

THE IMPACT OF THE COVID-19 PANDEMIC ON THE QUALITY OF EXAMINATION IN EYE CLINICS IN THE CZECH REPUBLIC – QUESTIONNAIRE STUDY

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SUMMARY

Purpose: The aim of the study was to map the behavior of ophthalmologists regarding protective equipment during the COVID-19 pandemic (coronavirus disease 2019), both during the time of the mandatory restrictive measures and after their relaxation. Another aim was to evaluate the awareness of ophthalmologists in the Czech Republic about the possible impact of nose and mouth protective measures (masks, respirators) on the quality of eye examinations, especially on the results of standard automated perimetry (SAP) and intraocular pressure (IOP) measurement.

Materials and Methods: As part of two professional ophthalmological events in the Czech Republic, which took place in 2022, we obtained and evaluated data from the ophthalmologists in attendance using a questionnaire. We evaluated demographic parameters, frequency of use and type of nose and mouth protective equipment and their influence on the quality of ophthalmological examination as well as the awareness of ophthalmologists about their possible influence on the outcome of SAP and IOP measurements.

Results: We obtained data from a total of 212 respondents (148 women, 44 men, in 20 cases gender was not stated). In 91.5% of cases, ophthalmologists agreed that the use of respirators and masks makes ophthalmological examination more difficult. The most common problems were eyepiece fogging (85.8%), examination lens fogging (85.8%), and lens fogging when spectacles correction was prescribed (79.2%). The respondents most often combated these problems either by completely removing the respirator (24.1%) or at least by pulling it under the nose (39.2%). At the time when the measures were relaxed, significantly more men did not use any nose and mouth protection at all during ophthalmological examinations (15.8% of men vs. 4.2% of women; $p = 0.032$). An alarming finding was the fact that 35.6% of respondents did not know whatsoever whether the nurse was performing a perimetry examination on a patient with a respirator/mask or without protective equipment, i.e. they were not aware whatsoever of the possible formation of artifacts. Only 21.2% of respondents were aware of the possible difficulties of measuring IOP while wearing a respirator, while 59.9% of respondents were not aware of this risk (39.6% had never considered this problem, 20.3% of respondents were convinced that a respirator could not have an effect on the measurement of IOP).

Conclusion: The use of nose and mouth protective equipment clearly affects the ophthalmological examination and makes it more difficult. Although ophthalmologists belong to a group at high risk for the possible transmission of infection in the performance of their profession, they often removed nose and mouth protection in an effort to eliminate fogging of eyepieces and examination lenses. The awareness of ophthalmologists regarding the possible influence on the results of SAP and IOP measurement by wearing a respirator was low in our questionnaire survey. It is therefore advisable to discuss this issue more widely and warn doctors about these risks.

Key words: nose and mouth protective measures, surgical mask, respirator, COVID-19, ophthalmology, intraocular pressure, standard automated perimetry

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INTRODUCTION

In recent years the world has been faced with a dramatic global health crisis as a consequence of the outbreak of the COVID-19 pandemic (coronavirus disease 2019). In December 2019 the virus was first identified in Wuhan in China, and was eventually named SARS-CoV-2 (Severe acute respiratory syndrome-related coronavirus 2) and identified as the causative agent of the disease [1]. The World

Health Organization declared a pandemic in March 2020, and this pandemic brought a series of new challenges to various fields of medicine, including ophthalmological practice. With regard to the fact that SARS-CoV-2 is highly contagious and transmission occurs through contact with infected individuals (especially droplet infection), on March 18, 2020 the government of the Czech Republic responded by declaring the mandatory wearing of protective aids over the nose and mouth, such as a respirator, face

mask, scarf, muffler etc. During the course of the pandemic the stringency of the measures was adjusted according to the current epidemiological situation.

Since the onset of the pandemic, ophthalmologists have belonged to a group at high risk of the possible transmission of infection in the performance of their profession. Diagnostic and therapeutic ophthalmological procedures frequently require close contact with the patient. Conjunctivitis (among other ocular complications) was one of the common symptoms of the COVID-19 disease, and this applied also in patients who were otherwise as yet without symptoms [2]. The American Academy of Ophthalmology (AAO) responded to the situation by issuing recommendations for the prevention of transmission of the virus in both surgical and diagnostic ophthalmological procedures [3,4]. The Czech Ophthalmological Society also responded proactively to the situation, among other factors providing guidelines on how to install a protective shield on a slit lamp [5]. The introduction of stringent hygiene and barrier measures with the objective of preventing the transmission of the virus was therefore the standard in ophthalmological practices.

However, these measures also entailed negative impacts. In 2021 a study was published dealing with the impacts of these measures on the course and quality of ophthalmological examination [6]. The authors confirmed the fact that the use of protective aids during an eye examination may lead to negative consequences – fogging of lenses and eyepieces, impairment of handling of the slit lamp and a time delay with regard to hygiene measures. Further published studies following on from this, which mapped the situation in individual countries and under specific conditions, for example in Turkey [7,8], Egypt [9] and the USA [10], confirmed this finding. In the international literature studies have also appeared which have pointed to the potential influencing of the results of testing on standard automated perimetry (SAP) when wearing protective aids over the nose [11–13]. Soon afterwards the first studies were published highlighting the potential influence of respirators on the precision of measurement of IOP with the aid of Goldmann applanation tonometry (GAT) [14,15]. However, nothing has been published to date within the Czech specialist literature.

The aim of our study was to evaluate the situation within the Czech Republic with the aid of a questionnaire investigation. The first part of the questionnaire aimed to map the behavior of ophthalmologists regarding the use of protective equipment worn over the nose and mouth – respirators and face masks in ophthalmological practice both during the peak of the COVID-19 pandemic and after the relaxation of the restrictive measures. We also focused on the experiences and difficulties of the respondents concerning the quality of ophthalmological examination when using protective equipment. The second part of the questionnaire aimed to evaluate the awareness of ophthalmologists about the danger of distortion of results of certain examinations when using protective

equipment (examination using protective equipment and measurement of IOP with the aid of GAT).

MATERIAL AND METHOD

Design of study and characteristics of cohort:

At two specialist ophthalmological events held in the Czech Republic in 2022 (the 23rd Vejdovský Science Day in Olomouc on March 26, 2022, and the 12th Congress of the Czech Glaucoma Society, April 7–9, 2022), a questionnaire was distributed to those in attendance upon registration. This questionnaire was completely anonymous and voluntary, and respected the principles of the Helsinki Declaration. In the questionnaire we determined data from a number of areas: demographic data (age and sex), use of protective equipment during the period of the peak of the pandemic and after the relaxation of the restrictive measures, the influence of this protective equipment on the course and comfort of ophthalmological examination, as well as on its quality, experiences regarding the willingness of patients to respect the introduced protective recommendations, and the awareness of ophthalmologists concerning the danger of distortion of certain results upon the use of protective equipment. The obtained responses were converted into electronic form and statistically processed.

Demographic data

In total we obtained and evaluated data from 212 doctors, consisting of 148 women (69.8%) and 44 men (20.8%), in 20 cases gender was not stated. The respondents were classified into three age categories, the largest of which was the age group of 41–60 years (41%), followed by the group up to 40 years (37.7%), and the smallest group over 61 years (9.9%), while in 24 (11.3%) cases the age category was not stated.

Statistical analysis

The software IBM SPSS Statistics version 23 was used for the statistical analysis. A chi-square test or Fisher exact test was used for the comparison of men and women and for the comparison of age groups in the responses to the questionnaire. In the case of a significant result in the comparison of age groups, a Fisher exact test with Bonferroni correction of significance was used for a more detailed analysis. The tests were conducted on a level of significance of 0.05.

RESULTS

Use of protective equipment by doctors and patients, modification of slit lamp:

The frequency of use of respirators and surgical masks to prevent the transmission of SARS-CoV-2 by doctors during the period of the peak of the pandemic and after its subsidence is presented in summary in Graph 1. Doctors unequivocally preferred to use the respirator FFP2 (filtering face piece 2), both during the period of the peak of the pandemic (78.8%) and after the relaxation of the

restrictive measures (66.5%). An interesting finding is that after the relaxation of the measures, significantly more male doctors ceased to use any protection of the nose and mouth in comparison with women (15.8% of men vs. 4.2% of women; $p = 0.032$). The overwhelming majority of the ophthalmologists questioned modified the slit lamp (85.4%), by installing a certain type of protective shield.

During the time of the peak of the pandemic, doctors most often also demanded that patients use at least an FFP2 respirator (64.2%), after the relaxation of the measures either an FFP2 respirator (21.2%) or a surgical mask (32.5%), while an FFP2 respirator was demanded from patients more often by doctors in the age group of 41–60 years than by younger doctors aged up to 40 years (25.6% vs. 18.1%; $p = 0.039$). The details are presented in Graph 2.

Quality of ophthalmological examination upon use of protective equipment

A total of 91.5% of respondents concurred that the use of protective equipment made ophthalmological examination more difficult. The most common difficulties included fogging of eyepieces (85.8%), fogging of the examination lens (85.8%) and lens fogging when spectacles correction was prescribed (79.2%). The details are presented in Graph 3. Other reported difficulties in the use of protective equipment were dominated especially by impaired communication with the patient, increased fatigue on the part of the doctor and allergic reactions.

Most doctors attempted to combat eyepiece fogging by pulling the respirator under the nose (39.2%), holding their breath (28.3%) or removing the protection of the nose and mouth entirely (24.1%). An interesting finding was that women were more likely to hold their breath during the examination than men (18.9% of men vs. 53.2% of women). The details are presented in Graph 4. During indirect fundoscopy 36.1% of doctors left the respirator or face mask on the patient, 25.7% of doctors asked the patients to pull it under the nose, or adjusted the position of the protective equipment as required (8.4%), and 22.3% of doctors asked the patients to remove the protective equipment for the examination. During the prescription of spectacles correction, most of the respondents asked the patients either to remove the protective equipment (41.1%), pull it under the nose (29.2%) or adjusted it as required themselves (11.9%). The details are presented in Graph 5.

Awareness of ophthalmologists regarding the danger of distortion of the results of examination by protective equipment

To the question of whether a respirator could influence the result of measurement of intraocular pressure (IOP) in some cases, 20.3% of respondents answered negatively, and 39.6% of respondents answered that they had never considered this issue (Graph 6). During non-contact measurement, most doctors left the patients wearing protection over the nose and mouth (Graph 7).

Upon perimetric examination 35.6% of respondents did not know whether or not the patient should be we-

aring a respirator/surgical mask during the examination (examined by a nurse), 23.8% of respondents asked the patients to remove the nose and mouth protection for the examination, while by contrast 13.9% always left patients wearing the respirator/surgical mask during the examination (Graph 8). During examination with the aid of imaging methods, 41.1% of respondents left patients wearing the surgical mask or respirator (Graph 9).

Additional data, comments

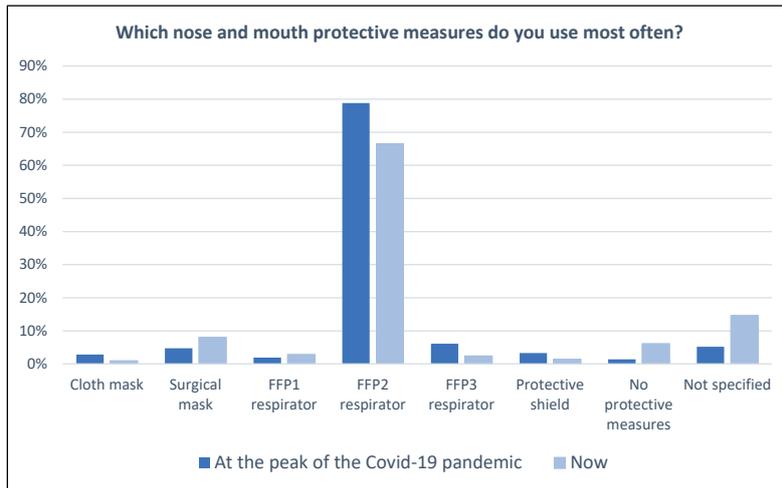
An interesting finding was the answer to the question regarding how patients predominantly responded to requests to remove the respirator/face mask during the examination. The overwhelming majority of respondents stated that patients were happy to remove the equipment (82.7%), the details are presented in Graph 10. Most of the respondents had experienced conflict with a patient who had refused to wear a respirator/surgical mask only on rare occasions (Graph 11).

In the concluding part of the questionnaire, space was provided for comments and experiences with the use of respirators and surgical masks. The comments most often concerned inappropriate use of a respirator – patients often had a soiled respirator, had been using it for a demonstrably long time, or wore it inappropriately (only over the chin). There were frequent comments regarding impaired communication with patients and greater fatigue after the working day. On the other hand, the opinion was also expressed that this barrier protection was always unequivocally appropriate in ophthalmological practice during the time of respiratory diseases.

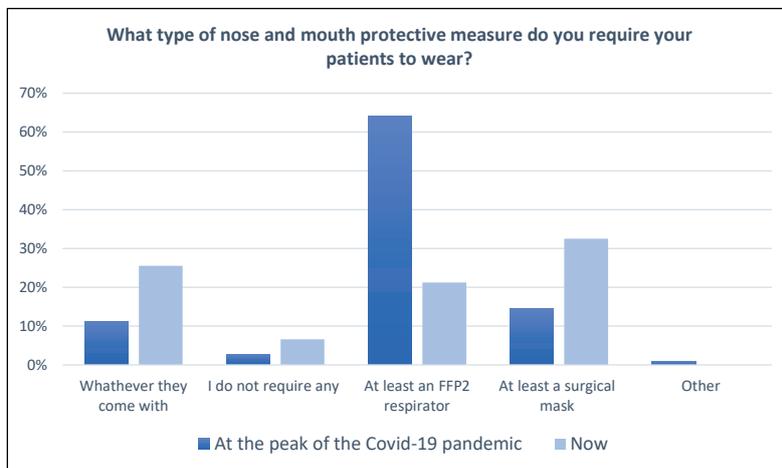
DISCUSSION

The fact that hygiene and restrictive measures during the course of the pandemic have a pronounced impact on ophthalmological practice has been substantiated by a study conducted by Rauchegger et al. [6]. The authors succeeded in gathering a total of 120 completed questionnaires from 10 countries. Further published studies have mapped the situation in individual countries, e.g. in Turkey [7,8], Egypt [9], and the USA [10].

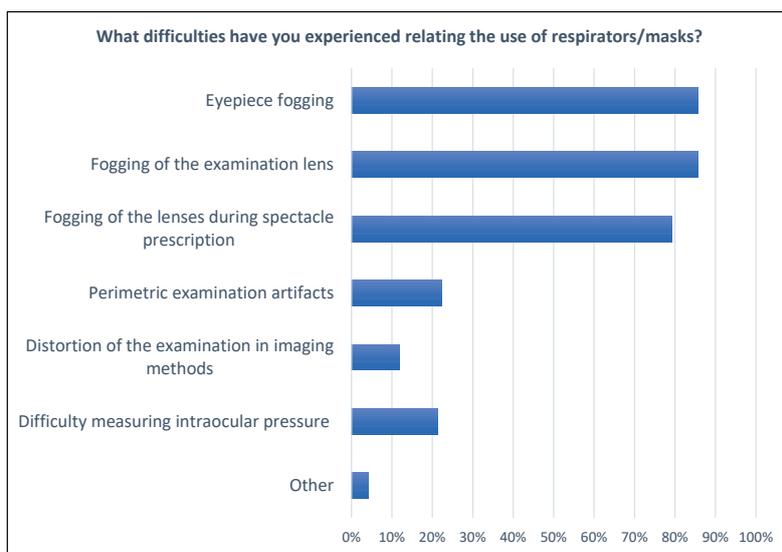
According to the best of our knowledge, our study is the first to map the situation among ophthalmologists within the Czech Republic. There was a consensus among the overwhelming majority of our respondents especially that the use of respirators/surgical masks makes ophthalmological examination more difficult, while this most frequently related to fogging of eyepieces, the examination lens and lenses when spectacles correction was prescribed. The obtained data are entirely in accordance with the above-presented studies. However, we consider the frequency of the possible ways by which the ophthalmologists dealt with the problem of fogging to be an interesting finding. A large number of ophthalmologists were prepared to expose themselves to a higher risk of infection in order to attain better quality of examination. During examination on a slit lamp 39.2% of doctors pulled the mask under the



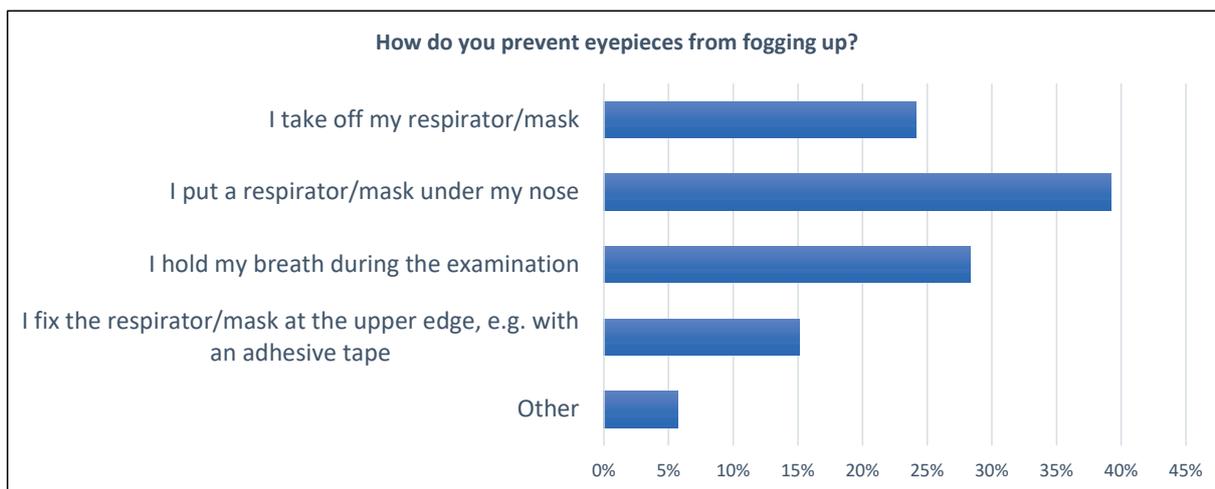
Graph 1. Respondents' answers regarding the use of different types of nose and mouth protective measures



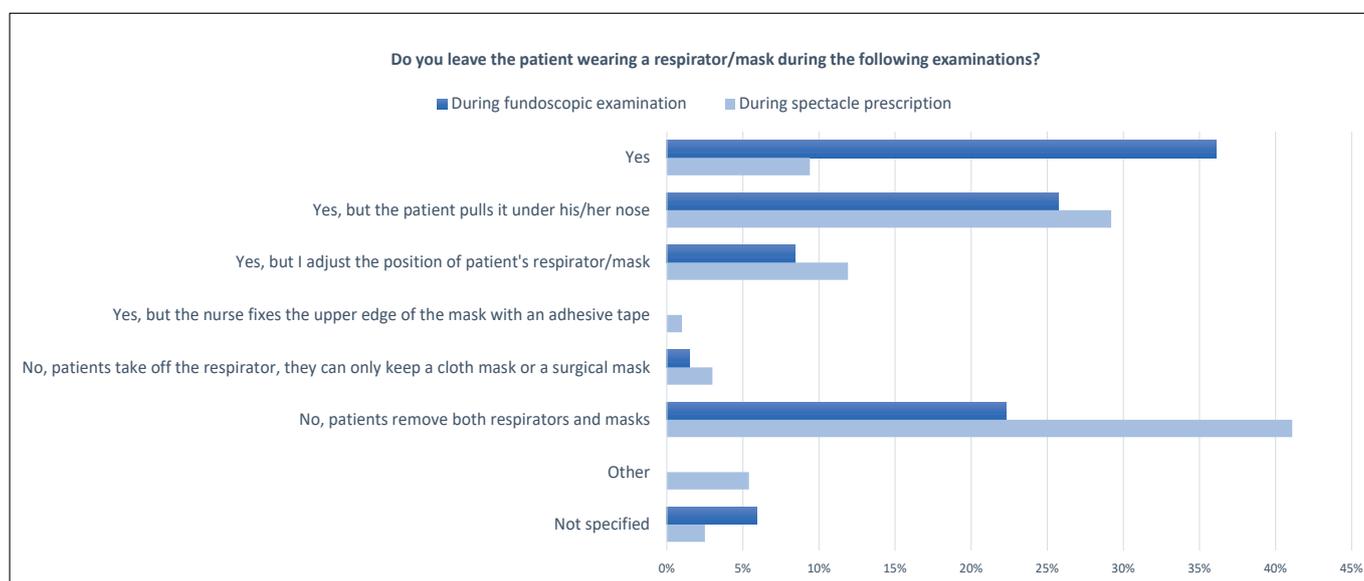
Graph 2. Respondents' answers regarding the use of different types of nose and mouth protective measures that they required for patients in different periods of the pandemic



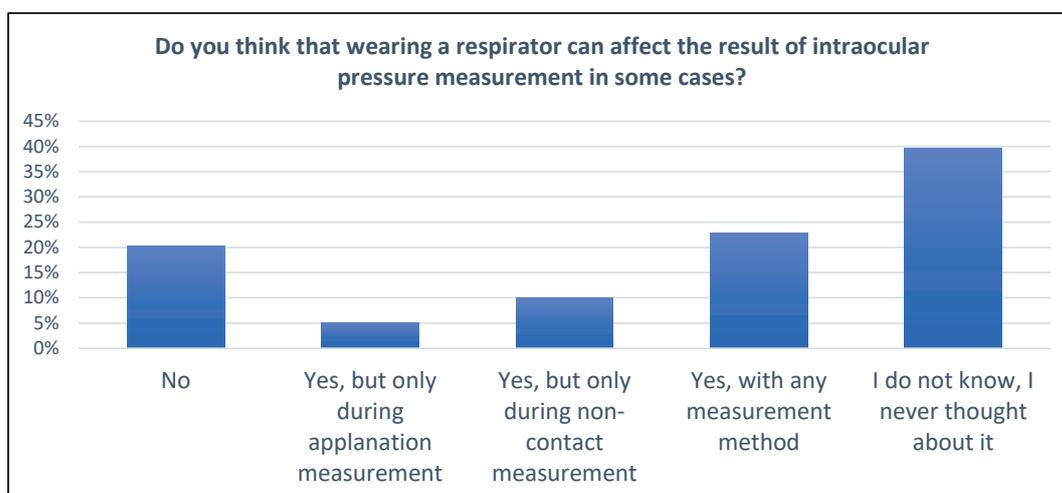
Graph 3. Problems noted by respondents in connection with the use of nose/mouth protection



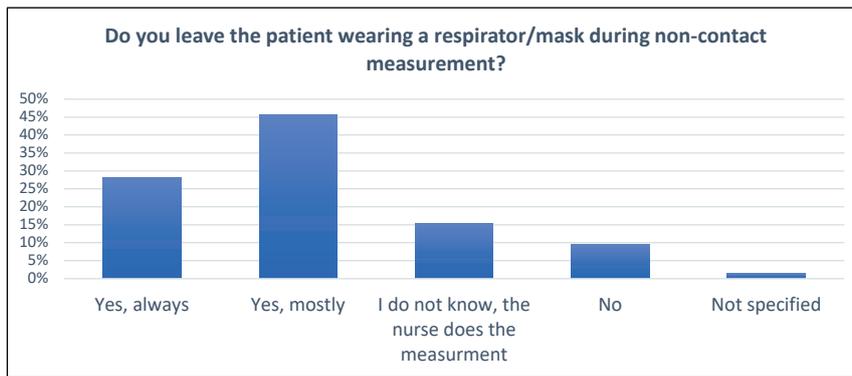
Graph 4. Results of a questionnaire survey on how respondents solved problems with fogging of eyepieces



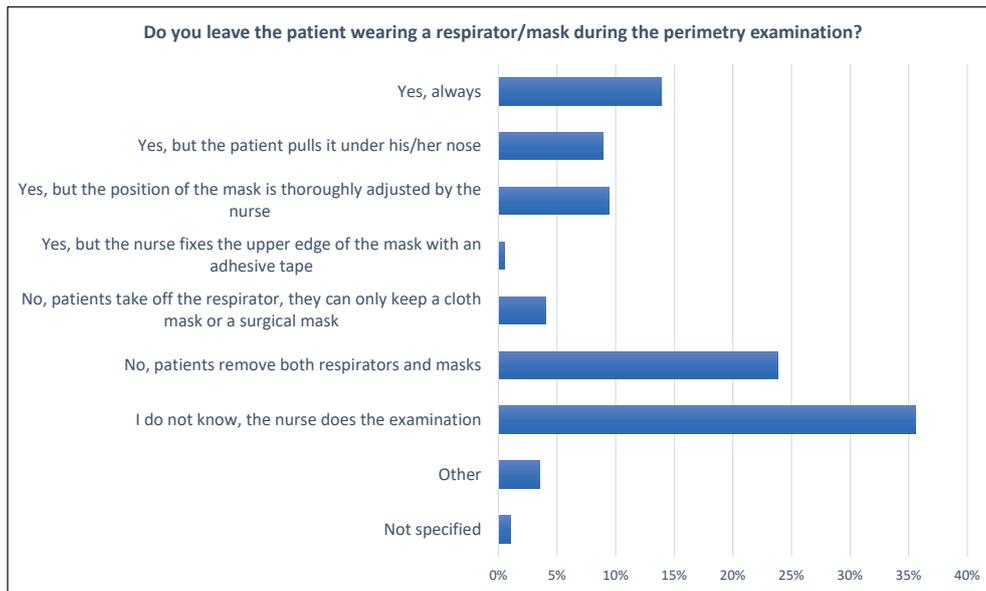
Graph 5. Results of a questionnaire survey on how respondents solved problems with fogging during fundoscopic examination and during spectacle prescription



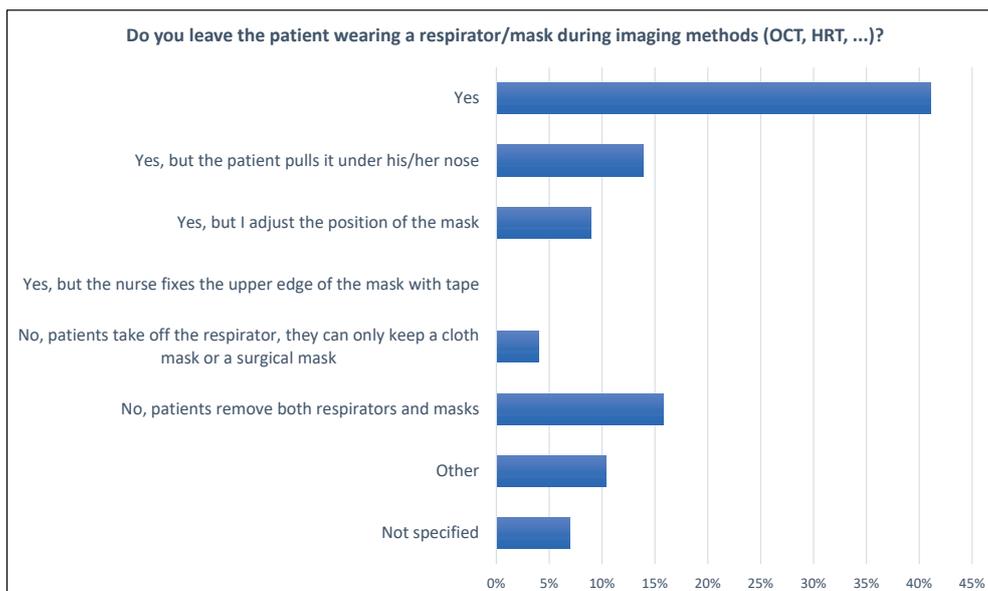
Graph 6. Respondents' opinion on whether nose/mouth protection can affect intraocular pressure measurement



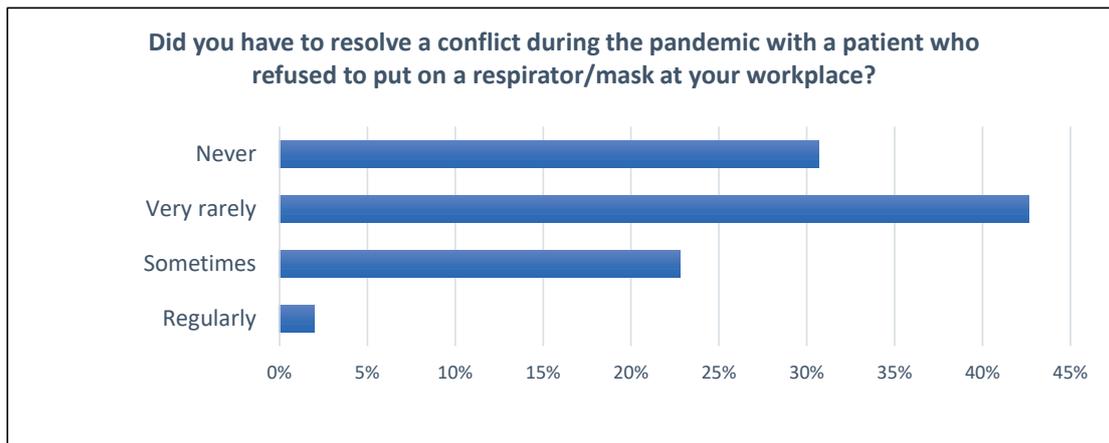
Graph 7. Results of a questionnaire survey on whether the respondents leave their patients with nose/mouth protective measures while measuring intraocular pressure using a non-contact tonometer



Graph 8. Respondents' approach to nose/mouth protective measures during perimeter examination



Graph 9. Respondents' approach to nose/mouth protective measures during examinations using imaging methods



Graph 10. Respondents' experiences with patients' willingness and cooperation



Graph 11. Respondents' experiences with patients' willingness to take off their respirator/mask for examination

nose, or entirely removed the nose and mouth protection (24.1%). During indirect funduscopy and when spectacles correction was prescribed, a significant number of doctors also asked patients to remove the nose and mouth protection (22.3% and 41.1% respectively). Significantly more men than women exposed themselves to this risk. After the relaxation of the measures, when the use of nose and mouth protection was now on a voluntary basis, significantly more male doctors ceased to use any kind of protection of the nose and mouth in comparison with women. (15.8% of men vs. 4.2% of women; $p = 0.032$). Rauegger et al. also arrived at the same result (that men voluntarily expose themselves to a greater risk) [6]. This fact is in accordance with psychological studies, which state that men have a greater tendency towards risk behavior [16]. On the other hand, a protective shield was attached to the slit lamp by 85.4% of ophthalmologists (Fig. 1).

Evidence that ophthalmologists were aware of the high risk of transmission of infection is provided by the fact that during the period of the peak of the pandemic, a large number of doctors markedly limited their office hours and provided either only acute care, or closed their practices entirely and provided care via telemedicine (issuing of prescriptions, consultation by telephone or e-mail). This was confirmed by a study conducted by Nair et al. [17], who addressed 1260 ophthalmologists in India. The study found that 59.1% of the ophthalmologists addressed felt themselves to be at greater risk, while as many as 72.5% of respondents had not examined a single patient personally during the quarantine period, though on the other hand 77.5% of respondents had provided care to patients via telemedicine. Khanna et al. [18] focused on the psychological aspects of the pandemic, and in their study determined that 32.6% out of 2355 addressed ophthalmologists in India had suffered from symp-

toms of very mild depression (which is more than the 10% stated prevalence of psychological disorders in India). The incidence of depression was also more common among younger ophthalmologists. In a study conducted by the Turkish authors Karslıoğlu et al., the results were even more alarming. Severe anxiety in association with the COVID-19 pandemic was suffered by 67.2% of ophthalmologists [19]. We did not include questions directed towards the psychological condition of respondents in our study.

Several possibilities for preventing fogging of eyepieces and lenses (without the need to remove the respirator or pull it under the nose) have been described in the literature. The first and probably most widely used method is the long-familiar trick of attaching the respirator on the nose with an adhesive strip [20], as graphically demonstrated in Fig. 2. This method was used by a minimal number of ophthalmologists in our cohort. Another possibility would be to use two surgical masks, as described by Patil et al. [21]. Jordal et al. [22] described a highly effective modified method of using a surgical mask in order to sit better on the bridge of the nose, while also creating two side ventilation holes through which air can flow upon exhalation. This procedure is graphically demonstrated in Fig. 3. In our cohort these alternative methods were used rather in exceptional cases. Some specialists helped themselves by warming the examination lenses before the examination, as stated in the section designated for comments and experiences. The opinion was repeatedly stated in this section that protection of the nose and mouth also markedly

impaired communication with the patient, in addition to which doctors felt increased fatigue especially in the afternoon, and also experienced allergic reactions. On the other hand, it was emphasized that this barrier protection was always unequivocally appropriate in ophthalmological practice during the time of respiratory diseases.

The potential distortion of the results of perimetry testing while using protection of the nose and mouth was described by Jang et al. in 2020 [11]. El-Nimri et al. [12] confirmed on a series of six patients with ocular hypertension, glaucoma or suspected glaucoma that lens fogging during the perimetry examination may be the reason for defects similar to glaucoma in the visual field. They described both defects of the type of nasal step or arcuate defects, as well as an intensification of a pre-existing defect. In suspect cases they unequivocally recommended repeat performance of the examination. On the other hand, they verified that these defects could be prevented by attaching the respirator to the nose with the aid of an adhesive strip. We can unequivocally confirm this finding from our clinical practice, since at the beginning of the pandemic we repeatedly witnessed how reported deterioration and progression on the perimeter was caused by lens fogging when using a respirator. Baryam et al. in their study came to a similar conclusion [13]. Our questionnaire investigation produced the very alarming finding that 35.6% of respondents did not know whatsoever whether the patient was wearing a respirator/mask during the examination, because the examination was performed by a nurse who had not received detailed instruction. The



Figure 1. Example of a protective shield that can be attached to a slit lamp



Figure 2. Fixing the respirator with an adhesive tape to the nose leads to less fogging of the eyepieces and lenses

doctor therefore did not take into account whatsoever the conditions under which the examination was performed.

The recommendations for measurement of IOP during the COVID-19 pandemic progressively developed along with the increased observations, and the Czech Glaucoma Society responded accordingly. Guo et al. [23] in their study determined that measurement with the aid of a non-contact tonometer (NT) caused an increased concentration of aerosol with microbial colonies in the surrounding area of the instrument. This could be a potential risk for the transmission of diseases. They therefore recommended thorough disinfection of all surfaces after each measurement. Tang et al. [24] determined that more aerosol was stirred up in patients with higher IOP. They confirmed that an installed protective barrier on the NT reduced the density of aerosol, and therefore viewed its installation as highly beneficial. In our cohort the majority of doctors left patients with protection worn on the nose and mouth (28.2% always and 45.5% mostly). The risk here was therefore increased especially for healthcare staff. Measurement with the aid of Goldmann applanation tonometry (GAT) was not initially at the center of attention with regard to the risk of transmission of infection. Nevertheless, the first works were soon published that drew attention to the potential influence of respirators on the precision of measurement of IOP. Davanian et al. [14] demonstrated in a case report on a patient that a respirator may cause falsely high values of IOP due to pressure on the arm of the measuring instrument. In our cohort 20.3% of respondents

had no awareness of this danger, and 39.6% had never considered this issue. It is always necessary to remember this fact when measuring with the aid of GAT (if the patient is wearing a respirator), and to carefully check the position of the respirator. In Fig. 4 a graphic demonstration is provided of how a respirator may interfere with the arm of the instrument upon measurement with the aid of GAT. Our results concerning the awareness of doctors unequivocally confirmed the fact that this topic merits greater attention in ophthalmological forums and in the domestic professional literature, because despite the subsidence of the epidemiological situation, protection of the nose and mouth is becoming a part of our standard practice.

According to the best of our knowledge, this study is the first to focus specifically not only on difficulties in ophthalmological practices in connection with protective equipment, but also on the level of awareness of ophthalmologists regarding the potential influence on the results of SAP and the measurement of IOP by worn protective equipment. It is also the first to map this situation in ophthalmological practices during this challenging period within the Czech Republic. For these reasons we have also included graphic pictorial documentation from practice.

CONCLUSION

The results of our questionnaire investigation confirmed the experiences published in the foreign literature and encountered in everyday practice, namely that



Figure 3. A surgical drape tied in this way results in less fogging of eyepieces and lenses. This is because it rests better on the nose bridge and at the same time creates two side vents through which air can flow when exhaling

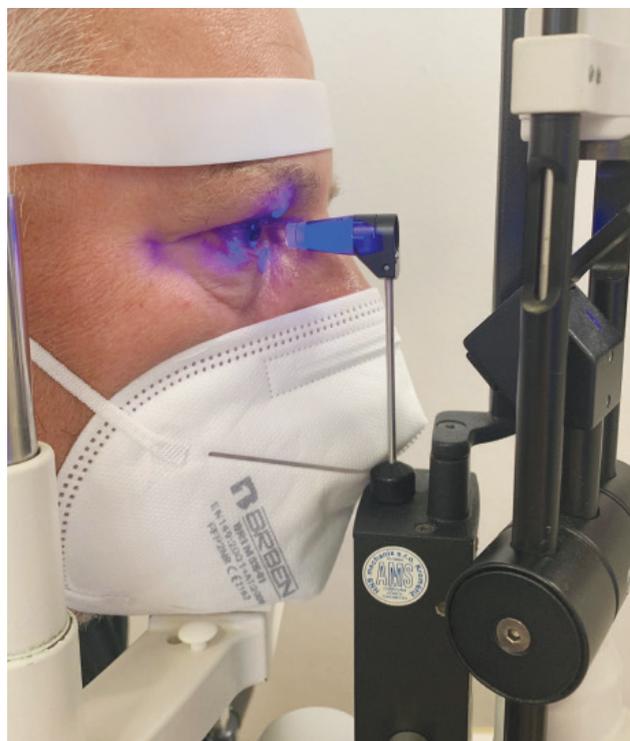


Figure 4. During Goldmann applanation tonometry, the respirator can influence the result of the intraocular pressure measurement by pressing on the measuring arm (in this case, falsely high values would be measured)

protective equipment worn over the nose and mouth may markedly influence the quality of ophthalmological examination and make it more difficult. Ophthalmologists unequivocally belong to a group with a high risk of potential transmission of infection in the performance of their profession, though despite this fact they frequently removed protection of the nose and mouth during examination in an endeavor to eliminate fogging of eyepieces and examination lenses, and to attain a higher quality of examination.

A very important finding in our study for future practice was the fact that to date ophthalmologists remain poorly informed about the potential distortion of the results of SAP and measurement of intraocular pressure with the aid of GAT when a respirator is worn. The doctor

should always be aware of the possibility of distortion of the results of SAP upon the use of protective equipment, should always have information available as to whether perimetry was performed with or without protective equipment, and if necessary should repeat the examination upon suspicion of worsening of the finding. Upon measurement with the aid of GAT also it is necessary to pay sufficient attention to the correct position of the respirator. With regard to the fact that protection of the nose and mouth (of both the patient and the doctor) is becoming a part of our standard practice during certain seasons of the year, in future it is appropriate to discuss this issue and to inform doctors of the possible risks of influence on the results of SAP and measurement with the aid of GAT when protective equipment is worn.

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