


Original Article

Impact of COVID-19 on Neuro-Ophthalmology in the United States: A National Survey

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ABSTRACT: Purpose: To evaluate the impacts of the COVID-19 on neuro-ophthalmology practice in the United States. **Design:** Cross-sectional study. **Methods:** The North American Neuro-ophthalmology Society distributed a survey on the impact of COVID-19 on neuro-ophthalmic practice to its members. The survey consisted of 15 questions regarding the impact of the pandemic on neuro-ophthalmic practice and perspectives. **Results:** Twenty-eight neuro-ophthalmologists practicing in the United States responded to our survey. In this survey, 64% of survey respondents were male ($n = 18$), while 36% were female ($n = 10$). The average age of a respondent was 55 years old. According to 77% of survey respondents, various neuro-ophthalmic diseases were reported to have worsened during the pandemic including idiopathic intracranial hypertension, compressive optic neuropathy, optic neuritis, and giant cell arteritis. **Conclusions:** This survey represents one of the largest studies to describe the impact of the COVID-19 pandemic of neuro-ophthalmology. Given the underrepresentation of neuro-ophthalmology in the United States as described in the literature, this study strengthens the need for more neuro-ophthalmologists to provide timely care, particularly during the pandemic. Further interventions to incentivize the pursuit of neuro-ophthalmology training may help combat the effects of COVID-19 on neuro-ophthalmic conditions.

RÉSUMÉ : L'incidence de la COVID-19 sur la neuro-ophtalmologie aux États-Unis : résultats d'une enquête nationale. But : L'étude visait à évaluer l'incidence de la COVID-19 sur la pratique de la neuro-ophtalmologie aux États-Unis. **Type d'étude :** Il s'agit d'une étude transversale. **Méthode :** La North American Neuro-ophthalmology Society (NANOS) a envoyé à ses membres un questionnaire d'enquête sur l'incidence de la COVID-19 sur la pratique de la neuro-ophtalmologie. Le formulaire comptait 15 questions concernant l'incidence de la pandémie sur la pratique de la neuro-ophtalmologie ainsi que l'avenir. **Résultats :** Au total, 28 neuro-ophtalmologistes exerçant aux États-Unis ont participé à l'enquête. Parmi les répondants, il y avait 64 % ($n = 18$) d'hommes et 36 % ($n = 10$) de femmes. La moyenne d'âge était de 55 ans. Selon 77 % des répondants, différentes affections neuro-ophtalmologiques se sont aggravées durant la pandémie, notamment l'hypertension intracrânienne idiopathique, la neuropathie optique par compression, la névrite optique et la maladie de Horton (artérite à cellules géantes). **Conclusion :** Il s'agit de l'une des études les plus importantes sur l'incidence de la pandémie de COVID-19 sur la neuro-ophtalmologie. Compte tenu de la sous-représentation de cette spécialité aux États-Unis dont fait état la documentation, l'étude renforce la nécessité de former davantage de neuro-ophtalmologistes afin qu'ils puissent fournir des soins en temps opportun, surtout durant la pandémie. Aussi l'application de nouvelles mesures visant à rendre intéressante la formation en neuro-ophtalmologie aiderait-elle peut-être à contrebalancer les effets de la COVID-19 sur les affections neuro-ophtalmologiques.

Keywords: Neuro-ophthalmology; COVID-19; Healthcare delivery

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Introduction

The coronavirus disease (COVID)-19 pandemic drastically affected the delivery of medicine around the world. The presence of a highly contagious respiratory virus presented an

unprecedented challenge to neuro-ophthalmology. In response to the pandemic, the American Academy of Ophthalmology (AAO) issued a statement in March 2020 for ophthalmologists to “cease any treatment other than urgent or emergent eye care

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Neuro-ophthalmologist Survey Respondents over Map of United States

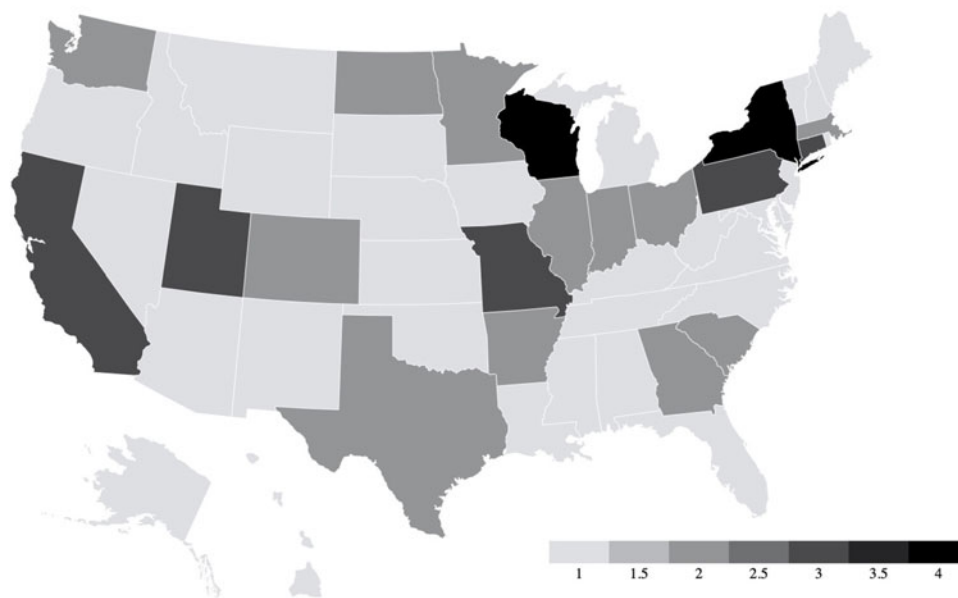


Figure 1: Geographic heat wave schematic of survey respondents by state within the United States.

immediately.”¹ One month later, however the AAO issued another statement calling for a cautious re-opening of ophthalmic services.

A typical comprehensive ophthalmology exam (including neuro-ophthalmology) requires the neuro-ophthalmologist to be less than 2 m from a patient for much longer than 1–2 minutes. This requirements of the typical eye exam qualify as a prolonged patient exposure according to the Centers for Disease Control and Prevention.² Also, non-contact tonometry has been shown to be a micro-aerosol generating procedure because of tear film disturbances, potentially further increasing transmission risks.³ Due to the risks imposed by the constraints of the eye exam and close proximity to the patient, we conducted a survey of the impact of COVID-19 on neuro-ophthalmology in the United States.

Methods

Data Collection

This study was approved by the Institutional Review Board at University of Nevada, Reno. A 14-question survey was emailed to neuro-ophthalmologists using a survey program (Momentive Inc., San Mateo, United States). Our survey was approved by and then emailed via the North American Neuro-ophthalmology Society (NANOS) listserv (NANOSNet) to its society members. Our survey was open from August 26, 2021, until October 9, 2021, for 68 days. A total of 30 neuro-ophthalmologists responded to our survey from three different countries; however, only responses from neuro-ophthalmologists practicing in the United States were included (two responses excluded).

Results

Twenty-eight neuro-ophthalmologists practicing in the United States responded to our survey. This represents 6% of neuro-ophthalmologists in the United States. In our survey, 64% of respondents were male ($n = 18$) and 36% were female ($n = 10$). The average age of a respondent was 55 years old. Respondents were distributed throughout the United States (Figure 1).

Neuro-ophthalmologists that responded to our survey tended to be practicing in very large cities, with an average population of 1,018,000 people. Only three respondents to our survey were practicing in a city with a population of under 125,000 people. The majority of survey respondents worked in a university, public, or government hospital 61% ($n = 17$) while 39% worked in private practice, either in a group or solo ($n = 11$). The relatively low response rate of our survey (6%) may have resulted in a non-representative sampling of the population of United States neuro-ophthalmologists.

Prior to the COVID-19 pandemic, telemedicine was rarely used in neuro-ophthalmology practice (Figure 2). Pre-pandemic, the surveyed use of telemedicine was only 19%, which increased to 78% post-pandemic.

The adoption of telemedicine varied by age group (Figure 3). Adoption in telemedicine was 100% for neuro-ophthalmologists below 40 years of age. The lowest use of telemedicine usage was seen in the 40–49 years age group, which may have been a result of the low number of neuro-ophthalmologists in this age group responding to our study ($n = 2$). The remaining age categories showed very similar levels of usage of telemedicine.

After the first stay-at-home orders, 68% of the neuro-ophthalmologists in our study temporarily stopped seeing all patients (Figure 4). This period with no patient consultations varied widely, from less than a week (11%), more than a week but less than a month (36%), more than a month but less than 3 months (18%). 32% did not stop seeing patients at all, while 4% had to self-quarantine during this time.

Neuro-ophthalmic patient volume varied widely throughout the pandemic (Figure 5).

For the first month of the pandemic, patient volume significantly declined, with many reporting almost no patients. Two months into the pandemic, the majority of neuro-ophthalmologists reported a significantly lower patient volume. After 6 months, patient volume tended to be similar to pre-pandemic levels. One year after the start of the pandemic, patient volume has increased significantly.

The use of Telemedicine in Neuro-ophthalmology

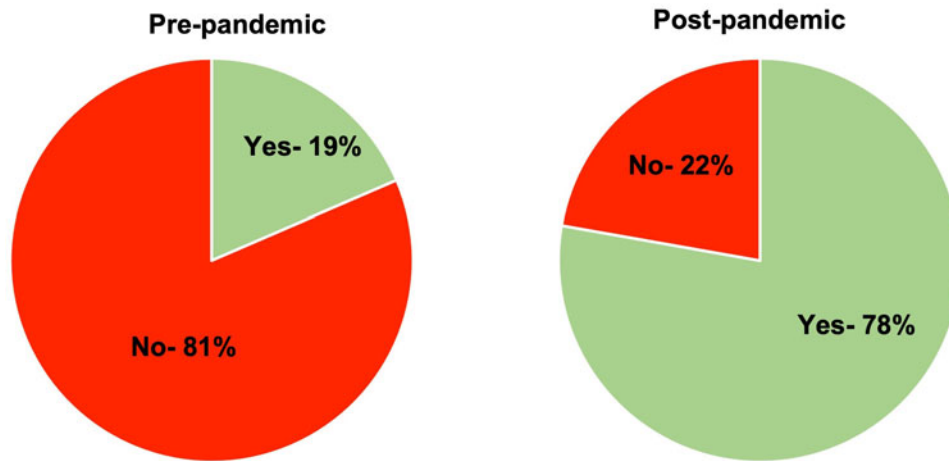


Figure 2: The adoption of telemedicine in neuro-ophthalmology greatly increased post-pandemic.

Telemedicine in Neuro-ophthalmic practice after the COVID-19 Pandemic

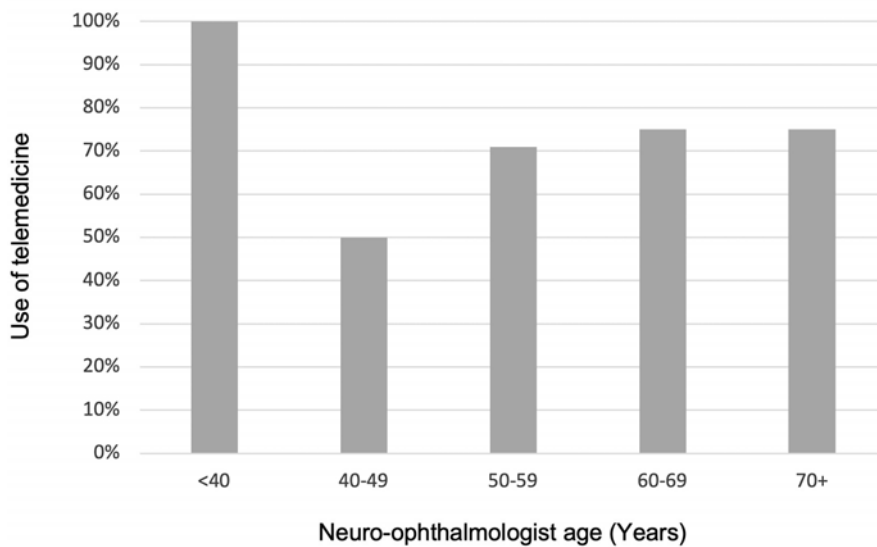


Figure 3: The usage of telemedicine in neuro-ophthalmology by age groups.

A variety of neuro-ophthalmic diseases were reported to have increased in severity during the pandemic by 77% of survey respondents (Figure 6). Of these conditions, idiopathic intracranial hypertension was reported to have worsened the most, followed by compressive optic neuropathies. Twenty-three percent (23%) of responding neuro-ophthalmologists reported no difference in disease severity.

Discussion

COVID-19 stay-at-home orders created significant barriers to neuro-ophthalmic care in the United States. Based on our survey, we believe that the likely pent-up demand for neuro-ophthalmic care after the pandemic will increase significantly. Neuro-ophthalmology is one of the most outpatient-oriented areas of medicine. The thousands of canceled neuro-ophthalmic visits at the start of the pandemic likely led to the delay of treatment that may have potentially led to significant preventable loss of vision. This is

particularly concerning due to the relatively low number of neuro-ophthalmologists relative to the United States population. The waitlist for a new appointment in neuro-ophthalmology in most parts of the country was already long pre-pandemic, and we believe that the pandemic shutdowns and restrictions likely further increased the difficulty to promptly access neuro-ophthalmic care.⁴ Debusk et al.⁴ reported pre-pandemic that there are no practicing neuro-ophthalmologists in six US states. Additionally, only eight states had met the ratio of one clinical full-time equivalent for every 1.2 million individuals. This likely explains the trend of significantly increased patient volume 1 year after the start of the COVID-19 pandemic seen in our study.

A study by Stunkel et al.⁵ showed the importance of early consultations with neuro-ophthalmology, in a study of 496 consecutive adult patients seen at three different neuro-ophthalmic clinics across the United States. This study found that in 49% of these patients, the referral diagnosis was incorrect and 26% of these misdiagnosed patients experienced harm.⁵ An early referral to

How long did you stop seeing patients after the first stay-at-home orders?

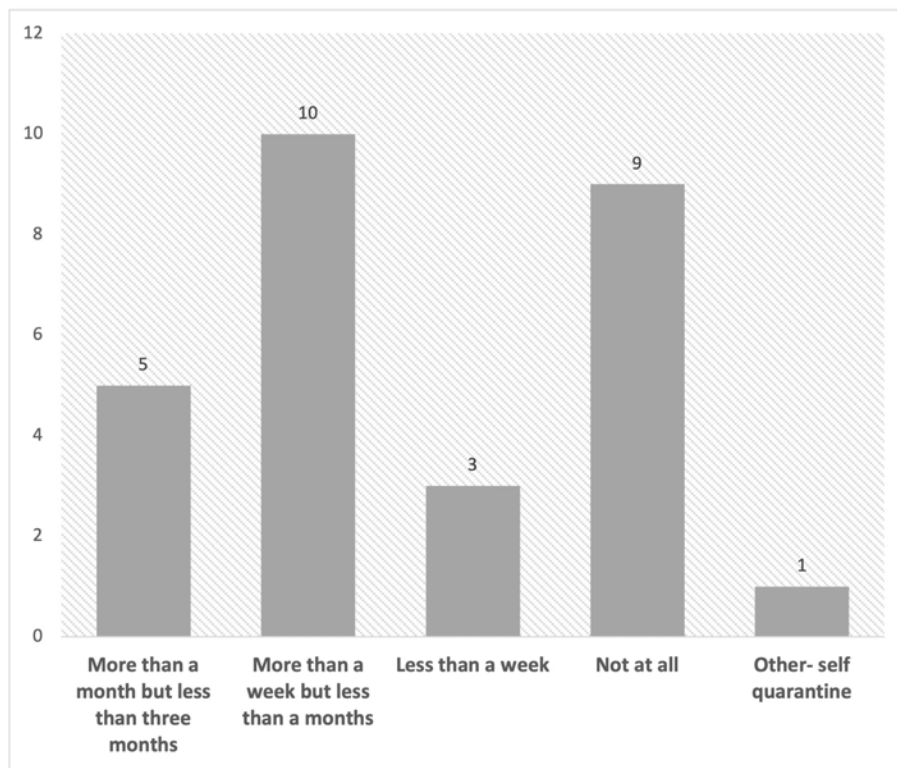


Figure 4: Schematic of the amount of time that neuro-ophthalmologists stopped seeing patients after stay-at-home orders.

Neuro-ophthalmology Patient Volume after start of COVID-19 Pandemic

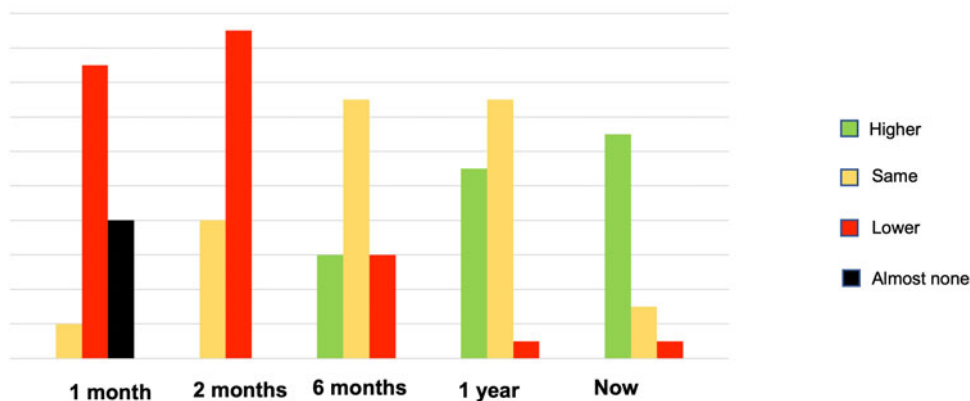


Figure 5: Neuro-ophthalmic patient volume after the start of the COVID-19 pandemic.

neuro-ophthalmology would have also prevented the need for unnecessary diagnostic imaging, laboratory testing, and treatment in many of these patients. This study shows the important of neuro-ophthalmic consultations and shows the potential danger that exists when barriers to neuro-ophthalmic care exist such as the COVID-19 pandemic.

Moss et al.⁶ studied neuro-ophthalmic patient encounters for a 3-month-long period in 2020 and found that compared with the year prior, neuro-ophthalmic care volume decreased, the use of telemedicine increased and the proportion of consults with established patients increased. It is important to note that this study only included four neuro-ophthalmologists, located in two geographic regions; however, these findings mirror the trends seen in our study. Jin et al.⁷ examined the usage of telemedicine in ophthalmology in Ontario, Canada, and found a significant increase at

the start of the pandemic, which later decreased. This study also found that ophthalmologists aged between 60 and 69 years were most likely to provide telemedicine services, in contrast to our study which found neuro-ophthalmologists below the age of 40 to be most likely to do so.

The COVID-19 pandemic highlighted the importance of telemedicine in neuro-ophthalmic practice. Phone visits may also be useful to discuss recent laboratory results, neuroimaging, and medication tolerance and compliance. Although less optimal than an in-person visit, video telemedicine can also be used to allow for external examinations to visualize conditions such as ptosis, strabismus, or orbital issues. Further advances are required to perform a full neuro-ophthalmic assessment, without the need for a patient to be physically present. The development of this technology would not only be useful for use during future pandemics but also allow

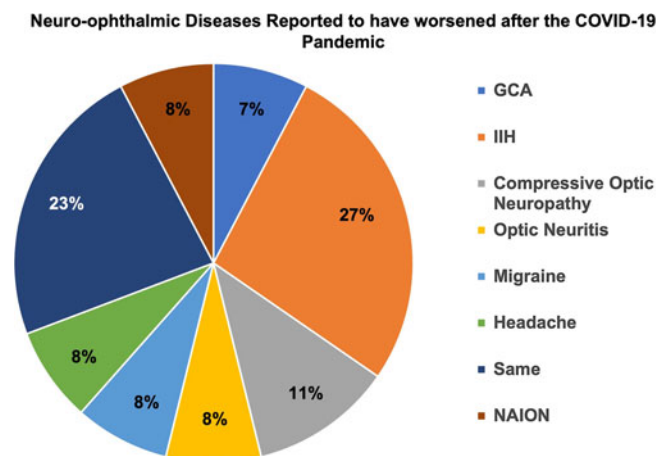


Figure 6: Neuro-ophthalmic diseases reported to have worsened after the COVID-19 pandemic.

patients in remote regions to access ophthalmic care. Our survey showed a significant lack of neuro-ophthalmologists practicing in small cities, which is a common trend in neuro-ophthalmic practice.

Additional research is needed to address the challenges to face-to-face patient care highlighted during the COVID-19 pandemic.⁸ Specifically, home-based, portable, or even “pop-up” testing sites could be a potential countermeasure to care restrictions in any future pandemic. Serious potential countermeasures considered at the home institution of one of us (AGL) included “pop-up” drive through intraocular pressure check stations, home computer-based visual acuity, color, and visual field testing applications and software, and drone-based testing for home delivery. Fortunately, the restrictions were relatively short lived and these countermeasures were never deployed. In addition, our research group is currently developing a head-mounted visual assessment device to assess subtle visual changes for astronauts in spaceflight.^{9–11} This novel technology may one day be useful terrestrially to aid ophthalmologists in conducting rapid, and comprehensive visual assessments at remote sites or at the patient’s home.¹² Having the ability to conduct an accurate visual assessment with a low-cost headset could be vital for ophthalmic monitoring in remote communities as well as in developing countries.¹³

Conclusion

To our knowledge, this study represents the largest study evaluating the impacts of COVID-19 on the subspecialty of neuro-ophthalmology. Neuro-ophthalmologists’ patient volume across the United States drastically slowed during the first two months of the pandemic, normalized around 6 months into the pandemic, and after 1 year increased significantly. We also report a significant increase in the use of telemedicine in neuro-ophthalmology.

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Statement of authorship. E.W. – Study Design, Data Acquisition, Writing, Figure Development.

J.O. – Study Design, Data Acquisition, Writing, Figure Development.

N.Z. – Review, Intellectual Support.

S.K. – Review, Intellectual Support.

A.G.L. – Review, Intellectual Support.

A.T. – Study Design, Data Acquisition, Review, Intellectual Support.

Conflict of interest. The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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