

## ORIGINAL RESEARCH ARTICLE

Assessment of depressive symptoms among  
medical students and doctors using PHQ-9Kamile Pociute<sup>1,2</sup>  and Sigita Lesinskiene<sup>1\*</sup> <sup>1</sup>Clinic of Psychiatry, Institute of Clinical Medicine, Faculty of Medicine, Vilnius University, Vilnius, Lithuania<sup>2</sup>Mental Health Centre, Karoliniškės Polyclinic, Vilnius, Lithuania**Abstract**

Medical students and doctors are at increased risk of experiencing depression. Doctors exhibit varying severity of depression symptoms at different stages of their careers. This study aimed to evaluate the prevalence of depressive symptoms among medical students and doctors using the Patient Health Questionnaire-9 (PHQ-9). We conducted a cross-sectional study in Lithuania from February to March 2024, using an anonymous online questionnaire that collected demographic data and included the PHQ-9. A score of  $\geq 10$  indicated criteria for depression. The questionnaire was completed by 146 respondents, comprising 77 medical students and 69 doctors or resident doctors. Overall, 40% of respondents met the criteria for depression, including 48% of medical students and 32% of doctors. Medical students had a higher mean PHQ-9 score compared to doctors, and the difference in PHQ-9 scores between students and doctors was significant ( $P = 0.045$ ). No significant differences were found in PHQ-9 scores between genders ( $P = 0.430$ ) or among respondents living in different city sizes ( $P = 0.780$ ). Our data align with the literature findings that medical students exhibit higher depression scores than doctors. The study underscores the importance of regularly monitoring the emotional well-being of medical students and doctors and implementing interventions to improve their emotional health.

**Keywords:** Medical students; Doctors; Residents; PHQ-9; Depression; Prevalence**\*Corresponding author:**Sigita Lesinskiene  
(sigita.lesinskiene@mf.vu.lt)**Citation:** Pociute K, Lesinskiene S. Assessment of depressive symptoms among medical students and doctors using PHQ-9. *J Clin Basic Psychosom.* 2024;2(3):3570. doi: 10.36922/jcbp.3570**Received:** May 3, 2024**Accepted:** June 6, 2024**Published Online:** July 5, 2024**Copyright:** © 2024 Author(s). This is an Open-Access article distributed under the terms of the Creative Commons Attribution License, permitting distribution, and reproduction in any medium, provided the original work is properly cited.**Publisher's Note:** AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.**1. Introduction**

The World Health Organization reports a global prevalence of depression among adults at 5%, with women being 50% more likely to experience depression than men.<sup>1</sup> Depression and anxiety contribute significantly to lost work time, costing the world economy about US\$1 trillion annually, a figure projected to rise to US\$16 trillion by 2030.<sup>2</sup> Studies indicate that the prevalence of depression among medical students, residents, and doctors is higher than in the general population.<sup>3-5</sup> During medical studies, the prevalence of depression increases, with reported symptoms varying widely from 1.4% to 73.5% among students.<sup>6</sup> Medical students experience numerous challenges, including intense academic rigor, financial difficulties, lack of sleep, lack of control, constant exposure to sickness and death, inappropriate behavior during studies, and/or other challenges.<sup>7</sup> Research revealed that doctors generally have better mental health ratings than medical students. For example, a study involving 1417 medical students, residents,

and doctors discovered that almost half of the students exhibited symptoms of depression, while about a third of doctors and residents did. However, despite doctors having better mental health ratings compared to students, their mental health remains poorer than that of the general population.<sup>8</sup> Factors such as being single, longer weekly working hours, an increased average number of on-call days per week, lower levels of expertise,<sup>9</sup> and personality traits such as perfectionism<sup>10</sup> significantly risk the emotional health of doctors. At work, doctors mostly deal with human health and constantly encounter a multitude of intense emotions in their interactions with patients. Some doctors employ strategies such as depersonalization and acquiescence to cope with negative emotions such as anger, frustration, and guilt, stemming from the tension between professional ideals of expertise and the realities of organizational constraints and self-preservation. These coping mechanisms may contribute to the deterioration of doctors' relationships with their work, posing a significant threat to the health system.<sup>11</sup>

Growing research underscores the significant impact of poor mental health among doctors on the health-care system, which includes lower quality of communication and/or care, increased errors, poorer overall outcomes, and/or higher costs.<sup>12</sup> The specifics of doctors' work often involve uncontrollable stress, unpredictability, and low work control. Research indicates that such uncontrollable stress directly disrupts the function of the prefrontal cortex, causing neuronal connections in this brain region to deteriorate, which explains the psychological difficulties experienced by doctors and the decline in their work efficiency when subjected to prolonged, chronic stress.<sup>13</sup> The decreased work productivity and errors among doctors lead to patient morbidity and mortality and pose an economic burden. For example, annually in England, there are 237 million medication errors, with 66 million potentially clinically significant. These avoidable adverse drug events cost the National Health Service £98,462,582 annually.<sup>14</sup> Despite global progress in reducing the harm caused by adverse effects of medical treatment (AEMT), the overall incidence and prevalence of AEMT remained largely unchanged.<sup>15</sup>

Considering the high rates of depression among medical students and professionals, the lack of studies, and depression's burden on the healthcare system, we have decided to investigate the symptoms of depression among medical students and doctors in Lithuania using the Patient Health Questionnaire-9 (PHQ-9). Our goal is to raise awareness about this critical population, stimulate further research, deepen understanding, and advocate for interventions aimed at improving mental health.

## 2. Methods

### 2.1. Study design and population

Between February and March 2024, we conducted a cross-sectional study involving medical students and doctors (including resident doctors) in Lithuania. The survey was conducted in Lithuanian and utilized an anonymous online survey consisting of the PHQ-9 and demographic questions. The distribution of the survey was carried out via social media platforms, specifically closed groups on Facebook dedicated to medical students and doctors.

We opted for a cross-sectional study design for two main reasons: Firstly, there is a lack of recent studies examining the prevalence of depression symptoms among doctors and medical students in the scientific literature, especially in Lithuania. Secondly, we intend to pursue further research aimed at implementing interventions to improve the mental health of medical students and doctors. The results of this research will guide our decision-making regarding which group — whether medical students or doctors — should be prioritized for these interventions.

### 2.2. PHQ-9

The severity of depressive symptoms was assessed using the Lithuanian version of the PHQ-9. The PHQ-9 is a self-administered instrument that is used for screening depressive symptoms and their severity in the general population. The PHQ-9 is a reliable and valid screening tool, demonstrating high sensitivity and specificity in detecting major depression.<sup>16,17</sup> So far, the PHQ-9 has been widely used in various scientific studies,<sup>18</sup> as well as in the screening for depression in doctors,<sup>19</sup> making it a valuable instrument for comparative analysis of results.

The questionnaire consists of nine questions and an additional patient-rated difficulty item assessing symptom-related impairment. Each answer is rated by the respondent on a 4-point Likert scale, ranging from 0 ("not at all") to 3 ("nearly every day"), reflecting experiences over the previous 2 weeks. Total scores range from 0 to 27, with higher scores indicating greater severity of depressive symptoms. The summed-item scoring method with a threshold of  $\geq 10$  is favored, as it seems to be a better option than the PHQ-9 algorithm in identifying major depression. When comparing a PHQ-9 cutoff of  $\geq 10$  to semi-structured interviews, sensitivity and specificity (95% confidence interval [CI]) were 0.88 (0.82 – 0.92) and 0.86 (0.82 – 0.88), respectively.<sup>20</sup> For major depression screening, we used a cut-off score  $\geq 10$ . Also, we presented the results by categorizing PHQ-9 scores into the following categories: none (0 – 4), mild (5 – 9), moderate (10 – 14), moderately severe (15 – 19), and severe (20 – 27). Our

survey did not include an additional patient-rated difficulty item.

As we proceeded with our discussion, evaluating the prevalence of depression symptoms compared to data from other countries on doctors' depression, we included a paragraph detailing studies that specifically used the PHQ-9 questionnaire to make comparisons more significant.

### 2.3. Sociodemographic variables

The questionnaire included demographic data such as gender, age, city size, and group. When selecting gender in the questionnaire, options included female, male, non-binary, or choosing not to say. When comparing PHQ-9 scores between genders, we compared them between men and women, as only two individuals chose non-binary, and one chose not to say. City size options included large cities (>250,000 inhabitants), medium cities (50,000 – 250,000), small cities (<50,000), and rural areas. The average PHQ score was compared between individuals living in large cities and others (medium cities, small cities, and rural areas). The group question allowed selections from medical students, doctors, and others. In the introductory text, we noted that the definition of doctor includes resident doctors.

### 2.4. Statistical analysis

The statistical analyses were conducted using MS Excel and SPSS v29 software. Given the non-normal distribution of the data, the Mann–Whitney U test was employed to assess differences in the PHQ-9 scores among the two groups. Statistical significance was defined as  $P < 0.05$ .

## 3. Results

A total of 146 respondents answered the questionnaire, with 77 identifying as “medical students,” 69 as “doctors,” and none selecting “other.” Among the respondents, 117 (80.1%) were female, 26 (17.8%) were male, two (1.4%) chose the non-binary option, and one (0.7%) preferred not to disclose their gender. The median age of respondents was  $24 \pm 8.26$  (range: 18 – 70 years). Regarding residency, 124 individuals reported living in a large city (more than 250,000 inhabitants), six in a medium-sized city (50,000 – 250,000 inhabitants), nine in a small city (<50,000 inhabitants), and seven in a rural area. The overall mean PHQ-9 score was  $9.60 \pm 5.93$ . Table 1 provides an overview of the demographic characteristics of medical students and doctors in this study.

### 3.1. PHQ-9 scores

A total of 59 (40.4%) respondents scored  $\geq 10$ , meeting the criteria for depression. Among them, 37 (48.1%) were

Table 1. Demographics of medical students and doctors

Demographics	Medical students	Doctors
Gender, <i>n</i> (%)		
Female	63 (81.8)	54 (78.3)
Male	13 (16.9)	13 (18.8)
Non-binary	1 (1.3)	1 (1.4)
Chose not to say	0 (0.0)	1 (1.4)
City size, <i>n</i> (%)		
Large city	62 (80.5)	62 (89.9)
Medium city	4 (5.2)	2 (2.9)
Small city	6 (7.8)	3 (4.3)
Rural area	5 (6.5)	2 (2.8)
Median age, years (min – max)	21 (18 – 24)	29 (25 – 70)
PHQ-9 (mean±SD)	10.49±5.89	8.46±5.52

Abbreviations: PHQ-9: Patient Health Questionnaire-9; SD: Standard deviation.

medical students, and 22 (31.9%) were doctors. The mean PHQ-9 score was  $10.49 \pm 5.89$  for medical students and  $8.46 \pm 5.52$  for doctors, revealing a statistically significant difference between the groups (mean rank: 80.12 vs. 66.11;  $P = 0.045$ ). For gender differences, the mean PHQ-9 was  $9.78 \pm 6.01$  for women and  $8.46 \pm 4.60$  for men. There was no statistically significant difference between genders (female mean rank = 73.29; male mean rank = 66.21;  $P = 0.430$ ). Among medical students, the mean PHQ-9 score for women was 10.86 and for men was 8.69, with no statistically significant difference found between genders (mean rank 39.98 vs. 31.35,  $P = 0.198$ ). Similarly, among doctors, the mean PHQ-9 score for women was 8.52 and for men was 8.23, with no statistically significant difference observed (mean rank = 33.65 vs. 35.46;  $P = 0.762$ ). Regarding residency, 124 individuals answered that they live in large cities and 22 in other areas. No statistically significant difference was found in the PHQ-9 scores between people who live in large cities and those in other areas (mean rank = 73.91 vs. 71.18;  $P = 0.780$ ). Correspondingly, no differences in PHQ-9 were found when comparing medical students ( $P = 0.577$ ) and doctors ( $P = 0.181$ ) living in different locations. Table 2 presents the detailed data on PHQ-9 scores between groups.

## 4. Discussion

Our study revealed that nearly half of medical students and a third of doctors met the criteria for depression. If we lower the threshold to include scores from five upwards instead of using a cut-off of  $\geq 10$ , the prevalence would be even higher. These findings are similar to previous research conducted in Lithuania. For example, a study conducted in 2019 discovered that 36% of medical residents and

**Table 2. PHQ-9 scores among medical students and doctors**

Depression severity	Medical students (n=77)	Doctors (n=69)
None – minimal (0 – 4), n (%)	12 (15.6)	20 (29.0)
Mild (5 – 9), n (%)	28 (36.4)	27 (39.1)
Moderate (10 – 14), n (%)	18 (23.4)	13 (18.8)
Moderately severe (15 – 19), n (%)	11 (14.3)	5 (7.2)
Severe (20 – 27), n (%)	8 (10.4)	4 (5.8)
Depression ( $\geq 10$ ), n (%)	37 (48.1)	22 (31.9)

26% of doctors in Lithuania have depressive symptoms, i.e., a PHQ-9 score  $\geq 10$ .<sup>21</sup> Our findings are also similar to a study conducted in Lithuania during the COVID-19 pandemic period (December 2020 – February 2021), which reported that 41.6% of medical students and residents had depressive symptoms with a PHQ-9 score  $\geq 10$ ,<sup>22</sup> although our study identified a higher prevalence among medical students. Looking at the 2019 population data in Lithuania, the proportion of people experiencing symptoms of depression was 18.1%. The highest prevalence of depressive symptoms in Lithuania is observed among people aged 75 and over (35%), and the lowest prevalence is among people aged 35 – 44 (11%). The prevalence of depression among people aged 15 – 34 is around 15%.<sup>23</sup> The aforementioned study assessed depressive symptoms using the PHQ-8. Research indicates that there is no difference in the operational attributes between the PHQ-8 and PHQ-9 for distinguishing major depressive disorder.<sup>24</sup> Both PHQ-9 and PHQ-8 exhibit comparable overall scores, with a slight decrease in sensitivity observed with the PHQ-8. However, their specificity remains similar.<sup>25</sup> Nevertheless, it is difficult to draw conclusions due to methodological differences in the studies, as well as the fact that our research was conducted during a different time than the data we presented for the general population of Lithuania. However, we can observe a tendency toward poorer mental health among health-care professionals compared to the general population.

Symptoms of depression among medical students, assessed using PHQ-9 with a cutoff of 10 or higher, vary widely across different countries, ranging from approximately 15 – 64%,<sup>26-29</sup> with the lowest prevalence in Nigeria and the highest prevalence among medical students in Iraq. No gender differences were found in studies conducted in Nigeria, whereas in Nepal, symptoms of depression were more common among women. Our findings are similar to those from European Union countries, such as Poland, where about 50% of medical students exhibited depressive symptoms in 2020,<sup>30</sup> and

a study in Greece in 2021 reported a prevalence of 45%, with significantly higher rates among women.<sup>31</sup> Regarding doctors, a similar prevalence to our study was observed in a study conducted in Latvia in 2020, where 25% of doctors exhibited symptoms of depression using the PHQ-9 questionnaire.<sup>32</sup> Similarly, using the same cut-off of  $\geq 10$ , a study in Malaysia published in 2021 reported that 25% of residents have depression.<sup>33</sup> In contrast, a study conducted in Romania in 2022 reported exceptionally high depression scores among residents, with a prevalence of 73% using the  $\geq 10$  cutoff. If we consider depression scores  $> 5$ , all residents would meet the criteria for depression. In the same study, depression scores for radiologists and infectious disease specialists were 34%. It should be noted that the sample sizes in the mentioned study were small, with only 15 residents surveyed and 35 doctors.<sup>34</sup>

Most of our reviewed cross-sectional studies consisted of research conducted in 2020 – 2021, a similar timeframe to the COVID-19 pandemic. Systematic reviews and meta-analyses conducted during similar periods indicate a lower depression rates among doctors compared to our research. For example, a systematic review and meta-analysis that analyzed the prevalence of depression among doctors globally during COVID-19, including studies conducted until March 2021, found that the pooled prevalence of depression was 21%. One of the conclusions drawn was that while symptoms of depression during COVID-19 are high, they may not be higher than pre-pandemic levels.<sup>35</sup> The lowest score was found among imaging doctors, with a prevalence of depression using the PHQ-9 being  $< 7\%$ . It is important to note that this study excluded doctors with diagnosed mental disorders, which may have contributed to the low prevalence of depression found.<sup>36</sup> The highest prevalence of depression was found among emergency medical doctors. Based on a Hospital Anxiety and Depression Scale score of 11 or higher, the prevalence was 74%.<sup>37</sup> Another systematic review and meta-analysis, which analyzed the prevalence of depression in healthcare workers from December 2019 to September 2020, found that 24% of medical doctors had depression.<sup>38</sup> In this systematic review and meta-analysis, the highest prevalence was found among doctors in China, with a rate of 45% using the Self-Rating Depression Scale.<sup>39</sup> The lowest prevalence was among pediatricians, at 8% using the 21-item Depression Anxiety Stress Scale, but the authors excluded mild depression scores. In the original article, we found that the prevalence is 17% when using a cut-off of  $\geq 10$ .<sup>40</sup> There is a lack of more recent studies that would have collected data on doctors' depression in 2023 or 2024. Our research shows slightly higher rates of doctor depression than those mentioned in the systematic reviews and meta-analyses during the COVID-19 pandemic period.

Our study revealed that female medical students exhibit slightly higher depression scores compared to males; however, this difference was not statistically significant. In addition, we did not observe a significant disparity in PHQ-9 mean scores between genders within the doctor population. It is important to note that our study involved a small sample of men, which could have influenced the results. Data from the general population often exhibit higher estimates of depression in women.<sup>1</sup> This difference is not unambiguous among doctors. There are studies showing a significant link between female gender and depression in medical students and doctors. For example, a study conducted in Saudi Arabia from December 2021 to January 2022 among 1<sup>st</sup>- and 2<sup>nd</sup>-year medical students found statistically significantly higher levels of depression among female medical students.<sup>41</sup> A study conducted in 2019 in China, assessing emergency doctors, also discovered that women were more likely to suffer from depression.<sup>42</sup> In the scientific literature, we can also find results showing no gender differences in depression or a higher prevalence of depression among men than among women. A study conducted in 2020 found no difference in the prevalence of depression between Moroccan male and female medical doctors.<sup>43</sup> A study conducted in Nepal reported higher depression rates among male medical students and proposed that female students' increased involvement in extracurricular activities might have contributed to better stress management, overall mental well-being, and lower depression rates.<sup>44</sup> Further research is needed to better understand the prevalence of depression among genders and related factors.

Specific environmental factors of urbanization, such as social deprivation, air pollution, street networks, and urban land-use density, are positively correlated with poorer mental health.<sup>45</sup> Previous studies indicated that in developed countries, depression is more prevalent in urban areas than in rural ones, while this is not the case in developing countries.<sup>46</sup> In contrast, a study in the United States of America (US) reported that people living in larger urban areas had significantly lower rates of depression.<sup>47</sup> Another study from the US did not find any differences in rates of psychiatric diagnosis between people from rural and urbanized areas.<sup>48</sup> Studies assessing doctors' mental health based on the size of the city in which they live are lacking. Our study showed that doctors living in larger cities were more depressed, although the difference was not statistically significant. However, it would be meaningful to further investigate this aspect in future studies, as there is limited literature on mental health in relation to city size.

Doctors appear to experience depression more often than the general population; yet, the exact causes and

barriers to seeking help remain unclear. Out of 316 Pakistani medical students, 44% had a negative attitude toward seeking professional help. When students were asked about barriers to seeking help, social stigma was the most frequently mentioned factor.<sup>49</sup> Beliefs about confidentiality, the impact on career progression, and other convictions can also hinder seeking help.<sup>50</sup> Research indicates that doctors with high rates of anxiety, depression, and stress are more prone to having negative attitudes towards seeking help for their mental health.<sup>51</sup> It is important to find ways to help doctors access mental health services when they feel their mental health is deteriorating. Furthermore, it could be helpful to develop and implement screening models that are not only effective but also acceptable to clinicians. Artificial intelligence could also be used for this purpose; e.g., studies reported that accurate voice recognition of depression can be as high as 90%.<sup>52</sup>

It would be important to further investigate the risk factors for depression among doctors. For instance, a study reported that shorter sleep duration is significantly associated with higher depression and suicidal ideation scores.<sup>53</sup> A study conducted in Egypt reported that 22% of doctors had been diagnosed with psychiatric disorders, with no significant difference in depression prevalence across almost all specialties. They also indicated that doctors with fewer academic degrees tended to exhibit more symptoms of depression.<sup>9</sup> In another study, younger age and employment at a primary care hospital were identified as risk factors.<sup>54</sup> Factors such as longer working hours,<sup>55</sup> living with family members aged  $\leq 16$  or  $\geq 65$  years,<sup>56</sup> higher work demands, and lower recovery experience<sup>57</sup> could also have an impact on worsened mental health. It is also important to evaluate the risk factors using a cultural lens. For example, a risk factor like neuroticism may be a risk factor in the US population, but it may not increase the risk of depression in the Chinese population.<sup>58</sup> Race/ethnicity can also affect doctors' mental health. In a study examining US doctors, the Hispanic/Latinx, non-Hispanic Black, and non-Hispanic Asian incidence of occupational burnout was lower compared to non-Hispanic White doctors. However, no disparities by race/ethnicity were observed in terms of depressive symptoms or career satisfaction.<sup>59</sup> The exploration of the risk factors for depression among medical students and doctors remains one of the most important directions for further research.

Protective factors should be an area of further research. One study reported that students who initially had high levels of self-efficacy, resilience, and cognitive self-regulation were more likely to be classified as non-depressed.<sup>60</sup> Resilience was also identified as an important factor in addressing depression in another

study conducted with doctors. Researchers found a negative correlation between total resilience scores and depression.<sup>52</sup> Long years of service, specifically more than 20 years of service, are indicated as one of the protective factors in one of the studies.<sup>54</sup> Biological markers, such as telomere length, could serve as helpful tools for identifying stress in health-care professionals. The study reported that during the internship, telomere length significantly shortens, and this shortening is six times greater than typical telomere shortening in other populations. Greater telomere shortening among doctors is associated with longer working hours, a stressful family environment, and neuroticism.<sup>61</sup> The biological and cultural aspects should not be excluded from further research on doctors' health.

It is known that depression rates tend to increase globally. For example, a study conducted in Norway comparing the well-being of medical students in 2015 to those who studied at the same faculty from 1993 to 1999 found that the well-being of students in 2015 was significantly worse.<sup>62</sup> In Lithuania, there is also a trend of increasing depression symptoms, with rates rising from 12.4% in 2014 to 18.1% in 2019.<sup>23</sup> During the COVID-19 pandemic, more cases of depression have emerged globally.<sup>63</sup> To better understand the prevalence of depression among healthcare professionals and compare it with the general population of other countries, it would be important to conduct international studies during the same period and use the same screening instruments.

It is essential to implement effective interventions to improve emotional well-being in medical study programs and healthcare systems. Various educational and skill-building interventions can have a positive impact. One such example is an intervention like the 8-week mindfulness course for doctors, which has been shown to improve patient safety and reduce errors compared to a group of doctors who did not undergo this mindfulness training.<sup>64</sup> Special mobile apps also show a positive effect on the mental health of healthcare professionals. For example, researchers conducting a randomized trial found that a mobile app designed to reduce burnout significantly reduced burnout scores compared to the control group.<sup>65</sup> Future studies should investigate the benefits and effectiveness of implementing interventions aimed at medical students and doctors, as well as combinations of various interventions.

This study encountered several limitations. It is important to acknowledge that the PHQ-9 functions primarily as a self-report screening tool rather than a diagnostic instrument. Therefore, scores exceeding validated thresholds may not always indicate clinically significant depression. Furthermore, the small sample size

and the non-random sampling method employed in our study suggest that our data may not fully represent the entire target population. In future studies, it would also be important to categorize and analyze medical students based on their academic years of study. In addition, it would be necessary to separately analyze residents, and it would also be valuable to analyze groups of doctors based on their specialization or age.

## 5. Conclusion

Half of medical students and one-third of doctors exhibited symptoms of depression. Regular screening for mental health among health-care professionals, along with interventions aimed at improving mental well-being, holds paramount importance within medical education and practice. Recognizing and addressing barriers within the medical community that discourage seeking help and engaging in preventive initiatives are crucial steps toward improving doctors' mental health outcomes and ensuring high-quality care.

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## Conflict of interest

The authors declare that they have no competing interests.

## Author contributions

*Conceptualization:* All authors

*Formal Analysis:* Kamile Pociute

*Investigation:* All authors

*Methodology:* All authors

*Writing – original draft:* Kamile Pociute

*Writing – review & editing:* Sigita Lesinskiene

## Ethics approval and consent to participate

Ethics board approval was deemed not necessary for this study since participation was voluntary, and the research posed no health risks to participants.

## Consent for publication

Not applicable.

## Availability of data

Data used in this work are available from the corresponding author on reasonable request.

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