

# UC San Diego

## UC San Diego Previously Published Works

### Title

Students at a crossroad: A cross-sectional survey gauging the impact of COVID-19 on medical and biomedical graduates in the United States and Sweden

### Permalink

<https://escholarship.org/uc/item/7bj5h9tw>

### Journal

Biochemistry and Molecular Biology Education, 51(5)

### ISSN

1470-8175

### Authors

Lange, Stephan

Soták, Matúš

Hagberg, Carolina E

et al.

### Publication Date

2023-09-01

### DOI

10.1002/bmb.21761

Peer reviewed



# HHS Public Access

Author manuscript

*Biochem Mol Biol Educ.* Author manuscript; available in PMC 2024 September 01.

Published in final edited form as:

*Biochem Mol Biol Educ.* 2023 ; 51(5): 508–519. doi:10.1002/bmb.21761.

## Students at a crossroad: a cross-sectional survey gauging the impact of COVID-19 on medical and biomedical graduates in the US and Sweden

Stephan Lange<sup>1,2,3,4,#</sup>, Matúš Soták<sup>4,5,6</sup>, Carolina Hagberg<sup>7,8</sup>, Grace Bagunu<sup>9</sup>, Sylvi Vigmo<sup>10</sup>, Emma Börgeson<sup>2,3,4,5,6,#</sup>

<sup>1</sup>Department of Medicine, University of California San Diego, CA-92093 La Jolla, USA.

<sup>2</sup>Department of Biomedicine, Aarhus University, Aarhus, DK-8000, Denmark.

<sup>3</sup>Steno Diabetes Center Aarhus, Aarhus University Hospital, Region Midtjylland, Aarhus, DK-8200, Denmark.

<sup>4</sup>Department of Molecular and Clinical Medicine, Wallenberg Laboratory, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, SE-405 30, Sweden

<sup>5</sup>Wallenberg Centre for Molecular and Translational Medicine, University of Gothenburg, Gothenburg, SE-405 30, Sweden

<sup>6</sup>Department of Clinical Immunology and Transfusion Medicine, Region Västra Götaland, Sahlgrenska University Hospital, Gothenburg, SE-413 45, Sweden

<sup>7</sup>Division of Cardiovascular Medicine, Department of Medicine Solna, Karolinska Institutet, Stockholm, SE-171 74, Sweden

<sup>8</sup>Center for Molecular Medicine, Karolinska Institutet, Stockholm, SE-171 74, Sweden

<sup>9</sup>Revelle College, University of California San Diego, CA-92093 La Jolla, USA.

<sup>10</sup>Department of Education, Communication and Learning, University of Gothenburg, Gothenburg, SE-405 30, Sweden

### Abstract

Graduate programs in medicine and biomedical sciences have been severely impacted by the SARS-CoV-2/COVID-19 pandemic over the last two years. Following two years since beginning of the pandemic, data on student support, educational and academic performance as well as sentiment on changes to educational programs are starting to emerge.

---

#Correspondence should be sent to: Emma Börgeson, Department of Molecular and Clinical Medicine, the Wallenberg Laboratory and Wallenberg, Centre for Molecular and Translational Medicine, University of Gothenburg, 41345 Gothenburg, Sweden. emma.borgeson@wlab.gu.se; Stephan Lange, Department of Medicine, University of California, San Diego, CA-92093 La Jolla, United States of America. slange@health.ucsd.edu; Stephan Lange, Department of Biomedicine, Aarhus University, DK-8000, Aarhus, Denmark. stephan.lange@biomed.au.dk.

Author contributions

SL and EB conceptualized the survey and study design, collected and analyzed data, and wrote the manuscript. MS, GB, SC and CH curated and analyzed data, and contributed to writing and editing of the manuscript.

Conflict of interest

The authors have no conflicts of interests.

We performed and compared results of two cross-sectional surveys of Swedish and US-based medical and biomedical graduate students on how the pandemic has affected their studies, research productivity and career trajectory. Students were also asked to assess support provided by the university and supervisors. The surveys also captured student demographics and a range of other factors, such as pressures brought on by caretaking and financial responsibilities.

We analyzed answers from 264 and 106 students attending graduate programs in universities in Sweden and the US, respectively. US-based students faced more severe restrictions on their research program compared to students in Sweden, reporting more delays in productivity, scientific output and graduation, and increased worries about their career trajectory. Swedish students had more caretaking responsibilities, although these did not cause any delays in graduation. While support by universities and supervisors was comparable between the countries, financial worries and mental health concerns were particularly prominent in the US cohort.

Student performance and outlook was hugely dependent on the breadth of the restrictions and the available support. Besides the governmental and university-led approach to counter the pandemic, societal differences also played a role in how well students were handling effects of the pandemic.

## Keywords

PhD; graduate program; COVID-19; biomedical education; survey

---

## 1. Introduction

The SARS-CoV-2/COVID-19 pandemic has disrupted the education in biomedical and medical science graduate programs, which may have long-lasting impacts on the supervision and career progression of graduate students<sup>1-6</sup>. Students enrolled in biomedical and medical graduate programs may be particularly affected by the pandemic as their education and research typically requires physical presence at the university and/or hospital and potentially also the access to human volunteer subjects or patients. It is therefore critical for medical and biomedical education programs to understand how to provide support and supervision for students to adequately help the generation of new medical fellows and junior scientists during a pandemic.

We recently published a cross-sectional survey of Swedish biomedical sciences graduates that illustrated how the supervision of students has been affected by the pandemic<sup>7</sup>. However, it remains unclear how these data would translate to other nations. Sweden and its universities had a relatively libertarian albeit controversial approach to the pandemic, without lock-downs and widespread restrictions, rather relying on voluntary adherence to recommendations<sup>8</sup>. Universities in Sweden switched to distance/online learning from March 18, 2020 onwards. Swedish universities issued only recommendations to wear masks and for social distancing in case students used university facilities and work in laboratories<sup>9</sup>.

We now completed a mirroring survey of biomedical science graduate students at universities in the US, concentrating on one of the biggest university systems: the University of California. The US state of California and its cities have experienced several lock-downs and stay-at-home orders over the 2020-2021 period and thus serve as a contrasting example

to Sweden (Figure 1A). The first of these stay-at-home orders was issued by the governor of California on March 19, 2020<sup>10</sup>. This was followed by a plan that lifts restrictions in stages as outlined by the ‘Blueprint for a Safer Economy’ reopening framework on August 28, 2020<sup>11, 12</sup>, ultimately rescinding the stay-at-home order on June 11, 2021<sup>13</sup>. In addition, the University of California restricted access to campuses, housing, laboratories and university facilities to essential personnel that maintained critical infrastructure and services, but severely limited the ability of students and supervisors for in-person work and meetings<sup>14</sup>. Access to university facilities and laboratories was gradually increased from June 1, 2020 onwards<sup>15</sup>. However, throughout the pandemic, social distancing, mask-wearing, daily online symptom-checks and weekly COVID-19 testing and, once available, vaccinations were mandatory and/or highly recommended<sup>16, 17</sup>.

For the survey, graduate students in both countries were asked to answer questions related to their demographics, and provided detailed examples of positive and/or negative working, teaching and mentoring experiences during the pandemic. Our analyses highlight how the pandemic has affected both European and USA based graduate students. We provide insights what measures taken by governments, the university and supervisors shaped the experience and education of the students, how the pandemic affected the progress of their graduate studies and the influence it had on their personal lives.

## 2. Methods

### 2.1. Study design and participants

The survey was conducted using Entergate software ES Maker<sup>18</sup> and investigated how the education, supervision and mentoring of graduate students was affected by the COVID-19 pandemic. It was distributed via the administrative offices of biomedicine and medicine graduate programs at eight Swedish and four California-based universities (Figure 1B), between November 2020 and February 2021. In the Swedish cohort a total of 264 answers were received, while in the California cohort 106 answers were received. A sub-cohort of the Swedish survey was previously reported in a separate publication that focused on the pedagogical aspects of mentoring graduate students during the COVID-19 pandemic<sup>7</sup>.

### 2.2. Ethics

The survey was assessed by the Swedish Ethical Review Authority (Dnr 2021-00481) and the Institutional Review Board of the University of California San Diego (Project #201972XX), and found to be exempt by both authorities. Participants provided informed consent to publication of the anonymous survey results and we followed the general principles and recommendations provided by the Helsinki Declaration<sup>19</sup> and the Belmont Report<sup>20</sup>.

### 2.3. Data analysis and availability

The open-ended question was independently analyzed using inductive thematic analysis<sup>21</sup>. The answers were read after which they were coded, analyzed and categorized. When highlighting quotes, obvious spelling mistakes were corrected to facilitate reading. Analysis of word frequency was done using <https://www.wordclouds.com/>. Survey questions and

the original dataset of answers are available on Mendeley Data using the following DOI: [10.17632/4yx8vmt5fm.1](https://doi.org/10.17632/4yx8vmt5fm.1)

Data on Covid-19 cases and deaths as of January 13, 2022 were obtained from the WHO COVID-19 Dashboard <sup>22</sup>.

### 3. Results

#### 3.1. Demographic analysis of study participants

We first analyzed the demographics of our study cohorts as well as their educational background and the type of research in their graduate work (Table 1). The survey was distributed among graduate programs that focused on biomedical/medical degrees, and most US students were registered to the biology or biomedicine programs at the University of California, while most Swedish students were registered with medical programs at several Swedish universities. Approximately the same number of women and men volunteered to answer our survey. The majority of US students had a BSc degree, while most Swedish students had enrolled in their graduate programs with an MSc degree. Out of those that answered the survey, 12% vs 19 % were international students, in the US and Sweden, respectively. While 15% of US students reported COVID-19 related impacts on visa restrictions, only 7% of Swedish graduate students indicated similar worries. We also asked what research tools the students used. Whereas the US cohort mainly conducted “wet-lab research,” Swedish students focused more on data collection and clinical studies.

#### 3.2. Self-estimated impact of the COVID-19 pandemic on graduate students.

Our survey aimed to broadly assess the self-reported impact that the pandemic had on the graduate students, their education, productivity, career trajectory and personal situation. Both groups of graduates reported that the pandemic had comparably large effects on their course curriculum, including travel and conference attendance. US students placed more emphasis on health considerations in response to the pandemic compared to their Swedish counterparts. This is specifically attested by the fact that 80% of US student disclosed mental health concerns, while only 30% of Swedish graduates voiced similar worries.

We next asked the students if the pandemic had affected their productivity and whether they estimated that this would impact their graduation and/or future career trajectory (Table 2). Nearly all US graduate students reported a decreased research productivity, with 65% of participants stating that the pandemic had caused a reduction in scientific output. This may be related to the fact that the US student reported more significant restrictions in their access to research facilities (e.g. lab space, core facilities and office environment), as well as problems related to obtaining supplies. In light of this, 71% of the US cohort believed that their graduation would be delayed. In contrast, most Swedish students reported no problems accessing the laboratory or research infrastructure and the majority of Swedish students (57%) estimated that the timeline of their graduate studies would remain unaltered in spite of the pandemic. However, both US and Swedish students reported reduced access to both co-workers and mentors/supervisors.

### 3.3. Caretaking responsibilities during the pandemic

We hypothesized that changes to caretaking responsibilities might affect graduate students, as the pandemic resulted in an overall shift in working remotely from home and restrictions to child or elder care. We speculated further that there may be also gender-specific differences, as inequalities in housework and caretaking rooted in traditional gender roles may disproportionately affect women more than men<sup>23-25</sup>. Our survey asked students to clarify what caretaking responsibilities they had and how these responsibilities have been affected by the pandemic. We also inquired if students felt that changed caretaking responsibilities may affect their graduate studies (Table 3).

Approximately half of the Swedish students had caretaking responsibilities, most of which (94%) were devoted to the care of children. Although most of the Swedish cohort reported spending more time caring for their dependents due to the pandemic, most of the students (60%) did not believe that this would affect their ability to graduate. In contrast, very few US students (only 13%) had caretaking responsibilities. However, nearly all students (>90%) reported that they spent more time caring for their dependents due to the pandemic, estimating that this would considerably delay their graduation. Intriguingly, both cohorts of students showed no sex differences when asked if they spent more time on care compared to before the pandemic, as increases were comparable between men and women in Sweden (50% of women vs. 55% of men) and the US (100% of women vs. 90% of men).

### 3.4. University support

In order to identify how to best care for graduate students during the pandemic, we asked the participants to rate and describe the level of support that they received, or lacked, from the university during the pandemic (Table 4 and Figure 2). Overall, the perceived level of support received from supervisors and the university was lower in the US than in Sweden. In fact, Swedish graduate students stated more often that no additional help was needed compared to their US peers.

Support for Swedish students was mostly related to the provision of IT equipment, while more US students indicated that they received protective personal equipment (PPE) and support in dealing with mental health and financial concerns.

We proceeded to analyze answers that described the type of support the students received from the university, and/or what support they wished that they would have had on a thematic level, and by creating wordclouds that represent word-frequencies in the open answered question (Figure 2). Analysis of word frequencies specifically highlighted financial and mental health concerns as well as testing for US students, while their Swedish peers were more concerned with working from home and lack of pandemic-related restrictions. Our thematic analyses revealed seven distinct themes that largely follow along the same lines (Figure 2, middle panel). However, it emerged that only two themes were similar in the US and Sweden.

In the US, the most common theme was regarding financial concerns, whereas this was rarely mentioned by Swedish students. The US students highlighted problems with paying rent and that their bills had become more expensive as a result of e.g. increased electricity

usage. The students were thus appreciative when their departments or other organizations provided financial support (e.g. through stipends or subsidized groceries). On the other hand, students requested that universities would reduce (or ideally remove) parking fees during the pandemic, both to provide relief from the pandemic-inflicted financial strain, but also to encourage students and staff to not use public transport and thus limit the spread of COVID-19.

Mental health concerns, sometimes also interlinked/caused by financial worries, was another theme that affected most reporting students (80%) in the US. This is also reflected by quotes in Box 1 and data in Table 1, in spite of the increased mental health and financial support received by US students over their Swedish peers (Table 4). Many students struggled specifically with the pandemic-related isolation. Of note: having regular check-ins and support from faculty and peers appeared critical for the student well-being.

In Sweden, many students expressed concerns about going to work due to the fear of contracting COVID-19 compared to their US counterparts. As shown in Box 2, many Swedish students felt that government restrictions were not followed and that their work environment was unsafe. Students requested clearer rules and that more PPE (e.g. face masks) had been distributed, whereas their US peers were satisfied with the level of testing and PPE supplied by the university. A lack of protective equipment in Sweden was also seen in lower rates of PPE support received by graduate students (Table 4). Having an ergonomic home environment was also very important to many of the Swedish students. Some students had received help to set up a functioning work environment at home, while others would have liked more support in this area.

A theme that appeared both in the analyses of Swedish and US students' answers was that student's request for academic extensions to their graduate programs (Box 3). Students in both countries also stressed the importance of receiving regular updates and information from the university.

#### 4. Discussion

The COVID-19 pandemic had an enormous impact on the education of students around the world, whose full extent is only starting to emerge. We previously published data from a cross-sectional survey specifically looking how the pandemic has affected supervision of biomedical sciences and medical graduate students at different Swedish Universities<sup>7</sup>. Here we compared findings from a mirroring survey done with biomedical sciences students mostly based at different campuses of the University of California system in the US.

While the demographics of the two student groups was similar when it comes to gender, Swedish students were academically further advanced and largely focused on clinical research. Graduate students based in the US had overwhelmingly BSc degrees and were mostly engaged in biomedical research. Consequently, Swedish students worked predominantly in a clinical setting, whereas US graduates used more wet-lab facilities.

Our results show that US students were mainly worried about finances and graduating on time. This finding is mirrored in several other recent publications that additionally noted a



disproportionally larger impact on students from an underrepresented minority background<sup>27, 28</sup>. Financial problems may also fuel mental health concerns voiced by many students in the US. The overall problems caused by the pandemic left US students also with a sense that their career trajectory will be negatively affected, a predicament that extends also to medical fellowship and residency programs<sup>29, 30</sup>. In Sweden, students are mainly concerned with their ergonomic home environment and express a fear of being infected with COVID-19 due to much looser restrictions<sup>8</sup> compared to the US, but experienced less impact on their study outcomes and mental health.

These differences are striking but may also reflect societal differences at large. For instance, Swedish doctoral students are employed as staff during their graduate studies and are entitled to certain benefits, including an ergonomic work environment, paid parental leave and childcare. This, and the difference in academic level may explain why more students in Sweden have children and caretaking responsibilities. While 50% of the Swedish students with caretaking responsibilities estimate that they spent more time on these types of chores, most do not think that it will negatively affect their graduate studies. Fewer US students reported caretaking responsibilities. However, students felt that increased caretaking responsibilities during the pandemic will have a significant impact on their graduation and career trajectory.

A surprising finding was that there were no sex-specific differences in both cohorts when it comes to who bears the additional burden of caretaking caused by the pandemic. Women have previously been reported to be disproportionately affected by the pandemic with more housework and caretaking than men<sup>23-25</sup>. However, some limitations of this aspect in our study should be considered before drawing broader conclusions: the low percentage of study participants in the US with caretaking responsibilities, and a focus on students attending the University of California system in one of the most progressive US states may skew our results. European countries, and particular Nordic countries like Sweden, are known to have comparatively small sex-specific inequalities when it comes to caretaking responsibilities<sup>24</sup>. In addition, childcare services have been readily available in Sweden throughout the pandemic<sup>8</sup>, which has not been the case in the US/California.

In addition, our survey did not include questions that would enable us to determine on a gender basis if the partner or spouse of the study participant participated equally in the care of dependents.

Another important societal difference involves the difference in distribution of PPE and COVID testing. Swedish students have received the same treatment as the general population at large, with little to no distribution of free PPE and no hard mandate for the students or the general public to wear them. Most students would therefore have appreciated distribution of more PPE, increased testing and stricter rules regarding distancing and wearing of face masks. In the US, students were more dependent on the university and state policies. The students here appeared quite content with the amount of available PPE and free testing at that stage of the pandemic. These measures gave a sense of being “cared for” in the US cohort, whereas “fear” of catching COVID was a common theme among their Swedish counterparts.



For the academic community, it is important to acknowledge and consider that graduate students whose studies were dominated by COVID restrictions may be underprepared for the academic reality or future workplace. The pandemic is now in its third year, and in most countries a graduate program ranges between 3-5 years. This suggests that some students will have had the majority (or all) of their graduate time during the pandemic and are likely significantly affected by the negative consequences of a changing educational program and imposed restrictions. While ours and other surveys<sup>6, 7, 27, 31-33</sup> revealed that most pedagogical approaches shifted to increased work online or at home to counteract restrictions caused by the pandemic, the lack of real-world interactions with supervisors, peers or collaborators as well as decreased networking opportunities was a common complaint of both, Swedish and US-based students.

The survey also revealed that the estimated impact on career trajectory was much worse for graduate students in the US. Compared to their Swedish peers, more US students experienced a delay in their education, research, graduation as well as less scientific output and publications. This outcome is similar to a recent survey of Swiss medical students in years 2-6 of their program at the University of Geneva, which reported negative impacts of the pandemic on their training<sup>34</sup>. We and others<sup>27, 35</sup> speculate that limitations to the curriculum, academic delays and reduced scientific output will have a significant impact, with US students likely feeling more “left behind”. An important consideration in both Sweden and the US is that students affected by COVID restrictions have not had very much opportunity to network within the academic community; e.g. attendance of conferences has been significantly affected by the pandemic and students expressed in their open comments that they do not feel that attendance of online conferences was helpful, good or rewarding. It remains to be seen if these students, once graduated, are not as well educated or less prepared for their profession compared to graduates prior to the pandemic. Increased and continued mentoring<sup>36, 37</sup> may help to alleviate some of the educational and pedagogical deficiencies. Pedagogical approaches that had to be changed due to the pandemic may turn out to be beneficial in the long run<sup>28, 38</sup>, as educational programs had to adapt to novel and more modern teaching methods<sup>37, 39</sup>, update their pre-COVID curriculum, or allow specifically medical students earlier exposure to work in the clinic<sup>34</sup>.

## 5. Conclusion

Our study revealed intriguing differences in how students in the US/California and Europe/Sweden navigate the pandemic and its challenges. The diverging governmental and institutional restrictions/guidelines aimed at mitigating the spread of the virus played a major factor in how the students perceived and adapted to changes to their graduate program, and heavily influenced their personal outlook and wellbeing. Our study suggests that increased mentorship from supervisors and flexible support from the universities are key to alleviate negative effects of the pandemic on medical and biomedical graduate education.

## Acknowledgement

The authors would like to thank all funding bodies for their support, and the help of the graduate programs at all involved institutions. SL is supported by grants from the National Institutes of Health (HL152251), the Aarhus University Research Foundation (AUFF-E-2022-7-9), the Novo Nordisk Foundation (NNF22OC0079368) and the

Lundberg Foundation (R396-2022-189). The work of EB is supported by grants from the Wallenberg Centre at the University of Gothenburg, the Knut & Alice Wallenberg Foundation, the European Research Council (ERC-StG No. 804418), the Swedish Research Council (grant No. 2016/82), the Swedish Society for Medical Research (grant No. S150086), the Aarhus University Research Foundation (AUFF-E-2022-7-8), the Novo Nordisk Foundation (NNF22OC0079363). CH is supported by Karolinska Institutet grant 2-1062/2018.

The funding bodies played no role in the design of the study and collection, analysis, and interpretation of data and in writing of the manuscript.

## References

- [1]. Aydemir D, Ulusu NN (2020) Commentary: Challenges for PhD students during COVID-19 pandemic: Turning crisis into an opportunity. *Biochem Mol Biol Educ* 48, 428–429. [PubMed: 32271978]
- [2]. Paula JR (2020) Lockdowns due to COVID-19 threaten PhD students' and early-career researchers' careers. *Nat Ecol Evol* 4, 999. [PubMed: 32493949]
- [3]. Hlongwa M. (2020) Effects of COVID-19 lockdowns on PhD candidates. *Pan Afr Med J* 35, 123.
- [4]. De La Rosa MA (2021) Steering towards success in stormy times: FEBS Open Bio in 2021. *FEBS Open Bio* 11, 4–9.
- [5]. Machado RA, Bonan PRF, Perez D, Martelli DRB, Martelli-Junior H (2020) I am having trouble keeping up with virtual teaching activities: Reflections in the COVID-19 era. *Clinics (Sao Paulo)* 75, e1945. [PubMed: 32401961]
- [6]. Rose S. (2020) Medical Student Education in the Time of COVID-19. *JAMA* 323, 2131–2132. [PubMed: 32232420]
- [7]. Borgeson E, Sotak M, Kraft J, Bagunu G, Biorserud C, Lange S (2021) Challenges in PhD education due to COVID-19 - disrupted supervision or business as usual: a cross-sectional survey of Swedish biomedical sciences graduate students. *BMC Med Educ* 21, 294. [PubMed: 34022871]
- [8]. Brusselaers N, Steadson D, Bjorklund K, Breland S, Stilhoff Sörensen J, Ewing A, Bergmann S, Steineck G (2022) Evaluation of science advice during the COVID-19 pandemic in Sweden. *Humanities and Social Sciences Communications* 9, 91.
- [9]. The University of Gothenburg (2020) Inriktningsbeslut gällande universitetets verksamhet med anledning av Corona-pandemin från och med VT 2021. [https://medarbetarportalen.gu.se/digitalAssets/1780/1780741\\_gu-2020-2832-inriktningsbeslut-gallande-universitetets-verksamhet-fran-och-med-vt-2021.pdf](https://medarbetarportalen.gu.se/digitalAssets/1780/1780741_gu-2020-2832-inriktningsbeslut-gallande-universitetets-verksamhet-fran-och-med-vt-2021.pdf)
- [10]. Executive Department State of California (2020) Office of the Governor of California. Executive Order N-33-20. <https://www.gov.ca.gov/wp-content/uploads/2020/03/3.19.20-attested-EO-N-33-20-COVID-19-HEALTH-ORDER.pdf>
- [11]. Largent EA, Persad G, Mello MM, Wenner DM, Kramer DB, Edmonds BT, Peek M (2021) Incorporating Health Equity Into COVID-19 Reopening Plans: Policy Experimentation in California. *Am J Public Health* 111, 1481–1488. [PubMed: 34111945]
- [12]. The Governor of California (2020) Governor Newsom Unveils Blueprint for a Safer Economy, a Statewide, Stringent and Slow Plan for Living with COVID-19. <https://www.gov.ca.gov/2020/08/28/governor-newsom-unveils-blueprint-for-a-safer-economy-a-statewide-stringent-and-slow-plan-for-living-with-covid-19/>
- [13]. Executive Department State of California (2021) Office of the Governor of California. Executive Order N-07-21. <https://www.gov.ca.gov/wp-content/uploads/2021/06/6.11.21-EO-N-07-21-signed.pdf>
- [14]. Termini CM, Traver D (2020) Impact of COVID-19 on early career scientists: an optimistic guide for the future. *BMC Biol* 18, 95. [PubMed: 32731867]
- [15]. Pollock BH, Kilpatrick AM, Eisenman DP, Elton KL, Rutherford GW, Boden-Albala BM, Souleles DM, Polito LE, Martin NK, Byington CL (2021) Safe reopening of college campuses during COVID-19: The University of California experience in Fall 2020. *PLoS One* 16, e0258738. [PubMed: 34735480]

- [16]. The Regents of the University of California. Office of the President. (2020) Principles for responsible operation of university locations in light of the sars-cov-2 pandemic. <https://regents.universityofcalifornia.edu/regmeet/may20/b2.pdf>
- [17]. State of California (2020) Covid-19 Industry Guidance: Institutions of Higher Education. <https://files.covid19.ca.gov/pdf/guidance-higher-education--en.pdf>
- [18]. Entergate (2020) ES Maker. <https://entergate.se/products/esmaker/?lang=en>
- [19]. World Medical Association (1964) Declaration Of Helsinki – Ethical Principles For Medical Research Involving Human Subjects. <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>
- [20]. The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. Department of Health, Education, and Welfare. (1979) The Belmont Report, Ethical Principles and Guidelines for the Protection of Human Subjects of Research. [https://www.hhs.gov/ohrp/sites/default/files/the-belmont-report-508c\\_FINAL.pdf](https://www.hhs.gov/ohrp/sites/default/files/the-belmont-report-508c_FINAL.pdf)
- [21]. Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 77–101.
- [22]. World Health Organization (2021) Coronavirus Disease (COVID-19) Dashboard. <https://covid19.who.int/>
- [23]. Zamberlan A, Gioachin F, Gritti D (2021) Work less, help out more? The persistence of gender inequality in housework and childcare during UK COVID-19. *Research in Social Stratification and Mobility* 73.
- [24]. García-Mainar I, Molina JA, Montuenga VM (2011) Gender Differences in Childcare: Time Allocation in Five European Countries. *Feminist Economics* 17, 119–150.
- [25]. Anxo D, Mencarini L, Pailhé A, Solaz A, Tanturri ML, Flood L (2011) Gender Differences in Time Use over the Life Course in France, Italy, Sweden, and the US. *Feminist Economics* 17, 159–195.
- [26]. United States Congress (2020) Coronavirus Aid, Relief, and Economic Security (CARES) Act. <https://www.congress.gov/116/bills/hr/748/BILLS-116hr748enr.pdf>
- [27]. Liesman DR, Pumiglia L, Kemp MT, Alam HB (2020) Perspectives From Rising Fourth Year Medical Students Regarding Strategies to Counteract the Effects of COVID-19 on Medical Education. *J Med Educ Curric Dev* 7, 2382120520940659. [PubMed: 32704544]
- [28]. Doyle JM, Morone NE, Proulx CN, Althouse AD, Rubio DM, Thakar MS, Murrell AJ, White GE (2021) The impact of the COVID-19 pandemic on underrepresented early-career PhD and physician scientists. *J Clin Transl Sci* 5, e174. [PubMed: 34721892]
- [29]. Kilgore LJ, Murphy BL, Postlewait LM, Liang DH, Bedrosian I, Lucci A, Kuerer HM, Hunt KK, Teshome M (2021) Impact of the early COVID-19 pandemic on Breast Surgical Oncology fellow education. *J Surg Oncol* 124, 989–994. [PubMed: 34328640]
- [30]. Luc JGY, Nguyen TC, Ad N, Group, C.-N. A. C. S. S. W. (2021) Impact of the Coronavirus Disease 2019 Pandemic on Cardiac Surgical Education in North America. *Innovations (Phila)* 16, 350–357. [PubMed: 34167378]
- [31]. Gaur U, Majumder MAA, Sa B, Sarkar S, Williams A, Singh K (2020) Challenges and Opportunities of Preclinical Medical Education: COVID-19 Crisis and Beyond. *SN Compr Clin Med* 2, 1992–1997. [PubMed: 32984766]
- [32]. Wayne DB, Green M, Neilson EG (2020) Medical education in the time of COVID-19. *Science Advances* 6, eabc7110. [PubMed: 32789183]
- [33]. Singal A, Bansal A, Chaudhary P, Singh H, Patra A (2021) Anatomy education of medical and dental students during COVID-19 pandemic: a reality check. *Surg Radiol Anat* 43, 515–521. [PubMed: 33206209]
- [34]. Sophie W, Julia S, Bernard C, Barbara B, Nadia BM, Sebastian C, Monica E, Annick GL, Olivier G, Vanessa L, Georges S, Jacques S, Mathieu N, Marie-Claude AV (2021) Medical students' perceptions and coping strategies during the first wave of the COVID-19 pandemic: studies, clinical implication, and professional identity. *BMC Med Educ* 21, 620. [PubMed: 34915888]
- [35]. Harries AJ, Lee C, Jones L, Rodriguez RM, Davis JA, Boysen-Osborn M, Kashima KJ, Krane NK, Rae G, Kman N, Langsfeld JM, Juarez M (2021) Effects of the COVID-19 pandemic on medical students: a multicenter quantitative study. *BMC Med Educ* 21, 14. [PubMed: 33407422]

- [36]. Coutinho Baldoto Gava Chakr V. (2021) Impact of COVID-19 on a Mentorship Program for Pediatrics Residents. *Andes Pediatr* 92, 318–319. [PubMed: 34106174]
- [37]. Abdelhamid K, ElHawary H, Gorgy A, Alexander N (2020) Mentorship Resuscitation During the COVID-19 Pandemic. *AEM Educ Train*, 10.1002/aet2.10538.
- [38]. Sideris M, Hanrahan JG, Papalois V (2020) COVID-19 and surgical education: Every cloud has a silver lining. *Ann Med Surg (Lond)* 58, 20–21. [PubMed: 32864125]
- [39]. Tabatabai S. (2020) COVID-19 impact and virtual medical education. *J Adv Med Educ Prof* 8, 140–143. [PubMed: 32802908]

**Box 1:****Quotes of US students to open answered questions on financial and mental health support.**

“UCLA has provided financial support to students as well as mental health support. Also help with groceries and making sure students get enough help when performing well in classes.” US student ID 65

“My department has instituted a zoom check-in with the students every other week, which has been far more helpful than I anticipated.” US student ID 75

“My institute provided COVID relief funds for unanticipated expenses. The institute also provided some general well-being support online/opportunities for this support via newsletter.” US student ID 70

“The CARES act<sup>26</sup> funding was helpful.” US student ID 37

“University offered some financial help, which was greatly appreciated. I would have also liked IT equipment since I work entirely remotely, support with mental health, provision of PPE, and support with physical health ....” US student ID 79

“I wish the department or university would pay for parking since I no longer feel comfortable taking public transportation.” US student ID 55

**Box 2:****Quotes of Swedish and US students to open answered questions on the provision of safe working conditions.**

“Free covid testing with their insurance has been great.” USA student ID 42

“I will say the medical support (testing, updates on cases, etc) was excellent from the health department.” USA student ID 41

“Working in the lab doesn’t feel save, [because it is] very crowded and masks [are] not mandatory” Swedish student ID 146

“Facemasks/shields were provided very late”. Swedish student ID 147

“The university has set our clear guidelines for making the workplace safe but they are not enforced in the department so it feels very unsafe at the lab.” Swedish student ID 201

“Social distancing was not implemented in our laboratory... regional rules were not observed ... [and] safety concerns were largely ignored.” Swedish student ID 137

“I wish university kept stricter rules, alternate days working and more social distancing, not just recommending to stay at home or work from home .... At time it feels very comfortable to come to work ...” Swedish student ID 70

“I wish they would push harder on making more of us work from home whenever possible.” Swedish student ID 84

“I think more could have been done to accommodate safe (for example digital) social interaction between co-workers.” Swedish student ID 181

“They helped me getting my office settled at home, with support and openness to dialogue.” Swedish student ID 18

“Would’ve been great if I could get a computer screen for home ....” Swedish student ID 41

“There should be more possibilities to get ergonomic desk tools in order to have a good work place at home.” Swedish student ID 169

“Especially in terms of ergonomics for home office, there has been very little help ...” Swedish student ID 203”

“... encourage us more to set up an ergonomic office when working from home.” Swedish student ID 133

**Box 3:****Quotes of US and Swedish students to open answered questions on the extension of deadlines.**

“It would be better to keep updated with amount of students infected with COVID-19 to know the current situation. It would be easy for me to cope with different situations.”

Swedish student ID 91

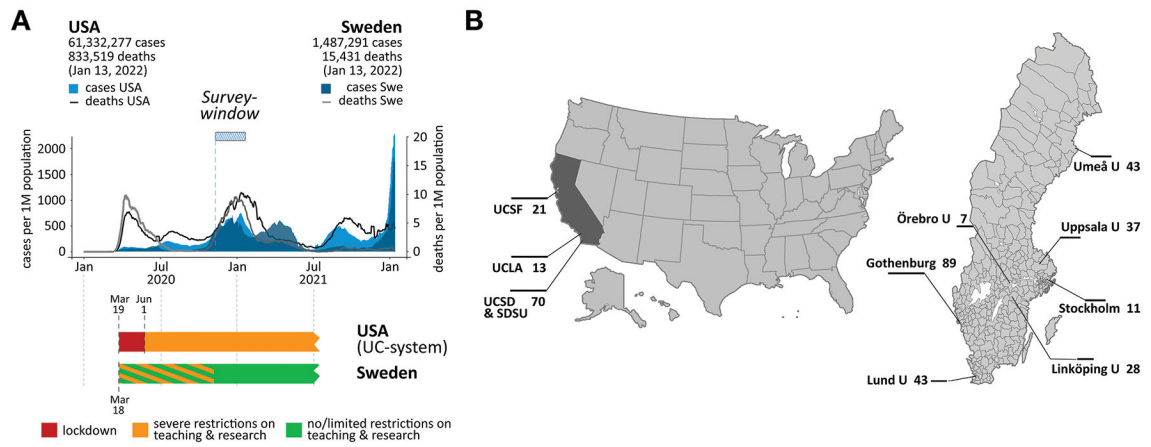
“I think they should increase the duration of my program!” Swedish student ID 183

“The delays in academic deadlines are incredibly helpful.” USA student ID 96

“I appreciate that the university in general pushed back time requirements...” USA student ID 82

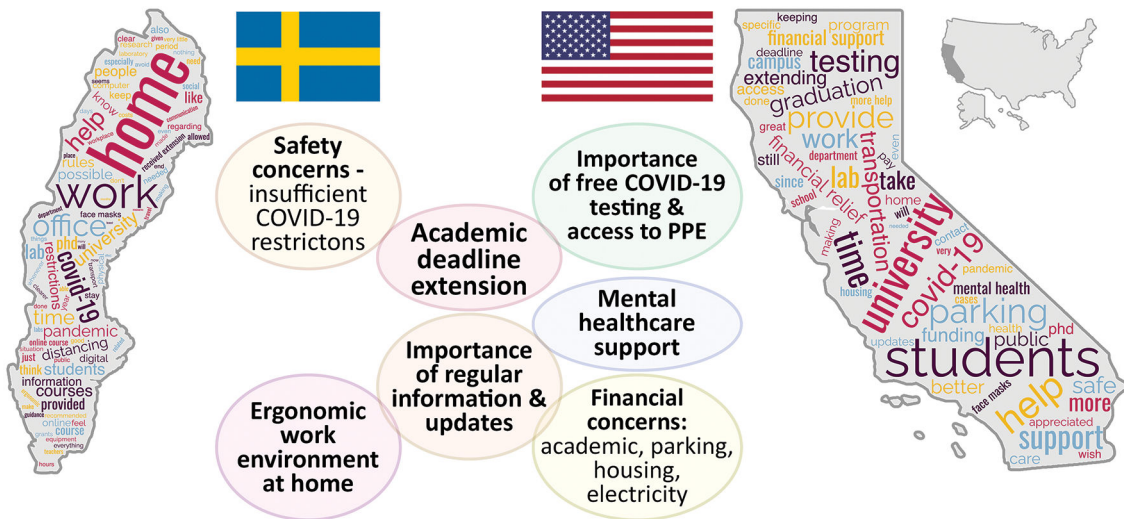
“I would rather have gotten information a day delayed that was clearer than a quick, ambiguous response.” USA student ID 73





**Figure 1.**

**A.** Timeline of COVID-19 cases and deaths per million population and restrictions in Sweden and the US (University of California system). Data from WHO Coronavirus (COVID-19) Dashboard. The window of the survey in both countries is indicated. **B.** Number of survey participants in the US and Sweden according to geographical location.



**Figure 2.** Thematic and word-frequency analyses to open answers in request for additional support from the university.

**Table 1.**

## Demographical analyses of study participants

Gender	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Female	143	54	61	58
Male	118	45	44	42
Do not want to state	2	1	0	0
Other	0	0	1	1
Answer frequency	99% (263/264)		100% (106/106)	
Highest degree	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
BSc	4	2	68	64
MSc	165	64	29	27
MD	76	29	0	0
other	15	6	9	9
Answer frequency	99% (260/264)		100% (106/106)	
PhD program	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Biomedicine	31	12	36	34
Medicine	155	59	3	3
Biology	14	5	43	41
other	61	23	24	23
Answer frequency	99% (261/264)		100% (106/106)	
Research tools. Check all that apply	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Wet lab work (working on the bench)	96	38	90	85
Animal studies	40	16	54	51
Clinical studies / clinical trials	101	40	7	7
Collection of human biopsies / samples	57	23	12	11
Bioinformatics and other online tools	60	24	68	64
Working in the library	40	16	18	17
Core facilities	58	23	63	59
Collection of biological samples (animal or plant origin, not human)	26	10	41	39
Collection of research data	158	63	65	61
other	27	11	4	4
Answer frequency	96% (252/264)		100% (106/106)	
International student	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Yes	50	19	12	12
No	209	80	89	86
other	1	0	3	3

Gender	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Answer frequency	99% (260/264)		98% (104/106)	
Impact of COVID-19. Check all that apply	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
VISA considerations	16	7	15	14
Travel considerations	127	53	73	70
Housing considerations	15	6	32	31
Delay of the program start/end	33	14	37	36
Personal physical health considerations	66	27	57	55
Personal mental health considerations	73	30	83	80
Financial considerations	23	10	42	40
Courses	131	54	53	51
Conferences	193	80	87	84
other	36	15	9	9
Answer frequency	92% (242/264)		98% (104/106)	

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**Table 2.**

Impact of the COVID-19 pandemic on research productivity and career trajectory.

Research productivity (e.g. experiments, collecting data/materials)	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Not affected	76	29	6	6
Delayed	164	63	97	92
Accelerated	2	1	2	2
Other	19	7	1	1
Answer frequency	99% (261/264)		100% (106/106)	
Scientific output (e.g. publications)	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Not affected	129	50	28	26
Delayed	120	46	69	65
Accelerated	2	1	3	3
Other	9	4	6	6
Answer frequency	99% (260/264)		100% (106/106)	
What has changed since the pandemic? Check all that apply.	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Reduced access to the laboratory	59	23	95	90
Reduced access to core facilities	49	19	79	75
Reduced access to the library / office / writing space	95	37	73	69
Reduced access to research samples / specimen	46	18	32	30
Reduced access to supplies	55	22	75	71
Reduced access to animals	6	2	28	26
Reduced access to clinical trials / patients	62	24	8	8
Reduced access to coworker(s)	168	66	91	86
Reduced access to supervisor(s) / mentor(s)	139	55	72	68
Increased access to the laboratory	3	1	0	0
Increased access to the library / office / writing space	3	1	0	0
Increased access to research samples / specimen	2	1	0	0
Increased access to coworker(s)	6	2	1	1
Increased access to supervisor(s) / mentor(s)	13	5	6	6
other	34	13	3	3
Answer frequency	96% (254/264)		100% (106/106)	
Administrative tasks (e.g. assembling data, statistics, lab-look)	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
Not affected	128	49	38	36
Delayed	120	46	52	49
Accelerated	9	3	12	11
other	5	2	4	4

<b>Research productivity (e.g. experiments, collecting data/materials)</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Answer frequency	99% (262/264)		100% (106/106)	
<b>Planning experiments</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Not affected	99	38	13	12
Delayed	135	52	82	77
Accelerated	4	2	7	7
Unchanged	9	4	1	1
Other	13	5	3	3
Answer frequency	99% (260/264)		100% (106/106)	
<b>Planned graduation</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Delayed by 1-6 months	53	20	37	35
Delayed more than 6 months	35	13	38	36
Accelerated by 1-6 months	1	0	0	0
Accelerated by more than 6 months	1	0	1	1
No change	148	57	28	27
Other	24	9	1	1
Answer frequency	99% (262/264)		99% (105/106)	
<b>Impact on your graduate program</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Negative impact	151	59	73	70
No impact / neutral	99	38	27	26
Positive impact	8	3	5	5
Answer frequency	98% (258/264)		99% (105/106)	
<b>Estimated impact on finding a job after graduating</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
More difficult to find work	100	38	69	66
No impact	138	53	29	28
Other	24	9	7	7
Answer frequency	99% (262/264)		99% (105/106)	
<b>Estimated impact on career trajectory</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Negative impact	93	36	63	59
No impact / neutral	159	61	36	34
Positive impact	7	3	7	7
Answer frequency	98% (259/264)		100% (106/106)	

**Table 3.**

Impact of having caretaking responsibilities during the pandemic.

<b>Caretaking responsibilities.</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Yes	126	48	14	13
No	136	52	90	85
Prefer not to answer	2	1	2	2
Answer frequency	100% (264/264)		100% (106/106)	
<b>Type of caretaking (select all that apply)</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Children under 5 years of age	73	57	7	47
School-age children	73	57	2	13
Elder care	6	5	3	20
Disabled care / care for ill person(s)	1	1	1	7
Prefer not to answer	0	0	0	0
other	3	2	3	20
Answer frequency	98% (128/131)		88% (15/17)	
<b>Nr. of individuals to care for.</b>	<b>Sweden</b>		<b>USA</b>	
<b>Name</b>	<i>n</i>	%	<i>n</i>	%
1	41	32	9	60
2	54	42	5	33
3 or more	31	24	1	7
Prefer not to answer	2	2	0	0
Answer frequency	98% (128/131)		88% (15/17)	
<b>Time spent on caretaking.</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
More time on care	65	51	14	93
Less time on care	7	6	0	0
About the same	56	44	1	7
Answer frequency	98% (128/131)		88% (15/17)	
<b>Estimated impact of caretaking on graduation date.</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Delayed by 2-6 months	29	23	4	27
Delayed by more than 6 months	12	10	10	67
Accelerated by 2-6 months	1	1	0	0
Accelerated by more than 6 months	1	1	0	0
It will not impact my graduation	74	60	1	7
Prefer not to answer	3	2	0	0
other	4	3	0	0
Answer frequency	95% (124/131)		88% (15/17)	



Caretaking responsibilities.	Sweden		USA	
	<i>n</i>	%	<i>n</i>	%
<b>Extra help (e.g. babysitter, nanny, daycare, grandparents)</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
Yes	17	13	4	27
No	109	85	11	73
Prefer not to answer	0	0	0	0
Other	2	2	0	0
Answer frequency	98% (128/131)		88% (15/17)	

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**Table 4.**

Perceived level of support during the pandemic.

<b>Help from graduate study supervisors/mentors.</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
No help needed.	127	49	29	29
Got all the help required.	80	31	27	27
Did not get any help.	50	20	45	44
Answer frequency	97% (257/264)		95% (101/106)	
<b>Help from the university.</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
No help needed.	90	34	10	10
Got all the help required.	49	19	7	6
Got some help.	42	16	43	41
Got little help.	47	18	35	34
Did not get any help.	34	13	9	9
Answer frequency	99% (262/264)		98% (104/106)	
<b>Did you receive any of the following?</b>	<b>Sweden</b>		<b>USA</b>	
	<i>n</i>	%	<i>n</i>	%
IT equipment	66	44	12	13
Time off to deal with personal matter	39	26	24	27
Home office ergonomics	37	24	12	13
Support with mental health concerns	27	18	37	41
Help with commuting (including parking)	3	2	14	15
Provision of PPE	37	25	51	57
Financial support	2	1	23	26
Other	30	20	15	17
Answer frequency	57% (151/264)		84% (89/106)	