

RESULTS OF THE 2023 MENTAL HEALTH SURVEY OF THE PLANETARY SCIENCE COMMUNITY.

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Introduction: Several recent studies have recognized mental health concerns in academia and in the research field more broadly [e.g., 1,2]. In planetary science, a 2022 survey found that the prevalence of clinically significant anxiety and depressive symptoms among our community is higher than in the general United States public, especially among graduate students, postdoctoral researchers, soft money researchers, and tenure-track faculty [3]. Further, 76% of planetary science participants in the 2022 survey noted that their anxiety and/or depressive symptoms impacted their work, their ability to take care of things at home, and interpersonal relationships. Thus, these symptoms may play a role in decreased research quality and productivity.

Interpretations of the 2022 mental health survey of planetary science also noted potential diversity, equity, and inclusion concerns. There were indications of statistically significant greater severities of anxiety, depression, and stress among women, people of color, and those who identify as LGBTQ+ compared to the dominant groups in planetary science. Furthermore, survey participants who identify as LGBTQ+ reported a greater likelihood of considering leaving the planetary science field.

With the growing recognition of these mental health concerns, including evidence from the 2022 mental health survey of planetary science, the planetary science community advocated that NASA should further recognize the impact of mental health on science products and composition and work to address these issues including regular monitoring of the health of the community [3–5]. With the 2023 survey, we shed light on the factors that may contribute to these mental health concerns, which may help the planetary science community and NASA on how to address the issue.

Survey and Methods: We conducted an IRB-approved survey from October 10, 2023, to December 30, 2023. The survey was advertised through e-mail, social media, and online newsletters as well as at meetings and conferences. We obtained a total of 269 participants, which is lower than the 307 participants in the 2022 survey [3].

For the 2023 survey, we used five different instruments to examine three constructs: anxiety, depression, and stress. The first assessment, the Depression Anxiety Stress Scale-42 (DASS-42),

measures all three constructs, and focuses on low mood, motivation, and self-esteem [6]. For this study, items were focused on the past year. This instrument includes 42 items using a 4-point scale [6]. The DASS-42 has high internal consistency and is stable over time with construct and convergent validity [7]. The other two assessments are the Generalized Anxiety Disorder-7 (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9), which are used to screen for anxiety-related disorders and depressive related disorders, respectively [8,9]. The GAD-7 and PHQ-9 use the same 4-point Likert scale and contain 7 and 9 items, respectively. Both scales have high internal consistency and test-retest reliability [10,11]. Although these three assessments have the potential to screen for several disorders, we emphasize that the results are not intended to make clinical diagnosis, nor are they used to do so in this study.

In addition to measuring the severity of anxiety, depressive, and stress symptoms, the survey contained demographic items and items related to work in the planetary science field. Demographic items included gender, ethnicity, LGBTQ+ identity, career stage, and mission participation. Work-related items included questions on which aspects of planetary science work contributed to the participant's symptoms (e.g., performing research, teaching, lacking resources and support, working in a toxic work environment, securing funding, working long hours, feeling undervalued/underappreciated). We also asked whether participants planned to continue in planetary science after graduation or the next two years, and to report their reasons for considering leaving the field.

Results: In this preliminary look at the results, we focus on the severity of anxiety (GAD-7) and depressive symptoms (PHQ-9). Scores that were rated moderate to severe are considered clinically significant [8,9]. We report the prevalence of participants scoring in the clinically significant range of the two assessments.

From all the participants that took the survey, we found that the prevalence of clinically significant anxiety is 23% and the prevalence of clinically significant depression is 31%. As in the 2022 study, we observed variations among the participants in terms of gender, ethnicity, and LGBTQ+.

Gender: Among participants identifying as a woman, the prevalence of clinically significant anxiety

and depression is 24% and 33%, respectively. Participants that identify as a man experienced clinically significant anxiety and depression at 20% and 27%, respectively. Using a student's t-test to evaluate for significance, based on the average total score ($\alpha=0.05$; significant results when $p<\alpha$), we found that the differences between the two groups are statistically significant with $p=0.004$ for the GAD-7 and $p=0.022$ for the PHQ-9.

Ethnicity: We evaluated differences between those who identify as White and those who identify as a person of color or mixed race. The prevalence of clinically significant anxiety among participants that identify as White is 21% and clinically significant depression is 28%. In contrast, participants identifying as a person of color or mixed race show clinically significant anxiety and depression at 37% and 38%, respectively. Using a student's t-test ($\alpha=0.05$) on the average total score, we observed significant differences between the two groups with $p=0.007$ and $p=0.013$ for severity of anxiety and depressive symptoms, respectively.

Sexual Orientation: We examined differences in experiences between those who identify as LGBTQ+ or questioning and those who do not identify as LGBTQ+. Among those who do not identify as LGBTQ+, the prevalence of clinically significant anxiety and depression is 16% and 25%, respectively. In contrast, the prevalence of clinically significant anxiety and depression among those who identify as LGBTQ+ or questioning is 41% and 51%, respectively. The student's t-test ($\alpha=0.05$) of the average total scores between the two groups show statistically significant differences in both the GAD-7 and PHQ-9 ($p<0.001$).

Career Stage: Graduate students have the highest prevalence of clinically significant anxiety and depression at 47% and 56%, respectively. Postdoctoral researchers also show high prevalence of clinically significant anxiety and depression compared to most other groups at 31% and 45%, respectively. Among full professionals, soft-money researchers appear to have the highest prevalence of clinically significant anxiety (19%) and depression (28%). Tenure-track faculty show prevalence of clinically significant anxiety and depression at 13% and 15%, respectively; the prevalence of clinically significant anxiety and depression among government workers is 8% and 18%, respectively.

Next, we explored the major contributors to these anxiety and depressive symptoms (i.e., the factors that, can alone—or almost alone—influence their anxiety and depressive symptoms). In our research, 56% of graduate students and 53% of postdoctoral researchers

noted “not feeling good enough or belonging in the field” and job instability (55% and 58%, respectively) are two major contributors to their symptoms. Among soft money researchers, 42% said one of the major contributors to their symptoms is trying to secure funding and 33% said job instability. Tenure-track faculty reported that their top two major contributors are their personal life (38%) and institutional related work (e.g., staff meetings, search committees) (35%). A close third major contributor, 32% of tenure-track faculty mentioned teaching responsibilities. Among government workers, the top two major contributors to their symptoms were feelings of working off hours or long hours (40%) and performing research (31%).

Discussion: Comparing with the 2022 mental health survey of planetary science [3], the general prevalence of clinically significant anxiety and depressive symptoms decreased. This trend may be reflective of the amount of time since the peak of the COVID-19 pandemic and social isolation. However, one pattern that persists is that planetary science community members from marginalized backgrounds experience more severe anxiety and depression than the dominant population. Another continued pattern is that 71% of participants (compared to 76% in 2022) report that their anxiety and depressive symptoms impact their work, their ability to take care of things at home, and/or get along with others, which may have implications on research quality and productivity [3].

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