



Pertussis Awareness and Vaccination Status of Healthcare Workers in the Neonatal Intensive Care Unit

Yenidoğan Yoğun Bakım Ünitesindeki Sağlık Çalışanlarının Boğmaca Farkındalıkları ve Aşılama Durumları

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ABSTRACT

Aim: Pertussis is a disease that is transmitted by droplets and has a long contagious period. It can cause severe illness presentation and hospital-acquired outbreaks, especially in preterm babies and infants whose vaccinations have not been completed. For this reason, it is recommended that the mother should be vaccinated with Tdap (tetanus, adult-type diphtheria and acellular pertussis vaccine) during pregnancy and people who will come into contact with the baby should be vaccinated. This practice is called the cocoon strategy and healthcare workers are also included in the cocoon strategy. The aim of this study is to determine whooping cough awareness and Tdap vaccination status of healthcare workers working in the neonatal intensive care unit (NICU) within the scope of the cocoon strategy.

Materials and Methods: Our research was designed as a cross-sectional and descriptive face-to-face survey study. Health workers working in Samsun Training and Research Hospital NICU were invited to the research. The questionnaire consisted of four parts, including 21 questions, in order to learn the demographic data of the participants, the level of knowledge about pertussis disease, the level of knowledge about the pertussis vaccine and their vaccination status.

Results: Of the 89 participants whose mean age was 38.7 ± 7.3 years, 76% (n=68) were nurses/midwives and doctors. The level of knowledge about pertussis and its vaccines was significantly higher in doctors than in other groups ($p < 0.001$, $p < 0.003$). There was no one vaccinated with Tdap among the participants. A high Pertussis vaccine knowledge score was found to be associated with a positive intention to be vaccinated ($p = 0.02$). When evaluated according to occupations, the intention to be vaccinated was higher among doctors than other groups ($p = 0.007$).

Conclusion: As a result, although the Ministry of Health recommends that health workers working in the NICU be vaccinated with Tdap, it is thought that there are problems in practice. There is a need for all physicians who recommend vaccines to healthcare professionals to raise their awareness of whooping cough disease and put the cocoon strategy into practice. Interventions are needed to increase the level of knowledge of allied health personnel about whooping cough disease and pertussis vaccines.

Keywords: Pertussis vaccine, healthcare workers, neonatal, intensive care

ÖZ

Amaç: Boğmaca hastalığı, damlacık yoluyla bulaşan, bulaştırıcılık süresi uzun bir hastalıktır. Özellikle preterm doğanlarda ve aşıları tamamlanmamış süt çocuklarında ağır hastalık tablolarına, hastane kaynaklı salgınlara sebep olabilir. Bu nedenle, gebelikte annenin ve bebeğe temas edecek kişilerin Tdap (tetanos, erişkin tip difteri ve asellüler boğmaca aşısı) ile aşılama önerilmektedir. Bu uygulama koza stratejisi olarak adlandırılır ve sağlık çalışanları da koza stratejisi kapsamında yer almaktadır. Bu çalışmanın amacı, koza stratejisi kapsamında yenidoğan yoğun bakım ünitesinde (YYBÜ) görev yapan sağlık çalışanlarının boğmaca farkındalıklarını ve Tdap aşısı olma durumlarını belirlemektir.

Gereç ve Yöntem: Araştırmamız, kesitsel ve tanımlayıcı tipte yüz yüze anket çalışması şeklinde tasarlandı. Samsun Eğitim ve Araştırma Hastanesi YYBÜ'de görev yapan sağlık çalışanları araştırmaya davet edildi. Anket, katılımcıların demografik verileri, boğmaca hastalığı hakkındaki bilgi düzeyleri, boğmaca aşısı hakkındaki bilgi düzeyleri (BABD) ve aşılama durumlarını öğrenmek amacıyla 21 sorudan oluşmaktadır.

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Bulgular: Yaş ortalamaları $38,7 \pm 7,3$ yıl olan 89 katılımcının %76'sı ($n=68$) hemşire/ebe ve doktorlardan oluşmaktaydı. Boğmaca hastalığı ve aşıları hakkındaki bilgi düzeyi doktorlarda diğer gruplara göre anlamlı derecede yüksekti (sırasıyla $p<0,001$, $p<0,003$). Katılımcılar arasında Tdap ile aşı kimse yoktu. BABD puanının yüksek olması, Tdap aşısı olma niyetinin olumlu olması ile ilişkili bulundu ($p=0,02$). Mesleklere göre değerlendirildiğinde ise doktorlar arasında, diğer gruplara göre Tdap aşısı olma niyeti daha yüksekti ($p=0,007$).

Sonuç: Sağlık Bakanlığı YYBÜ'de görev yapan sağlık çalışanlarının Tdap ile aşılmasını önermesine rağmen, uygulamada sorunların olduğu düşünülmektedir. Sağlık çalışanlarına aşı önerisi veren tüm hekimlerin boğmaca hastalığı hakkındaki farkındalıklarının artırılıp, koza stratejisini uygulamaya geçirmelerine ihtiyaç vardır. Yardımcı sağlık personellerinin de boğmaca hastalığı ve aşıları hakkındaki bilgi düzeylerini arttıracak müdahaleler gerekmektedir.

Anahtar Kelimeler: Boğmaca aşısı, sağlık çalışanı, yenidoğan, yoğun bakım ünitesi

INTRODUCTION

Pertussis is a highly contagious respiratory disease caused by *Bordetella pertussis*. It is more severe in infants younger than six months, preterm infants and unvaccinated infants¹. In infancy, the need for mechanical ventilation due to pneumonia, pulmonary hypertension, leukocytosis requiring complete exchange transfusion, seizures, and death have been reported². For this reason, in order to prevent pertussis cases under the age of one year, it is primarily necessary for mothers to be vaccinated with Tdap (tetanus, adult-type diphtheria and acellular pertussis vaccine) between the 27th and 36th weeks of the pregnancy and in addition, people who will have close contact with the baby are recommended to be vaccinated with Tdap.

The Centers for Disease Control and Prevention (CDC) has called this practice a cocoon strategy since 2005 and recommends vaccination of those with close contacts with the baby³. Similarly, it is recommended that people and healthcare workers who come into contact with unvaccinated infants younger than six months should be vaccinated against influenza⁴.

Pertussis may start as an upper respiratory tract infection and its diagnosis may be missed in the early period. In untreated cases, it can be contagious for three weeks. It has been observed that pertussis causes hospital-acquired epidemics. Healthcare workers are also included in the cocoon strategy in order to prevent nosocomial pertussis. Nosocomial pertussis outbreaks have been reported in different units such as the surgical ward and neonatal intensive care unit (NICU)⁵⁻⁷. In the study of Calugar et al.⁸, a baby with pertussis was shown to infect 17 healthcare workers and cost the hospital 74,000 dollars. CDC recommends a single dose of Tdap to healthcare workers who have direct contact with patients, regardless of previous Tetanus, adult-type diphtheria (Td) vaccine status. Giving priority to health personnel who have contact with infants younger than one year old emphasizes the application of a vaccine that includes nurses, nurse assistants, radiology technicians, medical and nursing students, secretariat workers as well as physicians⁹.

Within the scope of vaccination of healthcare workers by the Ministry of Health, Tdap vaccine is recommended especially for healthcare personnel and cleaning personnel working in NICU, delivery room, bone marrow transplantation units, 112 emergency health services and National Medical Rescue Team personnel. In this way, it is aimed to protect the newborn and immunocompromised patient group, whom pertussis can progress with severe morbidity and mortality, with the cocoon strategy. In addition, within the scope of the secondary gains of vaccines, it will also be possible to prevent the loss of workforce of qualified health personnel¹⁰.

The primary purpose of this study is to determine pertussis awareness and Tdap vaccination status of healthcare workers working in the NICU within the scope of the cocoon strategy. Secondly, it is aimed to determine other recommended vaccination conditions for healthcare professionals, to inform personnel about the vaccines recommended by the Ministry of Health, and to determine their intentions for Tdap vaccination.

MATERIALS AND METHODS

Selection of Patients

Our research was designed as a cross-sectional and descriptive questionnaire study using face-to-face interview technique and conducted at Samsun Training and Research Hospital NICU between May and June, 2021. Ninety-one health workers, consisting of nurses/midwives, medical secretaries, cleaning staff, and pediatricians working in rotations working in the unit, were invited to the research and 89 people agreed to be interviewed.

The questionnaire consisted of four parts, including 21 questions, in order to learn about the demographic data of the participants, their level of knowledge about pertussis disease (LKPD), their level of knowledge about pertussis vaccine and their vaccination status. Thirteen questions aiming to measure the level of knowledge were prepared considering the informative writings of the Ministry of Health and Child Health Association about pertussis disease and vaccines to cover all healthcare professionals. The questions prepared to measure the level of knowledge were asked to be answered

as Yes-No-I don't know. While scoring, correct answers were evaluated as 3 points, answers of 'I have no idea' as 2 points, and wrong answers as 1 point. The sum of the scores of the eight questions about pertussis disease was named the LKPD, and the sum of the scores of the answers to the five questions about the pertussis vaccine was named the LKPV.

On pertussis, questions were asked about the contagion rate and transmission route of the disease, the clinical picture it caused, whether permanent immunity was acquired by having the disease, and the regional outbreaks that occurred every three years. For pertussis vaccines, it was asked whether the vaccine was included in the vaccine calendar of the Ministry of Health, whether there were different forms for adults, whether the person having suffered from the disease needed to be vaccinated, and whether it was on the list of vaccines recommended to healthcare professionals. After the written consent of the participants was obtained, the survey, which lasted approximately 7 minutes, was administered face-to-face by the researcher. The last question in the questionnaire was about the participants' intention to get vaccinated. Before asking about the vaccination intention, the participants were informed verbally and in writing about the Tdap vaccine recommendation of the Ministry of Health. Immediately after the briefing, the participants were asked if they were considering getting the Tdap vaccine to determine their vaccination intentions.

Ethics committee approval was obtained from Samsun Training and Research Hospital for the study (protocol no: GOKA/2021/10/3, date: 26.05.2021).

Statistical Analysis

Comparison of the results between the groups was analyzed with the Statistical Package for the Social Sciences (version 23) program. The chi-square test was used for categorical variables. The distribution of independent variables in the groups was examined with the Shapiro-Wilk test, and those with normal distribution were compared with the t-test and those without normal distribution were compared with the Mann-Whitney U test. A p value of <0.05 was considered significant.

RESULTS

91% (n=81) of the participants were female and 9% (n=8) were male, and their mean age was calculated as 38.7 ± 7.3 years. 76% of those interviewed consisted of nurses/midwives and doctors. The professional characteristics of the participants are given in Table 1.

The LKPD and vaccines were significantly higher in physician participants than in other groups (LKPD: $p < 0.001$ - LKPV: $p < 0.003$). While 14 (16%) of the participants answered the

information questions about pertussis disease correctly, only 3 people answered the questions about vaccines correctly. The questions aiming to measure the level of knowledge and the rates of correct answers are shown in Table 2.

The health workers working in the unit were asked about their vaccination status based on their own notification. None of the participants were vaccinated with Tdap. Figure 1 shows the rate of the team vaccinated with the highest rate of Td ($n=66.74\%$) and the other vaccinations.

When the participants were asked about the vaccines which were mostly recommended because they were healthcare professionals, 67% (n=60) stated that they did not receive any advice. There were 21 people who received recommendations for more than one vaccine. Vaccines recommended for healthcare workers are shown in Figure 2. When it was evaluated from whom they received the recommendation to be vaccinated, 20 of the 29 people getting recommendation stated that they received this recommendation from the workplace doctor, 2 from the family doctor and 2 from the infectious diseases specialist.

When asked about their Tdap vaccination intentions after debriefing, more than half of the participants stated that they were not considering getting the Tdap vaccine. There were

Table 1. Occupations of the participants and duration of their working experience

| Occupation | n=89 (%) |
|--------------------------------|----------|
| - Physician | 17 (19) |
| - Nurse/midwife | 51 (57) |
| - Medical secretary | 5 (6) |
| - Cleaning staff | 16 (18) |
| Occupational experience | |
| - <5 years | 7 (8) |
| - 5-15 years | 35 (39) |
| - 15 years < | 47 (53) |

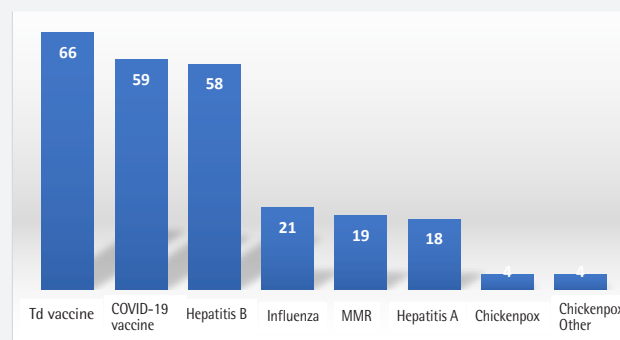


Figure 1. Vaccination status of the participants

COVID-19: Coronavirus disease-2019

32 (36%) people stating that they would be vaccinated if the vaccine was provided by the hospital, and 6 (7%) people stated that they would be vaccinated by covering the cost of the vaccine, even if it was by their own means. A high score of

LKPV was found to be associated with a positive intention to be vaccinated ($p=0.02$) (Table 3). When evaluated according to occupations, the intention to get Tdap vaccine was determined as 71% among doctors, and this rate was statistically significantly higher than in other groups ($p=0.007$) (Table 4).

DISCUSSION

In our research, it was aimed to determine the pertussis awareness and Tdap vaccination status of healthcare professionals working in the NICU. There were no healthcare workers in the unit vaccinated with Tdap. It was known by a small number of participants ($n=28$, 32%) that pertussis vaccine was among the vaccines recommended by the Ministry of Health to health workers. High level of knowledge about vaccination was found to be significantly associated with positive vaccination intention ($p=0.02$).

Tdap vaccination rates in healthcare workers vary according to the vaccination strategies of countries. While countries such as the United States of America (USA), England, and Germany recommend all healthcare personnel to be vaccinated with Tdap, it is recommended for healthcare professionals who may have contact with a risky group in France, Austria and Turkey⁹⁻¹¹. Vaccination rates of healthcare workers in the USA and France are included in national data record systems. In a systematic review evaluating 28 studies, mostly of which are from these two countries, it has been reported that vaccination rates are still low, but vaccination among healthcare workers has become widespread with interventions over the years. In the USA, Tdap vaccination rates among healthcare workers

| Table 2. Questions asked to determine the level of knowledge and participants' answers | | | |
|--|---------------|---------------|-----------------|
| Questions about pertussis disease | Correct n (%) | No idea n (%) | Incorrect n (%) |
| Pertussis is a common disease all over the world. | 59 (66) | 13 (15) | 17 (19) |
| *Pertussis can cause regional epidemics every 3-4 years. | 38 (43) | 26 (29) | 25 (28) |
| Pertussis is only seen in the childhood age group. | 52 (58) | 10 (11) | 27 (30) |
| Pertussis can cause lung infections, brain hemorrhages, and convulsions in infants. | 68 (76) | 18 (20) | 3 (4) |
| Pertussis can cause death in young infants. | 78 (87) | 8 (9) | 3 (4) |
| Pertussis is transmitted from person to person through droplets produced during coughing and sneezing. | 75 (83) | 10 (11) | 4 (4) |
| Pertussis is not a very contagious disease. | 65 (73) | 15 (17) | 9 (10) |
| *Individuals who have had pertussis once develop a lifelong permanent immunity. | 33 (37) | 32 (36) | 24 (27) |
| Questions about pertussis vaccines | | | |
| Pertussis vaccines are very effective. | 61 (68) | 21 (24) | 7 (8) |
| *There are separate vaccines for pertussis for children and adults. | 22 (25) | 37 (42) | 30 (33) |
| In the Vaccination Calendar of the Ministry of Health, there is a total of 5 doses of pertussis vaccine, at the 2 nd , 4 th , 6 th and 18 th months, and then at the 48 th month. | 57 (64) | 27 (30) | 5 (6) |
| *Pertussis vaccine is also included in the list of vaccines recommended by the Ministry of Health for healthcare professionals. | 28 (32) | 26 (29) | 35 (39) |
| * Even if pertussis disease is passed, pertussis vaccine should be taken. | 36 (40) | 31 (35) | 22 (25) |
| *It was correctly known by less than half of the participants. | | | |

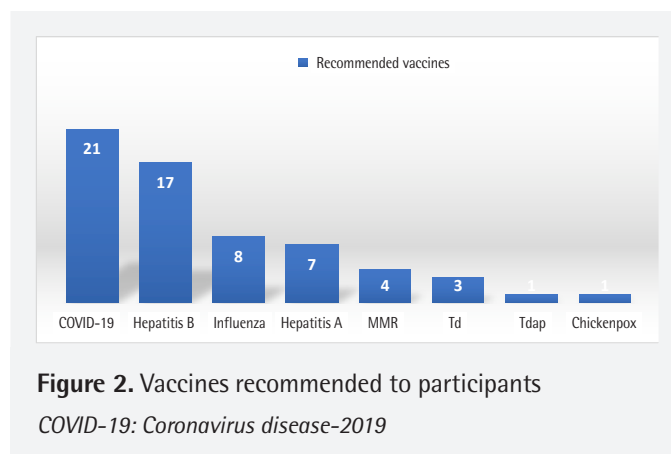


Figure 2. Vaccines recommended to participants
COVID-19: Coronavirus disease-2019

| Table 3. Vaccination intentions of the participants according to their level of knowledge | | | | | |
|---|------------|------------------|-----------|------------------|----------------|
| Vaccination intention (n=88) | Yes (n=38) | | No (n=50) | | p ^a |
| | Mean±SD | Median (min-max) | Mean±SD | Median (min-max) | |
| LKPD | 20.5±2.6 | 21 (15-24) | 19.6±3.08 | 19 (12-24) | 0.135 |
| LKPV | 11.7±2.1 | 12 (7-15) | 10.7±1.7 | 11 (6-15) | 0.02 |

^aMann-Whitney U test.
min-max: Minimum-maximum, LKPD: Level of knowledge about pertussis disease, LKPV: Level of knowledge about pertussis vaccine, SD: Standard deviation

increased from 6.1% to 45.1% between 2007 and 2015. In France, the rate of being vaccinated with Tdap was reported to be 63.9%¹².

Table 4. Intention to be vaccinated according to occupations

| Occupations | Intention to be vaccinated (n=88) | | p* |
|-------------------------|-----------------------------------|--------------|----|
| | Yes (n=38) (%) | No (n=50)(%) | |
| Physician (n=17) | 12 (71%) | 5 (29%) | |
| Nurse-midwife (n=51) | 15 (29%) | 36 (70%) | |
| Medical secretary (n=5) | 1 (20%) | 3 (60%) | |
| Cleaning staff (n=16) | 10 (62.5%) | 6 (37.5%) | |

*Chi-square test.

Since there is no such registration system in our country, studies on Tdap vaccination rates among healthcare professionals gain importance. In a seroprevalence study involving nurses and doctors working in a pediatric clinic, 39.6% of 169 participants were found to be seronegative against pertussis, while only 1.8% (n=3) were vaccinated with Tdap¹³. In the seroprevalence study conducted by Tanrıover et al.¹⁴ on 1303 people, 35 participants were healthcare workers, and the rate of seropositivity against pertussis was found to be 5.7% among healthcare professionals. Data on the vaccination status of the participants in this study were not shared. In our study, there was no healthcare worker vaccinated with Tdap among the participants.

Accurate perception of the benefits/risks of the vaccine based on evidence is among the factors affecting vaccine acceptance. The knowledge of healthcare professionals about vaccines affects their own vaccination practices and vaccine recommendations¹⁵. The vast majority of participants knew correctly that pertussis could cause death in young children and that the disease was transmitted by droplets. However, more than half did not know that pertussis could cause regional epidemics every 3-4 years, and that pertussis did not leave permanent immunity for life. Only 28 (32%) people knew that the Ministry of Health recommended Tdap to health workers working in specific departments. In our study, the increase in the level of knowledge about vaccines was found to be statistically significantly associated with the intention to be vaccinated ($p=0.002$).

Health workers are seen as the most reliable source for vaccines. In a study with the participation of occupational physicians in Italy, the rate of Tdap vaccination recommendation was found to be 52.7%¹⁶. The awareness of family physicians in our country in terms of the cocoon strategy was examined, and 47.4% stated that they did not have sufficient knowledge on this subject, and nearly 60% stated that they needed

expert opinion for the application of the cocoon strategy¹⁷. In our study, the participants stated that they received their vaccination recommendations from the occupational physician, family physician and infectious diseases specialist, but only one person stated that Tdap vaccine was included in these recommendations. Healthcare workers in our study were mostly recommended for Coronavirus disease-2019, hepatitis B and influenza vaccines, and similarly, they were found to be vaccinated at a higher rate with these vaccines. Although the recommendation rates for Td vaccine were low, it was observed that the rate of getting vaccinated was high. It was thought that this situation might be caused by the accidents that required tetanus prophylaxis.

When the studies conducted in our country are evaluated, no study has been encountered regarding Tdap vaccine applications in departments where the cocoon strategy is very important in terms of pertussis, such as the NICU. In this respect, our study is the first study that will contribute to this field and raise awareness. Evaluation of all healthcare professionals other than physicians and nurses is another strength of the research.

Study Limitations

Participants were asked about their vaccination intentions, but it was not investigated why they were not vaccinated. Once the underlying reasons for vaccine preferences are learned, a more effective policy can be created to increase vaccine acceptance.

Our research suggests that there is a need for further studies evaluating the knowledge and attitudes of physicians, especially occupational physicians, family physicians and infectious diseases, about the cocoon strategy.

CONCLUSION

Although it is recommended by the Ministry of Health to vaccinate healthcare workers working in the NICU with Tdap, it is thought that there are problems in practice. There is a need for all physicians, especially occupational physicians, family physicians and infectious disease specialists, who recommend vaccination to healthcare professionals, to increase their awareness of pertussis and to put the cocoon strategy into practice. Interventions are needed to increase the level of knowledge of allied health personnel about pertussis disease, its risks and pertussis vaccines.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from Samsun Training and Research Hospital for the study (protocol no: GOKA/2021/10/3, date: 26.05.2021).

Informed Consent: The written consent of the participants was obtained.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Ş.K., S.Ç.Ç., R.K., Concept: Ş.K., S.Ç.Ç., R.K., Design: Ş.K., S.Ç.Ç., Data Collection or Processing: Ş.K., R.K., Analysis or Interpretation: Ş.K., S.Ç.Ç., Literature Search: Ş.K., S.Ç.Ç., R.K., Writing: Ş.K., S.Ç.Ç., R.K.

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