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Impact of COVID-19 pandemics on advanced neuroscientific R&D activities: a focus on job age

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ABSTRACT

Notwithstanding the implementation of strategic responses to recover habitual levels of performance and productivity, global data points out that the outbreak and diffusion of COVID-19 have imposed a high cost on research activities. Starting from a national survey investigating the impact of pandemics on Italian research in neuroscience, we here specifically aims at exploring its effects on scientific productivity across junior-to-senior professionals. Data highlighted that, given a generalized decrease of objective markers of scientific productivity (i.e. submitted projects or papers), the extent of such decrease was most notable in junior, mid-level and early senior researchers. Also, subjective measures of impact of the pandemics on professional life and work efficiency revealed a coherent profile, with junior and mid-level research professionals referring the highest perceived impact, while the impact of pandemics at psychological and socio-relational levels was rated almost similarly by researchers with different levels of seniority.

Keywords: COVID-19; neuroscience research; R&D; seniority; job age; early-career

1. INTRODUCTION

Following the COVID-19 outbreak, both the healthcare system and scientific community have been required to identify and implement evidence-based policies to promote the development of new, resilient and shared cultural practices, based on the combination of effective remote working, and on-site activities.

Notwithstanding the prompt implementation of containment measures and strategic responses implemented to try and keep habitual levels of performance, efficiency, and productivity, first global data points out that the outbreak and diffusion of COVID-19 have imposed a high cost on Research & Development (R&D) activities across all European (EU) states and around the globe (British Neuroscience Association, 2020; Chinnery et al., 2021; Myers et al., 2020; Sparasci et al., 2022). For instance, the impact on R&D activities of the outbreak has been estimated as medium or severe in 85% of reached research centers or institutions, while only 2% of them reported the absence of a relevant impact on their R&D projects (EURAXESS China News, 2020).

A similar scenario appears, consistently, when focusing on biomedical, neuroscientific, and clinical research (British Neuroscience Association, 2020; Campanella et al., 2021; Myers et al., 2020; Sozzi et al., 2020; Vlisides et al., 2021). Indeed, research activities in such fields strongly rely on the use different specific equipment, direct physical interaction with users, and first-hand data collection with test animal, test subjects or patients (e.g. sensors placement) that can hardly - and only partly - be translated into remote activities. The loss or limited access to research equipment and facilities, the inability to purchase new instruments, and the cancellation of scientific events and conferences due to mandatory implementation of specific guidelines for containment of the pandemics outbreak have led to the suspension of most research projects not primarily related to COVID-19, especially for basic research institutions.

In order to explore and appraise the impact of pandemics and its containment measures on basic and applied research in neuroscience research, the Catholic University of the Sacred Heart, together with the Foundation "Policlinico A. Gemelli" and the University of Genoa implemented the a project focusing on Italian research institutions, the MIRNA ("Monitoring tools and intervention policies for the enhancement and protection of advanced neuroscientific research post COVID-19") project (Balconi et al., 2021). The project specifically focused on the management of basic and clinical research activities conducted by Italian laboratories for neuroscience, neurophysiology, and clinical neuropsychology during the pandemic emergency and post-emergency phases, starting from a preliminary mapping of the state of the art and then collecting experiences and first-hand data from professionals

operating in research/clinical laboratories and centers.

The survey was guided by the general aims of: outlining the main activities of research units and laboratories operating in the field of basic, clinical and applied neuroscience, neurophysiology and neuropsychology in Italy; parsing out critical issues raised by COVID-19 outbursts and related containment measures in those settings; highlighting the strategies used to address or mitigate such unprecedented challenge.

Building on project findings and first insights from such observations that have been preliminarily reported in found in Balconi et al. (2021), we here intend to present and focus on data mirroring the impact of pandemics on research activities based on job age in research/clinical institution. Namely, we here introduce a first exploratory report on perceived and objective measures of impact of COVID-19 outbreaks and related containment measures on scientific productivity across junior-to-senior professionals.

2. METHODS

2.1 Participants

The mapping of Italian neuroscientific, neurophysiological and neuropsychological research structures allowed to identify 254 specialized laboratories/units/centers, which are distributed across the national territory and are representative of different types of institution (e.g. universities, research centers, scientific institutes for research and healthcare, and clinical centers). More information on the outcome of such mapping can be found in Balconi et. al (2021).

Starting from the mapping, the coordinators of identified laboratories/units/centers have been invited to complete the online survey. A total of 76 respondents completed the survey, almost equally represented by healthcare professionals primarily involved in clinical research (53%) and basic research professionals (47%).

The study was approved by the Ethics Committee of the Department of Psychology, Catholic University of the Sacred Heart and was performed according to principles of the Declaration of Helsinki.

2.2 Materials and procedure

The survey was implemented on the Qualtrics XM platform (Qualtrics LLC, Provo, UT, USA) and was created to include five main parts: i) consent and introduction; ii) general data on the respondent's institution, on the

respondent him/herself, and on his/her activities in the pre-pandemic period; iii) research activities during the first pandemic period (first lockdown); iv) research activities during the second pandemic period (second lockdown); v) overall considerations regarding the impact of the pandemic periods on research activities and countermeasures that have been implemented or planned at his/her laboratory/unit/center to promote reprise.

The survey was disseminated from June to July 2021 by sending the link for participation to the managers and coordinators of the research laboratories/units/centers identified thanks to the above-mentioned mapping of the Italian institutions in our areas of interest. In addition, its dissemination was also promoted thanks to the support of various stakeholders, in particular the order of Psychologists and scientific societies active on the Italian national territory (i.e. the Italian Psychological Association, the Society of Psychologists of the Neuropsychological Area, and the Italian Society for Neuroethics and Philosophy of Neuroscience).

2.3 Data analysis

Participants' responses at the survey were automatically collected via the online survey administration platform and safely processed and stored in the cloud.

Self-report data concerning professional experience, job position, and subjective evaluation and ratings of R&D activities before and during COVID-19 pandemic outbreaks and consequent lockdown periods have, then, been exported for offline qualitative-quantitative analysis.

The dataset was checked for missing values, evident typing errors in participant responses, and duplicate unfinished attempts to respond to the survey. The cleaned set of data was then used to explore the distribution of participants' responses and of their identifying features (e.g. job age, discipline, type and primary mission of their hosting institution) via descriptive statistics.

Namely, potential influence of job age (i.e. less than 5 years, 6-to-15 years, 16-to-25 years, 26-to-35 years, more than 35 years) on R&D productivity measures and perceived impact of pandemics will be below sketched, taking into account even the main job duties (i.e. only research activities, more healthcare than research activities, equal involvement in healthcare and research activities), via cross-tables.

3. RESULTS

Respondents were almost equally representative of professionals primarily involved in clinical research (53%) and basic research (47%). The regional distribution reflected, while not overlapping in full, the disparity in terms of number of clinical and basic research centers in neuropsychological, neurophysiological, and neuroscience fields that was outlined by the mapping. About three quarters of the sample has reported, as the location of the hosting institutions, the regions of Lombardy, Emilia-Romagna, Liguria, Piedmont or Tuscany. Neuropsychology and neuroscience are the professional sectors most represented in the sample (respectively cited as fields of activity by 44% and 23% of the sample), followed by neurophysiology and other mixed sub-disciplines (e.g. neuropedagogy, neurorehabilitation, exercise science). Regarding the categories of users or experimental subjects typically involved in basic/clinical research activities, neurological patients (40%) and healthy adults/elderly (37%) almost equally represent the most reported categories.

Focusing on the respondents' main job duties, 45% of the sample stated to be fully involved in research activities, 35% reported to be involved more in clinical care and assistance activities than in research ones, and 20% stated to be equally involved in healthcare and research duties. As for the job age category, almost half of the sample (43%) was represented by highly experienced professionals, with seniority higher than 16 years (specifically: 16-to-25 years = 23%; 26-35 years = 14%; more than 35 years = 6%), about one fifth of the sample (22%) was constituted by junior professionals with less than 6 years of experience, and the remaining part of the sample (35%) was representative of mid-level professionals with job age between 6 and 15 years.

The analysis of data concerning scientific productivity, highlighted a general reduction of the number of submitted research projects and papers during the pandemics with respect to a pre-pandemic reference period (-13% overall, for both projects and papers). Also, second-level analysis taking into account respondents that are fully dedicated to research activities or that dedicate at least half of their time to research activities allowed us to get a better picture of such reduction of productivity, and to point out how it was differently represented depending on the job age of respondents. Namely, as shown in *Figure 1*, junior research professionals are the only category presenting a increase of the number of submitted projects (+15%). More experienced professionals reported, generally, a decrease of the number of submitted projects, with the most remarkable reduction showed by senior researchers with 26 to 35 years of experience – who reported a decrease in - submitted projects equal to 57% – followed by mid-level research professionals

(job age: 6-to-15 years) – who showed a 15% decrease in submitted projects. As for submitted scientific papers, a notable loss of productivity can be observed in among junior, mid-level, and early senior research professionals, with, respectively, a 28%, 28%, and 22% decrease of the number of submitted papers. Experienced researchers with greater seniority, instead, reported an increase of the number of submitted papers during the pandemics with respect to the pre-pandemic year. Namely, professionals with 26-to-35 years of job age reported a 22% increase of their publication productivity, and professionals with more than 35 years of job age reported a 50% increase of their publication productivity

Moving the focus on perceived impact of pandemics (as measured via 5-point Likert scales), explorative data analyses highlighted how the highest cost of pandemics has been generally ascribed to socio-relational factors ($M = 3.91$; $SE = 0.17$), followed by psychological ($M = 3.85$; $SE = 0.17$), and professional life ($M = 3.57$; $SE = 0.16$). Second-level analysis taking into account respondents that are fully dedicated to research activities or that dedicate at least half of their time to research activities, then, offered a richer view on research professionals' subjective perception of the impact of pandemics on those three core aspects of their life, also taking into account their job age. Specifically, as reported in *Figure 2*, the highest perceived impact of pandemics on own profession was reported by junior and mid-level researchers, with more experiences researchers reporting almost unpolarised estimates. A greater perceived cost of pandemics over psychological and, even more, social-relational factors, instead, can be observed even among more experienced research professionals. Such trends seemed, however, not evident in the category of professionals with the highest job age, yet it has to be acknowledged that the limited number of respondents in such category might have biased the estimates.

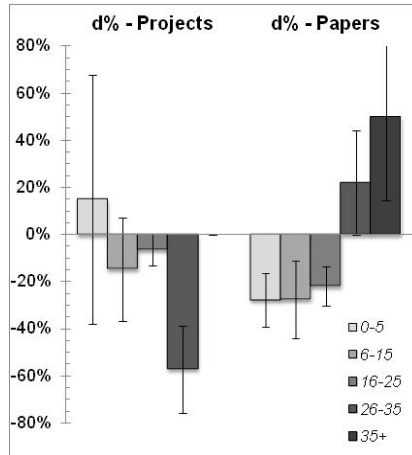


Figure 1. Differential indices (d%) mirroring the percent increase or decrease of the number of projects or papers submitted by research professionals during the pandemic period with respect to the pre-pandemic reference period (year 2019), taking into account respondents' job age. Bars represent mean percent changes for each job age category, whiskers mirror ± 1 SE

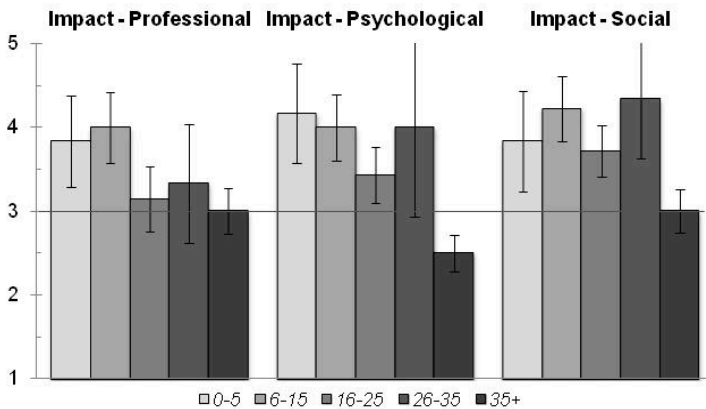


Figure 2. Perceived impact of pandemics on professional, psychological and social-relational aspects of research professionals' life, taking into account respondents' job age. Bars represent mean ratings for each job age category, whiskers mirror ± 1 SE.

4. DISCUSSION AND CONCLUSION

The present report was aimed at presenting data concerning the impact of COVID-19 outbreak and related containment measures on research activities on Italian laboratories/units/centers conducting research in the multiple fields of neuroscience, placing specific attention on seniority of research professionals.

Data collected via a national survey has highlighted that, whilst given a generalized decrease of objective markers of scientific productivity (i.e. differential index based on the number of submitted projects or papers during the pandemics with respect to a pre-pandemic reference period), the extent of such decrease differed across research professionals with different levels of work seniority. Namely junior researchers with less than 6 years of experience reported an increase in the number of submitted research projects, in the face of a clear decrease of submitted papers. Mid-level researchers with 6-to-15 years of experience reported a relevant decrease in submission of both research projects and papers. Early senior researchers with 16-to-25 years of experience similarly reported the reduction of submitted papers and, even if smaller, of submitted projects. Senior researchers with 25-to-35 years of experience, in face of an increase in submitted papers, showed a dramatic decrease of the number of submitted research projects. Finally, the limited sample of most experienced researchers only reported a clear increase of submitted papers.

Consistently, subjective measures of impact of the pandemics on specific aspects of researchers' life – i.e. professional, psychological, and socio-relational – revealed a coherent profile, with junior and mid-level research professionals referring the highest perceived impact with regard to professional life and work efficiency, while the impact of pandemics at the individual psychological and socio-relational levels was rated almost similarly by researchers with different levels of seniority.

Whilst the uniformly reported cost of COVID-19 outbreak and of its containment measures on quality and richness of social-relational aspects of life and on psychological status is consistent with common experience and with well-established local and global reports (Moccia et al., 2020; Sparasci et al., 2022; Taquet et al., 2021), present findings on the objective and subjective markers of job performance do raise additional interesting issues.

It is, indeed, plausible to hypothesize that the increase of publication productivity in experienced researchers might be, among other factors, ascribed to the creation of large networks of experts aimed at concentrating knowledge and creating a critical mass to outline guidelines and general recommendations to face the unprecedented challenged imposed by the pandemics, as well as to read and interpret the growing set of data on its nature, evolution, care, and impact. Those remarkable and critical efforts has led to novel and still

flourishing multidisciplinary literature. Yet, mandatory lockdown and closure of most research facilities, especially those not primarily linked also to clinical activities (such as universities and purely research or technological development centers), have necessarily halted data collection and suspended most of ongoing research projects not related to the COVID-19 infection. That has hindered research in non-COVID-related areas, a phenomenon referred to as the 'Covidization of research' (Chinnery et al., 2021; Pai, 2020)

Also, present findings concerning the greater perceived impact of pandemics in younger researchers' professional life and its observed effects on scientific productivity especially in junior, mid-level, and early senior research professionals are consistent with the available reports on potential short- and longer-term effects of pandemics on scientists careers (Maas et al., 2020; Myers et al., 2020; Radecki & Schonfeld, 2020). Such reports coherently stress the factual inequality of the nature and magnitude of the disruptions scientists have experienced professionally, with greater costs being paid by female scientists, early-career researchers, and researchers with young dependents, especially when at least one child is 5 years old or younger (Myers et al., 2020). Again, according to a recent report promoted by De Gruyter (Smith, 2020), 51% of the mid-career researchers that responded to their survey said that they have been 'severely limited' from researching and writing because of caring for young children, compared with just 16% of late-career scholars.

To sum up, evidence are there supporting the common perception of disruption that pandemics and related countermeasures have brought upon scientific research in general and, for the interest of this paper, neuroscientific research specifically. The outbreak of COVID-19 has imposed new rules shaping the 'new normal' in research undertaking and available reports show that the price of such global emergency has been higher for female scientists and for research professionals who, given their age, are more likely to have to care for children (or aging parents). The first findings from a national survey reported here add to such growing evidence base, showing specific trends in subjective and objective measures of professional performance and scientific productivity based on job age. Yet, it has to be acknowledged that the limited size of the current sample of respondents prevents stronger generalizations. Present empirical observations and related conclusions would benefit from the increase of samples and collected reports. Also it would be interesting to extend the field of observation to compare data on neuroscientific research with data concerning researchers from others scientific disciplines, and/or to extend the investigation to other countries.

To conclude, even if the detrimental effects of the delays incurred to researchers track record due to the global emergency are harmful, if not irrevocably damaging for scholarly career progress, it also has to be

acknowledged that mitigating actions have begun to be taken by national governing institutions and both national/international research funding institution, in an attempt to reduce long-term effects of past hard times and to contain the risk of a secondary epidemic of lost early-career scientists. As suggested by Subbaraman (2020), the pandemics might have underlined the importance of research and collaboration in science, and spurred long-term support especially for basic research, much as the Second World War did.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Department of Psychology, Catholic University of the Sacred Heart. All participants gave written informed consent for participation before taking part in this study.

Consent for publication

Not applicable.

Availability of data and material

Datasets are available from the corresponding author on reasonable request.

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Competing interests

The author declares that there are no competing interests regarding the publication of this paper.

Authors' contributions

DC and LA designed the methodology. LA collected the data. DC and LA analyzed and interpreted the data. DC and LA drafted and revised the manuscript. All the authors approved the final version of the manuscript.

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