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EDUCATION RESEARCH

Impact of COVID-19 on access to laboratories and human participants: exercise science faculty perspectives

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Abstract

Restrictions due to the coronavirus (COVID-19) pandemic impacted the ability of faculty and students in exercise science to work in lab settings with human participants. The purpose of this study was to determine how exercise science faculty were impacted by COVID-19 restrictions with respect to access and use of exercise science lab and research facilities. Of the 100 surveyed participants categorized as requiring access to people and lab spaces (lab-based faculty), 61% (n = 61) reported decreased research productivity with 87% (n = 53) of those faculty in one or more of the following subdisciplines: exercise physiology, clinical exercise physiology, or biomechanics. Of all lab-based faculty, 40% (n = 40) participants reported having access to students and lab spaces and 55% (n = 55) indicated they were allowed to conduct in-person research. Of tenure-track lab-based faculty, 80% (n = 20) reported a decrease in research productivity, of which 60.0% (n = 12) identified as female. Among faculty with 5 or less years of teaching experience (n = 23), 69.6% (n = 16) reported a decrease in productivity, with 68.8% (n = 11) of those being female. All exercise science faculty surveyed reported issues with safety and social distancing, modified lab and research procedures, faculty workload, and research productivity. This information can be leveraged to create better infrastructure to support faculty and develop and implement strategies to reduce workload inequities.

higher education; pandemic; research productivity; workload inequity

INTRODUCTION

Due to the coronavirus (COVID-19) pandemic, more than 1,300 higher education institutions canceled in-person classes and moved to online delivery in March 2020 (1). Emergency Remote Teaching (ERT) during spring 2020 forced faculty and students to transition online with little to no preparation (2). Course delivery methods were impacted during fall 2020 with 44% of institutions continuing primarily online during fall 2020, whereas 21% moved to a hybrid delivery method, and 27% offered socially distanced, in-person learning (1). As the pandemic lingers, instruction continues to shift between in person, hybrid, and remote modalities.

Many faculty in higher education rely heavily on access to laboratories and close physical interaction with human participants to effectively teach laboratory skills and conduct meaningful research. Additionally, laboratory-based experiential learning is considered a high-impact teaching practice (3, 4). The COVID-19 pandemic forced many colleges and universities to implement safety policies which restricted access. While these restrictions were necessary to mitigate the spread of COVID-19, the changes severely impacted human research laboratories and experiential learning opportunities for students (5).

Safety guidelines had a large impact on exercise science faculty, particularly those in subdisciplines requiring access to people and laboratory spaces such as exercise physiology, clinical exercise physiology, and biomechanics. Exercise presents an additional challenge to mitigating COVID-19 spread due to the transmission of the virus through respiratory droplets (6). Not only was there wide variation in course delivery methods among institutions, but there was also wide variation in what was permitted in exercise science laboratories and by Institutional Review Boards for face-to-face research (5, 7). Some institutions allowed all exercise testing, including maximal oxygen consumption testing in exercise science laboratories, while others closed laboratory spaces completely. Therefore, the purpose of this study was to determine how exercise science faculty were impacted by COVID-19 restrictions with respect to access to and use of exercise science laboratory facilities for teaching and research.

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Table 1. *Subdisciplines of kinesiology*

Subdiscipline	Frequency
Exercise physiology	66
Clinical exercise physiology	16
Biomechanics	11
Motor/behavioral control	9
Sport nutrition	14
Physical education	8
Athletic training	7
Coaching	8
Other	5

Note: participants were not limited to one response for this question.

METHODS

Participant Recruitment and Study Design

In January 2021, a convenience sample of exercise science faculty teaching in higher education was recruited through email and social media platforms to complete a survey on teaching and research experiences during fall 2020. For this article, data from five quantitative and three qualitative questions on faculty pedagogy practices in laboratory courses and faculty research productivity during the COVID-19 pandemic were analyzed. All methods were approved through the University Institutional Review Board. To begin the survey, participants agreed to a statement of consent by selecting an agreement box at the start of the electronic survey.

Data Categorization

From the overall survey, laboratory-based faculty were used in this analysis (n = 100). Faculty were classified as laboratory based if they taught in a discipline that typically requires human subjects data collection in an exercise science laboratory or other in-person space (Table 1). Lab-based faculty fell into two groups: those who had access to face to face interactions and exercise science laboratory spaces, and faculty who did not. Faculty were classified as "having access" if they could be in a physical laboratory space, either teaching students fully face to face or in a hybrid format, or performing research with human participants. Faculty were classified as "not having access" if they were prohibited from conducting any in-person laboratory and/or research activities during fall 2020. Within each access category, three main themes from the open-ended questions were identified and explored: safety and social distancing, modified laboratory and research procedures, and faculty workload and productivity. Each of the themes identify challenges and successes faced by faculty during fall 2020.

Statistical Analysis

Descriptive statistics (mean, standard deviation, and frequencies) were calculated. For questions addressing laboratory access for teaching, participants were categorized into two groups: fully remote (no access), and those with access, which were broken down into hybrid (some access) and face-to-face (full access). Data were further analyzed by faculty rank, years of teaching experience, and gender identity. Analysis of proportions were performed to examine associations between access to laboratory spaces and participants with the following: tenure status, faculty rank, research productivity changes, gender, and shifts in research agenda. An analysis of proportions was also done between faculty rank and changes in productivity. Open-ended response questions were analyzed using the thematic and content analysis method (8). Responses were read and coded independently by two researchers who identified themes based on responses to individual questions. The researchers compared their independent themes for concordance and finalized themes, which established interrater reliability.

RESULTS

Participant Demographics

Participants included faculty from a wide variety of institution types, faculty ranks, and years of experience. The participants were mostly non-Hispanic white with almost equal gender distribution. In the sample, 53% of faculty were tenured and 40% had less than 10 yr of teaching experience in higher education (Table 2).

Lab.

Of the laboratory-based faculty surveyed, 61% (n = 61) indicated they taught or supervised laboratories during fall 2020 and 85.2% (n = 52) of those were in one or more of the following subdisciplines: exercise physiology, clinical exercise physiology, or biomechanics. Faculty were nearly evenly distributed between laboratories taught fully online (34.4%, n =

Table 2. *Participant demographics*

Descriptor	Frequency
Gender	
Male	48
Female	52
Race/ethnicity	
Non-Hispanic White	93
Hispanic or Latino	2
Black or African-American	1
Native Hawaiian or other Pacific Islander	2
Prefer not to disclose	2
Years of experience	
<10 yr	40
10–19 yr	33
20–29 yr	19
>30 yr	8
Tenure status	
Tenured	53
Tenure track	25
Nontenure track	22
Academic rank	
Instructor*	9
Assistant professor	34
Associate professor	26
Full professor	27
Adjunct (part time)	4
Institution type†	
R1/R2/doctoral or professional	31
Public 4-yr institution	34
Private 4-yr institution	37
Community college	4

*Includes full-time instructor, lecturer, visiting assistant professor, clinical faculty. †Faculty selected all applicable options.

Table 3. *Faculty demographics for research based on access to labs and participants*

	Access		No Access	
	n	%	*n*	%
Gender				
Female	26	47.3	16	57.1
Male	29	52.7	12	42.9
Type of institution*				
R1/R2/doctoral or professional	22	40.0	7	25.0
Public 4-yr institution	17	30.9	11	39.3
Private 4-yr institution	19	34.5	9	32.1
Community college	1	1.8	1	3.6
Tenure status				
Tenured	35	63.6	12	42.9
Tenure track	10	18.2	10	35.7
Nontenure track	10	18.2	6	21.4
Faculty rank				
Full professor	20	36.4	4	14.3
Associate professor	16	29.1	8	28.6
Assistant professor	14	25.5	13	46.4
Instructors†	5	9.1	3	10.7
Shift in research agenda‡				
Large changes	23	41.8	18	64.3
Small changes	14	25.5	2	7.1
No changes	10	18.2	1	3.6
N/A	8	14.5	7	25.0
Impact on research productivity§				
Increased	2	3.6	0	0.0
Decreased	33	60.0	20	71.4
No change	12	21.8	2	7.1
N/A	8	14.5	6	21.4

These results do not include participants who indicated "I don't know" (n = 11) or "N/a" (n = 6) to the question, "did your institution allow in-person data collection for research?" *Faculty selected all applicable options. †Includes full-time instructor, lecturer, visiting assistant professor, and clinical faculty. ‡Significant association between access and shift in research agenda. §Does not include student research.

21), laboratories taught in a hybrid format (37.7%, n = 23), and laboratories taught face-to-face (27.9%, n = 17). Regardless of teaching modality, 52% (n = 52) of faculty reported spending 0–5 h per week in extra preparation time per course and 27% (n = 27) reported an extra 6–10 h per week of extra preparation time during the fall of 2020.

Research.

Overall, 28% (n = 28) of participants indicated they were not allowed to perform in-person data collection for research and 55% (n = 55) indicated they were allowed to conduct in-person research (Table 3). Only 7.3% (n = 4) of the 55 participants had no restrictions on in-person data collection (11 were unsure about data collection restrictions, and 6 indicated the question was not applicable to their situation). There was a nonsignificant association between access and tenure status [$\chi^2(2) = 3.88$; $P = 0.143$; $\varphi = 0.216$; $n = 83$], faculty rank [$\chi^2(3) = 5.69$; $P = 0.128$; $\varphi = 0.262$; $n = 83$], research productivity changes [$\chi^2(3) = 4.29$; $P = 0.232$; $\varphi = 0.227$; $n = 83$], and gender [$\chi^2(1) = 0.723$; $P = 0.395$; $\phi = 0.093$; $n = 83$]. There was a significant association between access to laboratory spaces and participants and shifts in research agenda [$\chi^2(3) = 9.23$; $P = 0.026$; $\varphi = 0.334$; $n = 83$), with 41.8% of those with access making large shifts to their research agendas and 64.3% of those without access making large shifts to research agendas.

A majority of faculty reported decreased research productivity (61%, n = 61), with 87% (n = 53) composed of faculty in one or more of the following subdisciplines: exercise physiology, clinical exercise physiology, or biomechanics. Of the 61% who reported decreased productivity, 46% (n = 28) were in nontenure track or tenure-track positions (Fig. 1). Of these nontenure track and tenure-track participants, 64% (n = 18) identified as female. There was a significant association between faculty rank and changes in productivity [$\chi^2(12) = 30.08$; $P = 0.003$; $\varphi = .317$; $N = 100$]. Decreased productivity was most prevalent among assistant professors (37.7%, n = 23) and associate professors (31.1%, n = 19).

Themes

Three themes were identified in the open-ended responses: safety and social distancing, modified laboratory and research procedures, and faculty workload and productivity. These themes were identified in both those who had access in regard to laboratory teaching and research (Table 4) and those faculty who did not have access to laboratory space and human participants for laboratory or research (Table 5).

DISCUSSION

The COVID-19 pandemic had a significant impact on faculty in higher education. Unique challenges existed for faculty who required access to laboratory spaces and human participants (9). The aim of this study was to explore the

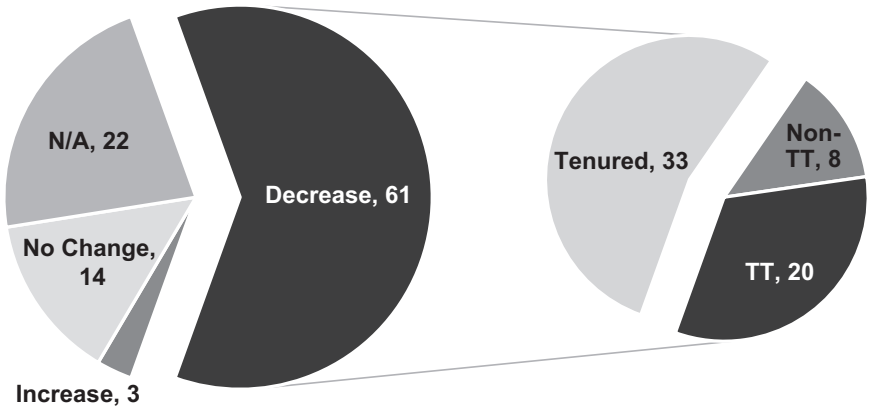

Figure 1. Changes in research productivity among faculty and breakdown of those who reported decreased productivity by faculty rank (data label numbers indicate n for each subgroup). N/A, not applicable; TT, tenure track.

Table 4. *Faculty perceptions of effects of COVID-19 with access to lab spaces and human subjects for teaching and research*

Theme	Sample Quotations
Safety and social distancing	"Many in-person studies were heavily restricted and limited the number of participants as well as the types of research that we could do. There was a concern that heavy breathing from exercise would increase the spread of COVID-19 and therefore we could not conduct any exercise protocols."
	"Everything we do requires in person testing, it's difficult to get people willing to come in."
	"it was inconvenient for students to get temperature checks and S/S [signs/symptoms] checks prior to every entry in the lab"
	"Creating lab groups that came in at different times so we could have less students in the lab at a time. This also allowed us to clean and sanitize equipment between lab groups coming in."
Modified lab and research procedures	"Many students needed to revise their projects or adjust them to be "COVID policy proof". This slowed them down."
	"Thankfully we did have some data that we can write several manuscripts from. However, most plans for new data collection are reliant on adapting and/or creating research questions that can be answered with virtual data collection. The most frustrating part has been mentoring students in data collection, as they miss so much of the data collection experience when they are relying on remote data collection. The questions they are answering matter just as much, but it feels like there is a part of what we consider standard curriculum for graduate student research"
	"did all labs outdoors with masks and social distance. used old lab data for research projects. were able to focus on academic skills more (info literacy and data analysis)"
	"I had ongoing projects involving human participants that I decided to put on hold but shifted my attention to other research projects that involve online survey research."
Instructor workload and productivity	"With the modifications and risk-benefit ratio, though I had aspirations to do some limited work it just wasn't worth it"
	"Although policy allowed for it, getting approval took many months so no data collection was possible."
	"Minimal contact with stacked classes. The admin overloaded my classes. Maxes were 18 and they went to 25, 25, 50."
	"That faculty were willing to "teach twice" so that all students could still have a hands-on lab experience. Also, we found one alternative location so that all Athletic Training students could have labs at the same time (groups of 10-12 students in a lab space in another building)."
	"There was no change in my productivity BUT the stress and fatigue I felt increased. I was able to be productive by working long hours in the spring and summer."

COVID, coronavirus; $n = 55$.

effects of the COVID-19 pandemic on exercise science faculty with respect to laboratory course delivery and research productivity, specifically those in laboratory-based subdisciplines, during fall 2020. Access to exercise science laboratory spaces and human participants varied widely across the sample with some faculty reporting no access. While over half of faculty surveyed reported having access, many were forced to adjust laboratory courses and adapt research

Table 5. *Faculty perceptions of effects of COVID-19 without access to lab spaces and human subjects for teaching and research*

Theme	Sample Quotations
Safety and social distancing	"virtual labs worked with the right videos but lack interaction"
	"Labs were fully online, so it was difficult to replicate the practical experiences students should be getting through remote teaching."
	"My normal use of student interns in our Human Performance Lab was eliminated, thus potential research efforts were delayed."
	"Students didn't have access to equipment that they needed. Videos on YouTube only do so much and I wasn't able to help teach them skills they will need in the future. ie- Blood pressure, Exercise test administration"
Modified lab and research procedures	"Most of my agenda is working face to face with individuals. I continued writing manuscripts for data in my files, but no new data were collected over summer and fall, despite having an approved IRB in hand."
	"I cannot do research with human subjects at the moment so research opportunities are severely impacted. I do not know when this will change. I would have to try to write a review paper and get it published, which is know it be much harder, if I am to publish this academic year."
	"Labs were fully online, so it was difficult to replicate the practical experiences students should be getting through remote teaching."
Instructor workload and productivity	"created video content that may be able to be utilized in the future"
	"Challenge of creating "interactive" and applied experiences related to exercise physiology labs as well as in the personal trainer preparation course."
	"Learning virtual delivery"
	"My research was completely shut down until December 2020. Administration at my University refused to let us conduct in-person data collection, but had no changes to expectations regarding research productivity."

IRB, institutional review board; $n = 28$.

agendas to conform to COVID-19 safety and social distancing protocols. These changes were often accompanied by increased faculty workload and decreased research productivity.

Modified Lab and Research Procedures

One major challenge due to COVID-19 restrictions was the implementation of safety procedures, which varied widely across institutions (10). Examples of new safety procedures included the following: wellness and temperature checks, surface disinfecting, personal mask use, hand hygiene, and increased ventilation in indoor spaces. For those with access to laboratory spaces, the additional safety protocols added significant time and effort to laboratory and research testing preparation and clean up. In some cases, social distancing requirements necessitated the addition of course sections to accommodate all students in laboratory courses. In the present study, many faculty noted little institutional guidance for developing safe laboratory protocols during the COVID-19 pandemic. Professional organizations such as The Physiological Society and local healthcare facilities provided useful guidance (6). Faculty worked with safety offices and institutional leaders to develop laboratory safety policies for research and teaching (10).

Lab and research procedures were limited, even for faculty who had access to laboratories and participants. This disproportionately affected laboratory-based faculty, particularly those in exercise physiology, clinical exercise physiology and biomechanics. For example, faculty reported data collection requiring respiratory and metabolic measurements could not be performed or needed to be modified. Collecting and understanding respiratory gas measurements are a core learning goal for students in exercise science and a standard procedure in many exercise research studies. The 6-foot social distancing requirements restricted personal interactions such as physiological data collection. Faculty noted that social distancing limited room capacities, student group work, and skill development. Even when procedures could be performed, quarantine and participant hesitation about being face to face presented challenges in access to people. Abshire and colleagues (11) noted similar barriers in participant recruitment and enrollment for nursing research.

Another limitation reported by faculty in this study was obtaining ethics board approval to conduct research with human participants due to safety and social distancing restrictions. Exercise science laboratories involve exercising protocols, which add a level of risk for COVID-19 transmission. Many institutions decided to shut down laboratory and participant access altogether, forcing those faculty to make the largest changes. Even when access was permitted, some faculty still opted to shut down their exercise science laboratory due to the complications presented by safety and social distancing protocols.

In many health-related fields such as exercise science, students are expected to demonstrate competencies that are traditionally evaluated face to face. Students are often evaluated on their ability to demonstrate correct lifting techniques, exercise testing protocols, and blood pressure measurements among others. Despite the challenges posed by the COVID-19 pandemic, strict safety procedures allowed for some in-person learning experiences and research to continue. Faculty in this study were able to modify laboratory and research procedures to accommodate social distancing in laboratory spaces. The shift to fully virtual laboratory pedagogy forced some faculty to rethink the way they engaged students with respect to experiential learning. Ray and Srivastava (12) suggested virtual laboratories and online resources could be effective alternatives for remote learning, particularly in cases where in-person opportunities are interrupted or unavailable. Ray et al. (13) found no significant differences in learning outcomes between virtual and physical laboratories. Davis and Pinedo (14) recommended the use of science demonstration and interactive videos as well as virtual game-based learning activities as viable alternatives to hands-on anatomy and physiology laboratories during the COVID-19 pandemic. Similarly, Morrison et al. (15) shared successful examples of active learning approaches in biology to create meaningful student experiences during the pandemic. While many faculty in the present study found the rapid shift to fully virtual laboratory delivery challenging, a few faculty reported positive outcomes such as the ability to meet student learning outcomes and having a richer body of supplemental resources for the future.

Lab-based exercise science faculty were not only affected in the way they taught laboratory courses but also how they conducted research. This impact was also observed in institutions that may have allowed exercise science laboratory access but did not allow interaction with human participants. In the present study, 67.3% of faculty with access to laboratories made changes in their research agendas and nearly 71.4% of faculty who had no access reported the same. Faculty reported performing research with preexisting data sets, writing up previously collected data, and shifting focus to survey research or grant writing. In a survey conducted during spring 2020, Betancourt (16) noted that over half of faculty surveyed from five institutions were able to access and analyze preexisting data sources. The use of preexisting data and data sharing between laboratories opened opportunities for new collaborations among researchers (17). Research agenda modifications found in the present study were also supported by Omary et al. (18) who noted the importance of shifting to develop different research skills when access to typical research practices are limited or unavailable. Abshire et al. (11) also noted the use of virtual data collection for overcoming access to laboratory space and human participant barriers among nursing faculty. In March 2020, ResearchGate surveyed 3,000 international members to measure the impact of the pandemic on their scientific research agendas and 82% reported that the pandemic impacted their work, 45% indicated they spent more time looking for and reading scientific research, and 43% reported an increase in writing and submitting peer-review work (19). Data from the survey also suggests that more researchers were focused on analyzing existing data sets and planning for future projects (19). Some universities provided support for research faculty during the pandemic, offering suggestions for continuing research productivity despite laboratory access limitations (20).

Faculty Workload

Safety procedures, especially social distancing, created challenges with course offerings, which increased faculty

workload and influenced research productivity. Some faculty were asked to teach additional sections of courses due to room capacity limits. Increased faculty teaching and service workload (e.g., redesigning courses and developing safety protocols) limited time for faculty research. More than half of respondents indicated an increase in work related responsibilities during fall 2020 (e.g., service commitments, meetings, ad hoc committees, task forces, etc.). The challenges of creating new policies for laboratory safety procedures also relates directly to the challenge of increased faculty workload. Many faculty spent extra time and energy researching and developing laboratory safety procedures in consultation with institutional leaders so exercise science laboratory activities with students and human participants could continue (10). Faculty input in designing safety procedures that directly affect their work is positive for those with that opportunity; however, additional meetings increased faculty workload likely during the summer months preceding the fall semester, a time when many faculty are off contract.

Prior to the COVID-19 pandemic, only about half of faculty at institutions in the United States had taught a fully online class (21). Designing well-structured didactic online courses is difficult enough but moving experiential content to a fully virtual format is even more challenging, particularly in an ERT context (2). Half (52%, n = 52) of faculty in the current study reported spending 0–5 h per week in extra preparation time per course and 27% (n = 27) reported an extra 6–10 h per week of extra preparation time during the fall of 2020. In a survey of student and faculty experiences online during spring 2020, McDaniel et al. (22) found that faculty reported a significant workload increase. A common theme among survey respondents was extra time spent searching for and creating quality virtual laboratory content. While this was noted as a challenge for faculty teaching laboratories, it was also cited as a success of being forced to adapt to a fully virtual environment as they now have a richer pool of resources to help students reach learning outcomes.

Faculty Research Productivity

Almost all faculty sampled who reported making changes to their research agenda during the fall of 2020 saw a decrease in their research productivity. In contrast to the present study, Myers et al. (23) reported a 11% decline in total working hours (from 61 to 54 h). While this seems to contradict findings of the current research, Meyers et al. (23) noted that the decline was primarily attributable to a 24% decrease in time allotted to research endeavors. The largest decline in research time (30–40%) was reported by scientists who depended on physical laboratory spaces (23). In the present study, similar impacts on research productivity were noted in the subsample analysis of natural science faculty. More than half of the faculty noted a decrease in research productivity. Exercise physiologists, clinical exercise physiologists, and biomechanists composed most of this subsample.

In the present study, 60% (n = 33) of faculty with access to laboratories and participants and 71.4% (n = 20) of faculty with no access reported a decrease in research productivity during fall 2020. No faculty without access reported increasing their productivity. In a survey conducted in May and June 2020, across several higher education institutions, ~75% of faculty reported that the effects of the pandemic had a negative impact on their research (16). While shifts in scholarly work still allowed faculty to publish, a lack of access to laboratory spaces and research participants likely impacted faculty working toward publication requirements which may or may not have been adjusted due to the pandemic (24). Many faculty also lost student research assistants. Faculty who collaborate with undergraduate student researchers are more productive scholars and produce more student-faculty collaborative papers than those who do not work with undergraduate student researchers (25). Additionally, lack of face-to-face research has negative implications for pretenure faculty working to meet institutional scholarship requirements. Some faculty in the present study noted that summer research programs for students were canceled. These changes likely had productivity implications for faculty.

Overall, 16 of the 20 (80%) tenure-track faculty surveyed reported a decrease in research productivity, more than half of whom were female. Tenure-track females experienced a significant research disadvantage during the fall 2020. Similar trends were observed across other subgroups, notably with tenure-track faculty teaching laboratories and early-career faculty (26). Both Betancourt (16) and Myers et al. (23) reported about half of respondents in each survey reported a decrease in research output, with a higher proportion of women being impacted. Wiggington et al. (10) also reported that the effects of the pandemic disproportionately affected women, early career researchers, and low-income support staff and researchers in higher-risk health categories. In April 2020, Wehner et al. (27) surveyed 4,535 faculty or Principal Investigators from the U.S. and Europe and found that women with young dependents were most impacted. More specifically, a 5% larger decrease in time devoted to research was reported by female scientists, while a 17% larger decrease was reported in scientists with at least one dependent under the age of 5 yr. The pandemic further increased the gender gap in research productivity by at least 32% between January 2020 and April 2020 (27).

Prepandemic research demonstrates that access to academic success is more difficult for early career female researchers, due primarily to family-related circumstances such as starting a family (28). In the science, technology, engineering, and mathematics fields, 43% of female faculty left their job following the birth of their first child, compared with only 23% of male counterparts. While women typically take on more household and child rearing responsibilities, research suggests that the pandemic exacerbated this gap and further increased the existing gender inequity with respect to research productivity (29). According to a survey by the *Chronicle of Higher Education*, 74% of females reported deterioration of work-life balance compared with 63% for males (24). When asked about changes in workload, 82% of females reported an increase compared with 70% of males. Lack of caregiving assistance and greater household responsibilities due to the pandemic had a greater impact on female faculty than male faculty (24). According to the survey, 66% of tenured female professors and 69% of tenure-track female professors responded that they felt their scholarship productivity suffered compared with 58% and 61%, respectively, of male professors (24).

Pandemic-related disruptions are likely to impact research productivity for years to come and further exacerbate these inequities. Despite reopening laboratories and returning to in-person teaching, the pandemic will have lasting impacts on faculty. Those most affected are likely to be tenure-track faculty, women, and those in exercise physiology, clinical exercise physiology, and biomechanics because they rely heavily on access to laboratory spaces and human research participants. Restarting laboratories and start-up for new projects will take considerable time and energy for already overextended faculty. Additionally, teaching evaluations, which likely suffered for these vulnerable groups, will continue to be negatively impacted and could affect tenure and promotion. Cardel et al (30) put forth actionable strategies aimed at supporting and retaining early career women with children in research to mitigate the impact of COVID-19 on this already vulnerable population in academia. These recommendations include improved childcare infrastructure, targeted funding, and modified promotion and tenure management.

Looking to the Future

Changes in access to laboratory spaces, students, and human participants during the pandemic will potentially have long-term consequences for faculty and students. The limited interactive and experiential aspects of exercise science laboratories caused by the COVID-19 pandemic (e.g., graded exercise testing or metabolic testing) may result in significant loss of student learning experiences and skill building. Lack of practical experiences during training may impact student interest in the field and skills for success (31). Institutions and professional organizations should consider investing in more sustainable solutions to minimizing this gap as the threat of additional closures due to COVID-19 variants looms. Since resources are often limited, focusing on vulnerable faculty groups, particularly females, nontenure track and tenure track, and early career faculty are worthwhile investments for support and retention.

Although early reports suggest that federal grant funding for scientific research has been minimally affected by the pandemic, without access to laboratory spaces and human research participants much of the planned research cannot take place (5, 32). During the pandemic, researcher salaries associated with federally funded grants were maintained even with laboratory closures and remote work. Faculty who depend on grant money to fund their salaries may be adversely affected by no cost grant extensions for research. Institutions may not be able to cover salary gaps for those faculty, which could result in decreased earnings (32).

Limitations

The results of this study are limited primarily by the subjective nature of the self-reported data. The aim was to keep the survey brief to encourage participation by a large number of individuals; however, the full survey took ~20–25 min to complete, which may have limited some faculty's open-ended responses. Additionally, the results are limited by the geographical distribution of faculty. Faculty were primarily located in the eastern and midwestern United States. The use of author networks and social media to distribute the survey resulted in a convenience sample of faculty with potential for a snowball effect of sampling. However, the diversity in types of higher education institutions and faculty ranks was a strength of the study.

Conclusions

As a result of closures due to the COVID-19 pandemic, there were wide variations in faculty access to exercise science laboratory spaces and human research participants. Lab-based activities were either forced online or restricted, which impacted laboratory experiences as well as student and faculty research. Many faculty and students pivoted laboratory work to move online with virtual laboratory experience and survey-based data collection. Adjustments due to safety and social distancing and modified laboratory and research procedures increased faculty workload and productivity, with early career and female faculty impacted the most. Institutions can leverage this information to create more sustainable and robust infrastructure to support exercise science faculty with respect to laboratory teaching and research. Support should include developing and implementing strategies to reduce the inequities and encourage retention of early career and female faculty.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

M.C.S., J.K.F., S.L.J., J.L.C., K.E.S., and A.E.M. conceived and designed research; M.C.S., J.K.F., S.L.J., J.L.C., K.E.S., and A.E.M. performed experiments; M.C.S. and A.E.M. analyzed data; M.C.S., J.K.F., S.L.J., J.L.C., K.E.S., and A.E.M. interpreted results of experiments; M.C.S., J.K.F., S.L.J., J.L.C., K.E.S., and A.E.M. prepared figures; M.C.S. and A.E.M. drafted manuscript; M.C.S., J.K.F., S.L.J., J.L.C., K.E.S., and A.E.M. edited and revised manuscript; M.C.S., J.K.F., S.L.J., J.L.C., K.E.S., and A.E.M. approved final version of manuscript.

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