	.001
Preschool children[g]			1.00	-0.24	-0.59	-0.63	0.02
				.001	.001	.001	.69
Beneficiaries[h]				1.00	0.76	0.53	0.06
					.001	.001	.27
Households[i]					1.00	0.55	0.17
						.001	.002
Benefit fam[j]						1.00	-0.06
							.32
Advice[k]							1.00

[a] population in poviats
[b] number of nurses per 10,000 population
[c] number of medical doctors per 10,000 population
[d] average monthly gross salary (PLN)
[e] number of people working in poviats
[f] number of foster families per 10,000 population
[g] number of children aged 3-5 in preschool education institutions
[h] number of beneficiaries of environmental social assistance
[i] number of households that have benefited from community-based social assistance benefits per 10,000 population
[j] number of families receiving child benefit per 10,000 population
[k] number of medical consultations in primary health care per 10,000 population

Table A3. Correlations between the variables of interest in 2016

	Workers[e]	Foster fam[f]	Preschool children[g]	Beneficiaries[h]	Households[i]	Benefit fam[j]	Advice[k]
Population[a]	0.17	-0.04	0.61	-0.11	-0.44	-0.45	-0.11
	.003	.49	.001	.041	.001	.001	.051
Nurses[b]	0.20	-0.01	0.35	0.17	-0.02	-0.22	0.01
	.001	.80	.001	.002	.67	.001	.89
Physicians[c]	0.15	0.12	0.50	-0.04	-0.25	-0.42	0.11
	.008	.032	.001	.44	.001	.001	.060
Salary[d]	0.14	0.15	0.65	-0.03	-0.34	-0.61	-0.04
	.011	.007	.001	.59	.001	.001	.43
Workers[e]	1.00	-0.49	0.30	-0.03	-0.28	0.10	-0.07
		.001	.001	.57	.001	.08	.20
Foster fam[f]		1.00	0.01	0.03	0.20	-0.40	0.25
			.84	.65	.001	.001	.001
Preschool children[g]			1.00	-0.23	-0.59	-0.60	-0.01
				.001	.001	.001	.91
Beneficiaries[h]				1.00	0.76	0.50	0.06
					.001	.001	.33
Households[i]					1.00	0.51	0.17
						.001	.002
Benefit fam[j]						1.00	-0.07
							.201
Advice[k]							1.00

[a] population in poviats
[b] number of nurses per 10,000 population
[c] number of medical doctors per 10,000 population
[d] average monthly gross salary (PLN)
[e] number of people working in poviats
[f] number of foster families per 10,000 population
[g] number of children aged 3-5 in preschool education institutions
[h] number of beneficiaries of environmental social assistance
[i] number of households that have benefited from community-based social assistance benefits per 10,000 population
[j] number of families receiving child benefit per 10,000 population
[k] number of medical consultations in primary health care per 10,000 population

Table A4. Correlations between the variables of interest in 2017

	Workers[e]	Foster fam[f]	Preschool children[g]	Beneficiaries[h]	Households[i]	Benefit fam[j]	Advice[k]
Population[a]	0.17	-0.03	0.64	-0.13	-0.46	-0.44	-0.08
	.002	.54	.001	.016	.001	.001	.16
Nurses[b]	0.21	-0.01	0.34	0.14	-0.06	-0.23	0.02
	.001	.79	.001	.014	.28	.001	.70
Physicians[c]	0.18	0.09	0.49	-0.07	-0.27	-0.40	0.10
	.001	.10	.001	.19	.001	.001	.06
Salary[d]	0.17	0.16	0.65	-0.05	-0.36	-0.60	-0.02
	.003	.005	.001	.34	.001	.001	.74
Workers[e]	1.00	-0.46	0.30	-0.05	-0.29	0.10	-0.04
		.001	.001	.35	.001	.08	.47
Foster fam[f]		1.00	0.01	0.02	0.18	-0.42	0.27
			.91	.68	.001	.001	.001
Preschool children[g]			1.00	-0.23	-0.60	-0.58	0.00
				.001	.001	.001	.99
Beneficiaries[h]				1.00	0.76	0.48	0.08
					.001	.001	.17
Households[i]					1.00	0.48	0.17
						.001	.002
Benefit fam[j]						1.00	-0.08
							.14
Advice[k]							1.00

[a] population in poviats
[b] number of nurses per 10,000 population
[c] number of medical doctors per 10,000 population
[d] average monthly gross salary (PLN)
[e] number of people working in poviats
[f] number of foster families per 10,000 population
[g] number of children aged 3-5 in preschool education institutions
[h] number of beneficiaries of environmental social assistance
[i] number of households that have benefited from community-based social assistance benefits per 10,000 population
[j] number of families receiving child benefit per 10,000 population
[k] number of medical consultations in primary health care per 10,000 population

Table A5. Correlations between the variables of interest in 2018

	Workers[e]	Foster fam[f]	Preschool children[g]	Beneficiaries[h]	Households[i]	Benefit fam[j]	Advice[k]
Population[a]	0.18	-0.03	0.66	-0.14	-0.46	-0.42	-0.04
	.002	.55	.001	.016	.001	.001	.46
Nurses[b]	0.25	-0.05	0.34	0.13	-0.07	-0.22	0.05
	.001	.37	.001	.025	.24	.001	.36
Physicians[c]	0.23	0.06	0.50	-0.12	-0.32	-0.40	0.14
	.001	.30	.001	.033	.001	.001	.010
Salary[d]	0.17	0.17	0.66	-0.06	-0.37	-0.60	0.00
	.002	.003	.001	.26	.001	.001	.94
Workers[e]	1.00	-0.43	0.29	-0.05	-0.27	0.06	0.00
		.001	.001	.42	.001	.25	.96
Foster fam[f]		1.00	0.01	0.02	0.17	-0.39	0.23
			.88	.69	.002	.001	.001
Preschool children[g]			1.00	-0.22	-0.59	-0.57	0.01
				.001	.001	.001	.88
Beneficiaries[h]				1.00	0.76	0.47	0.04
					0.001	0.001	0.48
Households[i]					1.00	0.46	0.14
						.001	.012
Benefit fam[j]						1.00	-0.10
							.07
Advice[k]							1.00

[a] population in poviats
[b] number of nurses per 10,000 population
[c] number of medical doctors per 10,000 population
[d] average monthly gross salary (PLN)
[e] number of people working in poviats
[f] number of foster families per 10,000 population
[g] number of children aged 3-5 in preschool education institutions
[h] number of beneficiaries of environmental social assistance
[i] number of households that have benefited from community-based social assistance benefits per 10,000 population
[j] number of families receiving child benefit per 10,000 population
[k] number of medical consultations in primary health care per 10,000 population

fam, in 2015, of two: *advice, households*, in 2016, of one: *households*, in 2017, of two: *households*, *benefit fam*, and in 2018, of two: *advice, households*.

Supplementary tables A1-A5 present the correlations between the socio-economic variables. The number of physicians, medical consultations provided in primary health care, children in pre-school education institutions, average monthly gross salary and people working in poviats were positively correlated with calendar year. Across the time the number of medical doctors, medical consultations provided in primary health care, children in pre-school education institutions, average monthly gross salary and people working in poviats have increased. However, the negative correlation with calendar time was observed between number of households that have benefited from community-based social assistance benefits, number of foster families and the number of beneficiaries of environmental social assistance.

Supplementary table B presents the odds ratios of parameters that were concerned significant independent predictors of ≥95% MMR2 vaccination coverage of all variables considered.

Neither the number of foster families in poviat, nor *workers*, nor *salary* are variables that independently determine MMR2 vaccination status. In contrast, across the years, *advice,*

Table B. Calendar year-dependent final models of the sufficient MMR2 vaccination coverage (≥95%) consisting of significant predictors selected from all variables considered

Calendar year	2014			2015			2016			2017			2018		
	OR[§]	95%CI	P	OR[§]	95%CI	P	OR[§]	95%CI	P	OR[§]	95%CI	P	OR[§]	95%CI	P
Salary[a]															
Workers[b]															
Foster Fam[c]															
Preschool children[d]															
Beneficiaries[e]															
Households[f]				1.05	1.02–1.09	.006	1.06	1.02–1.1	.001	1.04	1.00–1.08	.035	1.06	1.02–1.10	.002
Benefit Fam[g]	1.06	1.03–1.09	.001							1.04	1.00–1.07	.027			
Advice[h]	3.03	1.54–5.97	.001	2.76	1.46–5.24	.002							1.73	1.01–2.95	.046

[§] refers to significance of correlations
[a] average monthly gross salary (PLN)
[b] number of people working in poviats per 100 people
[c] number of foster families per 10,000 population
[d] number of children i aged 3-5 in preschool education institutions per 1,000 population
[e] number of beneficiaries of environmental social assistance per 1,000 population
[f] number of households that have benefited from community-based social assistance benefits per 1,000 population
[g] number of families receiving child benefit per 1,000 population
[h] number of medical consultations in primary health care per person

households, beneficiaries, number of families receiving child benefit, *preschool children* reveal as independent variables determining MMR2 coverage. These variables are independent of the poviat size, the number of physicians and the number of nurses in the poviat. The independent predictors of sufficient MMR2 coverage that repeat in more than 1 year are: *households, advice, benefit fam.*

DISCUSSION

Main findings and result analysis. Despite the provision of vaccines being funded for all children by the National Immunization Programme, the current study shows evidence that an association between socio-economic variables and vaccination coverage exists in Poland.

Univariate analyses involving socio-economic variables revealed five variables: *preschool children, beneficiaries, households, benefit fam, advice,* as those significantly associated with greater chances of sufficient MMR2 vaccination coverage. However, not all of them turned out to be independently associated with sufficient MMR2 vaccination coverage, which was revealed in multivariate analyses.

Only three of the variables (of the five above) turned out to be independent: *households, benefit fam and advice*. In poviats with greater number of *households, benefit fam* and *advice*, the chance of sufficient vaccination coverage was higher. The current study, however, did not answer the question whether this phenomenon would also be observed at the individual level, nor whether it would be possible to discover a better correlation of socio-economic variables with sufficient vaccination coverage by examining smaller or bigger units than a poviat.

The variables of interest can hardly be considered modifiable. The number of beneficiaries of environmental social assistance, number of households that have benefited from community-based social assistance benefits, and number of families receiving child benefit, are indicators, because they reflect the needs in these areas of life, but they can also be factors when they reflect the efficiency of activities in this area by the relevant services. The variables of interest are the resultant of these indicators and factors.

The current study proves that by examining the administrative unit at the poviat level in terms of sufficient MMR2 coverage, shows the relationship between these socio-economic variables and people's willingness to vaccinate their children with MMR2. It is possible that the two variables that revealed their relationship with the risk of sufficient MMR2 coverage in univariate analyses (*pre-school* and *beneficiaries*), were also directly related to the end point. The correlations found for these two variables with three independent variables supported this assumption (Tab. A in the Annex). Perhaps their independent relationship with the risk of sufficient MMR2 coverage would be revealed in multifactorial models at a lower or higher administrative level. At the moment, the relationship between *preschool children* and *beneficiaries* with sufficient vaccination coverage was observed only indirectly. Their absence in the model may be related to the study being conducted at the poviat level.

The chosen granularity at poviat level reflects very well the influence of the environment on individuals.

Limitations of the study. The most important limitation is that this is an ecological study. Socio-economic data is collected from the census and represents the average of the characteristics for the population in a given poviat, which can conceal the differences that exist between communities within each poviat. Although generalizations would still apply for data averaged at the poviat level, it is the smallest area for which most health status and use of health services information is available, and was the unit used in this study. Individual level data about socio-economic characteristics was not available in the vaccination register. Sanitary-epidemiological stations shared vaccination coverage data in various formats, including handwritten hard copies, scanned images, and digital records. To standardize the dataset for subsequent analysis, one of the authors manually digitized the information, ensuring consistency and compatibility across formats.

Future research. The sole education-related variable examined in this study was the number of children aged 3–5 enrolled in preschool education institutions. In future research, additional educational factors should be taken into consideration, as prior research has demonstrated that children whose mothers attained secondary or higher education exhibit significantly greater odds of completing the full childhood vaccination schedule, compared to those whose mothers had no formal education [22]. These findings underscore the substantial influence of educational attainment on vaccination coverage.

A complete implementation of the Electronic Vaccination Card will allow gathering data at the individual level, which would serve future analysis on vaccine uptake in Poland. Thus, while it is important that these findings are confirmed by individual level data on vaccination coverage, population level data can provide useful insight, particularly where individual level data is not available.

CONCLUSIONS

In Poland, MMR2 coverage at the poviat level is predictable when using selected socio-economic variables There are variables that allow prediction whether there is an increase or decrease in vaccination coverage. Based on that, it may be hypothesized that benefitting from social assistance results in an increased odds of achieving sufficient MMR2 coverage at the poviat level, which is predictable, regardless of the size of the poviat, and the number of physicians and nurses in the area. Even though the trend of decreasing MMR2 coverage is visible, the majority of poviats are characterized by sufficient MMR2 coverage. Tailoring immunization intervention at the poviat level enables local authorities to address specific barriers and allocate resources more efficiently. This localized approach is essential to reduce immunity gaps and prevent outbreaks in high-risk communities.

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DOI: 10.12923/cipms-2025-0030 Curr. Issues Pharm. Med. Sci., Vol. 38, No. 3, Pages 187-195

Current Issues in Pharmacy and Medical Sciences
Formerly ANNALES UNIVERSITATIS MARIAE CURIE-SKLODOWSKA, SECTIO DDD, PHARMACIA

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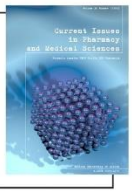

Attitudes towards vaccinations in selected medical groups in Poland

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ARTICLE INFO

Received 12 April 2024
Accepted 25 February 2025

Keywords:
vaccinations,
vaccines,
physicians,
nurses,
midwives,
students,
in-depth interviews.

ABSTRACT

The purpose of the study was to determine attitudes of medical staff and medical students towards vaccinations and to understand their needs and expectations regarding the popularization of vaccinations in the population. Forty semi-structured individual in-depth interviews were conducted in two groups, each with 20 interviews. The respondents were selected purposefully from all over Poland using the snowball method. The study revealed that more than a half of interviewed physicians (7 out of 13), half of all nurses (2 out of 4), and 1 out of 3 midwives observed views among healthcare workers that are inconsistent with current knowledge about the vaccinations that they are required to talk to their patients about. This suggests the need for medical staff to continually update their knowledge about vaccinations. Moreover, while medical and nursing students regarded vaccinations as effective and safe, almost all of medical students (9 out of 10) and all interviewed nursing students (10 out of 10) believed that their knowledge about vaccinations was limited. Students proposed introducing one subject devoted exclusively to vaccinations, the aim of which is to systematize knowledge in this field. In addition, vaccination education should be integrated across all study groups to enhance the societal health outcomes. What is more, healthcare professionals should be afforded opportunities to participate in training programs designed to update and expand their knowledge about vaccinations. The study suggests that there is a need to broaden the healthcare workers' competencies in effectively communicating with patients who hold unscientific views on vaccinations. Medical and nursing curricula should include a dedicated course focusing exclusively on vaccinations.

INTRODUCTION

Reluctance and refusal of vaccinations occurring in various professional groups pose a threat to public health on a global scale [1,2]. In 2019, the World Health Organization has recognized vaccine hesitancy as one of the ten greatest threats to global health [3]. In 2020, the World Health Assembly, including Poland, endorsed the Immunization Agenda 2030: A Global Strategy to Leave No One Behind (IA2030). IA2030 presents a vision of a world where everyone, everywhere, at every age fully benefits from vaccines for good health and well-being [4]. For the European Region, the Member States have designed and crafted the European Immunization Agenda 2030 (EIA2030), for achieving the full benefits of vaccination for the next decade. One of its key regional focus areas is to prepare and engage the entire health workforce to act as advocates for immunization [5]. However, studies on the attitudes of medical professionals towards vaccinations indicate the reluctance of nurses and physicians to vaccinations, stemming from a lack of trust in health authorities, their employers and a lack of confidence in the effectiveness and safety of vaccines [6]. Healthcare professionals play an

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important role in disseminating the topic of vaccinations. Their knowledge and belief in the effectiveness of vaccinations, and even their stress and burnout influence decisions made by their patients [7]. It is also crucial to assess the medical students' knowledge of vaccinations, as well as to observe their personal opinions and beliefs in this area [8,9]. News, peer-reviewed articles, social media, family and/or friends and healthcare professionals play an important role in shaping students' views on vaccinations [9-11]. The authors of the guidelines entitled "Good practices in vaccination" accentuate the key role of primary healthcare in building trust in vaccinations, which requires the support of key institutions from the perspective of the healthcare system [12].

Qualitative research offers a deeper understanding of human experiences, context and social phenomena [13-15]. It answers the questions: "how?" and "why?", which provides the opportunity to better recognize and understand human experiences. For example, Finn, G.M. *et al.* draw attention to the significance of using qualitative research methods in assessing the education level in medical professions [16]. The goal of our study was to determine attitudes of chosen professional groups: medical staff and medical students towards vaccinations, as well as to determine their needs and expectations regarding the popularization of vaccinations in the population. The study was also intended to address the issue of medical fake news and explores strategies for managing this problem within the study group.

MATERIAL AND METHOD

Research method

The interviews were conducted online, through the Microsoft Teams platform, between April and September 2021. The interview covered all vaccinations, excluding COVID-19, and were recorded in audiovisual form. Each participant of the study gave their written consent to participate in the study and to record the interview. When collecting personal data from the respondents, recording was turned off. A total of 40 semi-structured individual in-depth interviews were conducted in two professional groups, 20 interviews each:

1. healthcare workers (physicians, nurses, midwives);
2. medical and nursing students.

Each interview lasted 45-60 min.

Research tool

Interview scenarios were developed for each professional group as part of the qualitative research. Invitations to participate in the study were then distributed to individuals representing these groups using the snowball sampling method. Pilot interviews were conducted within each group, and transcripts were prepared for every interview. Detailed reports were subsequently compiled based on these transcripts.

Interview scenario

A separate, semi-structured interview scenario was prepared for each professional group, taking into account the specificity of each group. All scenarios were divided into 4 thematically similar sections. The first section covered an introductory conversation to initiate the interview. The second section concerned the respondents' workplaces and their work colleagues, and in the case of students - the higher education institution and colleagues from this environment. In the second section, the respondents were asked about their experiences connected with vaccinations at their place of work/study. The questions concerned talking about vaccinations with colleagues, patients and students. Questions were also asked about the possibility of being vaccinated against influenza at the place of work/study and about the attitude of co-workers/students to vaccinations. The third section concerned the respondents' immediate environment (family, acquaintances, neighbors, relatives and friends). In this section, respondents were asked about their experiences related to the topic of vaccinations among their closest ones. The fourth section concerned the respondent's personal attitude towards vaccinations.

Characteristics of the study group

Healthcare workers

This study group consisted of medical professionals; including 13 physicians (specialized in 10 different fields), 4 nurses, and 3 midwives. The average age in the study group was 46 (min-max: 30-57). The shortest work experience declared by the respondents was 4 years, and the longest was 36 years. Two respondents did not have children.

Medical and nursing students

The study group consisted of 20 students of medical universities. The average age in the study group was 23 years (min-max: 21-27). All respondents were single (unmarried) and did not have children.

Table 1 presents simplified characteristics of the study group. Detailed information about the characteristics of all study groups was presented in Table 2.

Table 1. Simplified characteristics of the study group

Group		N	Women n (%)	Men n (%)	Average work experience (years)
Healthcare workers	Physicians	13	8 (62%)	5 (38%)	20.6
	Nurses	4	4 (100%)	0	18
	Midwives	3	3 (100%)	0	28
Students	Medicine	10	5 (50%)	5 (50%)	n/a
	Nursing	10	10 (100%)	0	n/a

*n/a – not applicable

Table 2. Characteristics of the study group

Study Group: Medical Students							
Field of study	Sex	Age (years)	Children	Place of residence	Place of study	Marital status	Year of study
M	F	23	N	Opacz Kolonia	Warsaw	unmarried	4
N	F	22	N	Skrzeszew	Warsaw	unmarried	2 Bachelor's degree
N	F	21	N	Warsaw	Warsaw	unmarried	2 Bachelor's degree
N	F	22	N	Ełk	Warsaw	unmarried	1 Master's degree
N	F	21	N	Warsaw	Warsaw	unmarried	3 Bachelor's degree
N	F	24	N	Warsaw	Warsaw	unmarried	1 Master's degree
N	F	21	N	Węgrów	Warsaw	unmarried	2 Bachelor's degree

N	F	21	N	Tuchowicz	Warsaw	unmarried	2 Bachelor's degree
N	F	27	N	Warsaw	Warsaw	unmarried	1 Master's degree
N	F	24	N	Warsaw	Warsaw	unmarried	2 Master's degree
N	F	21	N	Radom	Warsaw	unmarried	2 Bachelor's degree
M	F	23	N	Warsaw	Warsaw	unmarried	2
M	F	25	N	Warsaw	Warsaw	unmarried	2
M	F	21	N	Warsaw	Warsaw	unmarried	2
M	M	21	N	Kielce	Kielce	bachelor	3
M	M	23	N	Katowice	Katowice	unmarried	5
M	M	24	N	Sobótka	Zielona Góra	unmarried	4
M	F	26	N	Olsztyn	Olsztyn	unmarried	2
M	M	27	N	Bydgoszcz	Bydgoszcz	unmarried	5
M	M	22	N	Rzeszów	Rzeszów	unmarried	3

Study Group: Medical professions							
Profession	Sex	Age (years)	Children	Education	Principal place of work	Marital status	Length of service (years)
specialist physician neurologist	F	32	no	Higher	Kalisz	married	8
physician undergoing specialization in family medicine	F	34	yes	Higher	Bydgoszcz	married	10
physician specialist in internal diseases, infectious diseases and marine and tropical medicine	F	41	yes	Higher	Białystok	married	16
Physician gynecology specialist	M	54	yes	Higher	Siedlce	n/a	30
pediatric surgery specialist	F	34	no	Higher	Bydgoszcz	unmarried woman	9
nurse	F	51	yes	Higher	Siedlce	n/a	14
midwife	F	56	yes	Higher	Siedlce	n/a	30
Physician undergoing specialization in pediatrics	F	30	yes	Higher	Białystok	married	4
physician specialist in pediatrics	F	54	yes	Higher	Węgrów	n/a	29
primary care physician	M	47	yes	Higher	Mińsk Mazowiecki	n/a	22
physician specialist in epidemiology	M	53	yes	Higher	Warsaw	n/a	29
epidemiologic nurse	F	50	yes	Higher	Siedlce	n/a	31
midwife	F	40	yes	Higher	Dębe	n/a	18
occupational medicine specialist, military health care organization	M	57	yes	Higher	in several, Warsaw, Ożarów Mazowiecki, Błonie, Mszczonów, Grodzisk Mazowiecki among other	married	30
physician specialist in travel medicine, tropical medicine	F	53	yes	Higher	Warsaw	married	27
physician occupational medicine specialist	F	53	yes	Higher	Warsaw	married	24
nurse	F	34	yes	Higher	Warsaw	married	11
physician specialist in pediatrics, gastrology, pediatric gastrology	M	55	yes	Higher	Warsaw	married	30
nurse	K	49	yes	Higher	Warsaw	married	16
community midwife	K	56	yes	Higher	Katowice	married	36

N – nursing, M – medical, F – female, M – male, N – no, n/a – not applicable

RESULTS

Problems expressed by all groups and the identified needs regarding vaccinations are presented in the Tables 3-5.

Table 3. Problems expressed in a medical group regarding talking about vaccinations with a patient

Item no.	Problems expressed	Respondent
1.	Physicians lack time to initiate a conversation about vaccinations in the outpatient clinic	P
2.	Patients fail to differentiate between tick-borne encephalitis and meningitis	P
3.	Feeling a lack of appropriate communication with patients expressing anti-vaccination views	P
4.	Lack of sufficient materials for patients on vaccinations at the respondent's workplace	P
5.	Patients do not fully understand the information provided to them by their physician during their appointment	P
6.	Patients who look for information about health make use of unreliable sources	P
7.	A patient's visit to a vaccination point is accompanied by stress and/or anxiety	P
8.	Communication with the fiftieth or hundredth patient at a vaccination center on a given day is more difficult than with the first patient	P
9.	Patients avoid the topic of vaccinations when talking to their physician	P
10.	Farmers are a professional group that does not vaccinate against tick-borne encephalitis	P
11.	Farmers are a professional group that is difficult to reach with information about vaccinations	P
12.	The most effective vaccination message has a narrow scope	P
13.	Some patients do not know about the diseases against which vaccinations protect people	P
14.	During a physician's appointment, patients rarely ask about sources of information they could use	P
15.	Patients obtain information about vaccinations from unreliable sources	P
16.	Patients do not understand the information provided to them by medical staff	P
17.	Patients are not a homogeneous group that will receive a general message	P
18.	Women planning to become pregnant and also pregnant women are afraid of vaccinations	P
19.	Anti-vaccination views are not always based on ignorance, but on faith, internal beliefs that are difficult to argue with	P
20.	The number of materials regarding vaccinations for patients in medical facilities is insufficient	P
21.	In the case of a patient receiving advice from many specialists, each of them may have the impression that the issue of vaccinations has been/will be raised by a different physician	P
22.	Patients do not always find reliable information on the Internet	P
23.	Patients do not have trust in physicians	P
24.	Patients receive conflicting information from medical staff	P
25.	Patients have greater trust in people seen in the media	P
26.	After unsuccessful attempts to reach patients expressing anti-vaccination views, the physician feels irritated, helpless, and resigned	P
27.	The medical facility lacks information materials on vaccinations for patients	P
28.	Patients do not obtain information about vaccinations from reliable sources	P
29.	Knowledge about vaccinations is specialist knowledge which the patient does not always understand	P
30.	The activities of anti-vaccination organizations contribute to the strengthening of anti-vaccination attitudes among patients	P
31.	Talking to a patient whose views are against vaccination arouses negative emotions in the physician	P
32.	Patients do not always understand the information provided to them by their physician during their appointment	P
33.	Health-related information posted on official websites is not always attractive and understandable to the patient	P

34.	Patients obtain knowledge about vaccinations from various sources including unreliable ones	P
35.	Patients obtain information about vaccinations from unreliable sources	P
36.	It happens that patients do not understand the information provided to them	P
37.	People with anti-vaccination views participate in discussions broadcast to a wide audience	P
38.	Unvaccinated populations pose greater challenges when it comes to crisis management	P
39.	Bots create false information that is perceived as true by recipients	P
40.	The media present a negative image of physicians, which contributes to the crisis of authorities	P
41.	Patients fear any side effects after vaccination	P
42.	Patients believe in conspiracy theories	P
43.	The media contribute to spreading of conspiracy theories	P
44.	Patients who do not believe in vaccinations cannot be convinced	P
45.	Not all patients understand the information provided to them by medical staff	P
46.	Patients do not fully understand how vaccinations work	P
47.	Sometimes there is an aggressive attitude towards the physician among patients opposed to vaccinations	P
48.	Patients obtain information about vaccinations from unreliable sources	P
49.	Patients repeat myths about vaccinations	P
50.	People with views opposed to vaccinations do not understand any of their physician's arguments	P
51.	There are physicians who advise against vaccination against COVID-19 for patients, even though there are no contraindications	P
52.	There is a lack of trust between physician and patient	P
53.	Patients have doubts about vaccinations	P
54.	Patients obtain information about vaccinations from unreliable sources	P
55.	The physician is not always able to determine whether the patient has fully understood the information he/she received	P
56.	The patient's decisions are influenced by the anti-vaccination attitudes of his/her friends	P
57.	Patients' approach to conventional medicine is not always consistent	P
58.	Some parents refuse to have their child vaccinated	N
59.	Parents who refuse to vaccinate their child do not always sign a declaration of conscious refusal	N
60.	Currently, fewer and fewer patients are taking the initiative when it comes to getting vaccinated against COVID-19	N
61.	People with a higher education degree living in urban areas are perceived by nursing staff as more difficult interlocutors when it comes to the subject of vaccinations	N
62.	Patients demand a guarantee from a health care professional that their child will not experience any adverse events following vaccinations (AEFI)	N
63.	Existing administrative mechanisms intended to encourage parents who oppose vaccinations to have their child vaccinated are ineffective	N
64.	The patient's parents bring a document for the physician to sign certifying that the physician agrees to pay compensation if something happens to their child after vaccination	N
65.	Medical staff are reluctant to talk to people who oppose vaccinations	N
66.	Young people are not aware of the adverse events which are associated with the diseases against which vaccinations are directed	N
67.	Patients do not fully understand the information provided to them by medical staff	N
68.	Less experienced medical staff do not communicate effectively with the patient	N
69.	Patients obtain information about vaccinations from social media	N
70.	Scientific knowledge is difficult to learn	N
71.	People look for information that goes along with their theories	N
72.	People with substantive information about vaccinations are not always perceived as trustworthy	N
73.	People trust individuals more than organizations	N
74.	Patients usually do not understand the information given to them by medical staff	N
75.	Fear and lack of knowledge influence anti-vaccination attitudes	N
76.	Parents have many questions about vaccinating their children	N
77.	Time to talk to parents during the appointment is limited	N
78.	The media influence a parent's decision to vaccinate their child	N
79.	Parents are afraid of the child's body reaction to taking of the vaccine	N
80.	Materials available on websites created by people opposed to vaccinations raise doubts even among people who are convinced of vaccinations	N
81.	Some female patients do not understand the information provided to them by medical staff	M
82.	Some female patients only follow the recommendations of medical staff that are considered compulsory	M
83.	A person with an extremely negative attitude towards the topic of vaccinations is not open to any other arguments	M
84.	Patients do not always obtain information about vaccinations from reliable sources	M
85.	Reliable sources of information do not always seem interesting to the patient	M
86.	Not all information received from medical staff is fully understandable to the patient	M
87.	The patient does not remember all information provided to him/her by the medical staff	M
88.	Medical staff avoid getting into a discussion with people opposed to vaccinations	M
89.	Information obtained from the Internet and the activities of anti-vaccination groups have a negative impact on parents' attitudes regarding vaccinations	M
90.	Parents are not always equally opposed to vaccinating their child	M
91.	Female patients who give birth for the first time usually do not understand the information given to them	M
92.	The reception of information depends on the female patient's condition	M
93.	Female patients sometimes do not know which vaccinations they do not consent to	M
94.	Some female patients do not want to talk about vaccinations	M
95.	Female patients have concerns about their child's vaccinations	M
96.	Some female patients do not understand the information provided to them by medical staff	M
97.	Some female patients only follow the recommendations of medical staff that are considered compulsory	M

P – Physician, N – Nurse, M – Midwife

Table 4. Identified needs of a medical group related to talking to the patients about vaccinations

Item no.	Needs identified	Respondent
1.	Physicians could benefit from training on how to communicate with patients who express unscientific views.	P
2.	Patients need clear information about vaccinations and the diseases against which vaccinations are directed.	P
3.	Patients could benefit from taking part in training on how to verify the credibility of the sources they use.	P
4.	Patients need to have the information provided during the appointment repeated several times.	P
5.	Patients sometimes need information that is not obvious from the doctor's point of view, e.g. whether they can eat and drink after vaccination.	P
6.	Physicians need more time during the appointment, so that the patient can repeat the information in his/her own words.	P
7.	Patients need encouragement to raise the topic of vaccinations when talking to their doctor.	P
8.	Farmers, as a professional group, require separate information campaigns regarding vaccinations.	P
9.	Physicians with over 16 years of experience could benefit from participating in training on communication with patients.	P
10.	Medical staff should point patients to reliable sources of information.	P
11.	Materials on extracting reliable information should be available in places where the patient is staying.	P
12.	Medical staff should provide information to the patient in a simple way.	P
13.	As part of their studies, students of medical sciences should take classes in communication with patients, which will include, among others: exercises in simplifying the message.	P
14.	The message addressed to patients should be diverse.	P
15.	Both medical and non-medical authorities should be involved in transmitting medical messages.	P
16.	An information campaign on vaccinations should be directed to pregnant women and women planning a pregnancy.	P
17.	Medical staff can benefit from training on how to talk to patients whose anti-vaccination views are based on their faith and internal beliefs.	P
18.	Healthcare entities could provide more materials informing patients about vaccinations.	P
19.	Every doctor should ask about your child's vaccination status during the appointment.	P
20.	Patients would use materials that help them distinguish reliable information from information they come across on the Internet.	P
21.	Patients' trust in physicians should be increased.	P

22.	Medical staff need training in effective communication/ persuasion.	P
23.	Patients need clear, consistent information about vaccinations.	P
24.	Patients should be provided with knowledge on how to verify the sources they use.	P
25.	Information about vaccinations should be presented in a form that is understandable to the patient.	P
26.	Anti-vaccination organizations should stop activities that threaten life and health.	P
27.	Physicians should be prepared to talk to patients with anti-vaccination views.	P
28.	The information provided to the patient during a medical appointment should be repeated during subsequent appointments.	P
29.	Institutions publishing health-related information could include some of it in a form that is attractive to the recipient.	P
30.	Patients need access to easily assimilable, proven, and reliable information on vaccinations.	P
31.	People with anti-vaccination opinions should not be guests on popular television programs with the largest reach.	P
32.	The public should be taught to independently verify the accuracy of information that appears on social media.	P
33.	The basis of conspiracy theories in the media should be clearly contradicted.	P
34.	Patients need real-life examples as arguments to convince them to get vaccinated.	P
35.	Healthcare professionals should ensure that the patient understands the information provided.	P
36.	Patients need education about vaccinations.	P
37.	Patients need education on how to distinguish credible information from other information.	P
38.	The information provided to the patient should be adapted to the patient in terms of the language used, arguments, and examples.	P
39.	Up-to-date knowledge about vaccinations should be available to healthcare workers.	P
40.	Patients' trust in physicians should be strengthened.	P
41.	Patients should be educated about vaccinations and their doubts should be dispelled.	P
42.	The patient should be equipped with the ability to distinguish reliable information from false information	P
43.	Physicians should have the opportunity to further gain education in communication with the patient.	P
44.	Parents require education on vaccination knowledge.	N
45.	Patients must be actively encouraged to get vaccinated against COVID-19.	N
46.	Medical staff could benefit from training in communication with patients, which would include providing information on vaccinations and discussing examples of staff work.	N
47.	Medical staff could benefit from supplementary training courses on vaccinations.	N
48.	The administrative enforcement system in the event of refusal to have a child vaccinated requires updating and improving its effectiveness.	N
49.	Young people could benefit from an information campaign about the diseases against which vaccinations are directed.	N
50.	On social media, people who arouse sympathy and trust among recipients should provide reliable information about vaccinations.	N
51.	Information about vaccinations and the method of providing it should be adapted to the target group.	N
52.	Filter bubbles are worth mentioning in organized educational campaigns.	N
53.	Medical staff need training on communication with the patients where they will receive feedback.	N
54.	Sources of vaccine concerns need to be identified and addressed.	N
55.	Additional consultation opportunities should be created for parents who have more questions about vaccinations.	N
56.	It is necessary to ensure consistent, reliable media coverage on vaccinations that is consistent with current knowledge.	N
57.	Educational campaigns addressed to parents should be introduced to dispel their doubts regarding vaccinations.	N
58.	The process of closing websites that spread content that threatens health and life should be made easier.	N
59.	The information provided to patients by medical staff should be tailored to the patient in such way, so that it is fully understandable.	M
60.	Medical staff could benefit from training on how to reach people with extremely negative views regarding vaccinations.	M
61.	Patients should be encouraged to, among other things: by medical staff to use reliable sources of information.	M
62.	The message regarding vaccinations should be attractive to the patient.	M
63.	Patients could benefit from online courses on preparing for a doctor's appointment.	M
64.	Medical staff could benefit from training on effective communication with patients, which would take into account practical aspects of discussing anti-vaccination views with patients.	M
65.	A team should be established whose task will be to systematically combat disinformation regarding vaccinations	M
66.	The information provided should be adapted to the female patient's condition.	M
67.	If the female patient initially does not agree to vaccinate her child, you should regularly check whether the patient has not changed her mind and talk about the reasons for the decision.	M
68.	The patient's concerns should be identified and addressed.	M

P – Physician, N – Nurse, M – Midwife

Table 5. Concerns of the medical group expressed regarding talking about vaccinations at work

Item no.	Problems expressed	Respondent
1.	There are views among medical staff that are contrary to science.	P
2.	Medical staff cannot always distinguish facts from myths about vaccinations.	P
3.	Vaccination against influenza is not a vaccination routinely promoted by employers of medical entities.	P
4.	Medical staff refrain from being vaccinated not only because of fear of adverse events following immunization, but also because of reluctance to miss work.	P
5.	Unvaccinated medical staff do not provide adequate information regarding vaccinations to patients.	P
6.	Medical staff share anti-vaccination views with patients.	P
7.	Medical staff cannot always indicate a reliable source of information.	P
8.	Some healthcare workers need encouragement to get the vaccine against influenza.	P
9.	Not all healthcare workers get vaccinated against influenza.	P
10.	There are different views on vaccinations among medical staff.	P
11.	There are different views on vaccinations among medical staff.	P
12.	There are people among healthcare workers who are not fully convinced about vaccinations.	P
13.	Physicians are afraid of making decisions about vaccinating patients with immunodeficiencies, oncological patients, and those suffering from rheumatic diseases.	P
14.	Not all physicians have up-to-date knowledge about vaccinations.	P
15.	Not all physicians have up-to-date knowledge in the field of immunology.	P
16.	There are people among health care workers who did not take advantage of the opportunity to be vaccinated against COVID-19.	P
17.	Some healthcare workers are against vaccination.	N
18.	The employer does not provide the opportunity to be vaccinated against influenza.	N
19.	There are different attitudes towards vaccinations among healthcare workers.	N
20.	Healthcare workers who get vaccinated have concerns about their health after vaccination.	N
21.	Nursing staff working outside vaccination centers do not broaden their knowledge about vaccinations.	N
22.	According to some midwives, not all healthcare workers working with patients should be vaccinated against influenza.	M
23.	There are people among medical staff who do not vaccinate their children by choice	M

P – Physician, N – Nurse, M – Midwife

Healthcare workers (physicians, nurses, midwives)

Conversation about vaccinations with patients

According to all respondents, patients generally exhibited insufficient knowledge about vaccinations. Patients often relied on unreliable sources of information, occasionally avoided discussing vaccinations during medical consultations, lacked opportunities to learn about vaccine-preventable diseases (VPDs) and displayed a degree of distrust towards medical doctors. Among the healthcare providers, one physician (out of 13) acknowledged experiencing negative emotions when discussing vaccinations with patients holding anti-vaccination views. Additionally, one midwife (out of 3) stated that medical staff tended to avoid such confrontations. Pregnant patients expressed doubts about vaccinations. According to another respondent (a midwife), first-time mothers usually struggled to

comprehend the health information provided to them, and sometimes they were uncertain about which vaccinations they declined to consent to.

Conversation about vaccinations at work, with co-workers

According to the majority of physicians surveyed (8 out of 13), not all healthcare workers had up-to-date knowledge about vaccinations sufficient for effective patient communication. One out of four nurses stated that nursing staff working outside of vaccination centers did not actively update their knowledge in this area. Seven physicians, two nurses, and one midwife observed that some healthcare workers held views contrary to current scientific understanding and shared these perspectives with patients. There was also noted difficulty among medical professionals in distinguishing between factual information and myths regarding vaccinations. Furthermore, vaccination against influenza was not routinely promoted by employers within medical entities. Medical staff sometimes refrained from vaccinations due not only to concerns about adverse events, but also from reluctance to be absent from work. One midwife stated that she had encountered medical staff who chose not to vaccinate their own children.

Conversation about vaccinations in the family

The respondent, identified as an authority figure within their immediate environment, generally influenced the vaccination attitudes of their family members, although occasional instances arose where family members did not seek the respondent's counsel on vaccination matters. Delays in timely vaccinations of healthcare workers' children were primarily attributed to organizational challenges rather than parental choice. The knowledge level of medical staff was occasionally insufficient to adequately address concerns about vaccinations raised by their family members.

Conversation on the respondent's attitude towards vaccinations

Concerns about vaccinations appeared also among medical staff. One of the interviewed midwives believed that vaccinations were administered to children at too early an age. Respondents also repeatedly highlighted the issue of healthcare workers lacking time or motivation to independently update their knowledge on vaccinations. There was a sentiment that medical specialists alone are primarily responsible for staying updated on vaccination-related topics. Moreover, respondents criticized the media for inadequately emphasizing vaccinations and prevention, contributing to a prevailing state of information chaos.

Medical and nursing students

Conversation on vaccinations at the higher education institutions

According to the majority of respondents, the issue of vaccinations (except for vaccinations against COVID-19) does not come up in regular conversation. Moreover, experiences related to promoting vaccinations by higher education institutions varied among respondents. Some indicated that their university had been promoting vaccinations against influenza. However, some pointed out that the promotion of vaccinations against influenza at the university began only after the outbreak of the COVID-19 pandemic. What is more, not every respondent regularly sought vaccination against seasonal flu. This was due to lack of confidence in this vaccination. Such respondents do not feel the need for such vaccinations because: they have doubts about the need for vaccination against influenza, they consider themselves healthy people, they do not believe in the effectiveness of vaccination (such arguments were given by 4 out of 10 medical students), and because people from their immediate environment have discouraged them from being vaccinated. In addition, they believe that they knew too little about vaccinations against influenza as no-one had yet explained to them why they should be vaccinated and why vaccinations were so important. On top of that, they felt that the lack of need for influenza vaccination is justified by the lack of knowledge about the course of influenza and the issue of virus mutations. Furthermore, according to other students, the university did not encourage vaccinations against infectious diseases, including influenza. Three (out of 10) nursing students believe that the campaign to vaccinate students against influenza at the university is inefficient and not very effective.

Opinions are divided among students regarding the teaching of the topic of vaccination within their followed curriculum. Moreover, respondents also mentioned that in their followed curriculums, the subject of immunology alone addresses the concept and practice of vaccination. While six out of 20 students (nursing and medical) positively assessed the proffered information in this area, in the opinion of six out of ten medical students, not enough attention is paid to the topic of vaccinations. Indeed, one 5th-year medical student stated that so far, during his studies, topics related to vaccinations had been discussed "*casually*". He believes that he has minimal knowledge about vaccinations. He also stated that his go-to source of knowledge about vaccinations is the Google search engine. The polled students do, however, state that the topic of vaccination and anti-vaccination movements does come up in private conversation. Eight out of ten nursing students also believe that not enough attention is paid to vaccinations during their classes. The students emphasized that this topic was discussed during pediatrics classes and was limited only to learning the immunization schedule.

Overall, students of both fields believe that educating medical school students about vaccinations is insufficient. To complement it, there should be more practical classes on vaccinations with the participation of patients. Moreover, according to the majority of students of both fields, lecturers do not sufficiently provide information about vaccinations. Both medical and nursing students also repeatedly emphasized the lack of practical classes in communication with patients. In addition, students fear having any conversation with patients regarding this issue. There was also an opinion that the problem in a potential conversation with a patient about vaccinations was that patients lacked "elementary knowledge" in this area.

The outcome of this situation is that students have proposed introducing one subject devoted exclusively to vaccinations, the aim of which is to systematize knowledge in this field. Therein, the students suggested that greater emphasis should be placed on subjects such as vaccine composition, classification of vaccine preparations, their safety and efficacy, the activities of anti-vaccination movements and techniques for effective patient communication. Of note, three out of 20 students had experienced a negative opinion about vaccinations among their lecturers (including doctors).

Conversation on vaccinations with people from one's immediate environment (family/friends)

Issues related to vaccinations are seldom discussed in the respondents' immediate environment (except vaccinations against COVID-19). Therein, however, Issues related to influenza and HPV vaccinations were the more frequent topic. Regarding being vaccinated against the flu, opinions among the respondents' closest relatives vary. Very often, the respondents pointed out that people from their immediate environment (family/friends) were against these vaccinations. Respondents also provided examples of their parents and grandparents voluntarily receiving the flu shot, but discouraging younger people from doing so.

According to the respondents, no one in their immediate environment questions vaccinations for children, and people from the immediate environment vaccinate their children according to the immunization schedule (Polish: PSO). They know they are obliged to and they do not question it. Most respondents did not encounter any support for anti-vaccination movements among their relatives.

Conversation on the respondent's attitude towards vaccinations

All of the respondents supported the notion of being vaccinated, and considered current vaccines to be effective and safe. Moreover, the current immunization schedule raised no objections. Their attitude towards vaccinations, however, depended on their trust in medical staff, primary care physicians and pediatricians, as well as on the knowledge obtained at the university.

The students did, however, point out that fake news about vaccinations were prevailing on the Internet and in the media. In their opinion, in order to prevent the spread of this false information, education in the field of vaccination should be extended, which should cover school-age children and youth in secondary schools. Moreover, they held that vaccinations should be promoted by celebrities and politicians. All respondents believed that public confidence in vaccinations should be increased. An educational campaign aimed at children, teenagers, and adults was suggested by 17 out of 20 students. Accordingly, education for children should take place within formal classes in their schools, for youth and adults via the Internet (e.g. in social media, on YouTube), and for seniors – via the press and TV programs.

Over all, the study revealed that medical and nursing students had very limited knowledge about vaccinations, and were not familiar with the immunization schedule. Moreover, they had no knowledge about the etiology and prevention of VPDs, or of vaccine mechanisms of action, their efficiency and purposefulness. In addition, medical and nursing students did not know what combined vaccines were.

DISCUSSION

Most important results

Our study has uncovered numerous issues related to the approach to vaccinations among medical staff, and students in medical fields, as well as within their environment. Indeed, within the healthcare sector, some individuals oppose vaccinations, refuse to vaccinate their children, and even advise patients against certain vaccinations. These findings have also allowed us to identify specific needs arising from these issues. Communication problems with patients were repeatedly highlighted, including insufficient time to address patient doubts, difficulties patients have in understanding medical terminology, and challenging emotions arising during conversations, especially with patients who oppose vaccinations. These communications issues often lead to the avoidance of vaccination topics in subsequent appointments. Furthermore, outpatient clinics lack adequate educational materials, such as leaflets and audiovisual content, to counteract the misinformation spread by anti-vaccination organizations' websites and in conversations between patients.

Our study found that medical students generally exhibited favorable attitudes towards vaccinations, although exceptions were noted. Often, the highlighted issues included insufficient knowledge about vaccinations and the need to broaden the scope of topics covered in university curricula.

Reference to the literature on the subject

The decision to receive vaccination is a multifaceted process influenced by numerous factors, making patient communication on this topic particularly challenging. This complexity was highlighted by participants in our study and has been extensively documented in the scientific literature. A systematic review of 38 qualitative studies [17] by Norwegian researchers, for example, examined the views and experiences of parents and guardians regarding communication about routine vaccinations for children under the age of six. Parents expected more information than they received and expected a balanced presentation of the potential benefits and risks of taking the vaccine. Healthcare workers were seen as an important information source, but concurrently, the parents expressed difficulty in determining which sources were the most reliable and provided unbiased and balanced information. Our study also confirms the critical importance of effective communication regarding vaccinations, underscoring the necessity for training healthcare workers and medical students in this area.

Pierz *et al*., in another publication on supporting American healthcare workers in effective communication on vaccinations, noted that the constant battle against misinformation among patients causes frustration among medical staff and negatively affects the physician-patient relationship. This issue was also confirmed by medical doctors who took part in our study [19]. Dempsey *et al*., in a review study describing the impact of medical staff communication on

the attitudes of patients and taking of vaccines against HPV, mentioned the so-called "best practices", which included short, firm, and unambiguous messages, and if resistance is encountered, the use of more complex techniques, such as motivational interviewing [20]. The authors of "Good practices in vaccination" suggest introducing professional doctors-influencers and other healthcare professionals into the public space who would provide health-related information in a straightforward way [12].

The need for postgraduate education of healthcare workers in the field of vaccinations, highlighted in this study, has also been demonstrated in other studies in the group of gynecologists [21-23], midwives [24], family doctors [25], nurses [26] and pharmacists [27]. Our study also confirmed the problem of insufficient knowledge about vaccinations among medical students [28-33], although it sometimes happens that students consider their knowledge about vaccinations as being adequate [34].

Strengths and limitations of the study

The strength of the study is the relatively large group of respondents – 40 individual interviews were conducted in 2 groups. Such large groups are rare in qualitative studies on vaccination. The multidimensional approach to the topic is another advantage – the issue of vaccinations was analyzed not only in the context of the respondent's own views, but also in relation to the place of work/study (attitude of work/study colleagues towards vaccinations, availability of vaccinations against influenza in the place of work/study), as well as in relation to issues raised in conversations with patients, family and friends. The psychological aspect, however, might be a limitation – the risk of respondents giving answers that are not entirely honest and tailored to the recipient (medical university employee) due to their fear of being judged.

A further limitation of the study is not including students of other medical fields, e.g. emergency medical services, pharmacy, laboratory diagnostics, etc. Another potential issue is the choice of the study group. The respondents were selected purposefully and using the snowball method. Despite the encouragement to focus on vaccinations other than those against COVID-19, the respondents returned to the topic of the pandemic and mostly commented on vaccinations related to it. Moreover, the dynamic course of regulations regarding the COVID-19 pandemic could have changed the perception of vaccinations in the general population in a short time, and already after the end of our study.

CONCLUSIONS

All respondent groups have identified a pervasive issue of information chaos in the media and a lack of consistent dissemination of reliable vaccination information. Continuous professional development is imperative for healthcare professionals to maintain up-to-date knowledge on immunization practices and to strengthen their capacity for critically evaluating the validity and reliability of information sources. Additionally, healthcare workers' competencies in effectively communicating with patients who hold unscientific views must be improved through appropriate training and access to relevant materials. Patients in turn should have access to concise, understandable and reliable information that justifies the need for vaccination against specific infectious diseases.

The negative portrayal of healthcare workers in the media exacerbates the crisis of authority and diminishes patient trust. Consequently, medical and nursing curricula should incorporate dedicated subjects on vaccinations and patient communication, with a strong emphasis on practical training in these areas. Moreover, medical universities should actively promote influenza vaccinations among their students.

FUNDING

This work was supported by the National Centre for Research and Development (NCBR) [grant numbers GOSPOSTRATEG-II/0007/2020-00].

DISCLOSURE

The authors declared no conflict of interest.

ACKNOWLEDGEMENTS

We would like to thank Mrs. Jolanta Grygielska for her help in proofreading the article.

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8. Oświadczenia współautorów

Warszawa, 25.09.2025 r.

Paulina Maria Nowicka
(imię i nazwisko)

OŚWIADCZENIE

1. Jako współautor pracy pt. „Socio-economic determinants of childhood vaccination coverage in high-income countries: a scoping review" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: opracowanie koncepcji pracy, zestawianie danych, analiza danych, interpretacja wyników, pisanie manuskryptu, krytyczna weryfikacja pracy, korekta w trakcie recenzji, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 100%.

2. Jako współautor pracy pt. „Socio-economic determinants of the second-dose measles vaccination coverage in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, zestawianie danych, analiza danych, interpretacja wyników, pisanie manuskryptu, krytyczna weryfikacja pracy, korekta w trakcie recenzji, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 60%.

3. Jako współautor pracy pt. „Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014-2018" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, zestawianie danych, analiza danych, interpretacja wyników, pisanie manuskryptu, krytyczna weryfikacja pracy, korekta w trakcie recenzji, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 55%.

4. Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: opracowanie koncepcji badania, przeprowadzanie badania, zestawianie danych, analiza danych, krytyczna weryfikacja pracy, korekta w trakcie recenzji, zatwierdzenie wersji do druku.

   Mój udział procentowy w przygotowaniu publikacji określam jako 15%.

Paulina Nowicka

.....

(podpis oświadczającego)

Warszawa, 08.09.2025 r.

Mariusz Gujski
(imię i nazwisko)

OŚWIADCZENIE

1. Jako współautor pracy pt. „Socio-economic determinants of the second-dose measles vaccination coverage in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, pisanie manuskryptu, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 10%.

2. Jako współautor pracy pt. „Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014-2018" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, pisanie manuskryptu, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 10%.

3. Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: znaczący wkład w koncepcję i projekt pracy, nadzór merytoryczny.
   Mój udział procentowy w przygotowaniu publikacji określam jako 4%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. prac jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....
(podpis oświadczającego)

Warszawa, 08.09.2025 r.

Zbigniew Lewandowski
(imię i nazwisko)

OŚWIADCZENIE

1. Jako współautor pracy pt. „Socio-economic determinants of childhood vaccination coverage in high-income countries: a scoping review" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, zestawianie danych, statystyczna analiza danych, pisanie manuskryptu, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 25%.

2. Jako współautor pracy pt. „Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014-2018" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, zestawianie danych, statystyczna analiza danych, pisanie manuskryptu, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 30%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. prac jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

Z. Lewandowski
.....
(podpis oświadczającego)

Warszawa, 03.09.2025 r.

Bolesław Samoliński
(imię i nazwisko)

OŚWIADCZENIE

1. Jako współautor pracy pt. „Socio-economic determinants of the second-dose measles vaccination coverage in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 10%.

2. Jako współautor pracy pt. „Granularity matters: measles first- and second-dose vaccination coverage in Poland, 2014-2018" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: udział w opracowaniu koncepcji badania, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.
   Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....
(podpis oświadczającego)

Warszawa, 28.08.2025 r.

Anna Kłak
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: opracowanie koncepcji badania, pozyskanie danych, analiza i interpretacja wyników, opracowanie pracy, korekta w trakcie recenzji, ostateczne zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 25%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

Anna Kłak
.....
(podpis oświadczającego)

Warszawa, 24.09.2025 r.

Magdalena Kuśmierska-Bucoń
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: analiza wyników, pisanie manuskryptu, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 15%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....

(podpis oświadczającego)

Warszawa, 24.09.2025 r.

Zygmunt Grochal
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: analiza wyników, pisanie manuskryptu, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 10%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

Zygmunt Grochal
.....
(podpis oświadczającego)

Warszawa, 03.09.2025 r.

Mira Lisiecka-Biełanowicz
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: opracowanie koncepcji badania, interpretacja wyników, krytyczna weryfikacja pracy, korekta w trakcie recenzji, nadzór merytoryczny, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 10%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....

(podpis oświadczającego)

Warszawa, 24.09.2025 r.

Agnieszka Drab
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 7%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....Agnieszka Drab.....
(podpis oświadczającego)

Warszawa, 24.09.2025 r.

Bartłomiej Drop
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: krytyczna weryfikacja manuskryptu, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 4%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....
(podpis oświadczającego)

Warszawa, 05.09.2025 r.

Artur Białoszewski
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: opracowanie koncepcji badania, interpretacja danych do pracy, krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

Artur Zygmunt Białoszewski

Cyfrowo podpisane przez Artur Zygmunt Białoszewski
DN: cn=Artur Zygmunt Białoszewski, o=Warszawski Uniwersytet Medyczny, ou=Centrum Kształcenia Podyplomowego, email=artur.bialoszewski@wum.edu.pl
Data: 2025.09.05 12:35:48 +02'00'

.....

(podpis oświadczającego)

Warszawa, 24.09.2025 r.

Jarosław Pinkas
(imię i nazwisko)

OŚWIADCZENIE

Jako współautor pracy pt. „Attitudes towards vaccinations in selected medical groups in Poland" oświadczam, że mój wkład merytoryczny w przygotowanie, przeprowadzenie i opracowanie badań oraz przedstawienie pracy w formie publikacji stanowi: krytyczna weryfikacja pracy, zatwierdzenie wersji do druku.

Mój udział procentowy w przygotowaniu publikacji określam jako 5%.

Jednocześnie wyrażam zgodę na wykorzystanie ww. pracy jako części rozprawy doktorskiej lek. Pauliny Marii Nowickiej.

.....

(podpis oświadczającego)

9. Wykaz innych publikacji

Nowicka PM. Zagrożenia bezpieczeństwa zdrowotnego związane z prywatyzacją i asymetryzacją konfliktów zbrojnych. W: Chałupczak H, Marzęda-Młynarska K, Pietraś M, Pogorzała E, red. Zagrożenia bezpieczeństwa w procesach globalizacji: zagrożenia zdrowotne, Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej, Wydawnictwo Akademii Zamojskiej; 2022:363-376.

Raciborski F, Tomaszewska A, Samel-Kowalik P, Białoszewski A, Rakocy K, **Nowicka P**, Kłak A, Stosunek mieszkańców Polski do szczepień ochronnych z uwzględnieniem podziałów ekonomicznych, społecznych i gospodarczych. Warszawa 2022. *Raport zrealizowano w ramach projektu naukowego pt. „Budowanie zaufania do szczepień ochronnych z wykorzystaniem najnowszych narzędzi komunikacji i wpływu społecznego”.* https://medfake.pl/news/stosunek-mieszkancow-polski-do-szczepien-ochronnych-raport-z-badan-wum/. Dostęp 26.09.2025.

Kłak A, Furmańczyk K, **Nowicka PM**, et al. The Relationship between Searches for COVID-19 Vaccines and Dynamics of Vaccinated People in Poland: An Infodemiological Study. International Journal of Environmental Research and Public Health 2022;19(20):13275. doi:10.3390/ijerph192013275.

Nowicka P. SARS-CoV-2 – Sytuacja w Europie – przegląd restrykcji wprowadzonych w Republice Słowackiej, Republice Czeskiej oraz w Republice Federalnej Niemiec od września do grudnia 2020 r. Biuletyn Rządowego Centrum Bezpieczeństwa. 2021;31. https://archiwum.rcb.gov.pl/wp-content/uploads/BIULETYN-ANALITYCZNY-nr-31.pdf. Dostęp 26.09.2025.

Gujski M, Raciborski F, Jankowski M, **Nowicka PM**, et al. Epidemiological analysis of the first 1389 cases of COVID-19 in Poland: A preliminary report. Medical Science Monitor. 2020;26:e924702-1. doi:10.12659/MSM.924702.

Nowicka P, Janiec J. Closing EU internal borders – end of the Schengen group? EU healthy GateWays Joint Action Newsletter. 2020;11. https://www.healthygateways.eu/Newsletters/newsletter-issue-11-july-2020. Dostęp 26.09.2025.

Nowicka PM. Cechy współczesnych konfliktów zbrojnych potęgujące zagrożenia dla bezpieczeństwa zdrowotnego ludności cywilnej. W: Moniuszko-Malinowska A, red., Zagrożenia cywilizacyjne XXI wieku. alfamedica press; 2020:162-183.

Nowicka PM, Izdebski R, Kitowska W, et al. Review of measles-related events recorded by the National IHR Focal Point in Poland in the years 2016 – 2018. Przegl Epidemiol. 2019;73(1):3-18. doi:10.32394/pe.73.02.

Nowicka PM, Kocik J. Zewnętrzne zagrożenia bezpieczeństwa zdrowotnego Polski. Studia BAS. 2018;4(56):103-121. doi:10.31268/StudiaBAS.2018.26.

Nowicka PM. Zagrożenia bezpieczeństwa zdrowotnego Ukrainy. Nowa Polityka Wschodnia. 2018;2(17):33-44. doi: 10.15804/npw20181702.

Światowa Organizacja Zdrowia. Health of refugees from Ukraine in Poland: a comparative analysis of 2022–2023 surveys and data innovations. 2025. https://www.who.int/europe/publications/i/item/9789289062381. Dostęp 29.09.2025.

Światowa Organizacja Zdrowia. WHO Country Office in Poland annual report 2024. 2025. https://www.who.int/europe/publications/i/item/who-country-office-in-poland-annual-report-2024. Dostęp 29.09.2025.