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Vaccination against influenza and attitudes towards seasonal vaccination of medical students from the Medical University of Silesia

Original Study

Marek Wojczyk[1,2*], Paulina Rutecka[2,3], Dawid Wolak[2,4], Zuzanna Zięba[2,5], Dorota Zatłoka[2,4], Filip Klimas[2], Urszula Wójsik[2,4], Katarzyna Wójtowicz[2,6]

[1] Doctoral School, Medical University of Silesia, Katowice, Poland
[2] Faculty of Medical Science in Katowice, Medical University of Silesia, Poland
[3] Students' Scientific Society of the Department of Gynaecological Endocrinology, Faculty of Medical Sciences in Katowice, Medical University of Silesia, Poland
[4] Students' Scientific Society of the I Department of Cardiology, Faculty of Medical Sciences in Katowice, Medical University of Silesia, Poland
[5] Students' Scientific Society of the Department of Neurology, Faculty of Medical Sciences in Katowice, Medical University of Silesia, Poland
[6] Students' Scientific Society of the Department of Cardiac Surgery, Faculty of Medical Sciences in Katowice, Medical University of Silesia, Poland

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Abstract

Introduction. To reduce the incidence of influenza, healthcare workers and medical students are recommended to receive annual seasonal vaccination. This study aimed to investigate the behavior of students regarding their willingness to be vaccinated against influenza and the attitudes influencing their approval or disapproval of influenza vaccination.

Materials and Methods. This cross-sectional study was designed as an online survey among students of the Medical University of Silesia (MUS) of all years and specialties, as MUS is the largest medical college in Poland. A total of 302 students participated in the study and completed an online questionnaire. The collected data were analyzed using descriptive and analytical statistics. The significance of the differences was tested using the chi-square test.

Results. The percentage of students who received influenza vaccinations in the past was 42.1%, and in the current influenza season (Autumn 2022) was 33.4%. The level of vaccination differed significantly depending on the study program *($p < 0.001$).* An important variable affecting the decision to vaccinate was participation in clinical classes. Among the students taking practical classes, 59.4% were vaccinated. Most respondents had a positive opinion about influenza vaccination (98%). Belief in the effectiveness of vaccination (35.6%) was the main reason for vaccination against influenza, as indicated by the respondents. The main reason for not being vaccinated was a lack of fear of influenza infection (22.9%).

Conclusions. The results obtained in this study indicate the need to introduce changes in the field of broader education regarding the effectiveness of vaccinations in reducing the number of influenza virus infections among medical students.

Keywords

influenza vaccine • health behavior • vaccine acceptance • influenza prevention • students

1. Introduction

Influenza is a highly contagious and virulent virus that kills 290,000 to 650,000 people worldwide [1]. Classic symptoms of infection include fever, myalgia, headache, sore throat, and dry cough. However, seasonal influenza is thought to cause a wide range of illnesses, including pneumonia, exacerbation of underlying lung disease, and extrapulmonary symptoms affecting the gastrointestinal and neurological systems [2, 3]. In 2019, 225 influenza-related deaths were registered in Poland [4]. Once symptoms of infection appear, antiviral drugs are the preferred treatment. There is also primary prevention in the form of vaccination, which is recommended for all people 6 months of age and older, including pregnant and postpartum women, unless there is a contraindication. Vaccination should be given at the beginning of the influenza season (usually in October) and repeated annually due to the high mutation rate of the virus [3]. Worldwide, there are two types of influenza vaccination, trivalent and quadrivalent. In Poland, quadrivalent vaccines are available in two forms: inactivated intramuscular/subcutaneous vaccines or live intranasal vaccines. Both types cause active immunization against the four strains of influenza virus (two strains of virus A and two strains of virus B) contained in a given vaccine [5]. The following influenza vaccines were offered in Poland for the 2022/2023 season: Influvac Tetra, Vaxigrip Tetra, Fluarix Tetra, Fluenz Tetra. Quadrivalent vaccines have been shown to reduce morbidity, mortality, and healthcare utilization compared to trivalent vaccines [3]. Both types of vaccines utilize humoral and cellular immunity. Intranasal vaccination is the preferred form in children because it is better tolerated this way. The attenuated virus administered into the nasopharynx replicates in mucosal tissues, simulating a physiological infection. Moreover, nasal administration results in higher secretory IgA titers than intramuscular administration of the inactivated vaccine [6]. In contrast, according to a meta-analysis of studies, the efficacy of

* *E-mail: marek.wo46@gmail.com*

the inactivated vaccine was 59% (95% CI 51-67) in the population aged 18–65 years [5].

On average, influenza vaccination rate in the EU was low compared with the WHO target of 75% for at-risk groups and healthcare workers set as an EU target in the 2009 Council Recommendation on seasonal influenza vaccination. The most recent data from 2018 show that influenza vaccination rates in the EU are approximately 41% among persons aged 65 years and older [7–9]. In contrast, influenza vaccination rates in Poland in recent seasons have ranged from only 4% in the general population to 15.1% in those aged 65 years and older [10].

Due to the effectiveness of influenza vaccination in reducing the number and severity of influenza complications, WHO gives high priority to preventive vaccination of healthcare workers who are in constant contact with pathogens during the influenza season, including through free vaccination programs [1]. At the same time, the issue of vaccination of medical students as a group of future healthcare workers is becoming increasingly common [11]. According to previous reports, the percentage of vaccinated healthcare workers in Poland is only 5% [12].

The aim of this study is to investigate the behavior of students regarding their willingness to be vaccinated against influenza and the attitudes influencing their approval or disapproval of influenza vaccination.

2. Materials and methods

2.1. Study design

The cross-sectional study was designed as an online survey among students of the Medical University of Silesia (MUS) of all years and specialties, as MUS is the largest medical college in Poland. In 2022, 10,235 students were studying there in 17 programs (e.g., medical studies, nursing, physical therapy, midwifery, dentistry).

Information about the research, accompanied by an invitation to participate in the study with a link to an online survey was posted on social media accessible only to MUS students (closed Facebook groups). Respondents answered questions in the form of additions to the online questionnaire, which was created based on Google Form capabilities.

The survey was conducted between November 14 and November 28, 2022. After the invitation was published on November 14, 87% of the questionnaires were completed in the first week. In the last 4 days, not a single questionnaire was completed, so after 14 days of receiving the responses, the authors decided to stop collecting the questionnaires.

2.2. Sample size

The general population of MUS is 10,235 students. To determine the minimum research sample size, a tool of OpenEpi calculator was used [13]. Based on literature data that the percentage of healthcare workers vaccinated against influenza in the Silesia region (where MUS is located) was 35% in 2021 [14], a hypothesis was made about the estimated percentage of vaccination among students, which amounted to 35%. Considering the above hypothesis, the size of the general population of MUS, and assuming a probability of 95%, it was calculated that at least 339 students should be screened. Finally, the number of surveyed students was 302 and the final sample of participants was 3% of all students from MUS.

2.3. The questionnaire

The author's questionnaire consisted of 14 questions divided into 3 sections. The first section concerned the respondents' data, such as age, gender, place of origin, field (program) of study, year of study. The second section was related to the indication of influenza and COVID-19 vaccination. The questions were related to influenza vaccination in the past, in the 2022/2023 season, and the number of vaccine doses taken against COVID -19.

The last section of questions concerned participants' attitudes toward seasonal influenza vaccination. Respondents were asked about their reasons for vaccinating or not vaccinating (choosing from the given options, with the possibility of self-justification) and about their assessment of the effectiveness of such vaccination in a group of health care workers as a method of influenza prevention. The survey also included a question on opinion about mandatory influenza vaccination in the group of health care workers.

The created questionnaire was first used in a pilot study on a group of 20 students. Then, the order of the questions was changed to better fit the chronological decision-making process regarding vaccination. Closed questions could be answered with "yes," "no," "I do not know/no opinion," or by selecting a specific option (e.g., year of study, field of study).

2.4. Statistical analysis

The collected data were subjected to statistical analysis using the methods of descriptive and analytical statistics. The analyses were performed based on the capabilities of the Statistica package (version 13.3, TIBCO Software Inc., USA).

Due to the difference between the number of the general student population and the actual sample, the statistical margin of error in the survey was 6%.

For the presentation of qualitative variables, the numerical and percentage values were used, while for the quantitative variable – age – the conversion to categorical values based on the median value was performed.

To assess the relationship between reported vaccination or willingness to get the vaccination and each grouping variable, the chi-square test for significance for differences was performed. Grouping variables included sex, age, place of residence, study subject, clinical classes in hospitals, influenza vaccination in

the past, opinion about the effectiveness of vaccination, and vaccination against COVID-19. Conclusion was based on the criterion of significance at the level of $\alpha < 0.05$.

2.5. Ethical considerations

The authors did not seek approval from the Bioethics Committee to conduct the study. Referring to the opinion of the Bioethics Committee of the Medical University of Silesia given on another study conducted by the authors (PCN/CBN/0022/ KB /140/21), it was stated that the survey research did not require the opinion of the committee [14]. However, each participant in the survey who started answering the questions included in the online questionnaire was informed about the confidentiality of the answers given. Before participating in the study, participants were required to accept the content of the informed consent document. Responses were then given voluntarily and anonymously. The data collected remained confidential, and only the authors of the study had access to the data collected.

3. Results

3.1. Researched population

Students from all MUS faculties participated in the study (Medical Sciences, Health Sciences, Pharmaceutical Sciences). In the study were 302 participating students, representing 3% of the total population of MUS students. The largest number of respondents were medical students. The remaining respondents were studying physiotherapy (n = 46, 15.2%), midwifery (n = 46, 15.2%), and nursing (n = 33, 10.9%). Groups below 10% of all respondents were students of pharmacy (n = 19, 6.3%), dentistry (n = 4, 1.3%), and other faculties (n = 6, 2.1%). Other participants studied medical analytics (n = 1), medical biotechnology (n = 1), cosmetology (n = 1), emergency medical services (n = 1), public health (n = 1), and neurobiology (n = 1). The exact data, with detailed response rate data by program of study, is presented in Table 1.

Regarding gender, 235 participants identified themselves as women (77.8%), 66 as men (21.9%), and 1 person reported a gender other than male or female (0.3%). The average age of the respondents was 21.1 years. The youngest respondent was 18 years old and the oldest was 43 years old. The median age was 21 years. Most of the respondents lived in cities with populations up to 100,000 (n = 174, 57.6%); the remaining 128 students reported living in cities with populations less than 100,000 (42.4%). First- and second-year students made up the majority of respondents and totaled 170 (56.3%). The oldest students (final year students) made up 7.3% of the respondents (n = 22). Of the respondents, 153 students (50.7%) had not had any clinical teaching – that is, direct patient contact – at the time of the study, or their program of study did not include such teaching, as in pharmacy or public health.

3.2. Vaccination uptake

The largest number of students who had been vaccinated against influenza were students in the following courses: medical studies, physiotherapy, and midwifery. A total of 42.1% of respondents (n = 127) had been vaccinated against influenza in the past. Similarly, in the current season of increased influenza incidence (that is, in the autumn-winter period of 2022/23), the largest number of students who were vaccinated or declared vaccinated in the near future were students of medical studies (64.4%), physiotherapy (11.9%), and midwifery (9.9%). The total percentage of vaccinated students or those who were declaring willingness to be vaccinated among the surveyed students in the autumn/winter season of 2022 was 33.4%.

In the study group, the majority of those who were vaccinated or planned to be vaccinated against influenza were women. However, no significant difference was observed due to gender ($p = 0.37$). In addition, there were no significant differences in the declaration of influenza vaccination according to age ($p = 0.44$) or place of residence ($p = 0.13$).

Most often, vaccinated students are medical or dentistry students. The vaccination rate differed significantly depending on the field of study ($p < 0.001$). As it turns out, an important variable in the decision to vaccinate was the fact whether the subjects had already held clinical classes, that is, they had been in contact

Table 1. Students of particular faculties participating in the study, vaccinated against influenza in the past, and those who are declaring their willingness to be vaccinated or have already been vaccinated in the current season (Autumn 2022)

Surveyed students	Pharmacy	Physiotherapy	Medical faculty	Dentistry faculty	Nursing	Midwifery	Other	In total
Number of surveyed students and response rate *	19 (2.5)	46 (4.9)	148 (3.4)	4 (0.5)	33 (3.2)	46 (6.1)	6 (0.4)	302 (3)
Received an influenza vaccination in the past n (%)	4 (21)	19 (41.3)	75 (50.7)	2 (50)	11 (33.3)	15 (32.6)	1 (16.7)	127 (42.1)
Receiving vaccination or declaring intention to be vaccinated in the current season (Autumn 2022) n (%)	1 (5.3)	12 (26.1)	65 (43.9)	3 (75)	9 (27.3)	10 (21.7)	1 (16.7)	101 (33.4)

** the values in brackets are the percentage of those participating in the study in relation to all students of the university in a presented group*

*Table 2. Differentiation of the vaccination rate in the autumn season 2022 in selected subgroups of students (**p** - value according to Chi-square test)*

Grouping variable		Number of students vaccinated against influenza n (%)	Number of students not vaccinated against influenza n (%)	Total number of researched students n	p
Gender	Women	78 (77.2)	157 (78.1)	235	0.37
	Men	22 (21.8)	44 (21.9)	66	
	Other	1 (1)	0	1	
Age	<21	43 (42.6)	94 (46.8)	137	0.44
	≥21	58 (57.4)	107(53.2)	165	
Place of residence	Up to 100,000 inhabitants	52 (51.5)	122 (60.7)	174	0.13
	Over 100,000 inhabitants	49 (48.5)	79 (39.3)	128	
Field of study	Medical or dentistry students	68 (67.3)	84 (41.8)	152	<0.001
	Other medical faculties students	33 (32.7)	117 (58.2)	150	
Participation in clinical classes	Yes	60 (59.4)	112 (55.7)	172	0.013
	No	41 (40.6)	89 (44.3)	130	
Previous influenza vaccination	Yes	77 (76.2)	50 (24.9)	127	<0.001
	No	18 (17.8)	119 (59.2)	137	
	Unknown	6 (5.9)	32 (15.9)	38	
Opinion on the effectiveness of influenza vaccination	Positive	99 (98)	142 (70.6)	241	<0.001
	Negative	2 (2)	59 (29.4)	61	
Opinion on the obligation of vaccination among medical staff	Positive	84 (83.2)	63 (31.3)	147	<0.001
	Negative	17 (16.8)	138 (68.7)	155	
Vaccination against COVID-19	No vaccination	1 (1)	11 (5.5)	12	0.007
	Primary vaccination	28 (27.7)	82 (40.8)	110	
	At least one booster dose	72 (71.3)	108 (53.7)	180	

with patients of hospitals and outpatient clinics. Almost 60% of the respondents taking practical classes in healthcare units were vaccinated. Thus, attending clinical classes significantly differentiated the groups (p = 0.013). Detailed results of the tests of the significance of differences for selected subgroups (chi-square test) are presented in Table 2.

Owing to the ongoing COVID-19 pandemic, respondents were also asked about being vaccinated against COVID-19. Only about 20% of the responders admitted to having a complete vaccination schedule, which included primary vaccination and two booster doses. Participants declaring having received at least one booster dose against COVID-19 also more often decided to be vaccinated against influenza in the current season.

3.3. Attitudes to vaccination

The vast majority of vaccinated individuals have a positive opinion regarding influenza vaccination. Some individuals underwent vaccination despite negative opinions on vaccination. A negative opinion regarding the effectiveness of influenza vaccination as a prophylactic method was expressed by 56 respondents. Approximately half of the respondents believed that this type of prophylaxis should be mandatory for healthcare workers. Respondents supporting such obligations were also significantly more likely to be vaccinated. However, almost half of the respondents were against introducing such a solution to the healthcare system.

The most common reasons for vaccination were belief in the effectiveness of vaccination and the need to protect oneself from disease. The frequency and content of the responses are shown in Figure 1. The main reasons for not being vaccinated were the lack of fear of influenza, lack of recommendation to vaccinate, and the view that vaccination is pointless. The exact data on the argumentation of vaccination decisions are presented in Figure 2.

The group of students who did not need to be vaccinated against influenza was additionally asked about the reasons that would be sufficient to change the decision on vaccination against influenza. The most frequently mentioned factors were the possibility of free-of-charge vaccination at the university and the results of scientific research confirming the effectiveness of vaccination. In addition, a frequently mentioned reason why the

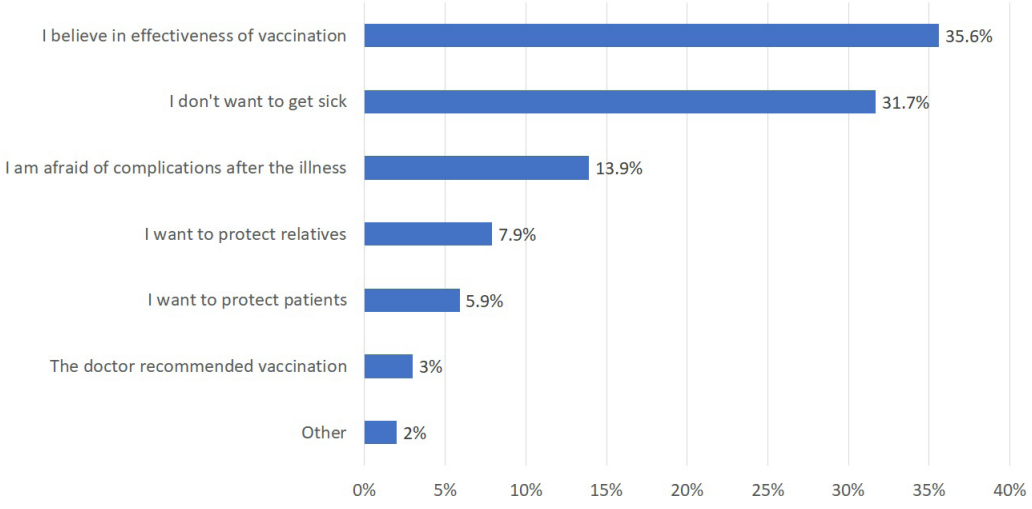

Figure 1. The most important arguments regarding the decisions of vaccinated students

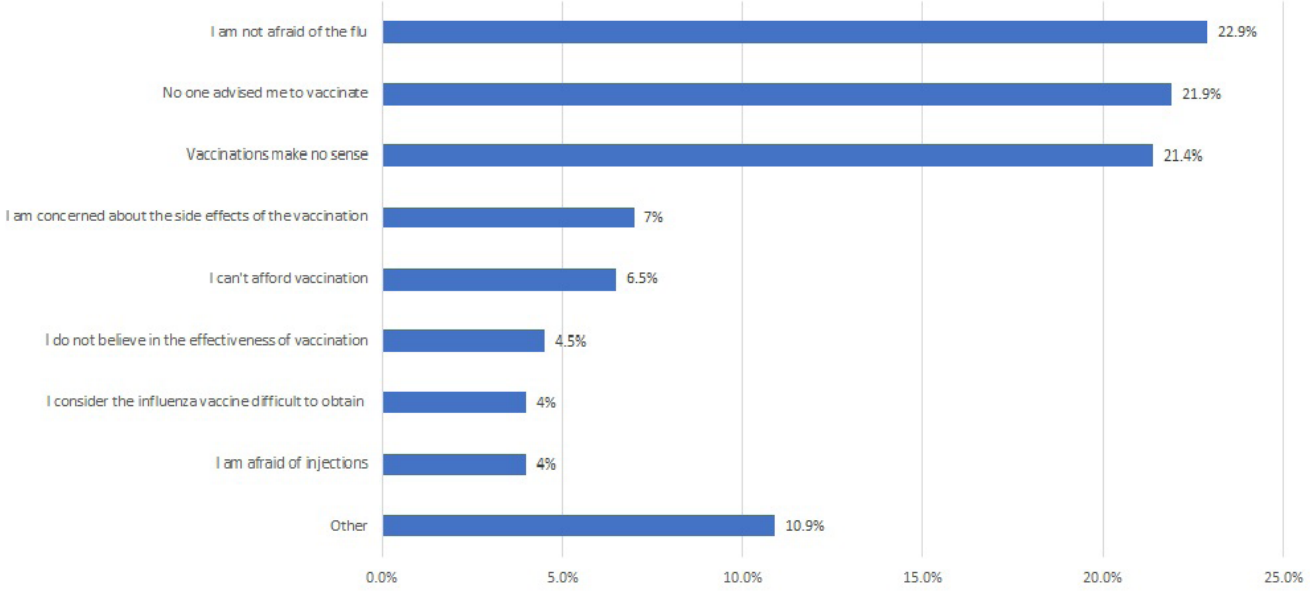

Figure 2. The most important arguments regarding the decisions of unvaccinated students

unvaccinated would change their minds would be the obligation to vaccinate among healthcare workers. The detailed responses of the respondents are presented in Figure 3.

4. Discussion

In our study, the percentage of vaccinated students during the study season was 33.4%. The largest group among the vaccinated was medical students (59.1%), especially those who had already had the opportunity to participate in clinical classes (59.4%). We showed the factors influencing participants' decision to vaccinate or not, including a worrying lack of awareness about the threat posed by influenza (22.9%). It was also observed that free vaccination campaigns can significantly increase the number of vaccinations in Poland, which may influence a change in vaccination policy.

As mentioned previously, the largest percentage of students vaccinated against influenza were medical students. Similarly, among healthcare workers, doctors more often decide to vaccinate against influenza than do nurses [9]. In the study group, 59.1% of medical students who had been vaccinated for influenza

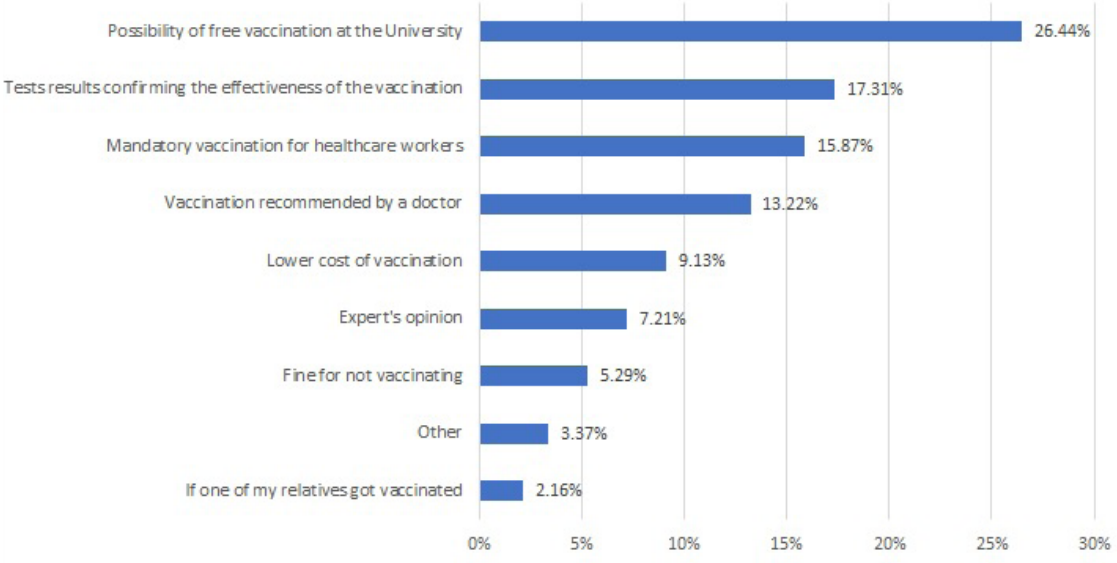

Figure 3. The most common factors that can change the decision to vaccinate against flu in the group of unvaccinated.

showed an upward trend compared to previous studies, in which the level of vaccination among medical students was 18.9% and 36.5%, respectively [1, 9].

Awareness of the possibility of easy transmission of infection in the hospital environment may vary, especially among students in different years and courses. Our study revealed that a significant difference was observed among those vaccinated between students participating in clinical classes in direct contact with the patient and students in earlier years of study, which coincides with the research from 2020 [1]. Because the majority of clinical-year students were vaccinated, we can attribute this to increased awareness and knowledge of infectious diseases and their prevention gained in later years of education. Being in a higher year of study was an important predictor in the US for clinical students (69% of clinical students vs. 34% of preclinical students) [15]. Other studies have found similar correlations between these two groups. For example, in Strasbourg, the vaccination rates were higher for students higher than the 4th year [16]. Similarly, in Cyprus, more clinical students were vaccinated and showed higher levels of knowledge about vaccination [17]. These results reveal the importance of educating students during the early years of their studies.

Our thesis may also be supported by the fact that after medical students, the next largest groups of vaccinated students are physiotherapy (15%) and midwifery (11.8%) students, who also take a large number of clinical classes in direct contact with patients as part of their education. Moreover, the findings of another study showed a higher percentage of vaccinated healthcare workers than students and nonmedical hospital employees [7]. However, an inverse relationship was presented in a British study, where a significantly higher percentage of vaccinated students was recorded in the group of students in preclinical education (84%) than in the group of students attending clinical classes (65%) [18]. Furthermore, a higher level of education has an overall significant effect on the chances of vaccine uptake, which has been shown in various studies [19–21].

Low awareness of the risks may, therefore, influence the decision not to vaccinate. The three most common reasons for not vaccinating in the study group were a lack of fear of influenza (22.9%), no recommendation to vaccinate (21.9%), and the view that vaccination is pointless (21.4%). At the turn of the years, the lack of fear of becoming sick remained the most important argument for a negative decision. This has been shown successively by Polish studies from 2015 to 2020 [12].

Our results show that medical students are not afraid of the course or complications of influenza. This may indicate a lack of knowledge regarding various aspects of influenza. In comparison, among Chinese students, the most common reasons for refusing vaccination were a low level of knowledge about the vaccination itself (46%), declared lack of need due to good health (45%), and fear of side effects (33%) [22]. Saudi students who refused vaccination claimed that they were not at risk of becoming ill with influenza (37.9%) and were afraid of the side effects of the vaccination itself (28.9%) [23].

The survey found that the second most common reason for refusing influenza vaccination was that the vaccine was not recommended by family doctors (21.9%). The authors of another Polish study believed that students may not have a family

doctor in the city where they study, making it difficult to access one during medical school. However, some physicians may not recommend, or may even advise against, annual influenza vaccination [12].

Considering factors that may have influenced the uptake of the vaccine, unvaccinated participants were also asked what could change their decision. The most frequently mentioned argument was the possibility of free vaccination at the university (26%). Free vaccination policies are a positive factor for higher global influenza vaccination rates [24].

However, in Strasbourg, where vaccination is free of charge, the percentage of immunized students is fairly low (29.7%) [24]. There is a need to describe this problem and find an effective solution, such as offering free vaccinations in conjunction with parallel educational campaigns. In addition, 88.8% of French midwifery students believed that vaccination directly at the university would increase the percentage of vaccinated students [25]. Improving the accessibility of the vaccination in time and space is a suggestion of medical students from the University of Zaragoza [26]. On-campus vaccination campaigns may be the only opportunity for many busy students to be vaccinated. Hence, one possible way to increase vaccination rates would be to hold several vaccination days on the university campus at the beginning of the flu season with the opportunity to receive vaccination free of charge. Signing up via an online form for a specific date and time before attending classes in the academic year would also be convenient.

Another argument is financial, as 26% of the surveyed students who have not been vaccinated would change their minds if the cost of vaccination was lower. Cost is also a barrier for 7.7% of Southern California public health students [27]. Another reason why students changed their decision to vaccinate was to make vaccination mandatory for healthcare workers (16%). A cross-sectional study conducted in Spanish university hospitals reported that influenza vaccination rates in hospitals where vaccination is not compulsory are below the standards recommended by the WHO, whereas the highest vaccination rates are observed in medical schools where vaccination is compulsory [28]. It is worth noting that 51% of the surveyed MUS students were in favor of introducing the obligation to vaccinate healthcare workers, while the group of European medical students and junior doctors who were in favor of mandatory vaccinations for medical staff (86.0%) and medical students (82.7%) were much larger [29].

The decision to vaccinate against influenza was also influenced by the duration of the COVID-19 pandemic. In our study, 71% of those vaccinated with at least one booster dose against COVID-19 were also vaccinated against influenza, which may indicate a positive effect of disseminating knowledge about vaccination during the COVID-19 pandemic. In 2020, 35% of the surveyed healthcare workers in the Upper Silesia Agglomeration (where the Medical University of Silesia is located) declared that they had been vaccinated against influenza [14]. In Lebanon, among healthcare workers, during the COVID-19 pandemic, the influenza vaccination rate more than doubled, from 33.1% in 2019/20 to 80.2% in the 2020/21 season [30]. In a pan-European study of medical students and junior doctors, despite the almost undisputed agreement of the respondents regarding the effectiveness of influenza vaccination (97.2%), only 68% of the respondents had ever been vaccinated against influenza; however, only 22.1% declared vaccination every year or every other year [29].

On the other hand, the unsatisfactory percentage of people vaccinated and declaring vaccination may also be related to the pandemic: it may be related to the process of dissemination of the topic of infectious diseases and epidemics. After the initial fear of an escalating pandemic and an increase in the number of vaccinations [1], almost three years later, we can see the opposite trend – a downward trend. For example, this is indicated by the fact that only 22.5% of MUS students surveyed received full COVID-19 vaccination (primary vaccination and two booster doses), while 4% of respondents were not vaccinated at all. The overall low coverage of influenza vaccination may be related to the prevailing negative perceptions of vaccination in the media. We speculate that this is also because of the widespread perception that influenza is not a dangerous disease. Many patients may be unaware of the number of flu complications, so they are reluctant to be vaccinated.

Furthermore, our study showed that the percentage of students who received influenza vaccination in the past was 42.1%, and in the current influenza season (autumn 2022) is 33.4%. The current trend of increasing vaccination rates among Polish medical students is therefore promising, although still at an inadequate level compared to vaccination rates in the United Kingdom, for example, where the percentage has reached 76% [12]. Although the Italian study indicated a percentage of vaccinated students of 20.9% [31] and a similar rate was found among Saudi students (20.7%) [23], Chinese researchers reported a vaccination rate of less than 10% in the same group [22]. In France, the vaccination coverage rate was 47.9% [11]. Considering students from other medical faculties, for example, in France 47.9% of midwifery students declared that they had received influenza vaccination, citing as the main reason the need to protect patients from infection [25]. Similarly, among the staff of the Swiss maternity hospital, despite the low percentage of people vaccinated against influenza (15%), 82% of those vaccinated cited the need to protect patients as the reason, 75% to protect themselves, and 61% to protect their families [32]. A similar situation was presented in the analysis of vaccination motives declared by German physicians, 80.6% of whom were vaccinated to protect their patients against influenza virus infection [8].

In our study, less than 6% of the surveyed students indicated that the analogous motive for vaccination was the most important. The most frequently given argument persuading the surveyed students to vaccinate against influenza was the belief in the effectiveness of vaccination (35.6%); the same answer was given most often among medical students in 2020 [12]. For Italian students, the most important factors in deciding to vaccinate were receiving a personal invitation for vaccination (aOR = 3.8; CI:1.2-12.3) and participation in training on preventive vaccination (aOR = 3.4; CI:1.7-6.7) [31]. Similarly, Saudi students considered training and recommendations of the National Health Department as the most important motivators for vaccination [23].

In turn, an increasing number of medical students do not believe in the effectiveness of vaccination, and this is worrying. According to studies conducted among medical students, the prevalence was 19.5% in 2015 and 10% in 2020. However, our study showed that by 2022, this group was already at a level of 21.4%.

It should be noted, however, that the group of respondents included students from other medical faculties, as well as students from medical courses. In a French study from 2019, 21.3% of obstetric students showed a lack of confidence in the effectiveness of vaccines [25]. An Italian study conducted in the same year at the University of Palermo showed that 10.02% of nursing students held the same position [33]. Conversely, 88% of California public health students reported that they were encouraged to receive a flu vaccination during their studies, but only 43% took up the opportunity to get vaccinated. Nearly half of the students who had refused vaccination believed that it could cause influenza in them [34].

Our study has some limitations: a relatively small research sample and the non-representativeness of some fields of medical studies. Nevertheless, the results of the study indicate a certain tendency in the behavior of medical students and their motivation in the area of seasonal influenza infection prevention.

5. Conclusions

The relatively high percentage of vaccinated medical students (64.4%) significantly differed from the general percentage of influenza-vaccinated students in other medical-related courses (33.4%). The results obtained in this study indicate the need to introduce changes in the field of broader education on the effectiveness of vaccinations in reducing the number of influenza virus infections among medical students. However, more education should be paid to students in other medical courses where the percentage of vaccinated students is lower.

Authors' contribution

Research concept and design: M.W.; Supervising the project: M.W.; Acquisition of data: P.R., D.W, Z.Z., K.W., U.W., D.Z., F.K; Data analysis and interpretation: P.R., D.W., Z.Z.; Writing - Original Draft Preparation: D.Z., F.K., K.W.; Writing - Review and Editing: U.W.; M.W.; Visualization Z.Z., F.K., P.R.; Literature review: K.W.; U.W., D.W.; Final proofreading and approval of the version for publication: M.W., D.Z.; Funding Acquisition: M.W.

ORCID

Marek Wojczyk https://orcid.org/0000-0002-5104-368X
Paulina Rutecka https://orcid.org/0009-0000-7822-4651
Zuzanna Zięba https://orcid.org/0009-0002-1576-8058
Dawid Wolak https://orcid.org/0009-0008-5332-841X
Dorota Zatłoka https://orcid.org/0009-0003-3663-1891
Urszula Wójsik https://orcid.org/0009-0009-4313-5443
Filip Klimas https://orcid.org/0009-0000-5266-8676
Katarzyna Wójtowicz https://orcid.org/0009-0008-8441-1742

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Conflict of interest

The authors have no potential conflicts of interest to declare.

Ethics approval

Due to the nature of the research, the consent of the ethics committee was not required.

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