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Maria Tseroni *, Triantafyllia Tsavdaroglou, Petros Galanis, Polyxeni Mangoulia, Venetia- Sofia Velonaki, Panayota Sourtzi

Posted Date: 18 November 2024

doi: 10.20944/preprints202411.1230.v1

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Article

Vaccination Coverage Among Nursing Students in Greece: A Cross-Sectional Assessment

Maria Tseroni [1,*], Triantafyllia Tsavdaroglou [2], Petros Galanis [3], Polyxeni Mangoulia [4], Venetia-Sofia Velonaki [5] and Panayota Sourtzi [6]

National and Kapodistrian University of Athens

* Correspondence: mtseroni@nurs.uoa.gr; Tel.: +306906899276

Abstract: Background/Objectives: Vaccination coverage status of nursing students has a pivotal role as they are in direct contact with patients. Suboptimal vaccination status poses patients at high risk of transmission as healthcare providers may serve as reservoirs of pathogens. The present study aimed to assess the immunity status of nursing students of the National and Kapodistrian University of Athens against vaccine-preventable diseases (VPDs). **Methods:** It was a cross-sectional study which was conducted between June to July 2024. Univariate and Bivariate analyses were applied, and the x^2 statistical test (chi-square test) was used to correlate the data. p-value≤0.05 was considered as statistically significant. **Results:** A total of 152 students participated in the study. The full vaccination rate was as follows: 38.8% against Hepatitis B, 33.6% against Hepatitis A, 55.3% against MMR, 35.5% against varicella, 45.4% against HPV, 75% against COVID-19, 19.1% against influenza. In the past decade, only 25.7% of the students had received booster shot for diphtheria-tetanus. Hepatitis B antibodies test has been statistically correlated with the year of study ($p<0.05$). Also, HPV vaccination has been correlated with gender, which seems normal because most nursing students are women ($p<0.001$). **Conclusions**: There is a need for a comprehensive program for healthcare students which will include not only training and awareness for VPDs but also interventions such as individual consultation for VPDs, free-of-charge vaccination on-site, collection of anonymous data from vaccination booklets of students to ensure accurate data about vaccination coverage, free of charge titer testing and immunity confirmation.

Keywords: VPDs; Vaccination coverage; Immunization; Nursing students; healthcare students; Healthcare Professionals

1. Introduction

Vaccines have played a pivotal role in communicable diseases control and eradication [1]. However, even though vaccines have a definite contribution to population health, outbreaks are still existing globally. Several numbers of them are reported in healthcare settings as many healthcare providers are remaining unvaccinated against Vaccine Preventable Diseases (VPDs) [2].

Sydron and Perl, in 2014, stressed that healthcare providers (HCPs) are at high risk for occupational exposure to VPDs, and they can serve as a reservoir for potential disease transmission in the healthcare setting [3]. Also, a scoping review showed that there was transmission from HCPs to patients in 11 studies for influenza, 17 studies for measles, 2 studies for tuberculosis, 9 studies for pertussis and 1 study for rubella [2]. Moreover, during the COVID-19 pandemic, the disease was transmitted among HCPs, causing many outbreaks [4]. Such outbreaks can increase morbidity and mortality and contribute to absenteeism of HCPs [5,6].

Furthermore, a WHO study published last year estimated that vaccines already in use against pneumococcus pneumonia, Haemophilus influenzae type B and typhoid could avert up to 106.000 deaths associated with Antimicrobial Resistance (AMR) each year. More than 543.000 deaths associated with AMR could be prevented when vaccines for tuberculosis (TB) and Klebsiella pneumoniae will be developed and rolled out globally [7,8].

Both WHO and national vaccination programs have published recommendations for the vaccination of HCPs. However, despite the availability of vaccines and recommendations from

 doi:10.20944/preprints202411.1230.v1

national vaccination programs, the vaccination coverage of HCPs is not satisfactory due to several factors [5,6,9,10].

Vaccination rates or seroprevalence rates against VPDs vary. According to a literature review, HCPs' vaccination or seroprevalence rates were 15-90% for influenza, 63-95% for Hepatitis B,14-73% for Pertussis, 87-97% for MMR, 90-100% for varicella and 89-97% for Diphtheria- Tetanus [9], In addition, Maltezou et al. (2021) demonstrated that susceptibility rates in HCPs in Greece were as follows: 27.8% for measles, 39.6% for mumps, 33.4% for rubella, 22.2% for varicella, 86.3% for hepatitis A, 34.2% for hepatitis B, 68.2% for tetanus-diphtheria, and 92.9% for pertussis [11].

Healthcare students, especially nursing students, are in direct contact with patients due to their clinical practice, so they should comply with vaccination recommendations for HCPs [12].

The present study aimed to estimate full vaccination coverage rates and susceptibility rates against VPDs among nursing students of the Nursing Department of the National and Kapodistrian University of Athens (NKUA), Greece, as of 2024.

2. Materials and Methods

2.1. Study Population

This was a cross-sectional study conducted from June to July 2024. Students of the Nursing Department of the NKUA were invited to participate in the study.

2.2. Data Collection

The data were collected through a structured, web-based, anonymous, self-reported questionnaire, which was distributed to all students through a Google Forms link. The data collected were gender, year of study, vaccination history (number of doses) against measles-mumps-rubella (MMR), varicella, tetanus-diphtheria-pertussis (DTaP), Hepatitis A (HAV), Hepatitis B (HBV), seasonal influenza (in the last influenza season), COVID-19 and HPV. In addition, participants were asked if they had undertaken an anti-HBs test and if the result was positive or negative, as well as what the last booster shot from tetanus-diphtheria-pertussis was. Information about the natural history of measles, mumps, rubella, pertussis and varicella was also collected.

2.3. Definitions

Full vaccination was defined as two doses for MMR, varicella, HAV, and COVID-19 (the mRNA COVID-19 vaccines were administered to HCPs), three doses or more for HBV and three doses for HPV. Full vaccination against tetanus, diphtheria, and pertussis was defined as one booster dose within the past 10 years. Full vaccination against influenza was defined as one dose of influenza vaccine in the last season.

Self-reported immunity against measles, mumps, rubella and varicella was defined as either a history of full, up-to-date vaccination and/or a history of past infection leaving permanent immunity. Past infection was not considered for pertussis because of waning immunity after natural infection. A history of hepatitis B was also not considered for immunity since acute infection may lead to a chronic condition.

Susceptibility to VPDs was defined as a lack of self-reported immunity and was estimated as follows: (1-immunity) *100%. Susceptibility was not estimated for influenza and COVID-19 due to the need for annual shot.

2.4. Statistical Analysis

Processing and statistical analysis were carried out using the package software IBM SPSS V29 (Statistical Package for Social Sciences) for Windows.

The statistics analysis includes the following: (a) Univariate analysis and (b) Bivariate analysis. As it was not planned to collect demographic or personal data of students, except for their year of

 doi:10.20944/preprints202411.1230.v1

study, the x2 statistical test (chi-square test) was used to correlate the data. p-value≤0.05 was considered as statistically significant.

2.5. Ethical Issues

The protocol of the study was developed in accordance with the current regulation "General Data Protection Regulation - GDPR" (2016/679) of the European Parliament and the Council of the European Union for the protection of personal data, as well as with the relevant Greek legislation (law 4624/2019). Moreover, the study protocol it was approved by the ethics committee of the nursing department of the NKUA (protocol number 508, date: 18/6/2024)

3. Results

A total of 152 nursing students [34 male (22.4%), 118 female (77.6%)] distributed in 4 years of study participated in the study (response rate: 17.7%). There were 28 (18.4%) first-year students, 56 second-year students (36.9%), 25 third-year students (16.4%) and 43 fourth-year (28.4%).

Table 1 presents a) the reported vaccination coverage of students in the question of whether they have been vaccinated for each disease and b) the full vaccination rates according to the study definitions. The highest full vaccination rate was against MMR (55.3%), COVID-19 (46.7%), and HPV (45.6%). Overall, 38.8% of students had been vaccinated against Hepatitis B; and 28.9% had undergone a Hepatitis B surface antibodies measurement, of whom 75% had reported HBS antibody titer ≥ 10 IU/L.

Table 1. Rates of reported and full vaccination of nursing students.

Vaccines	Rates of Reported Vaccination n (%)	Rates of Full Vaccination n (%)
HBV vaccination	139 (91.4)	59 (38.8)
HAV vaccination	112 (73.7)	51 (33.6)
MMR vaccination	142 (93.4)	84 (55.3)
Varicella vaccination	127 (83.6)	54 (35.5)
DTaP vaccination	149 (98)	31 (20.4)
Booster shot for Diphtheria-Tetanus	39 (25.7)	39 (25.7)
HPV vaccination	98 (64.5)	69 (45.4)
COVID-19 vaccination (≥2 shots)	123 (80.9)	114 (75)
Influenza vaccination (last influenza season)	29 (19.1)	29 (19.1)

Regarding natural immunity, a history of measles was reported by 11.8%, mumps by 9.2%, rubella by 11.8%, pertussis by 12,5% of the students and varicella by 26.3%.

Table 2 shows susceptibility rates against VPDs. Susceptibility rates were estimated as follows: hepatitis B 61.2%, hepatitis A 66.4%, measles 38.8%, mumps 40.1%, rubella 39.5%, varicella 46.1%, diphtheria-tetanus 74.3%, pertussis 79.6%.

Table 2. Susceptibility rates against VPDs of nursing students.

VPD	Susceptibility rate
Hepatitis B	61,2%
Hepatitis A	66,4%
Measles	38.8%
Mumps	40.1%

 doi:10.20944/preprints202411.1230.v1

Rubella	39.5%
Varicella	46.1%
Diphtheria- Tetanus	74.3%
Pertussis	79.6%

From the bivariate analysis, hepatitis B antibodies test had been statistically correlated with the year of study, with the percentage rising during the progress of the year of study (first year: 7,14%, second year 32,14%, third year 32% and fourth year 37,2%, $p<0.05$). Also, HPV vaccination had been correlated with gender, which seems normal because most nursing students are women [56.8% of women (n=118) had been fully vaccinated against HPV, but only 5.9% of men (n=34), $p<0.001$] (Table 3).

Table 3. Correlations for study variables.

Variables	p-Value	
	Gender	**Year of study**
HBV vaccination	0.393	0.638
Hepatitis B surface antibodies measurement	0.552	**0.04**
HBS antibody titer ≥ 10 IU/L.	0.366	0.648
HAV vaccination	0.114	0.779
MMR vaccination	0.547	0.608
DTaP vaccination	0.383	0.140
Booster shot for Diphtheria-Tetanus-Pertussis	0.604	0.186
Varicella vaccination	0.572	0.979
HPV vaccination	**0.001**	0.778
COVID-19 vaccination (≥2 shots)	0.324	0.443
Influenza vaccination	0.159	0.839

4. Discussion

We conducted a cross-sectional survey to assess the full vaccination coverage and susceptibility rate against VPDs among nursing students of the NKUA, as few studies have assessed vaccination coverage among nursing students. To the best of our knowledge, this is the first study among nursing students of the NKUA to estimate vaccination coverage related to vaccines suggested by the national vaccination program for adults and the national guidelines for the immunization of HCPs. In this study, the vaccination rates between the reported vaccination status and the full vaccination rate are inconsistent. However, we must take into consideration that the students might filled out the questionnaire without access to their individual vaccination booklets (they had to recall their vaccination status and the number of doses).

According to a current systematic review, the vaccination rate of nursing students for HBV varies from 6.7 to 100% [13]. In our study, 91,4% of the participants had been vaccinated against Hepatitis B. However, nearly 39% reported being fully vaccinated, and 28.9% had undergone a Hepatitis B surface antibodies measurement. Similarly, a recent study on 1261 Greek nursing students showed the gap between the reported vaccination rate against HBV and the full vaccination rate (66.3% and 27.7%, respectively). In addition, in the above study, only 17.6% of the nursing students had done a Hepatitis B surface antibodies test [14]. Besides, Papagiannis et al. (2016) demonstrated

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that the reported vaccination with two or three doses against Hepatitis B in Greek nursing students was 81.4% [15], but two doses do not mean full vaccination for HBV, and this means that the rate of fully vaccinated nursing students was less. However, a Greek study conducted in 2013 and collected data directly from the vaccination booklets of healthcare students found that 70% of them were fully vaccinated for HBV [16]. On the other hand, a study in 2021 of dental students mentioned that 45.9% of them had been fully vaccinated with the HBV vaccine [17]. Moreover, Statiri et al. (2024) highlighted that the low full vaccination rate of Greek nursing students against Hepatitis B was not related to students' level of knowledge or attitudes; however, the longer year of nursing education was associated with better practices and attitudes towards HBV ($p<0.05$) [14]. Correspondingly, our results showed that the measurement of Hepatitis B surface antibodies was related to the year of study. Although in Greece, vaccination against HBV was included in the National Vaccination Program from 1/1/1998, and therefore students should report full vaccination against HBV, the above findings emphasize the need for more accurate data collection coming either from vaccination booklets of the students even if it is time-consuming or from a national vaccination registry for HCPs and healthcare students, which is necessary to be developed.

Regarding MMR, the rate of fully vaccinated nursing students (55.3%) was similar to that of dental students (56.5%) in a Greek study conducted in 2021 [17]. This rate seems low if we consider that the national recommendation for the MMR vaccine was issued more than three decades ago, as well as the campaign for MMR vaccination during the large measles epidemic in Greece in 2017–2018 [18]. Similarly, a cross-sectional survey on medical, nursing and midwifery students in 15 hospitals in Paris in 2013 showed a 49.6% vaccination rate for measles [19]. Moreover, a Greek study on healthcare students conducted in 2013 and collected data directly from the vaccination booklets of healthcare students demonstrated that the measles and mumps vaccination rate was 68.5% and for rubella, 79.5%. In our study, susceptibility rates were nearly 40 % against measles, mumps and rubella [16].

The susceptibility rate of nurse students against varicella was 46.1%, comparable with the susceptibility rate (32.3%) of a study in dental students in Greece in 2021 [17]. In contrast, Karageorgou et al. (2014), based on vaccination booklets and disease history, found the susceptibility rate of healthcare students against varicella to be 15.7% [16].

The vaccination rate against HAV in our study was 33.6%, even though the vaccine for Hepatitis A has been included in the National Vaccination Program since 2007. Two similar studies on dental and healthcare students found the vaccination rate against HAV 44.1% and 46.3%, respectively [16,17].

In addition, it raises concern that 25.7% of nursing students have received a booster shot for Diphtheria-Tetanus during the last ten years. Siddiqui et al. (2019) demonstrated that DTaP booster shot rate in medical students was 39.2% [20]. Maltezou et al. (2021) mentioned that 63.2% of dental students had received a booster shot for tetanus-diphtheria but fewer for pertussis (47,8%) [17] while Karageorgou et al. (2014) show that the booster shot for Diphtheria-Tentanus was 80.2% [16]. In addition, in a 2018 survey of 21 states of America, an overall 47.2% self-reported vaccination rate against diphtheria-tetanus was reported. The highest percentage was among doctors, 66.8% [21]. Furthermore, a study conducted in 2019 in Hungary and Germany in medical students showed that only 50% had received a booster shot for pertussis [22]. In our study, the susceptibility for pertussis was 79.6%, which raises concern considering that pertussis is a reemerging threat [23].

In this study, a high percentage of students had been vaccinated against COVID-19 with two doses at least (75%). A study conducted in Greece in 2021 in dental students demonstrated that vaccination against COVID-19 was 87.7% [17]. According to the literature review, nursing students seem to be afraid or hesitant to be vaccinated with the COVID-19 vaccine, with the most prevalent reason being fear of side effects [24,25]. Greece was one of the countries where COVID-19 vaccination became mandatory for HCPs, so unvaccinated healthcare students could not attend clinical practice [26].

As regards influenza vaccination, only 19.1% of nursing students were vaccinated. The influenza vaccination rate is far from WHO recommendations, which suggest that 75% should be vaccinated

 doi:10.20944/preprints202411.1230.v1

[27]. Similar levels to Greek nursing students have been noted among Hong Kong nursing students (15.2%), in Spain (5.3% of nursing students), Italy (less than one-third of students), and Slovakia, with only one-quarter of students having been vaccinated [28-31]. Statiri et al. (2024) suggest that nursing students' vaccine knowledge significantly influenced their attitudes towards vaccination and subsequent uptake. Moreover, social responsibility and intention to protect family members from influenza emerged as a primary motivation for those who did choose to vaccinate [32]. Probably, a campaign in the university prior to the start of influenza vaccination season could be helpful [33].

Finally, the HPV vaccine has been included in pediatric and adult vaccination programs since 2008 for girls and women. In 2022, this program included also boys aged 9-11 years old. In our study, 56.8% of female students were vaccinated against HPV. In a study of college students in China in 2021, the overall vaccination rate was 3.13% [34]. In a Greek study on higher education students in 2012, the vaccination rate against HPV was 25.8% [35]. A recent Greek study found that the HPV vaccination rate in Greece is 40% for women. In the same study, it is mentioned that a small proportion of the participants ignore the existence of HPV and that 24.1% of males and 23.4% of females believed that condom use may provide absolute immunity to HPV, and only 51.6% of males and 60.4% of females were aware of the high prevalence of HPV in the general population [36].

The susceptibility rates against VPDs of nursing students raise concern. Approximately one out of three are susceptible to measles, mumps or rubella. The susceptibility rate against Hep A and B was also high; and about 50% are susceptible to varicella. In addition, a major issue is the DTaP booster shot. These findings indicate the suboptimal full vaccination rates against VPDs, which has, as a result, the remerge of such diseases in the post-vaccination era [37]. Very few students had a natural history of measles, mumps or rubella. On the other hand, Karageorgou et al.,2014, found that susceptibility rates were lower (20.5% for measles, 26.4% for mumps, 13.9% rubella, 15.7% varicella) [16]. The rise of susceptibility rates over the decade should be underlined as it indicates that healthcare providers are vulnerable to diseases which had serious morbidity and mortality during adulthood. It has been reported that on-site vaccination and campaigns that provide updated knowledge towards VPDs can increase awareness and compliance with the national vaccination program for adults and HCPs [38-40].

Limitations

One of the limitations of this study is that it was not multicenter and took place only in one department of nursing schools in Greece. In addition, the response rate was 17.7%, which seems low, but it is similar to studies conducted in Greece in the past decade and consisted of participants from all academic years [16,17]. Furthermore, the students had called to recall their vaccination status, which was probably a limitation. However, despite this fact, it seems that nursing students' vaccination coverage could be increased.

5. Conclusions

Aiming to increase vaccination rates among healthcare students, including nursing students, it seems that education about VPDs is not enough to influence vaccination decision-making. There is a need for a comprehensive program for healthcare students which will include not only training and awareness for VPDs and their implications, particularly in vulnerable health populations but also interventions such as individual consultation for VPDs, free-of-charge vaccination on-site, collection of anonymous data from vaccination booklets of students to ensure accurate data about vaccination coverage, free of charge titer testing and immunity confirmation

In addition, longitudinal studies may contribute to the representation of vaccination rates over time. Moreover, the newly developed National Vaccination Registry in Greece should be utilised better by medical doctors, and as a branch of it, a separate registry section for healthcare professionals and students should be established.

Author Contributions: Conceptualization, M.T. and P.S.; methodology, M.T, P.G, P.M, V-S.V, P.S.; software, M.T, T.T, P.G; validation, M.T., T.T; formal analysis, M.T, T.T.; writing—original draft preparation, M.T, T.T.;

writing—review and editing, M.T, T.T. P.G, P.M, V-S.V ,P.S.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Nursing Department of the NATIONAL AND KAPODITRIAN UNIVERSITY OF ATHENS (protocol code 508 on 18 June 2024).

Informed Consent Statement: All participants agree to participate to the study. The study was anonymous, and the only demographic data collected were gender and year of stud**y.**

Data Availability Statement: The data supporting this article will be available by the authors on request.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Greenwood, B. The contribution of vaccination to global health: past, present and future. Philos Trans R Soc Lond B Biol Sci **2014**, 369 (1645) doi: 10.1098/rstb.2013.0433
2. Hasan, T.; Lynch, M.; King, C.; Wehbe, C.; Plymoth, M.; Islam, M.S.; Iannuzzi, T.; Dao, A.; Lai, J.; Martiniuk, A.; Desai, S.; Sheel, M. Vaccine-Preventable Disease Outbreaks Among Healthcare Workers: A Scoping Review. Clin Infect Dis **2024**, 79 (2):555-561. doi: 10.1093/cid/ciae209.
3. Sydnor, E.; Perl, T.M. Healthcare providers as sources of vaccine-preventable diseases. *Vaccine* ***2014***, 32, 4814–4822. doi: 10.1016/j.vaccine.2014.03.097.
4. Implementation guide for vaccination of health. Available online: workershttps://iris.who.int/bitstream/handle/10665/311184/9789241515320-eng.pdf?sequence=18 (last assess 10/10/2024)
5. Better use of vaccines could reduce antibiotic use by 2.5 billion doses annually, says WHO. Available online: https://www.who.int/news/item/10-10-2024-better-use-of-vaccines-could-reduce-antibiotic-use-by-2.5-billion-doses-annually--says-who (last access 8/11/24).
6. Kim, C.; Holm, M.; Frost, I.; Hasso-Agopsowicz, M.; Abbas, K. Global and regional burden of attributable and associated bacterial antimicrobial resistance avertable by vaccination: modelling study. *BMJ Glob Health* **2023**, 8(7): e011341. doi: 10.1136/bmjgh-2022-011341.
7. Maltezou, H.C.; Botelho-Nevers, E.; Brantsæter, A.B.; Carlsson, R.-M.; Heininger, U.; Hübschen, J.M.; Josefsdottir, K.S.; Kassianos, G.; Kyncl, J.; Ledda, C.; et al. Vaccination of healthcare personnel in Europe: Update to current policies. *Vaccine* **2019**, 37, 7576–7584. doi: 10.1016/j.vaccine.2019.09.061.
8. Imai, C.; Toizumi, M.; Hall, L.; Lambert, S.; Halton, K.; Merollini, K. A systematic review and meta-analysis of the direct epidemiological and economic effects of seasonal influenza vaccination on healthcare workers. *PLoS One* **2018**; 13: e0198685 doi: 10.1371/journal.pone.0198685.
9. Haviari, S.; Bénet, T.; Saadatian-Elahi, M.; André, P.; Loulergue, P.; Vanhems, P. Vaccination of healthcare workers: a review. *Hum Vaccin Immunother* **2015**; 11:2522–37. doi: 10.1080/21645515.2015.1082014.
10. Coppeta, L.; Morucci, L.; Pietroiusti, A.; Magrini, A. Cost-effectiveness of workplace vaccination against measles. Hum *Vaccin Immunother* **2019**; 15:2847–50. doi: 10.1080/21645515.2019.1616505
11. Maltezou, H.C.; Tseroni, M.; Drositis, I.; Gamaletsou, M.N.; Koukou, D.M.; Bolikas, E.; Peskelidou, E.; Daflos, C.; Panagiotaki, E. et al. Vaccination coverage rates and attitudes towards mandatory vaccinations among healthcare personnel in tertiary-care hospitals in Greece. Expert Rev Vaccines. 2022; 6:853-859. doi: 10.1080/14760584.2022.2063118
12. Loulergue, P.; Launay, O. Vaccinations among medical and nursing students: Coverage and opportunities. *Vaccine* **2014**, 32, 4855–4859. doi: 10.1016/j.vaccine.2014.01.014.
13. Statiri, A.; Adamakidou, T.; Maragari, N.; Dokoutsidou, E. Hepatitis B Vaccination Coverage among Nursing Students: A Systematic Review. *Int J Caring Sci* **2024**, 17,960-974.
14. Statiri, A; Adamakidou, T.; Govina, O.; Margari, N.; Vlachou, E.; Dokoutsidou, E. Hepatitis B Vaccination, Knowledge, Attitudes, and Practices Among Sample of Greek Nursing Students: A Cross-Sectional Study. *Nursing Reports* ***2024*** 14, 3220-3232.
15. Papagiannis, D; Tsimtsiou, Z.; Chatzichristodoulou, I.; Adamopoulou, M.; Kallistratos, I.; Pournaras, S.; Arvanitidou, M.; Rachiotis, G. Hepatitis B Virus Vaccination Coverage in Medical, Nursing, and Paramedical Students: A Cross-Sectional, Multi-Centered Study in Greece. *Int J Environ Res Public Health***2016** 13,323. doi: 10.3390/ijerph13030323
16. Karageorgou, K.; Katerelos, P.; Efstathiou, A.; Theodoridou, M.; Maltezou, H.C. Vaccination coverage and susceptibility against vaccine-preventable diseases of healthcare students in Athens, Greece. *Vaccine* **2014**, 32, 5083–5086 doi: 10.1016/j.vaccine.2014.06.031

17. Maltezou, H.C.; Rahiotis C.; Tseroni M.; Madianos Ph.; Ioannis Tzoutzas Attitudes toward Vaccinations and Vaccination Coverage Rates among Dental Students in Greece *Int J Environ Res Public Health* **2022** 19,2879 doi: 10.3390/ijerph19052879
18. Maltezou, H.C.; Dedoukou, X.; Vernardaki, A.; Katerelos, P.; Kostea, E.; Tsiodras, S.; Mentis, A.; Saroglou, G.; Theodoridou, M.; Georgakopoulou, T. Measles in healthcare workers during the ongoing epidemic in Greece, 2017-2018. *J Hosp Infect***2018,** 100,e261-e263. doi: 10.1016/j.jhin.2018.06.007
19. Loulergue, P.; Fonteneau, L.; Armengaud, J.B.; Momcilovic, S.; Levy-Brühl, D.; Launay, O.; Guthmann, J.P.; Studyvax survey group. Vaccine coverage of healthcare students in hospitals of the Paris region in 2009: The Studyvax Survey. *Vaccine* **2013** 312835-2838. doi: 10.1016/j.vaccine.2013.04.004
20. Siddiqui, A.A.; Khan, M.; Khan, J.A.; Haseeb, S.S.; Mohib, A.; Kadri, H.M. Awareness, Knowledge, and Coverage of Vaccination Against Tetanus, Diphtheria, and Pertussis Among Medical Students of Karachi: A Cross-sectional Analysis. *Cureus* **2019** 11, e4472. doi: 10.7759/cureus.4472.
21. O'Halloran, A.C.; Lu, P.J.; Meyer, S.A.; Williams, W.W.; Schumacher, P.K.; Sussell, A.L.; Birdsey, J.E.; Boal, W.L.; Sweeney, M.H.; Luckhaupt, S.E. et al. Tdap Vaccination Among Healthcare Personnel—21 States, 2013 *Am J Prev Med*. **2018** 54119-123. doi: 10.1016/j.amepre.2017.09.017.
22. Böhme, M.; Voigt, K.; Balogh, E.; Bergmann, A.; Horváth, F.; Kugler, J.; Schelling, J. Schübel, J.; Riemenschneider, H. Pertussis vaccination status and vaccine acceptance among medical students: multicenter study in Germany and Hungary. *BMC Public Health* **2019** 19, 182. doi: 10.1186/s12889-019-6516-8.
23. Increase of pertussis cases in the EU/EEA. Available online: https://www.ecdc.europa.eu/en/publications-data/increase-pertussis-cases-eueea. (last access 8/11/24)
24. Yeşiltepe, A.; Aslan, S.; Bulbuloglu, S. Investigation of perceived fear of COVID-19 and vaccine hesitancy in nursing students. *Hum Vaccin Immunother* **2021** 17, 5030–5037. doi: 10.1080/21645515.2021.2000817.
25. Zhou, Y.; Wang, Y.; Li, Z. Intention to get vaccinated against COVID-19 among nursing students: A cross-sectional survey. *Nurse Educ Today*. **2021,** 105152. doi: 10.1016/j.nedt.2021.105152
26. Wise, J. Covid-19: France and Greece make vaccination mandatory for healthcare workers. *BMJ* **2021**, 374, n1797. doi: 10.1136/bmj.n1797.
27. Managing seasonal vaccination policies and coverage in the European Region https://www.who.int/europe/activities/managing-seasonal-vaccination-policies-and-coverage-in-the-european-region (Last access 10/10/24).
28. Hernández-García, I.; Cardoso-Muñoz, A.M.; Valero-Juan, L.F.; Giménez-Júlvez, M.T. Influenza vaccination among nursing students from a university of Castilla-León for the 2014–2015 season after their inclusion as target group for vaccination. *Rev Esp Salud Publ* **2015**, 89, 615–625. doi: 10.4321/S1135-57272015000600009
29. Falato, R.; Ricciardi, S.; Franco, G. Influenza risk perception and vaccination attitude in medical and nursing students during the vaccination campaigns of 2007/2008 (seasonal influenza) and 2009/2010 (H1N1 influenza). *Med. Lav***2011**, 102, 208–215.
30. Madar, R.; Repkova, L.; Baska, T.; Straka, S. Influenza vaccination—Knowledge, attitudes, coverage—Can they be improved? *Bratisl. Lek Listy* **2003**, 104, 232–235.
31. Cheung, K.; Ho, S.M.S.; Lam, W. Factors affecting the willingness of nursing students to receive annual seasonal influenza vaccination: A large-scale cross-sectional study. *Vaccine* **2017**, 35, 1482–1487. doi: 10.1016/j.vaccine.2017.02.001.
32. Statiri, A.; Adamakidou, T.; Margari, N.; Govina, O.; Tsiou, C.; Giakoumidakis, K.; Dokoutsidou, E. Influenza Vaccination of Nursing Students: A Cross-Sectional Study of Uptake, Knowledge, Attitudes, and Practices in Greece. *Diseases* **2024** 12183. doi: 10.3390/diseases12080183.
33. Shropshire, A. M.; Brent-Hotchkiss, R.; Andrews, U. K. Mass Media Campaign Impacts Influenza Vaccine Obtainment of University Students. *J Am Coll Health* **2013,**61435-43. doi: 10.1080/07448481.2013.830619.
34. Deng, C.; Chen, X.; Liu, Y. Human papillomavirus vaccination: coverage rate, knowledge, acceptance, and associated factors in college students in mainland China. *Hum Vaccin Immunother* **2021** 17,828-835. doi: 10.1080/21645515.2020.1797368.
35. Donadiki, E.M.; Jiménez-García, R.; Hernández-Barrera, V.; Carrasco-Garrido, P.; López de Andrés, A.; Jimenez-Trujillo, I.; Velonakis, E.G. Knowledge of the HPV vaccine and its association with vaccine uptake among female higher-education students in Greece. *Hum Vaccin Immunother* **2013** 9,300-5. doi: 10.4161/hv.22548. Epub 2012 Oct 30.
36. Pergialiotis, V.; Papageorgiou, D.; Douligeris, A.; Mortaki, A.; Vlachos, D.E.; Thomakos, N.; Rodolakis, A.; Haidopoulos, D. Awareness, knowledge and attitudes of human papillomavirus infection, screening and vaccination: a survey study in Greece. *Arch Gynecol Obstet***2024** 309,2031-2040 doi: 10.1007/s00404-024-07398-1.
37. Phadke, V.K.; Bednarczyk, R.; Salmon, D.; Omer, S.; Association Between Vaccine Refusal and Vaccine-Preventable Diseases in the United States: A Review of Measles and Pertussis. *JAMA* **2016** 315,1149–1158. doi: 10.1001/jama.2016.1353

 doi:10.20944/preprints202411.1230.v1

38. De Sarro, C.; Papadopoli, R;, Cautela, V.; Nobile, C.G.A.; Pileggi, C.; Pavia, M. Vaccination coverage among health-care workers: pre-post intervention study to assess impact of an on-site vaccination-dedicated clinic. *Expert Rev Vaccines* **2021** 20,753-759. doi: 10.1080/14760584.2021.1915776.
39. Sutan, R.; Hoon, C.; Shuib, S.M.; Mat, SN; Lu, YM; Mihat, M; Jamil, N.; Sulaiman, H.F.; Ilias, S.R. et al. Systematic Review on Health Interventions Used in Enhancing Vaccination Uptake. *Clinics Mother Child Health*, **2017,** 14, 264
40. Kaur, E.; Charan, G.S. Effectiveness of Educational Intervention on Knowledge Toward Obligatory Vaccination among Mothers of Under Five Children.Int J Health Sci Res **2022**, 12,25-29. doi:10.3390/ijerph13030323