Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Beyond the Fear: A Conceptual Exploration of Neurophobia and Neurohesitancy Among Palestinian Medical Students and Interns Doctors

Salsabeel Juma
Al-Quds University
Tala Nori
An-Najah National University
Sara Shanaa
Hebron University
Bayan Alqtishat
Al-Quds University
Peter Bael
peter.bael@students.alquds.edu

Al-Quds University

Research Article

Keywords: Neurophobia, Neurology Education, Neuroscience, Medical Education, Palestine

Posted Date: May 22nd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9727392/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Jozefowicz defines neurophobia as “the fear of neuroscience and clinical neuroscience on the part of medical students”. Based on Bandura’s Social Cognitive Theory, our study proposes neurophobia as a consequence of low levels of self-efficacy, which is explained by environmental and educational obstacles. We aim to estimate neurophobia in Palestine and introduce the concept of “Neurohisitancy” to illustrate the conditional avoidance despite having interest.

Methods

We carried out a cross-sectional study with an online survey, conducted between September 2025 and January 2026. We developed a questionnaire designed to identify independent predictors of neurophobia and using logistic regression to determine the neurohesitant demographic students who would choose neuroscience and neurology only if educational methods changed.

Results

Our sample included 380 responses, 18.95% of them showed neurophobia, which is lower than regional and global averages despite scarcity of resources. Interestingly, a significant 22.63% of the sample was identified as “neurohesitant”. Transition from medical student into intern doctor reduces the prevalence from 26.28% to only 16%, this meaningful reduction explained by “reality shock” in the clinical rotations that negatively impacts self efficacy.

Conclusion

In lines with Murphy at el, intrinsic interest worked as a potent protective factor, significantly buffering students against neurophobia. While primary drivers of hesitancy are represented by reduced confidence in neurological examination and perceived insufficiency of educational resources.

Introduction

Studying neuroscience poses a significant challenge for medical students. Compared to other specialties, both academic excellence and specialty interest are rarely harbored by students. [1] From this perspective, Jozefowicz defines neurophobia as “the fear of neuroscience and clinical neuroscience on the part of medical students.” [2]

Neurologic disease exerts a heavy burden globally, as it negatively impacts quality of life for more than 3 billion patients, and is considered to be the cause of ill health and disability worldwide. It is the cause of

80% of the mortality and morbidity rate in the middle-and low-income countries, with the latter attributed to challenges in accessing treatments [3].

The prevalence of Neurologic disease and its effects are obvious globally. It is important to acknowledge it in the Palestinian condition. Stroke affects 3% of the Gaza Strip population [4], while in the West Bank there is a lack of information about prevalence, but in 2018, stroke contributed to 12% of the in-hospital mortality rate of patients, and 23% of patients suffered from at least one complication. Unfortunately Palestinian hospitals are experiencing scarcity of advanced treatment such as acute thrombolysis, mechanical thrombectomy and post-discharge rehabilitation[5].

Palestine is suffering from shortages of equipment and treatments necessary for these specialties, along with an inadequate number of neurologists and neurosurgeons, with an average 1 neurosurgeon for a population of 132,000 [6]. This shortfall extends into residency programs and medical student training, with an absence of neurology residencies, and minimal neurosurgical training, emphasizing the need to develop special and effective training. [7]

To date, most research on neurophobia focuses on the prevalence and risk factors, lacking the theoretical basis to address its underlying causes and possible reversibility. We think neurophobia is not only an intrinsic avoidant; on the contrary, it’s a consequence of decreased self-efficacy, as students' beliefs of mastering neuroscience are diminished by educational barriers and healthcare system problems.

In addition to identifying the prevalence and risk factors for neurophobia, we introduce a new term, "neurohesitancy." We define it as a state of conditional specialty choice depending on the quality of neuroscience education and training. We offer an advance in knowledge as we study neurophobia in the Palestinian context and its resource-limited and high-stress environment. We aim to change the perspective on neurophobia.

Methodology

We carried out a cross-sectional study with an online survey, conducted between September 2025 and January 2026, to estimate the prevalence of neurophobia among Palestinian medical students and intern doctors. We chose this study design because it helps us to reach our objectives and determine the prevalence, risk factors, and impact of neurophobia on academic performance and on choosing a future career.

Eligible participants were Palestinian medical students studying medicine at different Palestinian universities, and fresh graduates of local universities. We excluded first-year students, as they hadn’t encountered neuroscience in their courses yet. We disseminated our online self-filled questionnaire through targeted emails and social media platforms. We used a convenience sample, with a calculated minimum sample size of 380 based on a 95% CI and 5% margin of error.

We developed a questionnaire based on previous literature; containing 16 items in the Arabic language, covering different aspects related to teaching, practice and future prospects. This scale was validated by 3 independent experts including 2 neurologists and a medical education expert. Collected data also included demographics and career choice. Before continuing data collection, we conducted pilot testing among 90 students to assess clarity, validity, and reliability, ultimately subtracting a question from the scale.

The data was cleaned, and analyzed using R version 4.5.2. A P-value of 0.05 or less was considered significant. We developed a new neurophobia scale based on the NeuroQ scale, but supplemented with 8 additional questions to improve validity and reliability. The scale's final Cronbach α was 0.73, used to assess its internal consistency. We described our sample with frequencies and percentages for categorical data, and means and standard deviation for continuous variables. We also performed Chi-square tests with Cramer's V for relevant variables. Ultimately, we determined the main risk factors behind Neurophobia using logistic regression, with inclusion of statistically significant variables from bivariate analysis and factors deemed clinically relevant. Neurophobia was defined as anyone with a score above 60%.

Results

Our sample included 380 responses, of which 53.95% were medical students (n=205) and 46.05% were intern doctors (n=175). 41.05% were clinical students (n=156). The majority of our students attended or graduated from northern medical schools (45.53%, n=173) or central medical schools (35.53%, n=135). The mean age was 22.83 ± 1.68, with 85.26% of our sample composed of females (n=324). Most of our participants were from cities (45.26%, n=172), or villages (32.1%, n=122). Up to 83.42% (n=317) of our sample were 1st generation doctors. 17.63% (n=67) of our students had not taken neurology rotations. Student responses to the questionnaire are summarized in table 1.

Table 1: Questionnaire Responses		
Statement	Response	n (%)
Neuroscience courses are harder than other courses	Strongly Agree	48 (12.63%)
	Agree	178 (46.84%)
	Neutral	81 (21.32%)
	Disagree	69 (18.16%)
	Strongly Disagree	4 (1.05%)
I feel anxious and unconfident when studying neuroscience subjects	Strongly Agree	34 (8.95%)
	Agree	122 (32.11%)
	Neutral	92 (24.21%)
	Disagree	113 (29.74%)
	Strongly Disagree	19 (5%)
I’m not confident when being examined for neuroscience subjects	Strongly Agree	23 (6.05%)
	Agree	132 (34.74%)
	Neutral	149 (39.21%)
	Disagree	67 (17.63%)
	Strongly Disagree	9 (2.37%)
I don’t trust my therapeutic or diagnostic skills in the neurosciences (During exams or clinical scenarios)	Strongly Agree	28 (7.37%)
	Agree	143 (37.63%)
	Neutral	153 (40.26%)
	Disagree	52 (13.68%)
	Strongly Disagree	4 (1.05%)

It’s harder for me to recall neuroscience subjects than other medical subjects	Strongly Agree	141 (37.11%)
	Agree	64 (16.84%)
	Neutral	116 (30.53%)
	Disagree	53 (13.95%)
	Strongly Disagree	6 (1.58%)
Neuroanatomy is harder than other disciplines in anatomy	Strongly Agree	84 (22.11%)
	Agree	140 (36.84%)
	Neutral	85 (22.37%)
	Disagree	63 (16.58%)
	Strongly Disagree	8 (2.11%)
I find the neurosciences interesting	Strongly Agree	142 (37.37%)
	Agree	159 (41.84%)
	Neutral	56 (14.74%)
	Disagree	20 (5.26%)
	Strongly Disagree	3 (0.79%)
The lack and limitations of treatment options make the neuroscience less appealing*	Strongly Agree	39 (10.26%)
	Agree	136 (35.79%)
	Neutral	137 (36.05%)
	Disagree	53 (13.95%)
	Strongly Disagree	15 (3.95%)
How do you evaluate your knowledge of neurologic examinations**	Strongly Agree	33 (8.69%)
	Agree	133 (35%)

	Neutral	140 (36.84%)
	Disagree	62 (16.32%)
	Strongly Disagree	12 (3.16%)
The transition from basic science to clinical sciences is smooth in terms of neurosciences**	Strongly Agree	19 (5%)
	Agree	98 (25.79%)
	Neutral	132 (34.73%)
	Disagree	98 (25.79%)
	Strongly Disagree	33 (8.69%)
The lack of adequate learning resources for the neurosciences has made it more difficult	Strongly Agree	70 (18.42%)
	Agree	150 (39.47%)
	Neutral	108 (28.42%)
	Disagree	43 (11.31%)
	Strongly Disagree	9 (2.37%)
We were taught how to do the neuroexam well**	Strongly Agree	50 (13.16%)
	Agree	127 (33.42%)
	Neutral	121 (31.84%)
	Disagree	57 (15%)
	Strongly Disagree	25 (6.58%)
Neuroscience lectures were not of good quality	Strongly Agree	57 (15%)
	Agree	104 (27.37%)
	Neutral	127 (33.42%)
	Disagree	73 (19.21%)

	Strongly Disagree	19 (5%)
I would rather specialize in the neurosciences (Whether in terms of research or clinical specialty)	Strongly Agree	36 (9.47%)
	Agree	73 (19.21%)
	Neutral	117 (30.79%)
	Disagree	100 (26.32%)
	Strongly Disagree	54 (14.21%)
*This Question was dropped from the final scale, but was reported for the sake of its findings **Students were told to answer these questions based on experience, or their perception of it based on their older colleagues' impressions if they had no experience		

When explicitly asked about considering a specialization in neuroscience or neurology, 39.21% said yes (n=149). This number grew to 61.84% (n=235) when asked if they would reconsider should neuro-based teaching be enhanced in medical schools, leaving us with 22.63% (n=86) of our students in a conditional state of wanting to pursue neuroscience but having reservations due to the state of education.

The prevalence of neurophobia was 18.95% (n=72). This prevalence was highest among the aforementioned conditional students at 29.07% (n=25), and overall correlated with the interest state (X^2=29.59, p<0.001, Cramer's V=0.279). It was also most correlated (X^2=11.7, p=0.003, Cramer's V=0.175) among clinical students at 26.28% (n=41), as opposed to 16% in interns (n=28%).

Using logistic regression, we were able to rule out the effect of having completed the neurology rotation, being a 1st generation doctor, the geographic location, sex and age on neurophobia which were all insignificant. Our final model found an increase in risk in doctors living in towns (OR: 2.29, 95% CI: 1.13-4.63, p = 0.021), clinical stage students (OR: 4.99, 95% CI: 1.37-18.24, p = 0.015), and an equal risk in students with no interest or conditional interest with a protective effect on students with a clear interest in a career in neuroscience (OR: 0.16, 95% CI: 0.07-0.38, p < 0.001), (AIC=334.28). A forest plot summary is shown in figure 1.

Discussion

This is the first study to outline neurophobia among Palestinian medical students and interns, framed by Bandura's social cognitive theory. Our findings reveal neurophobia affects 18.95% of students, representing nearly one-fifth of participants. This is significantly lower than other better-resourced neighboring countries. The prevalence of neurophobia in Arab countries ranges from 26% to 85.5% [8-11]. This pronounced variation may be explained by the interplay between self-efficacy and

environmental stressors and not be a linear consequence of one of them. In the Palestinian context, a specialist and training facility shortage [5, 6] impedes students' belief in their capability of expertizing these modules. Nonetheless, the relatively low prevalence sheds light on a protective factor against these obstacles, which we will elucidate in this study; the importance of interest and intrinsic resilience in the etiology of neurophobia, and the concept of "neurohesitancy". It is of note that since we used a modified validated scale with a higher cronbach α, previous studies may have overestimated the prevalence of neurophobia. [12]

Introduction of neurohesitancy demographics

We propose the term Neurohesitancy to describe a state of conditional specialty choice depending on the quality of neuroscience education and training. This group accounted for 22.63% of our sample. The substantial difference between those who would specialize in the neurosciences, which is 39.21%, as opposed to those who would specialize in the neurosciences if they had received better education, which is 61.84%, provides evidence that neurophobia is not a static binary state. This is consistent with a recent study by Murphy et al. that revealed the reversibility of neurophobia [14]. Our study also found an important link of this state of neurohesitancy to neurophobia. By introducing the neurohesitant demographic, we offer a conceptual solution: neurophobia is not a genuine anxiety but rather an avoidance of neuroscience from perceived misconceptions. This shifts the global focus to modifying the educational systems which lead to this phenomenon. The conceptual framework of our study is illustrated in figure 2.

Our findings are supported by Murphy et al. who also reported on the reversibility of neurophobia and the relevance of education quality and teaching on its development. A study from Singapore further commented on the ambiguity of the term "Neurophobia" as opposed to neuroanxiety. Our findings are further suggestive of this terminology as reversible, manageable and more realistic, based on intrinsic interest-based factors and a more important issue of medical education with the possibility for elimination. [14]

Impaired self-efficacy and the clinical reality shock

Our data highlights the significant difference between the prevalence of neurophobia in the clinical years, which constitutes 26.28%, compared to intern physicians at 16%. This may be due to "reality shock" as students transition from basic neuroanatomical and physiological to clinical rotations, as well as encounter the limitations of the Palestinian healthcare system. These difficulties affect their self-efficacy negatively and increase neurophobia, but results showed that hands-on experience in the internship serves as a positive intervention that restores confidence. This supports our earlier conversation that neurophobia is a dynamic state that can be influenced by clinical experience and suitable effective mentorship.

More than 50% of our participants reported experiencing difficulty with studying neuroscience, despite 79% showing interest in it. This intriguing discrepancy indicates a multifaceted relationship between the two. These findings may suggest perceived difficulty can simultaneously generate fear and intellectual

curiosity, especially when the specialty is perceived as intellectually stimulating. Our findings differed from Egyptian studies, which revealed 41-44% of students perceived neurology as a difficult subject, while only 33-38% of them considered it an interesting specialty. [10]

Predictors of neurophobia: geography and previous interest.

Beyond this, our logistic regression model found predictors that further validate our conceptual framework: students residing in towns were at higher risk for developing neurophobia than those in cities. This is attributed to the resource access gap, as they face more difficulties encountering specialized centers or having more observational learning, a fundamental part of Bandura's theory. While having a previous interest in neuroscience serves as a potent protective barrier. Consistent with Murphy et al. This interest works as an internal motivator for students to encounter challenges, cope with them, and overcome them. [13]

Rejuvenating Interest in the Neurosciences

The critical significance of our findings is offering a base for the workforce shortage and encouraging the development to rescue the lost potential, whom we defined previously as "neurohesitant," which constitutes 22.28% of our participants. We recommend enhancing the educational system by incorporating interventional methods aimed at raising students' self-efficacy, such as stimulation-based learning, longitudinal mentorship, and simplified diagnostic guidelines. By targeting neurohesitant groups, medical schools can play a role in addressing the shortages in specialists and providing better neurological care in resource-limited countries.

Our findings highlight how educational and training deficiencies affect the development of neurophobia. As many of our participants mentioned diminished confidence in neurologic examination and making diagnoses. Rather than decreased interest in neurology or their capability, they reported the following as contributing factors: insufficiency of resources and poor-quality lectures, difficulty recalling the information, and neuroanatomy being harder than other disciplines. These factors aligned with those mentioned in the Egyptian and Sudanese research. [10, 11]

Neurophobia in our study has a defined pattern, as it increases - up to 26.28% - in the clinical years but decreases after graduation to 16%. Indicating that intensive clinical training exacerbates students' anxiety toward neuroscience. This trend may be explained by reality shock, exam-driven anxiety, fear of neurological examinations, and clinical responsibility pressure.

The critical significance of these findings stems from their effect on the student's future specialty decision. As 22% of our participants would choose neurological specialties if the method of education changes. This percentage reveals that neurophobia is not an isolated problem but an underlying factor for students' decisions.

Interestingly, having a previous interest in neuroscience was a protective effect from neurophobia, as they may develop higher self-efficacy, which refers to the belief of an individual in being able to handle and succeed in performing a task. And according to Bandura's social cognitive theory, those who have higher self-efficacy will perform much better, putting themself in a more challenging environment with trust to solve it, as well as reducing their anxiety and perceived difficulty, making them less susceptible to neurophobia. [15,16] This also helps distinguish between pure interest in neurology as different from the concept of neurophobia - the fear of neurosciences.

We found no relationship between neurology rotation/neuroscience course completion and neurophobia. This may be attributed to a lack of structured feedback for students, theoretical and observership rotations rather than patient intensive ones, and the short length of rotations compared to the large material assigned. We found no correlation between sex and neurophobia, though this could be due to our majority female sample.

Limitations & Recommendations:

The main limitation of our study is the cross-sectional study design which allows us to measure prevalence, but limits the generalizability of our correlational analysis. We also measured the overall impression on neurosciences as a whole, which may have introduced confounders for the interpretation of our findings for neurology, neurosurgery and neuroscience separately. Finally, we depended on an online survey and convenience sample which further limits the generalizability of our findings, particularly since the majority of our sample was composed of females.

Nonetheless, we believe that our findings are important for neurologic education as a whole, and offer not only a better tool for neurophobia assessment, but also for the university-based interventions into improving medical education and neurologic output. We recommend specific interventions into improving neuroscience education among medical schools with an emphasis on patient interaction, more hands-on training education and teaching, and simplification of concepts to ease the learning process. We also recommend the use of a prospective longitudinal design for better dynamic assessment of the condition. We also propose the involvement of medical students themselves continuously and actively into combating neurophobia both based on general opinion, and active representation in curriculum development and in the popularization of neuro-based interest groups.

Declarations

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Consent For Publication:

Not Applicable.

Ethics Approval & Consent to Participate:

This study was conducted in accordance with the declaration of Helsinki, and received ethics approval from the Al-Quds University Ethics Committee, under the identifier: 585/REC/2025. Informed consent for the participation in the study and publication of its findings was taken from all participants prior to data collection.

Funding:

This project has not received any funding.

Author contributions:

SJ - Data Curation, Investigation, Methodology, Validation, Writing - Original Draft. TN - Data Curation, Investigation, Methodology, Validation, Writing - Original Draft. SS - Data Curation, Investigation, Methodology, Validation, Writing - Original Draft. BA - Conceptualization, Investigation, Methodology, Project Administration, Supervision, Validation, Writing - Original Draft. PB - Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Validation, Writing - Original Draft.

Declaration of competing interest:

The authors have no competing interests to declare.

Acknowledgments:

The authors would like to acknowledge the role of the Medical Research Club in the preparation and mentorship of this project.

Generative AI use:

Generative AI and AI-assisted technologies were NOT used in the preparation of this work.

List of Abbreviations:

No abbreviations were used.

References

1. Jozefowicz RF. Neurophobia: the fear of neurology among medical students. Arch Neurol. 1994;51(04):328–9.
2. McCarron MO, Stevenson M, Loftus AM, McKeown P. Neurophobia among general practice trainees: the evidence, perceived causes and solutions. Clin Neurol Neurosurg. 2014;122:124–8. https://doi.org/10.1016/j.clineuro.2014.03.021.
3. Over. 1 in 3 people affected by neurological conditions, the leading cause of illness and disability worldwide. Geneva: World Health Organization; 2024 Mar 14. Available from: https://www.who.int/news/item/14-03-2024-over-1-in-3-people-affected-by-neurological-conditions--the-leading-cause-of-illness-and-disability-worldwide
4. Abuawad M, Daqour A, Alkaiyat A, Rjoub A, Zahra WA, Issa N, Dumaidi Y, Nasser S. Epidemiology of primary brain tumor among adolescents and adults in Palestine: a retrospective study from 2018 to 2023. BMC Neurol. 2024;24(1):168. https://doi.org/10.1186/s12883-024-03677-1.
5. Khatib R, Jawaadah AM, Khammash U, Babiker A, Huffman MD, Prabhakaran S. Presentation, Management, and Outcomes of Acute Stroke in Palestine. J Am Heart Association. 2018;7(22):e010778. https://doi.org/10.1161/JAHA.118.010778.
6. Darwazeh R, Darwazeh M, Sun X. History of Neurosurgery in Palestine. World Neurosurg. 2017;104:39–44. https://doi.org/10.1016/j.wneu.2017.04.150.
7. Nashef L, Prevett M. Letter from Palestine: undergraduate neurology. Pract Neurol. 2011;11(4):256–8. https://doi.org/10.1136/practneurol-2011-000057.
8. Abulaban AA, Obeid TH, Algahtani HA, Kojan SM, Al-Khathaami AM, Abulaban AA, Bokhari MF, Merdad AA, Radi SA. Neurophobia among medical students. Neurosciences J. 2015;20(1):37–40. https://nsj.org.sa/content/20/1/3.
9. Aljthalin RA, Aljagwani AS, Alshammari MA, Althaqafi AO, Almutairi MA, Alotaibi NM. Perceptions and satisfaction of Saudi medical students with neurology education: A national exploratory study. Dr Sulaiman Al Habib Med J. 2019;1:83–7. https://doi.org/10.2991/dsahmj.k.190820.001.
10. Farrag A, Abdelraouf A, Samir S, El–Sayed H, Mahmoud R. Assessing neurophobia: A comparative study of awareness and prevalence among medical students at Badr University in Cairo and Helwan University. Egypt J Neurol Psychiatry Neurosurg. 2025;61:82. https://doi.org/10.1186/s41983-025-01013-z.
11. Mohamed AA, Ahmed AM, Hassan MA. Neurophobia among medical students: A cross–sectional study from Sudan. EC Neurol. 2019;11(5):372–8. https://ecronicon.net/assets/ecne/pdf/ECNE–11–00506.pdf.
12. McGovern E, Louapre C, Cassereau J, Flamand-Roze C, Corsetti E, Jegatheesan P, Bendetowicz D, Giron C, Dunoyer M, Villain N, Renaud MC, Sauleau P, Michel L, Vérin M, Worbe Y, Falissard B, Roze E. NeuroQ: A neurophobia screening tool assesses how roleplay challenges neurophobia. J Neurol Sci. 2021;421:117320. 10.1016/j.jns.2021.117320. . Epub 2021 Jan 20. PMID: 33518377.
13. Tan Y, Lin SZZ, Tan Z. From Neurophobia to Neuroanxiety: An Opportune Review of Its Definition and Impact on Neurology Educators and Learners. Neurol Educ. 2025;4(3):e200247.

https://doi.org/10.1212/NE9.0000000000200247.

14. Murphy S, Carey E, Dablouk L, Alomairi J, Maasarani J, Ong JB, Gupta K, Sharma RM, McCracken O, Shinyanbola D, Alrujaib A, Sheridan R, Teixeira LM, O'Byrne GP, Rafiq N, Mazarakis N. & O'Brien, D. (2024). Neurophobia amongst medical students: Hype or reality. *Brain & spine*, *4*, 104134. https://doi.org/10.1016/j.bas.2024.104134
15. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977;84(2):191–215. https://doi.org/10.1037//0033-295x.84.2.191.
16. Artino AR Jr. Academic self-efficacy: from educational theory to instructional practice. Perspect Med Educ. 2012;1(2):76–85. https://doi.org/10.1007/s40037-012-0012-5.

Figures

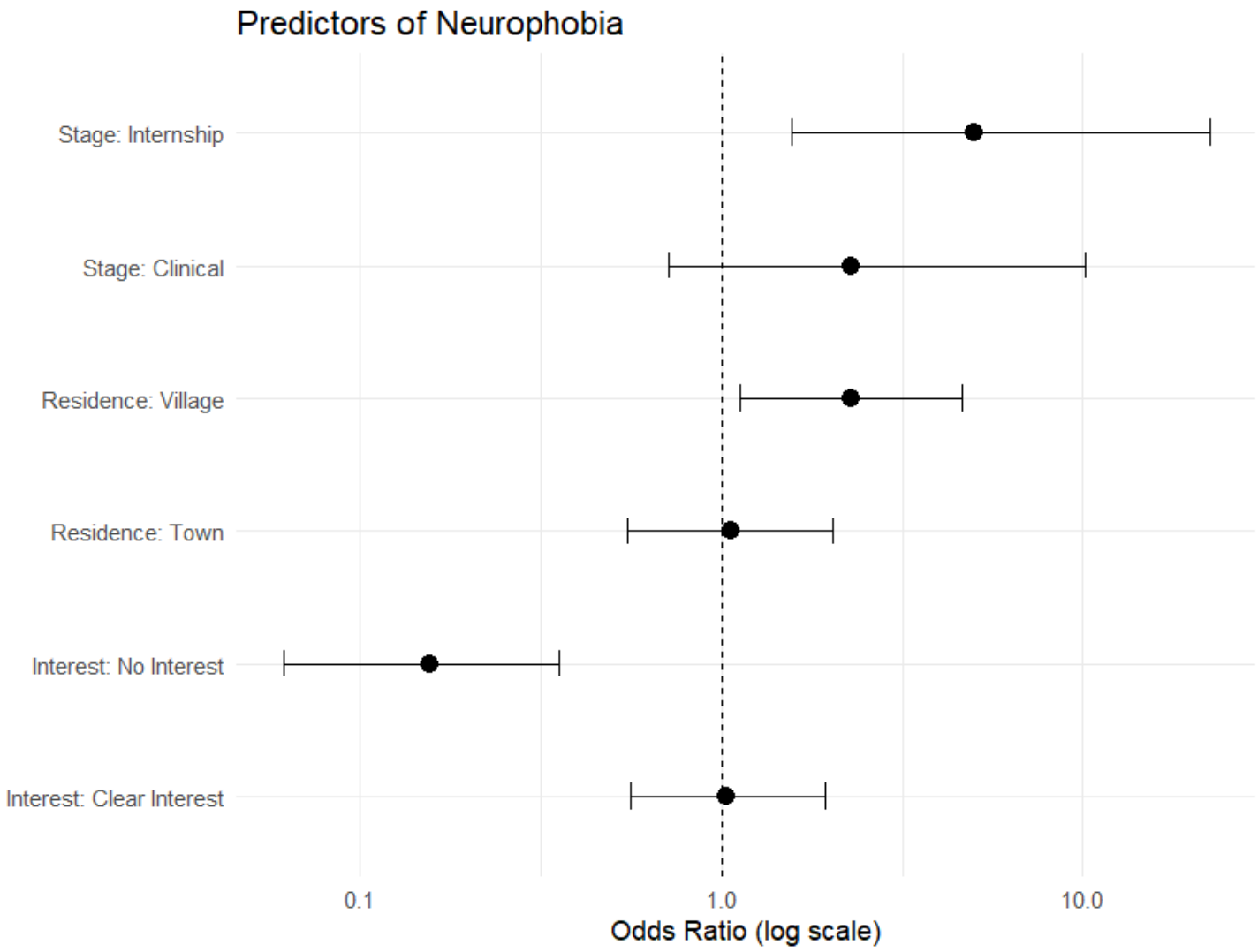


Figure 1

Predictors of Neurophobia

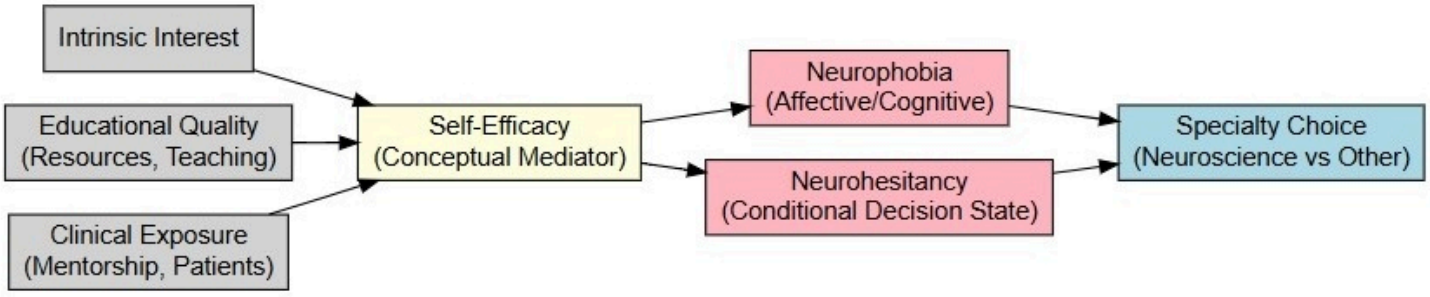


Figure 2

Conceptual framework of neurophobia and neurohesitancy