

Report of Findings: COVID-19 Impact on Extramural Research Surveys

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EXECUTIVE SUMMARY

Two central goals of the Chief Officer for Scientific Workforce Diversity (COSWD) at the NIH are to diversify the scientific workforce and to expand recruitment and retention. The COVID-19 pandemic has heightened the existing challenges faced by this diverse workforce and created new ones (see e.g., Flaherty, 2020; Goodwin & Mitchneck, 2020; Pulrang, 2020). To assess the impact of the pandemic on the research workforce and research institutions, and identify the potential implications on underrepresented groups in the scientific workforce, COSWD developed and fielded the *NIH COVID-19 Impact on Extramural Researchers Survey* and the *NIH COVID-19 Impact on Extramural Institutions Survey* in October 2020. The *NIH COVID-19 Impact on Extramural Researchers Survey* was taken by 45,348 of the 234,254 researchers invited to participate for a 19% response rate. The *NIH COVID-19 Impact on Extramural Institutions Survey* was taken by 224 of the 705 research leaders at top NIH-funded institutions for a 32% response rate.

This report provides an overview of the survey methodology, findings by research question, and implications of the results for the biomedical workforce. The key findings are as follows.

KEY FINDING 1: IMPACT OF THE PANDEMIC ON RESEARCH PRODUCTIVITY

The pandemic has had a uniformly negative effect on productivity. More than three out of four survey respondents (78%) reported that since the pandemic began in March 2020, their overall research productivity has been lower than normal. While responses varied little by demographic group, they differed by career stage and role. Senior investigators were not nearly as affected as early- or mid-career investigators, as roughly 80% of both groups reported a drop in productivity compared to only 75% of senior investigators.¹ Among early- and mid-career investigators, faculty members (82% and 83%) were more affected than researchers (69% and 68%). The strongest predictors of lower research productivity were changes in laboratory/animal facility access, negative impact on the ability to apply for grants since March 2020, and having one's research put on hold.

KEY FINDING 2: ANTICIPATED EFFECT OF THE PANDEMIC ON CAREER TRAJECTORIES

The majority of survey respondents (55%) "agreed" or "strongly agreed" that the pandemic would probably have a negative impact on their career trajectory, while 31% "neither agreed nor disagreed", and only 14% "disagreed" or "strongly disagreed." The most important predictor of a negative outlook was

¹ Early-career investigators include graduate students, postdoctoral fellows, and faculty and researchers up to six years after residency, postdoctoral fellowship, or last advanced degree. Mid-career investigators include faculty members and researchers 7 to 14 years after residency,

postdoctoral fellowship, or last advanced degree. Senior-career investigators include faculty members or researchers 15 years or more after residency, postdoctoral fellowship, or last advanced degree. Group definitions were developed in collaboration with the NIH.

reporting that the pandemic negatively impacted the respondent's ability to apply for grants. Caretaking responsibilities and losing access to staff and collaborators, in turn, strongly influenced respondents' ability to apply for grants.

Research type also influenced respondents' anticipated career trajectories. Laboratory-based researchers (61%) were more pessimistic than respondents conducting other, less site-specific types of research. In fact, 75% of the variation in attitudes toward expected career trajectory by racial and ethnic group can be attributed to the percentage within each group that conducted laboratory research.

KEY FINDING 3: EXTERNAL STRESSORS RELATED TO THE PANDEMIC AND VIRTUAL WORK

Mental health and/or physical health had a "substantially negative impact" on research productivity for 42% of researchers. It was the most frequently chosen factor impeding productivity among Hispanic or Latinos, those reporting a gender identity of "other", and respondents identifying with two or more races.² Mental health was negatively impacted by both societal and political events and physical and social isolation for over two-thirds of respondents (69% and 66%, respectively).

Caretaking responsibilities also affected productivity. Researchers with caretaking responsibilities comprised 45% of the sample, of which 46% reported that caretaking has made it "substantially more difficult to complete their work responsibilities." Caretakers were also more likely than non-caretakers to anticipate that the pandemic would harm their career

trajectory (61% versus 55%, respectively). Caretakers with children under five reported lower productivity (85%) and a negative anticipated career trajectory (68%) at a higher rate than any other caretaking group. Nearly two out of three women caring for children under five (61%) reported that their caretaking responsibilities have made it "substantially more difficult to complete their work responsibilities."

KEY FINDING 4: THE IMPACT OF THE PANDEMIC ON RESEARCH INSTITUTIONS AND RESEARCHERS' PERCEPTIONS OF INSTITUTIONAL SUPPORT

Research leaders agreed that the pandemic dealt a significant blow to their institution's research productivity and financial status. The majority (83%) reported that the pandemic has had a "moderate" or "major" impact on research activities. Two out of three respondents were "very" or "extremely" concerned about the impact of the pandemic on the financial status of their institution; 41% of respondents said that it was likely that the financial repercussions of COVID-19 will jeopardize their institution's ability to maintain its research function.

Leaders and researchers' views diverged on the pandemic's impact on tenure and promotions. While a quarter of research leaders believed that COVID-19 will make it harder to achieve tenure or a promotion, nearly a third of researchers said that it would impact their progress toward tenure or promotion. Most research leaders (77%) reported that their institution had put in accommodations to account for lost research time; however, only

² The "other" gender identities include transgender man, transgender woman, genderqueer or gender non-conforming, questioning, and something else.

26% of researchers reported that such accommodations had been put in place.

Institutions have widely implemented COVID-19-related flexibilities for faculty and staff, and a majority of researchers gave their institutions high marks on helping them remain productive during the pandemic. Research leaders also prioritized keeping their workforce safe to restore research functions, and most researchers said that their institution was effectively managing the impact of COVID-19 on the workforce.

INTRODUCTION

Since March 2020, the COVID-19 pandemic has transformed how much of the world lives and works, and the scientific workforce is no exception. Researchers have transitioned to virtual workspaces, taken on caretaking responsibilities in addition to their work responsibilities, and dealt with social distancing restrictions in laboratories, among other measures. There is also evidence that these changes have disproportionately affected groups underrepresented in the U.S. scientific workforce (see e.g. Flaherty, 2020; Goodwin & Mitchneck, 2020; Pulrang, 2020).

To assess the impact of the COVID-19 pandemic on the research community and identify potential implications for diverse groups in the biomedical workforce, the Chief Officer for Scientific Workforce Diversity (COSWD) at the National Institutes of Health (NIH) developed and fielded two surveys to gauge the impact of COVID-19 on the research community: the *NIH COVID-19 Impact on Extramural Researchers Survey* and the *NIH COVID-19 Impact on Extramural Institutions Survey*. These surveys aimed to gauge the impact of COVID-19 on the extramural research community, both in the short- and long-term. In addition, survey findings would outline important trends, provide actionable insights, and identify the need for dynamic and adaptable strategies to drive research functionality, and ultimately, to better support extramural research during these challenging times.

This report describes the goals, methods, and results of the 2020 surveys, and explores the larger implications of these findings for biomedical research and the investigators and

institutions that produce and support it. Additionally, this report identifies how and to what extent the pandemic has affected those groups designated as underrepresented in biomedical research, outlined in the [2019 Notice of NIH's Interest in Diversity](#), as well as other vulnerable groups due to the pandemic, such as early-career investigators, Asian researchers, and researchers with caretaking responsibilities.

METHODOLOGY

PARTICIPANT DEMOGRAPHICS

The NIH COSWD spearheaded the survey effort and helped obtain a sample for each survey. A census approach was used for both surveys, meaning that the whole population within set parameters were invited to participate. The demographics of each sample are presented below.

The *NIH COVID-19 Impact on Extramural Researchers Survey* was taken by 45,348 of the 234,254 researchers invited to participate, resulting in a 19% response rate. Responses were collected from October 14 to November 13, 2020. All respondents met the required qualifications, including having logged into eRA Commons in the past two years and identified in the system as having one of the following scientific roles: Principal Investigators, Trainees, Sponsors, Undergraduate students, Graduate students, Postdocs, Scientists, and Project Personnel. All participants were informed that they would be deidentified, they could withdraw participation at any point during the study, and provided informed consent.

Respondents were largely from academic institutions (81%) and conducted laboratory-based research (65%). The racial and ethnic

composition of the sample was White= 69%, Asian= 22%, Black or African American= 4%, Two or More Races= 3%, Alaska Native or American Indian= 0.4%, Native Hawaiian or Pacific Islander= 0.1%, and Hispanic, Spanish, or Latino origin= 9%.³ Over half of the sample identified as a woman (53%); those identifying as a man accounted for 46% of the sample and those with an “other” gender identity comprised 1% of the sample.⁴

The *NIH COVID-19 Impact on Extramural Institutions Survey* consisted of 224 total completed responses (out of a total of 705 invited), resulting in a 32% response rate. Responses were collected from October 7 to November 6, 2020. All respondents met the required qualifications including being a research leader (Vice President for Research, Vice Dean for Research, Chief Medical Officer, or equivalent positions) of: (1) a top NIH-funded domestic institution based on FY2019 NIH awards (top 1000), (2) schools that are part of the Association of American Medical Colleges (AAMC), or (3) Minority Serving Institutions (MSI) that received grant awards in FY2019. In addition, all participants gave informed consent, were informed that they would be deidentified, and that they could withdraw participation at any point during the survey. Sample demographics depicted participating institutions as primarily doctorate-granting universities (72%), both with and without professional schools and non-MSIs (76%).

SURVEY DEVELOPMENT

The *NIH COVID-19 Impact on Extramural Researchers Survey* was developed from May 21 to October 9, 2020, and responses were collected from October 14 through November 13, 2020. The *NIH COVID-19 Impact on Extramural Institutions Survey* was developed from May 21 through October 5, 2020, and responses were collected from October 7 through November 6, 2020.

Prior to fielding the survey, both survey instruments were developed using a three-phased approach. In the first phase, questionnaire development took place with the Coronavirus Survey Development Group. During weekly touchpoints, the survey instrument was drafted, discussed, and refined, in accordance with overall objectives. In the second phase, the survey underwent cognitive testing. Sessions differed slightly between the two surveys as the *NIH COVID-19 Impact on Extramural Researchers Survey* cognitive tests consisted of one-on-one phone interviews that were 60 minutes in length with nine researchers (five principal investigators and four trainees), whereas testing of the *NIH COVID-19 Impact on Extramural Institutions Survey* consisted of one-on-one phone interviews that were 30 minutes in length, with nine research leaders at top NIH-funded institutions. The third phase consisted of pilot testing. Survey invites were sent to 150 randomly selected eligible researchers and 12 research leaders at top institutions. Pilot test participants identified questions that could cause confusion or be misinterpreted and provided feedback on specific sections as well as the overall survey-taking experience.

³ Hispanic or Latino respondents can be of any race.

⁴ All percentages are out of valid totals, with missing values, “don’t know,” and “prefer not to answer” removed from the denominator.

Feedback from this phase was gathered and shared with the Development Group to make final adjustments.

SURVEY IMPLEMENTATION

Both surveys were fielded using the Qualtrics platform and introduced through a blog post on [Open Mike](#). Following the survey launch, in-field survey awareness efforts were conducted, and several reminders were sent to encourage participation. Two major takeaways from outreach efforts emerged. The first is that timing matters. The largest number of responses was received on the first day of the official survey launch. The second is that the messenger matters. Responses increased substantially after each reminder was sent to participants from a source known by the target audience. For example, reminders sent from the Office of Extramural Research (OER) Communications Office email address resulted in a substantially greater number of responses than reminders sent from the Qualtrics email address.

SURVEY ANALYSIS

Survey results were analyzed using descriptive statistics and generalized boosted models. The boosted models were used to gain an understanding of the factors that mattered most when predicting two outcomes of interest: an anticipated negative career trajectory and decreased productivity (see the [Appendix](#) for more details). The descriptive statistics were used to gauge the impact of the pandemic overall and compare how the pandemic affected different groups.

GROUPS OF INTEREST

The groups of interest for these analyses include those the NIH identified as underrepresented in the U.S. biomedical, clinical, behavioral, and social sciences, per the [2019 Notice of NIH's Interest in Diversity](#). These groups include those who identified as Black or African American, Hispanic or Latino, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, individuals with disabilities, and women.

Additionally, special focus was paid to groups hypothesized to be disproportionately affected by the pandemic.

- **Asian researchers**, who have been subject to heightened discrimination and assault since the onset of the COVID-19 pandemic in the United States (see Chen et al., 2020).
- **Gender minorities**, who are hypothesized to be disproportionately affected by the social, financial, and mental health impacts of the COVID-19 pandemic (Phillips et. al., 2020).
- **Women researchers**, who have also been disproportionately impacted by the pandemic (see e.g., Cui et. al., in press; Gabster et al. 2020), with those at the early stages of their careers or with caretaking responsibilities hit the hardest (Viglione, 2020).
- **Early-career investigators**, defined as graduate students, post-docs, and researchers or faculty members within the first six years in their role, have been particularly harmed by the pandemic. These researchers are “in a time of steep acceleration with respect to training milestones, protected time, fellowship funding and promotion” (Levine and Rathmell, 2020, p. 357). As a result, reduced productivity can greatly impact their career trajectory.

1. RESEARCH PRODUCTIVITY

WHAT HAS BEEN THE IMPACT OF THE PANDEMIC ON RESEARCH PRODUCTIVITY?

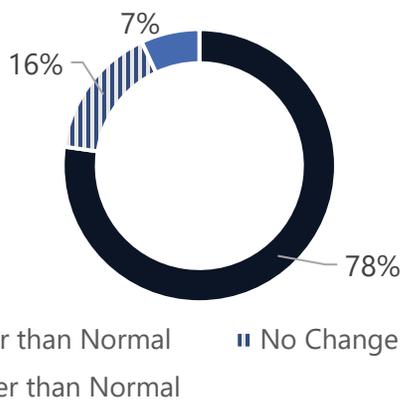
OVERALL FINDINGS

In this section, percentages represent the proportion of respondents selecting that response option among all survey respondents answering the survey item.

All survey respondents were asked about the extent to which the pandemic has impacted their research productivity. Overall, 78% of respondents reported decreased research productivity since the pandemic began in March 2020.⁵

The top factors that negatively impacted productivity include virtual instead of in-person interactions with trainees, mentors, or supervisors (53%), the cancellation of in-person

Figure 1. Changes in Research Productivity Since March 2020



regional, national, or international conferences (50%), and changes in laboratory and/or animal facility access (49%). In addition, the generalized boosted model indicates that (1) *changes in laboratory/animal facilities*, (2) *a negatively impacted ability to apply for grants*, and (3) *having research put on hold* were the most important factors predicting decreased productivity.

FINDINGS BY KEY GROUPS

A review of the distribution of responses on research productivity indicates that demographic groups were uniformly impacted by the pandemic. The greatest gap between racial groups was six points, from 75% among Black or African American respondents to 81% among respondents identifying with two or more races. The gender gap was only two points, ranging from 77% of women to 79% of men and those identifying with another gender.

Instead, research productivity varied by professional composition, namely *career stage* and *type of research*. An analysis by career stage showed that early- (82%) and mid- (83%) career faculty members were the most likely to report that their research productivity was lower than normal. Faculty at each career stage were more likely than researchers to cite negative impacts on their productivity. One potential explanation is that 57% of faculty have been spending more time on administrative activities since the

⁵ The survey question specified that research productivity includes submitting grant applications, publishing papers, etc.

pandemic began, compared to 45% of researchers. Thus, time spent on non-research obligations may have contributed to diminished research productivity among faculty.

The pandemic’s impact on productivity also varied by the type of research conducted. There is a 19-point gap in productivity by type of research, ranging from 84% of laboratory-based researchers to 65% of epidemiologic or public health researchers reporting “lower than normal” research productivity since the pandemic began in March 2020.

Modifying Variables by Key Groups

Generalized boosted models were generated to identify the most important predictors of decreased productivity among respondents

who identified as *Black or African American, Asian, Hispanic or Latino, and women*. The primary type of research a respondent conducted was one of the most important predictors of research productivity among all groups. Reporting that the pandemic negatively impacted the ability to apply for grants, changes in access to laboratories or animal facilities, and having research put on hold were strongly associated with decreased productivity. Among Asian respondents, reporting that “I have not lost access to research resources” was the most important predictor of research productivity and was strongly associated with research productivity increasing or remaining the same.

Figure 2. Percentage of Each Career Stage Citing Lower-Than-Normal Research Productivity

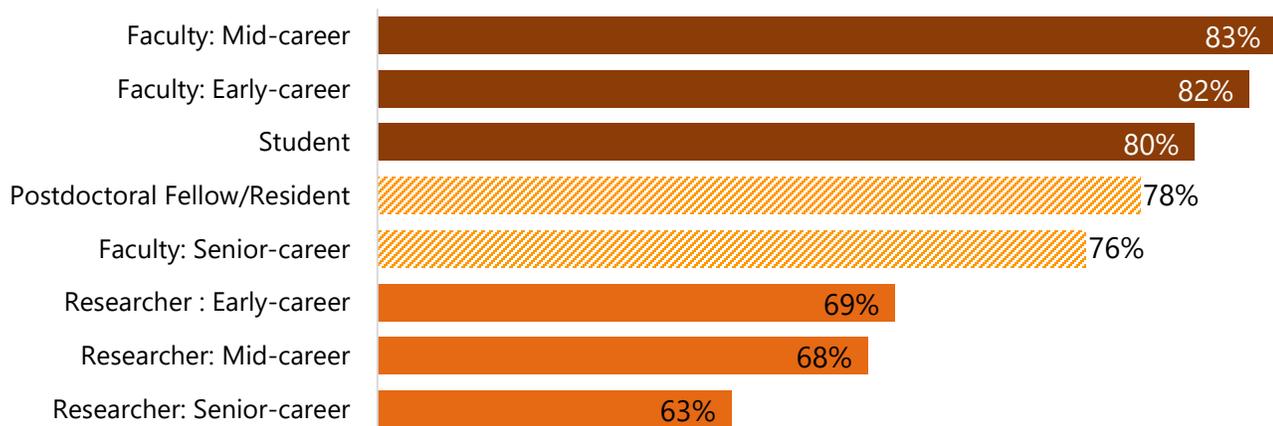


Table 1. Most Important Predictors of Research Productivity by Key Groups

Independent Variable	African American AUC: 80.7	Asian AUC: 83.8	Hispanic AUC: 83.8	Women AUC: 82.9
Q47. Ability to Apply for Grants	#1			#2
Q7/Q8. Primary Type of Research	#2	#2	#1	#3
Q26. Research Put on Hold	#3		#2	
Q24. I Have Not Lost Access to Research Resources		#1		
Q26. Changes in Laboratory/Animal Facility Access		#3	#3	#1

2. CAREER TRAJECTORY

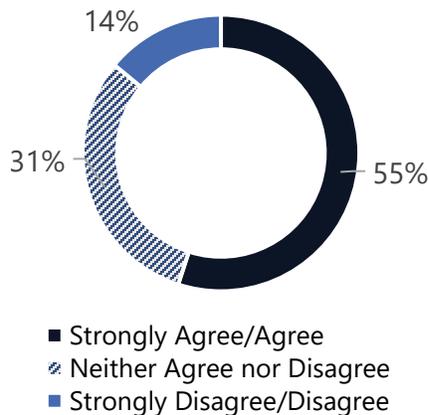
WHAT HAS BEEN THE IMPACT OF THE PANDEMIC ON RESEARCHERS' PERCEPTION TOWARDS THEIR CAREER TRAJECTORY?

OVERALL FINDINGS

In this section, percentages represent the proportion of respondents selecting that response option among all survey respondents answering the survey item.

Another important construct measured throughout the survey process was the extent to which respondents said that the pandemic will probably have a negative impact on their career trajectory. More than half (55%) "strongly agreed" or "agreed" with the statement.

Figure 3. Level of Agreement That the Pandemic Will Probably Negatively Impact Career Trajectory

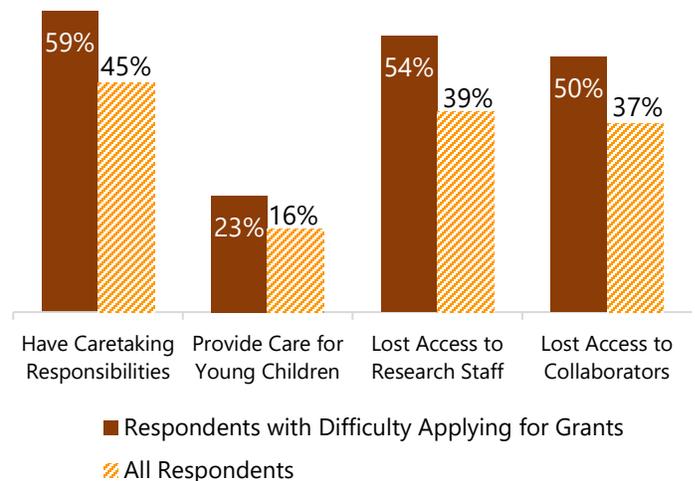


The generalized boosted model indicates that the most important predictors of a negative anticipated trajectory are (1) a hindered ability to apply for grants after the onset of lockdown in March 2020, (2) COVID-19 negatively impacting research-related activities, and (3) the respondent's career stage, with being an early-

career investigator most strongly associated with a higher likelihood of anticipating a negative career trajectory.

Among the respondents whose ability to apply for grants was negatively affected by the COVID-19 pandemic, a substantially higher percentage had caretaking responsibilities and had dependents under age five. They were also more likely to cite the "loss of access to research staff and collaborators" as diminishing research productivity. These findings suggest that diminished ability to apply for grants is related, in part, to teleworking, increased caretaking demands, and greater difficulty in collaborating.

Figure 4. Negative Perception of Career Trajectory, % of All Respondents



FINDINGS BY KEY GROUPS

Responses varied by *career stage, type of role, racial identity, type of research, and caretaking status.*

Early-career investigators were more likely than senior-career investigators to anticipate a negative career trajectory, with postdoctoral fellows and residents (69%) and early-career faculty members (67%) most likely to report a negative outlook. Furthermore, faculty at each career stage were more likely than researchers to perceive a negative impact on their career trajectory, similar to how faculty members at each career stage also reported lower productivity.

Turning to *race*, Asian respondents were more likely than average to anticipate a negative career trajectory (64% versus 55% overall) while Black or African American researchers were the least likely to perceive a negative impact on their career trajectory (39%). Much of the variation by racial and ethnic groups were associated with the type of research respondents conducted (see figure 6). The proportion of laboratory-based researchers in a racial group accounted for 75% of the variation in perceptions of career trajectory. The relationship is weakest among epidemiologic or public health researchers, accounting for 52% of variation in responses.

Figure 5. Percentage of Respondents Citing Lower-Than-Normal Productivity by Career Stage & Type of Role

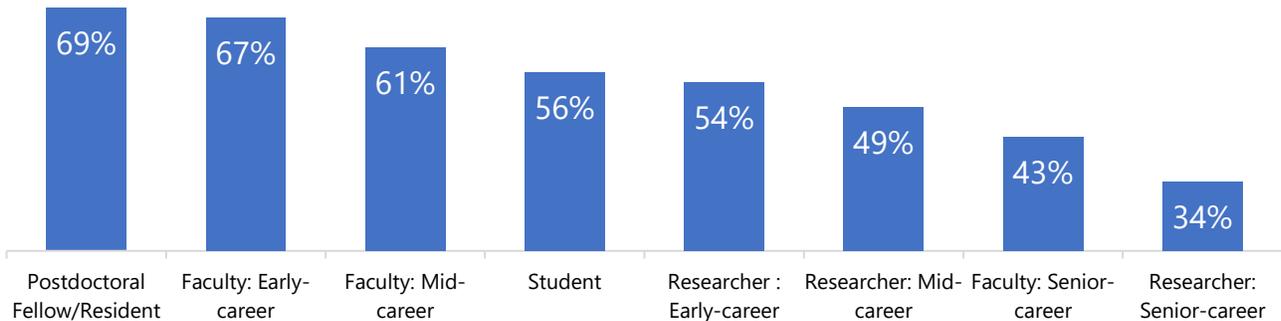
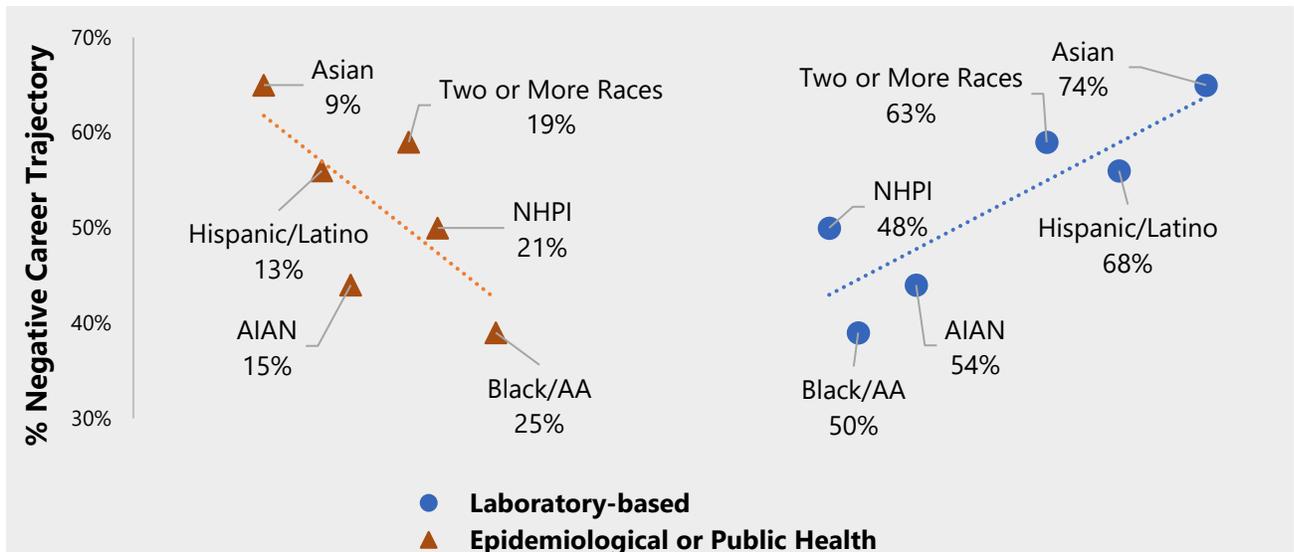


Figure 6. Negative Career Trajectory by Race/Ethnicity and Type of Research



Of the racial groups, Asian respondents had the greatest representation of laboratory-based researchers (74%). A quarter of Black or African American respondents conducted public health-based research, the highest among all racial and ethnic groups. These findings provide greater context for the observed variation by race.

Modifying Variables by Key Groups

Generalized boosted models were generated to identify the most important predictors of a negative anticipated career trajectory for respondents who identified as *Black or African American, Asian, Hispanic or Latino, and women*. The *impact of the pandemic on research activities* was the strongest predictor for all groups except Black or African American respondents. A diminished ability to apply for grants ranked first among Black or African American respondents and second for the other groups. The *primary type of research* respondents conducted ranked third for Asian and Hispanic or Latino respondents. For both groups, laboratory-based and clinical research were the types of research most strongly associated with a negative outlook. Among

women, those in the early stages of their career were very likely to have a negative outlook. Among Black or African American respondents, those who were separated respondents had the highest probability of a negative outlook by marital status.

QUALITATIVE FINDINGS

Qualitative findings provide further insight into how the pandemic was perceived to harm career trajectories. Natural language processing of responses to the open-ended question, asked of those with a negative outlook, revealed four themes: *budget cuts and reduced funding* (cited in 33% of responses), *increased teaching expectations and administrative burdens* (cited in 30% of responses), *hiring freezes* (cited in 28% of responses), and *an inability to get preliminary data for grant applications/funding* (cited in 28% of responses). The strong presence of teaching and administrative duties in written responses is consistent with the finding that faculty members were more negatively impacted by the pandemic than researchers.

Table 2. Most Important Predictors of a Negative Anticipated Career Trajectory by Key Groups

Independent Variable	African American AUC: 78.7	Asian AUC: 79.4	Hispanic AUC: 80.2	Women AUC: 81.6
Q28. Impact on Research Related Activities		#1	#1	#1
Q47. Ability to Apply for Grants	#1	#2	#2	#2
Q7/Q8. Primary Type of Research	#3	#3	#3	
Q6, 6a, 6b. Career Stage				#3
Q99. Marital Status	#2			

3. EXTERNAL STRESSORS

WHAT EXTERNAL STRESSORS RELATED TO THE PANDEMIC AND VIRTUAL WORK HAVE RESEARCHERS EXPERIENCED?

In this section, percentages represent the proportion of respondents selecting that response option among all survey respondents answering the survey item.

The survey asked a series of questions to understand the stressors related to the pandemic or virtual work respondents experienced. This section focuses on two stressors, *mental health* and *the assumption of caretaking responsibilities*, and their effects on respondents.

MENTAL HEALTH

Personal mental health and/or physical health negatively affected research productivity. Nearly half of the sample reported that “personal mental health and/or physical health” had a substantially negative effect on their productivity. It ranked seventh out of a list of 25 potential factors overall.

Data was collected on seven potential factors impacting mental health. The top two factors were “societal and/or political events” (69%), and “physical and/or social isolation” (66%).

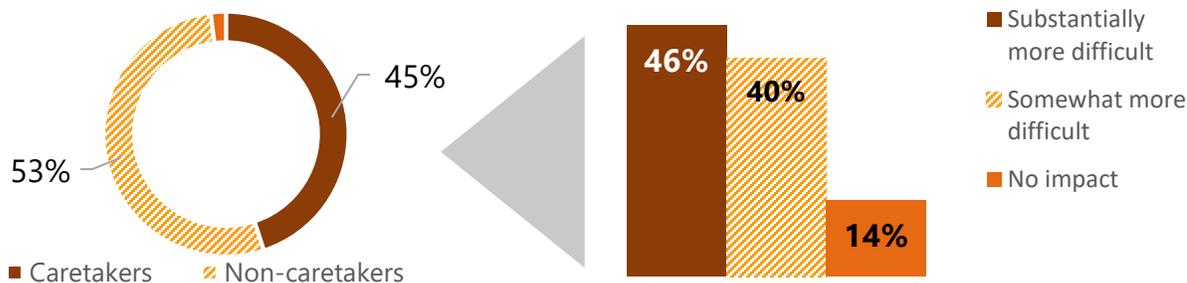
The third factor was “disruption of promotion/tenure timeline,” rated as negatively impacting mental health by 38% of respondents.

Findings by Key Groups

Group-specific stressors were also apparent. Among Asian respondents, “visa considerations” were cited as negatively affecting mental health at more than double the rate of all respondents (27% versus 13%).

Among those with an “other” gender identity, 81% reported that personal mental and/or physical health had a substantially negative impact on their productivity, almost twice the average rate of 42%.

Early-career investigators were consistently more negatively impacted than other career stages. Over half (52%) reported that the disruption of their promotion or tenure timeline negatively affected their mental health, compared to 38% overall, and 71% said that social and/or physical isolation negatively affected their mental health, compared to 66% overall.



CARETAKING RESPONSIBILITIES

Survey respondents were asked about their caretaking responsibilities to understand how increased duties impacted research productivity and how researchers have tried to mitigate its impact. Nearly half (45%) of the sample indicated that they have caretaking responsibilities for individuals who live in their household or family members who do not live with them; of these, nearly half (46%) reported that caretaking has made it substantially more difficult to complete their work responsibilities. Caretakers were also more likely than non-caretakers to agree that the pandemic would negatively impact their career trajectories (61% versus 55%, respectively). Conversely, they were less likely than non-caretakers to report that their personal mental health and/or physical health has had a substantially negative impact on their productivity since the pandemic began (39% versus 46%).

The age of dependents also mattered. Similar to findings in other research (Krukowski et al., 2020), those with children under age five were consistently more negatively impacted than those with children aged six years or older or those with ill, older, or disabled dependents. Among caretakers of young children, 61% said that their duties made it substantially more

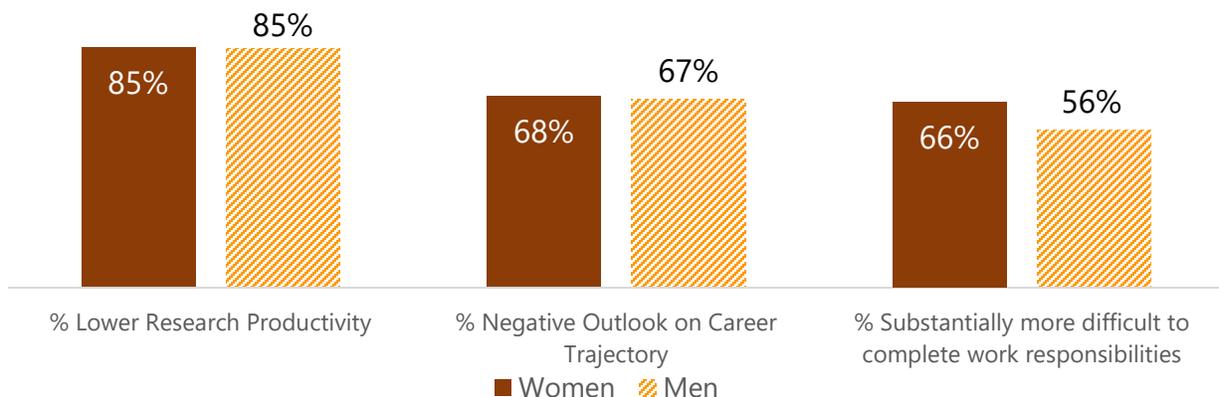
difficult to complete their work responsibilities. More than two in three caretakers of young children (68%) agreed that the pandemic would negatively impact their career trajectory.

Also consistent with the research (Krukowski et al., 2020), there were no differences between men and women providing care for children under five, with one exception. Women were more likely than men to report that caretaking responsibilities have made it substantially more difficult to complete work responsibilities (66% versus 56%, respectively). This gap may be due to women acting as the primary caregiver at a greater rate than men (55% versus 34%).

Findings by Key Groups

The impact of caretaking responsibilities varied by demographic and professional groups. Overall, *caretakers who identified as women (50%), Hispanic or Latino (50%), or with two or more races (53%)* were most likely to indicate that caretaking has made it “substantially more difficult to complete their work responsibilities.” Conversely, caretakers who identified as Black or African American (43%), men (42%), or Asian (41%) were the least likely to report the same.

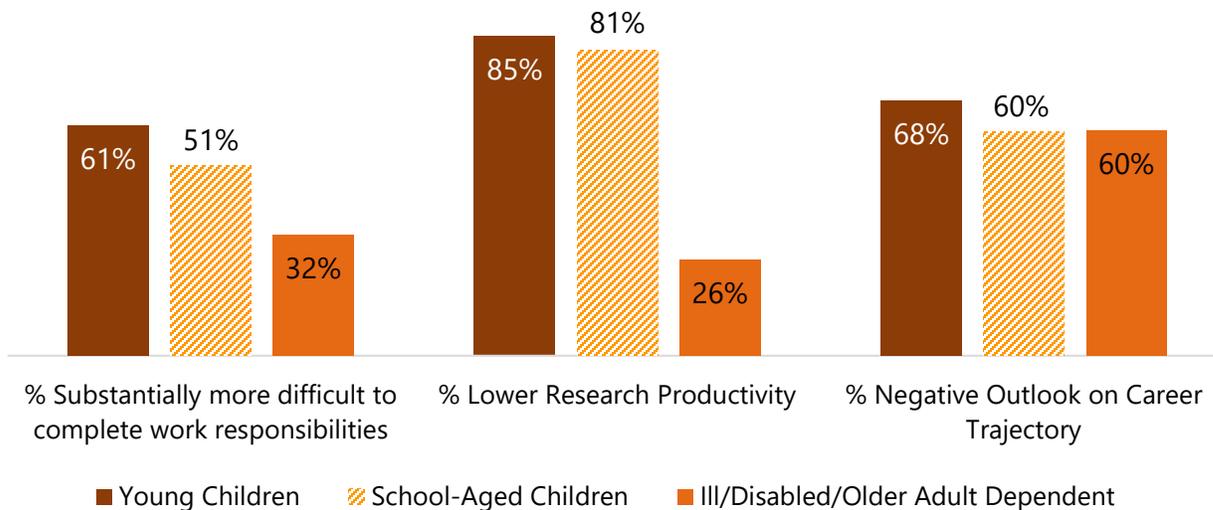
Figure 8. Professional Impact on Respondents Providing Caretaking for Children Under Five



The most impacted groups were defined by *career stage* and *gender*. Overall, 53% of both early- and mid-career investigators with caretaking responsibilities indicated that their work responsibilities were substantially more difficult to complete. The numbers were significantly higher among women: 57% of

early-career investigators and 59% of mid-career investigators reported that their caregiving duties made it substantially more difficult to complete their work tasks.

Figure 9. Professional Impact of Caretaking by Type of Dependent



4. INSTITUTIONAL SUPPORT

WHAT HAVE INSTITUTIONS DONE TO SUPPORT THEIR RESEARCHERS THROUGH THESE DISRUPTIONS? HAVE RESEARCHERS FOUND INSTITUTIONAL SUPPORT TO BE EFFECTIVE?

In this section, percentages represent the proportion of respondents selecting that response option among all survey respondents answering the survey item.

The collection of data from both institutional leaders and researchers provides a unique opportunity to compare how institutional leadership, on one hand, and the extramural workforce, on the other, perceive and evaluate institutional efforts to mitigate the pandemic's impact. This section reviews how COVID-19 has impacted institutional research activities, the actions research leaders have taken to mitigate these effects, and how researchers rate and perceive these efforts.

IMPACT ON RESEARCH ACTIVITIES

The *NIH COVID-19 Impact on Extramural Institutions Survey* focused on the extent to which institutions maintained their research functions and research productivity while gauging the impact of the pandemic on institutions' financial status.

Lost Research Time and Productivity

According to 83% of research leaders sampled, the pandemic has had a "major" or "moderate" impact on research productivity. Responses varied little by type of institution with one exception: research leaders who said that their institution considered itself to be an MSI were less likely to report a "moderate" or "major" impact than the average among academic institutions (74% and 85%, respectively).

Similar to the respondents of the *NIH COVID-19 Impact on Extramural Researchers Survey*, institutional leaders cited "reduced access to on-site laboratories" (62%) as having the most negative impact on their institution's research function.⁶ Turning to the type of institution, only research leaders at special focus/other institutions⁷ indicated differently, with half citing "reduced laboratory access to on-site laboratories" and "increased virtual meetings" as having the greatest negative impact on their institution's research function. The second and third most frequently selected factors among research leaders were "institutional hiring freezes" (32%) and "increased virtual meetings" (23%).

⁶ "Reduced access to laboratories" was the second-most frequently chosen item resulting from COVID-9 that negatively impacted respondents' research, selected by 60% of respondents; "reduced access to team members and/or colleagues due to the virtual environment" was the most chosen item, picked by 68% of respondents.

⁷ According to the Carnegie Classification of Institutions of Higher Education, special focus institutions are defined as

institutions where a high concentration of degrees is in a single field or set of related fields. Given the small number of institutions that research leaders described as either special focus (n=3) or "Other" (n=12), the two categories were combined. The institutions described as "Other" were primarily comprised of small businesses.

Impact on Tenure and Promotion

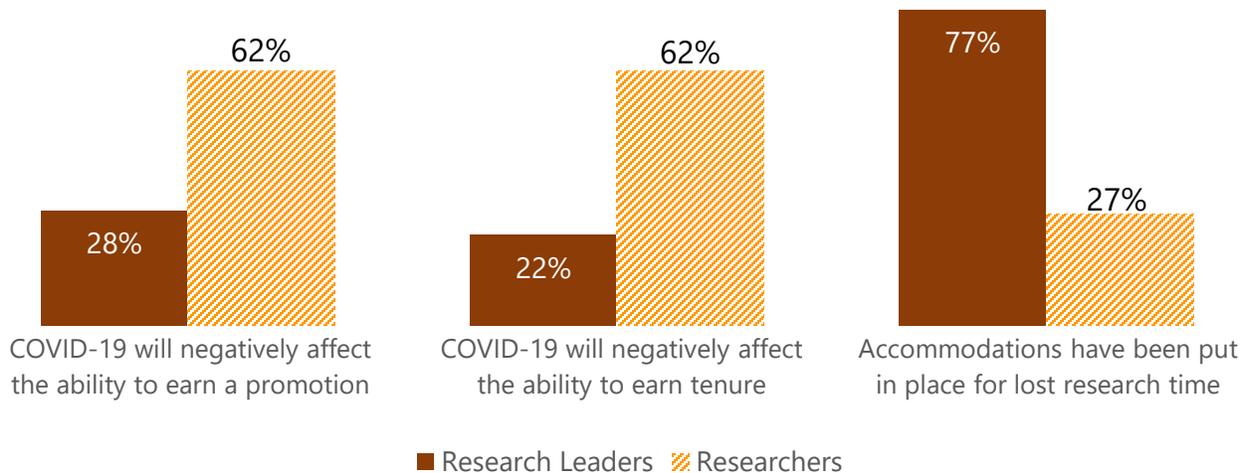
Both surveys asked respondents about the impact of the pandemic on the ability to earn tenure or a promotion. The results indicate a gap in opinion: 62% of researchers said that they expected that extended telework would negatively impact their progress toward promotion/tenure, while approximately a quarter of institutional leaders expected that COVID-19 would negatively affect the ability to earn a promotion (28%) or tenure (22%) at their institutions. Among those leaders who did believe the pandemic would affect the ability to earn tenure, 77% indicated that accommodations had been put in place to account for lost research time. In contrast, only 27% of respondents for whom the question applied said that their institution had put in place accommodations to account for lost research time. Over a third (37%) reported that their institution had not and another 36% did not know.

Despite the pessimism among tenure-track respondents toward their ability to earn tenure, *44% of all respondents said that their organization has been “extremely” or “very supportive” in helping them to remain productive*

during the pandemic; 21% felt that their organization had been “slightly supportive” or “not supportive at all.” Over a third (35%) stated that their organization had been moderately supportive. These numbers varied substantially by race and gender identity groups. On the one hand, 58% of Black or African American respondents said that their organization has been “extremely” or “very supportive” in helping them to remain productive, the highest of any racial, ethnic, or gender identity group. On the other hand, 33% of those with an “other” gender identity gave the same marks, and nearly the same proportion, at 31%, said that their institution had been only “slightly supportive” or “not supportive at all.”

Those respondents who said their organizations have been “slightly supportive” or “not supportive” in helping them to remain productive during the pandemic were invited to share what steps their organization should take to make them feel more supported. Among those who provided a response, 48% suggested providing bridge funding and financial support for research. Another 26% recommended reducing teaching and administrative workloads.

Figure 10. Views of Researcher Leaders and Researchers on COVID-19’s Impact on Tenure/Promotion



Financial Strain

The unexpected short- and long-term expenses associated with COVID-19 (e.g., cleaning and testing, supplemental technology, etc.) resulted in *two-thirds of research leaders expressing concern over their institution's financial status*. Every respondent expressed some level of concern about their institution's financial status – zero stated that they were “not at all concerned” – and the majority of respondents said they were “extremely concerned” or “very concerned.” More than 50% of responses from independent research and special focus/other institutions, however, indicated being only “moderately concerned” or “slightly concerned.”

When looking to the future, 41% of respondents believed that it is likely that the financial repercussions of COVID-19 will jeopardize their institution's ability to maintain its research function. For 37% of respondents, it was “unlikely” or “extremely unlikely” that the pandemic would jeopardize their institution's ability to maintain its research function.

MANAGING OF THE PANDEMIC – MITIGATING ACTIONS TO DRIVE RECOVERY

Research leaders reported that their institutions have taken many steps to mitigate the impact of the pandemic, to protect the health of researchers and research support staff, and to restore research operations.

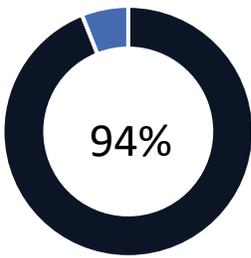
Eighty-three percent of respondents indicated that their institutions implemented “contact tracing, transmission modeling, and other measures”; 94% said that there is an organizational plan for reporting COVID-19 cases and emerging cases.

When asked about the priority of certain actions in restoring research operations, the greatest proportion of respondents stated that “maintaining a healthy environment through the cleaning and disinfecting of facilities” (70%) and “developing and implementing phased plans to return to the workplace safely” (63%) were “essential” to restoring research operations. The third factor was “maintaining financial sustainability considering budgetary restrictions and challenges” with 61% of respondents deeming it “essential.”

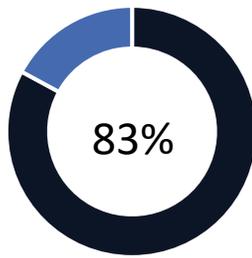
Institutions also offered COVID-19-related flexibilities for faculty and staff. Nearly all research leaders stated that their institutions currently offered the option for “telework” (98%). Over 60% of respondents stated that they offered flexibilities regarding “tenure-clock considerations,” (66%) and “employment hours” (63%). Caretaking needs were one area where responses indicated need for improvement. Only 21% of respondents said that their institution was providing or expanding facilities for child and family services, compared to 5% for whom their institution was in the planning phase for providing such facilities.

Most researchers (59%) substantiated the efforts of research leaders and said that they “strongly agree” or “agree” that their “organization is effectively managing the impact of COVID-19 on the workforce.” Only 18% disagreed. Suggestions for institutions to improve research support focused primarily on providing funding, providing COVID-19 testing and improving communication regarding cases on campus, and providing childcare support as areas for improvement.

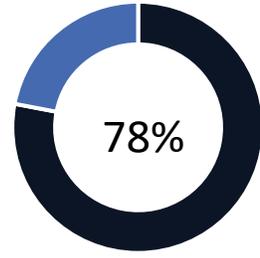
Figure 11. Mitigating Actions Impacted by Institutions in Response to the Pandemic



Of institutions have an organizational **plan for reporting COVID-19 cases and emerging cases**



Of institutions **have implemented** contact tracing, transmission modeling, and other **monitoring measures**



Of institutions claimed to **have COVID-19 testing available** for staff, faculty members, and students

5. CONCLUSIONS AND IMPLICATIONS

WHAT ARE THE IMPLICATIONS OF THESE FINDINGS FOR BIOMEDICAL RESEARCH?

The final section of this report summarizes the answers to the research questions and their larger implications for the future of biomedical research and on the biomedical research workforce.

WHAT HAS BEEN THE IMPACT OF THE PANDEMIC ON RESEARCH PRODUCTIVITY?

The pandemic has had an overwhelmingly negative impact on research productivity. More than three-fourths of respondents (78%) rated their research productivity as lower than normal since the pandemic began in March 2020. Little variation in opinion emerged by demographic group. Instead, respondents were more likely to report a drop in productivity if they were early- or mid-career investigators (80% and 81%, respectively). Within these groups, early- (82%) and mid-career faculty members (83%) reported lower levels of productivity at a far greater rate than their counterparts in research roles (69% and 68%, respectively).

The results from generalized boosted models suggest that the most important predictor for predicting research productivity is *negatively impacted research related activities*, followed by *impact on ability to apply for grants* and *research being put on hold*. Among the ten most important predictors, all were research related factors.

What are the implications for biomedical research and research productivity?

Research productivity is tied closely to career stage, access to laboratories, and access to

colleagues. For researchers carrying out work that cannot be conducted remotely, such as wet lab work, only so much can be done offsite, and productivity drops over time (Omary & Hussan, 2020).

Waning productivity has immediate economic and well-being costs, as well as longer-term impacts on advancements in biomedical research. For example, Omary and Hussan estimate that per week, \$185 million of NIH R01 awards are not being used for their intended efforts (2020, pg. 19613). Another negative externality of the pandemic is the toll on researchers' well-being, which can have a drag on productivity. Finally, the ability to make significant advances in research areas that impact health and disease has ground to a halt, which may set back progress in critical areas.

To mitigate the impact of reduced productivity, solutions should focus on helping those researchers who conduct work that cannot be performed remotely (e.g., wet lab-based research and clinical research) and researchers at especially time-sensitive points of their career (e.g., those on the tenure clock). Each are taken in turn below.

First, it is critical to ramp up safe return-to-work programs for the research workforce that maximize the number of researchers who return to full activity, such as through the use of shifts. These programs will need to include research support units and incorporate safety measures, such as virus testing and sanitary precautions. Second, it is important to consider extensions of NIH support of currently-funded researchers,

including those with career development awards. (As of March 2021, NIH has begun extending eligibility for extensions of NIH Fellowship, or “F”, awards and NIH Career Development, or “K”, awards.) These extensions will boost productivity directly and indirectly, via the impact on researchers’ well-being.

WHAT HAS BEEN THE IMPACT OF THE PANDEMIC ON RESEARCHERS’ PERCEPTION OF THEIR CAREER TRAJECTORY?

Over half of respondents agreed that the pandemic would probably harm their career trajectory. Laboratory-based researchers were especially affected, with 61% anticipating a negative career impact. While there appeared to be race-related differences in perceptions, these were largely a product of the primary type of research most group members conducted.

Overall, the most important predictors of researchers’ perceived impact of the pandemic on their career trajectory included a diminished ability to apply for grants, the pandemic negatively impacting research-related activities, and career stage, namely being an early-career investigator.

What are the implications for biomedical research and research productivity?

These findings suggest that lab-based and investigators in the first six years of their careers were especially likely to perceive that the pandemic will damage their careers. An implication of this finding is the potential for a “brain drain” as individuals with shaky career prospects leave biomedical research for other, more secure fields. As a result, the pandemic may “derail the impressive progress” seen in research over the last decade (Levine & Rathmell 2020, pg. 357). Similar to responses to productivity concerns, career outlook could be

improved through the implementation of measures to facilitate on-site lab research and extend of grant funding. NIH has already provided opportunities for recipients of NIH Fellowship and NIH Career Development awards who have been impacted by COVID-19 to extend their eligibility. The findings also suggest that approaches to promotion and tenure reviews ought to be adjusted. The most popular adjustment among academic faculty was to delay promotion/tenure reviews by a set amount of time and allow tenure-track investigators to “opt-in” to their reviews on schedule.

WHAT EXTERNAL STRESSORS RELATED TO THE PANDEMIC AND VIRTUAL WORK HAVE RESEARCHERS EXPERIENCED?

The pandemic and subsequent shift to remote work has created unwanted stress for researchers on multiple fronts - from research related factors such as promotion timeline/visa considerations to non-research related factors such as societal events and caretaking responsibilities at home. Among all respondents, the most frequently cited factor affecting mental health was *societal and political events* (69%), followed by *physical and social isolation* (66%) and *disruption of promotion or tenure timeline* (38%).

Despite universal impacts across researchers, certain groups were more negatively affected than others. For instance, 81% of respondents with an “other” gender identity reported that personal mental and/or physical health had a substantially negative impact on their productivity, almost twice the average rate. Over half (52%) of early-career investigators reported that disruptions to their promotion/tenure timeline negatively affected their mental health, compared to 38% overall.

For researchers with caretaking responsibilities, 46% reported more difficulty in completing work responsibilities, and 61% agree that the pandemic will negatively impact their career trajectory. The type and age of dependent also mattered: those with children under age five were consistently more negatively impacted than those with older dependents. Among caretakers of young children, 61% indicated that their duties made it substantially more difficult to complete their work responsibilities.

Interestingly, respondents who did not pay for caretaking help were less negatively impacted than those who did in terms of productivity, career trajectory outlook, and difficulty in completing work.

What are the implications for biomedical research and research productivity?

These findings suggest that external stressors stemming from the pandemic have taken a toll on researchers both mentally and physically. An implication of this finding is the risk for a decrease in research quality as well as burnout from certain parts of the research community.

An important aspect to note is the disproportionate effect of these stressors on under-represented groups. For instance, the unequal distribution of housework means that women are more likely to deal with non-work-related tasks during the lockdown and lose productivity, with younger cohorts of women academics penalized the most (Cui et. al., in press).

Therefore, it is important that funding agencies and hiring and promotion committees at national and international levels reconsider their policies in these exceptional times (Flaherty, 2020). To mitigate the negative impact of these stressors, solutions should focus on enhancing overall well-being of researchers.

It is also important for institutions to consider providing additional support, such as childcare support, to researchers whose productivity has been disproportionately affected. Universities and letter writers should keep this inequality in mind when evaluating professors for promotion (Cui et. al., in press).

What have institutions done to support their researchers through these disruptions? Have researchers found institutional support effective?

Besides individual researchers, institutions also felt the impact of the pandemic, with 83% experiencing “major” or “moderate” impacts on research productivity. The unexpected short- and long-term costs of COVID-19 resulted in two-thirds of research leaders expressing concern over their institution’s financial status. When looking to the future, 41% of respondents said that the financial repercussions of COVID-19 would likely jeopardize their institution’s ability to maintain its research function.

Research leaders and researchers hold divergent opinions on the impact of the pandemic on promotion and tenure. Researchers expect delays in their progress toward promotion and tenure; institutional leaders do not. Among those leaders who did believe the pandemic would affect the ability to earn tenure, the vast majority reported that accommodations had been put in place to account for lost research time; conversely, only 26% of respondents said that their institution had put in place accommodations to account for lost research time.

In terms of mitigating actions, 83% of researcher respondents indicated that their institutions implemented contact tracing,

transmission modeling, and other measures. Institutions have also offered COVID-19-related flexibilities for faculty and staff. Over 60% of respondents stated that they offered flexibilities regarding “tenure-clock considerations” (66%) and “employment hours” (63%). Meeting caretaking needs was one area where responses indicated need for improvement.

What are the implications for biomedical research and research productivity?

These findings point to the critical role institutions play in moderating the deleterious effects of the pandemic on researchers. The generalized boosted model indicates that the perception of organizational support was the eighth most important factor in predicting a respondent’s perception of their career trajectory. Institutions can stimulate research productivity by implementing policies and procedures to help researchers conduct their research, such as maximizing researchers’ access to specialized equipment through staggered schedules and providing monetary resources to reduce the anxiety associated with time-sensitive grants.

While policies ranging from contact tracing to tenure clock adjustments undeniably alleviate stress for researchers, they have also placed greater financial burdens on institutions themselves. Academic institutions are disproportionately affected given funding obligations beyond research activities coupled with reduced income from tuition and other sources.

Most higher education institutions have created emergency plans as they disseminated information about the virus, trained their employees to work remotely, and organized virtual sessions with their students and/or other stakeholders (Camilleri, in press). For example, the Provost’s Office at the University of Massachusetts adjusted the timing of decisions on tenure, reappointments, and continuing appointments, stating it is unreasonable to expect that normal progress can be made in all areas of faculty activity: research, teaching, and service (Clark et. al, 2020).

It is important that institutions continue to support researchers through targeted policies and the distribution of critical resources. The effectiveness of this support, in turn, should be evaluated regularly and adjusted as needed.

GLOSSARY OF KEY TERMS

Early-career investigators: The definition of an early-career investigator varies, though all describe researchers within, at most, the first ten years of their career and without an established publication record or substantial research grant (Horta & Santos, 2016; NIH, 2020). This includes PhD students, postdoctoral researchers, and those faculty or researchers in the first six years of their academic or other research-related employment following the completion of their postgraduate research training (Bazely, 2003; Levine & Rathmell 2020).

Mid-career investigators: Based on the career stage options included in the NIH survey, mid-career investigators include faculty members and researchers 7 to 14 years after residency, postdoctoral fellowship, or last advanced degree.

Gender identity: Refers to a person's basic sense of being a man, woman, or another gender, referred to "other" in this report. Gender identity can be congruent or incongruent with one's sex assigned at birth (Institute of Medicine, 2011).

- **Other gender identity:** Includes transgender or genderqueer or gender non-conforming—a rejection of the traditional binary classification of gender.

Generalized boosted model: A machine learning model that is used to predict the outcome of a dichotomous dependent variable based on a set of independent variables. This technique is derived from a treat-based machine learning method that factors in variable interactions and discovers variable importance in predicting the dependent variable.

Independent research institutions: Research institutions that are not part of a university, government, hospital, or corporation.

Minority-serving institutions (MSI): Institutions of higher education enrolling populations with significant percentages of undergraduate minority students populations. There are seven categories of minority-serving institutions as defined in US law under Title III of the Higher Education Act of 1965: historically Black colleges and universities; predominantly Black institutions; Hispanic-serving institutions; Tribal Colleges or Universities; Native American non-tribal institutions; Alaska Native- or Native Hawaiian-serving institutions; Asian American- and Native American Pacific Islander-serving institutions (U.S. Department of Education, n.d.).

Research productivity: The *NIH COVID-19 Impact on Extramural Researchers Survey* defined research productivity as including "submitting grant applications, publishing papers, collecting data, etc." This definition captures both research activities and their outcomes.

Senior-career investigators: Based on the career stage options included in the NIH survey, senior-career investigators include faculty members or researchers 15 years or more after residency, postdoctoral fellowship, or last advanced degree.

Special focus institutions: Includes institutions with a high concentration of degrees in a single field or set of related fields, at both the undergraduate and graduate levels. Institutions are determined to have a special focus with concentrations of at least 75 percent of undergraduate and graduate degrees (Carnegie Classifications, n.d.). In the NIH survey, respondents were provided with three examples: technology, arts-related, and cancer centers.

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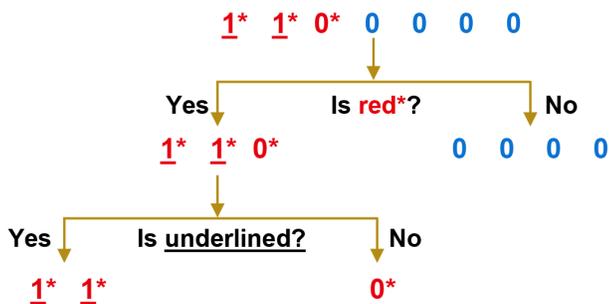
APPENDIX

GENERALIZED BOOSTED MODEL OVERVIEW

Generalized boosted classifiers are machine learning models aimed at predicting and explaining the outcome of a dichotomous dependent variable based on a set of independent variables.⁸ This analysis used the Generalized Boosted Regression Models package for R.

Generalized boosted models are derived from a tree-based machine learning method that is non-parametric, factors in missing values, and discovers variable importance and interactions (Breiman, 2001).

Figure 12. **Simple Decision Tree Model**



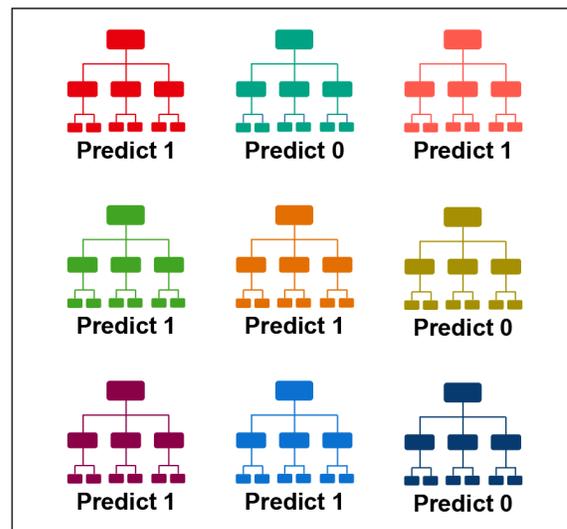
To understand generalized boosted models, it is important to understand its building blocks – decision trees. A basic decision tree is outlined in Figure 12.

Generalized boosted models consist of many individual decision trees that operate in an ensemble fashion. Various parameters are used to tune the model and define the number of decision trees that will be used in the

generalized boosting. Each decision tree is fitted on various sub-samples of the dataset and uses averaging to improve the predictive accuracy of the model and control over-fitting (memorization of the training dataset, which leads to suboptimal predictive accuracy). The sub-sample size is controlled with the “max_samples” parameter if the “bootstrap=True” default setting is applied, otherwise the entire dataset is used to build each individual decision tree.

The output from each tree in the generalized boosted model is a class prediction – in our case, either the positive class or the negative class – and the class with the most votes becomes our model’s prediction. Figure 13 depicts how generalized boosted models operate on the back end.

Figure 13. **Generalized Boosted Model**



Tally: Six 1s and Three 0s
Prediction: 1

⁸ There are also generalized boosted regressor models used for continuous dependent variables.

The underlying logic of all generalized boosted models might seem simple, but it is quite powerful and uses the wisdom of the crowd. In other words, a relatively large number of somewhat uncorrelated decision trees functioning as a “committee”, will outperform the sub-models in aggregate.

USE OF GENERALIZED BOOSTED MODEL IN THIS STUDY

Analysis of the *NIH COVID-19 Impact on Extramural Researchers Survey* focuses on two items – whether *researchers anticipate a negative trajectory to their career* and whether *their research productivity is lower than normal since March 2020*.

The model generated a forest for prediction of an anticipated negative career trajectory based on 48 variables from the survey. The classification model performed remarkably well, with an AUC⁹ of 83.0. The most important variables were Impact on Grant Application, COVID-19 Negatively Impacting Research-Related Activities, Career Stage, Race, and Caretaking Impact on Difficulty to Complete Work.

The model also generated a forest for prediction of research productivity based on a set of 48 binary variables derived from the *NIH COVID-19 Impact on Extramural Researchers Survey*. This model also performed quite well – with an AUC of 83.6. The strongest predictors of decreased research productivity were Negative Impact on Productivity: Changes in Laboratory/Animal Facility Access, Impact on Grant Application Ability, Negative Impact on Productivity: Research Put on Hold, Not Having

Lost Access to Research Resources, and Primary Type of Research.

TREATMENT OF MISSING VALUES

The approach to missing values is based on the data generating mechanism behind the missing values (Rubin 1976). For those features for which missing values are a product of exogenous factors, rather than observed values, we treated the missing values as another predictor. We did this as adaptive tree imputation still requires that the missing data mechanism be Missing at Random, meaning that there is a relationship between the propensity of missing values and the observed data (Ehrlinger 2016, pg. 13).

⁹ AUC, or Area Under the Curve, is an aggregate measure of performance in distinguishing between outcomes. The higher the AUC, the better the model is at predicting

negative outcomes as negative and positive outcomes as positive. An AUC of 1.0 indicates perfect classification ability, or 100% accuracy across varying threshold levels.