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Article

Research on Researchers. Coping during COVID-19. Results on a Nation-Wide Survey

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Abstract

This paper presents findings of a nation-wide study examining the impact of COVID-19 on researchers. Findings indicate that more than half of researchers experienced personal or family mental strain due to COVID-19 pandemic effects. COVID-19 pandemic is being treated as an opportunity by six out of ten researchers in terms of more time for study and planning future research activities (78 per cent). The majority of researchers (73 per cent) believe that Science and Technology will emerge enhanced from the pandemic in the public sphere. Relating our findings with research outcomes of existed surveys, it appears that COVID-19 had a significant impact on researchers' and workers' psychosocial life. Researchers' and scientists' standpoint suggest that Science and Technology will be upgraded in the public dialogue. Finally, researchers viewed the pandemic as an opportunity for more time for study and planning of future research activities while working time, with respect to other countries, decreased the most.

Key words: COVID-19; science; researchers; survey; policy; Greece

1. Introduction

The rapidity and the lethality of the pandemic has thrown into question a great number of long established certainties. Accordingly, different research and policy communities have reacted by attempting to understand how their respective fields and practices will be altered. Examples abound. From entrepreneurial (HBS 2020) to social (Lewnard 2020) and economic practices (Baldwin and Evenett 2020), including subthemes such as global value chains (Stellinger 2020) to industrial restructuring (Financial Times 2020; IDAP 2020; Sachs 2020).

Concerning research as a distinct policy domain, three large patterns can be discerned. First, is the major shift of the Biomedical and Health Sciences to cope with this pandemic.[1] Similarly, reporting on how other scientific fields can contribute to achieving this objective/goal, e.g. artificial intelligence (OECD 2020a), digital education (OECD 2020b), the difficulties in protecting personal details and keeping them private (OECD 2020c) or even the rapid conclusion of an otherwise lengthy process in drug approval (Thepharmaletter 2020). In all, a general transformation of how the research system is attempting to cope with the pandemic is observed.

Secondly, this transformation can, also, be discerned in other parts of the research continuum. Huge, urgent, and with less strings attached to them, sums of funds are being expediently provided by the public sector. In most cases, these are coupled by private funding sources of the same magnitude (ScienceBusiness 2020a, b). Obviously, without this funding the multiple and parallel epidemiological research, gene sequencing, etc. global infrastructure exploitation necessary to increase the speed so as to find a cure for this virus could not happen.

The third aspect of this transformation concerns the publication of science results. Editorial boards and science journals have entered into a fast-track mode of publishing COVID-19-related results, so as for the global community to be made aware of the relevant development as soon as possible. Associated with this is the decision by major journal owners to scrap fees for accessing papers. The rapidity by which this has become standard practice, while was founded on the realities presented by the pandemic, was facilitated by ethical considerations on science being a global public good and the realization that open science (OECD 2020d) is the only channel through which to keep abreast of new scientific developments, especially since conferences and other established means of science gatherings have also been annulled due to the lockdown.

What has been lacking, though, is a view on how the most important link of this science continuum, its people, the researchers

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themselves, have been coping with the pandemic. Indeed, although the amount of COVID-19-related publications is rapidly increasing (Hossain 2020; Kambhampati et al. 2020), very few research has been conducted regarding COVID-19 impact on the scientific community. That is, a substantial portion of the highly educated global workforce, researchers, has been understudied as a distinct population group.

While the rapidity of developments in everything COVID-19-related inescapably renders any such claims as potentially obsolete, and indeed, inaccurate, it appears that publications on how researchers as a distinct population have been coping with the pandemic are weak either in sample numbers (e.g. the EURAXESS (2020) study that examined 50 researchers as its study group, a number that is insufficient for deducing generalized outcomes), or was based on rather weak methodological footing (see OECD 2020e) where an open-link questionnaire was sent to be filled by scientists 'or any other individuals with an interest in science or science policy on the impact of the COVID-19 crisis from a science perspective'). To be fair, urgent times necessitate an urgent approach in the aim of quickly understanding. To be ever fairer, a good number of studies are currently under way and as such results will be published in the near future. Examples are the study on the impact of COVID-19 on researchers conducted by PLOS.[2] As of 28 June 2020, the questionnaire was still live, indicating that the survey was still in its collection phase. Another case of a currently ongoing research focuses on understanding how the COVID-19 pandemic affects time use among academic researchers.[3] A third pattern concerns publications that are based on personal accounts of young researchers (Science 2020a) or senior ones (Science 2020b) and discusses the effects the pandemic has brought upon them and/or their research teams. This personal discussion concerns issues such as anxiety (Science 2020c), research output (Science 2020d), and the capacity to conduct field studies (Undark 2020; Science 2020e). While these accounts provided a timely account of how researchers have been coping during the pandemic, and indeed provide tips for other research teams to follow (Sutherland et al. 2020), they lack a critical factor that prevents these accounts from obtaining a sufficiently wide claim. Self-narrating does not hold claims that can be deduced on larger population groups. A fourth pattern is found in Gibson et al. (2020). Herein, multiple authors discuss on COVID-19's impact on young researchers, yet do so exclusively on a normative format claiming that the pandemic presents an opportunity for the scientific establishment 'with an unprecedented opportunity to reset'.

Concerning gender, a bibliography based on larger samples has emerged. This concerns journal submission data indicating that COVID-19 has hindered women's research productivity on a larger scale than that of men (Amano-Patiño 2020; Andersen et al. 2020; Insidehighered 2020; Malisch et al. 2020; Viglione 2020).

1.1 Research gap

For all its merits, the above described bibliography provides little evidence on, e.g. their research performance and future priorities and their personal and family strains. Given the increased significance of knowledge in the 21st century, not knowing how the prime knowledge producers cope under the pandemic is rather ironic. Providing evidence for this population group presents an even greater interest for the purposes of science and technology policy making, since such data/evidence will help policy makers in performing evidence-based policies.

Upon this, a methodologically sound, research study aimed at a larger population group of researchers was conceived. Building on the insights of the above mentioned bibliography yet targeted at a much larger group exclusively populated by researchers was initiated. Significantly, the survey was conducted between 15 April 2020 and 24 April 2020 and its results have already been published as a report,[4] including a research note written in English to enable wider communication. Also, results were presented during a recent OECD workshop (NESTI workshop on STI Measurement during COVID-19 Crisis—June 2020). As such, the current study concerns the academic dissemination of the results on the way COVID-19 impacted the psychological, scientific, and technological state of Greek researchers. This is achieved by utilizing national survey data and applying data analysis techniques.

On a parallel note, appreciating the case of Greece as the 'spatial' characteristic of this paper, a number of wider, contextual aspects of the RDI system and more specifically of its human capital should be spelled out. Generally of high calibre, it is disproportionately over-represented in top US universities (Yuret 2017) and indicates significant outward mobility (Labrianidis 2014; Sachini et al. 2020). This science diaspora, however, has been indicating this outward mobility due to, among others, systemic R&D underfunding—a phenomenon, though, which has started to change towards the better.[5,6] In addition, and as a result of the decade-long economic crisis, tenured employment opportunities being scarce short-termed positions became the only means to curb this one-dimensional mobility (Sachini et al. 2020). Despite these, research performance in terms of scientific publications by researchers located in Greek institutions has been steadily rising during the 2004–2018 period,[7] while a 13.8 per cent success rate in Horizon 2020 projects, also, indicates research potential.[8]

1.2 Structure

The paper is structured as follows. Section 2 concerns the methodology. Specifically, in Section 2.1, the overall structure of the questionnaire is outlined. Section 2.2 presents the target population, whereas Section 2.3 describes the methodology followed for retrieving the data, outlining the whole data collection and analysis process. Section 3 provides an overview of the main outcomes of the study introducing the respondents' answers in relevance with the questionnaire's structure. Moreover, it contains descriptive statistics on researchers' gender, age, and scientific field. It also covers COVID-19 effects on researchers' psychological state, priorities, and insights upon the impact of science and technology in the public sphere. In Section 4, EKT's findings in comparison with other surveys are presented and analysed. Finally, Section 5 presents some conclusions and future directions.

2. Methodology: Questionnaire structure, sample, data collection, and analysis

2.1 Questionnaire structure

Formulating research questions during the pandemic had to seriously take into consideration the time element. As such, formulation of the questions had to assume that the researchers would be unwilling to fill in an extended questionnaire since the lockdown measures would have started to produce feelings of strain and uneasiness. Thus, it was decided to send out a short questionnaire that could be filled in less than 5 min. Also, formulating this short questionnaire, and indeed, navigating through the entire research study, had to

build upon a fast changing situation, for which we had no prior understanding. Third, given the limited format of our questionnaire, a decision on the orientation of the questions had to be made. Building on the bibliography and the personal accounts presented above, it was decided to explore three major pathways: the extent that COVID-19 affected their current way of living, both professionally and personally, how COVID-19 affected their future priorities, and an appreciation whether science and technology as distinct human endeavours will come out of this pandemic—strengthened or weakened. Rather than solely reporting on the actual difficulties researchers were facing during the pandemic, we wanted to explore how the pandemic will shape the researcher's future priorities and mind-sets. Thus, the questionnaire contained the following five questions:

1. Transcription of the researchers' field and subcategory of science as well their age categories (male/female; age groupings; selection among Frascati's six major fields; and two-digit subcategories of Fields of Research and Development).
2. A one–five Likert scale question on their capacity to perform research activity/ies as a result of the COVID-19 pandemic and its subsequent lockdown and social distancing measures. Variables were (a) access to the information/digital infrastructure of the country and (b) timely completion of research work.
3. A one–five Likert scale question on the psychological state of the researchers themselves as well as their family environment as a result of the COVID-19 pandemic and its subsequent lockdown and social distancing measures. Variables were (a) personal mental strain and (b) family mental strain.
4. A yes/no question on the manner in which the COVID-19 pandemic is being received by the researchers themselves. That is, is it being viewed exclusively as a situation of crisis or as a situation that presents itself also as an opportunity. For those researchers that selected the latter choice, a follow-up selection matrix of the following variables were presented. (a) Reduction of energy footprint, (b) increase of digital collaboration, (c) learning new skills, (d) attending new online courses (MOOCS), (e) new research directions, (f) more time for study and planning of future research activities, and (g) other. Each variable was structured in a yes/no format.
5. A yes/no question on whether the researchers appreciate that science and technology, as a distinct field of human endeavour, will come out of this pandemic in an enhanced or weakened position in the public sphere.

2.2 Target population

The results of this paper are based on a field survey in which an electronic questionnaire was sent to 4,719 researchers. These researchers constitute the comprehensive dataset of the recipients of the European Social Fund funding through the Greek Operational Programme 'Human Resource Development, Education and Lifelong Learning' (NSRF 2014-2020).

This funding scheme has been the prime public funding mechanism through which various categories of the domestic highly educated human capital were able to conduct R&D activities. Specifically, for the purposes of this study, the concept of researchers refers to individuals that are (a) preparing their doctoral dissertation, (b) conducting postdoctoral research, (c) being part of research teams, and (d) gaining academic teaching experience (Sachini et al. 2020). It was initiated during the years of the economic crisis and is currently in its phasing out period (2017–present/end of 2020). For the purposes of this survey, all the recipients were included (i.e. 4,719 researchers).

In the first phase (15 April 2020), the complete questionnaire (EKT 2020) was electronically sent to all researchers. A total of 162 emails bounced back and therefore the relevant owners never received the questionnaire. Reminders were sent out on two dates: 21 April 2020 and 23 April 2020. The questionnaire was successfully completed and submitted by 2,323 researchers by 26 April 2020, amounting to 51 per cent of the total population. This group constitutes our target population.

2.3 Data collection and analysis

The survey was developed and run on LimeSurvey platform. During the aforementioned period, active cases of COVID-19 pandemic in Greece were reaching their peak (Worldometers 2020) while the country was in a state of total curfew and as such everything had to be managed electronically.

After the completion of the survey, all completed responses (2,323) were extracted from LimeSurvey and loaded on SPSS platform. The analysis initiated by checking for data consistency issues like wrong answers, outliers, missing values, lost data due to platform compatibility issues (data and feature debugging). Since data robustness was ensured, variable modifications were applied, i.e data imputation of wrong values or missing values (set to 'NA') and variable concatenation according to the subfield of science. A research profile was additionally created by grouping data according to the sex, field of science, and age of the researchers. Last, the main descriptive analysis was conducted which includes tables and figures shown in the paper. The above took place on 5 May 2020.

3. Survey findings

The following findings are presented in a manner that addresses each related question introduced in section 'Questionnaire Structure'. Not all answers are presented here. This would not be possible in the context of one scientific paper, especially if correlations are taken into account. Rather, herein overall results concerning questions 1, 2, 4, and 5 are presented, respectively. This was selected in view of the potential comparisons with other studies that were decided to be included in this paper (see Section 4).

3.1 Gender, age, and researchers' field of science

In terms of gender, 51.4 per cent of the respondents (2,323) were men and 48.6 per cent women, whereas in terms of age distribution, the greatest portion of the respondents (47.2 per cent) ranged from 36 to 45 years of age, followed by those under 35 years (36.2 per cent). The remaining 16.6 per cent concerned researchers over the age of 46 years. In terms of the fields of science and technology, the researchers were classified as shown in Fig. 1. Social Sciences (23.5 per cent) and Engineering and Technology (19.8 per cent) constitute scientific fields under which the majority of researchers fall into. On the other hand, Agricultural and Veterinary Sciences (5.5 per cent) as well as Medical and Health Sciences (13.6 per cent) are fields with the lowest number of researchers in our sample. It is to be noted that the science classification system followed in the study is the Frascati Field of Science classification system (OECD 2015).

Fig. 2 refers to the scientific specialization of the Greek PhD holders as categorized into the six main scientific fields according to the Frascati Field of Science classification system[9] (OECD 2015). Such data were derived from the Greek National Archive of PhD

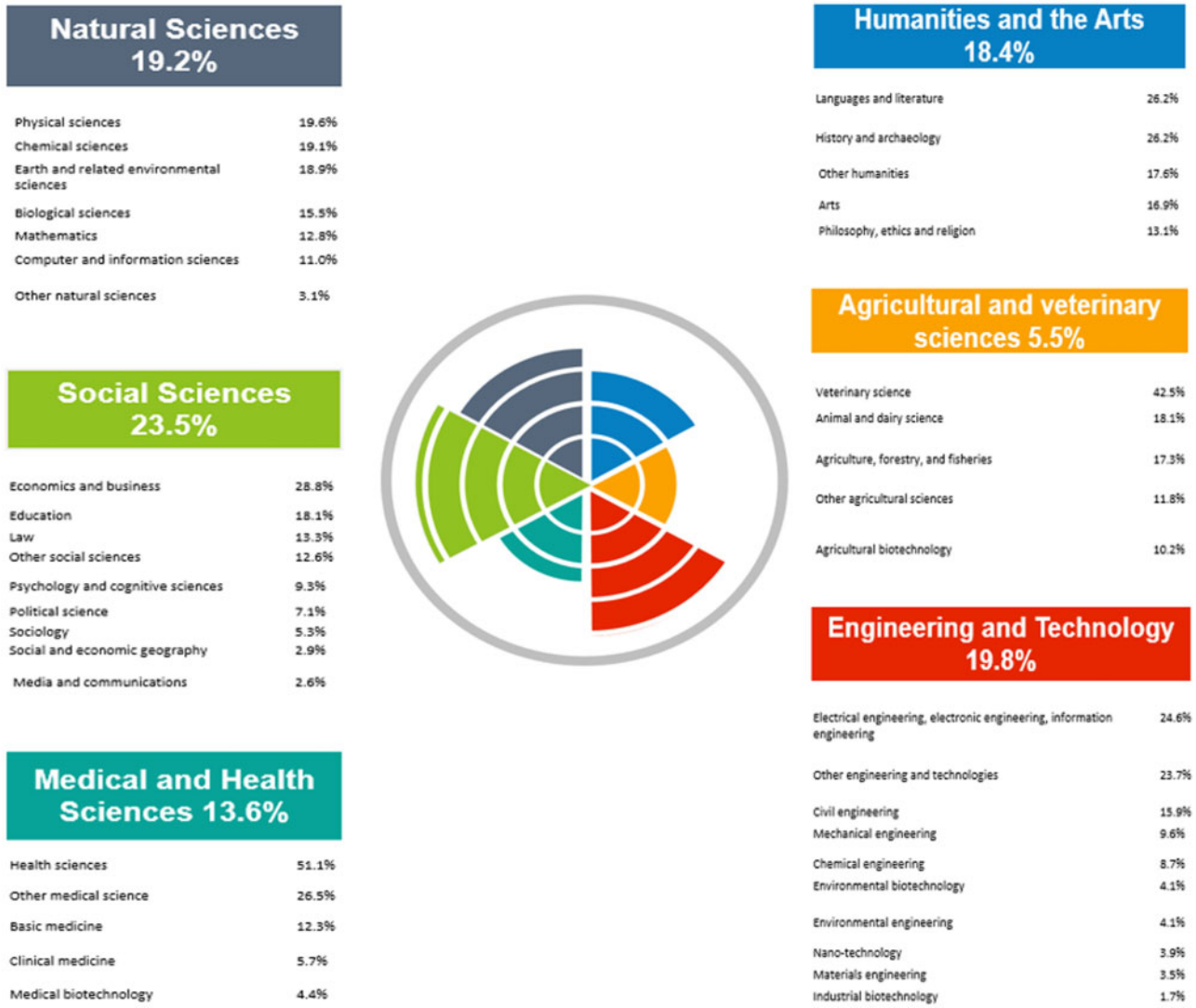

Figure 1. Researcher classification in accordance with the field and subfield of science and technology. The six major fields of research and development (FORD) in descending order as well as the top two-digit subcategory per field are presented.

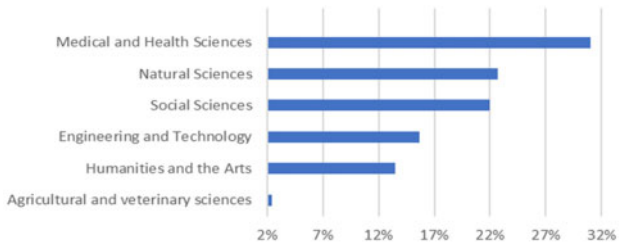

Figure 2. Percentage distribution of the PhD holders, in accordance with the field of science and technology, referring to the year 2018 (as% of responses).

Theses[10] (EADD) and pertain to the year 2018. EADD provides access to the PhD theses from all Higher Education Institutions (HEIs) in Greece as well as PhD theses awarded to Greek scholars by foreign HEIs and certified by the Hellenic NARIC/DOATAP (national agency for the recognition of academic and professional qualifications). EADD's archive ranges from 1985 to the present and refers to approximately 45,000 doctorate holders.

Although in this study, as aforementioned in Section 2.2, the concept of researchers refers to a population with certain characteristics, Fig. 2 presents the scientific specialization of a specific research community; the Greek PhD holders. It also pertains to the year 2018. Nevertheless, meaningful comparisons in terms of our sample of researchers and this research community can be made. As it is evident from Figs 1 and 2, Agricultural and Veterinary Sciences is the field with the lowest number of researchers both in our sample and the specific research community of the Greek PhD holders (5.5 per cent and 2.4 per cent, respectively). Considering both figures, the remaining five scientific fields (Medical and Health Sciences, Natural Sciences, Social Sciences, Engineering and Technology, Humanities and the Arts) show a discrepancy in terms of the manner that the portion of researchers is distributed.

3.2 Psychological state of researchers

While this paper (among others) aims to examine the impact and burden COVID-19 inflicted upon the researchers, the authors are not impervious to wider societal and economic aspects that

contextualize the behaviour of the researchers (Teixeira 2017). These 'pre-existing' conditions concern aspects of their everyday and professional life and revolve around the growing issue of the deteriorating working conditions of the highly educated young researchers (OECD 2020f). Indeed, unequal opportunities in access and advancement in their professional careers, employment on causal contracts, lack of tenured options, and emphasis on short-term research outputs have been widely recognized as examples of professional and economic precarious conditions afflicting research trajectories (Peacock 2016; Shin et al. 2018; Harris 2020). Certainly, interpretation of these parameters helps inform science and technology policy, as understanding the strains the COVID-19 pandemic inflicted upon researchers, their research performance, and future priorities (Chaubey 2020). The latter is a research agenda that had to answer to related questions in a much more time-compressed format, since the empirical part of this research was carried out during April 2020 and has cut across all segments of researchers' human capital.

Indeed, the pandemic COVID-19 affected significantly the psychological state of the researchers. The effects on researchers' personal and family environment are presented in Fig. 3. According to their answers, 53.3 per cent of the researchers are experiencing a high level to a very high level of personal psychological strain due to the lockdown and socially distancing measures. Additionally, 53.7 per cent of the researchers say the lockdown has taken a toll on their family environment adding a further burden (see Fig. 3). Below 8 per cent of researchers state that they experienced no personal or family mental strain against COVID-19 pandemic effects.

Observing Figs 4 and 5 it is evident that female researchers experienced a higher level of personal as well as family mental strain with respect to male researchers. Specifically, both figures suggest that the highest burden of personal and family mental strain was inflicted upon female researchers of Agricultural and veterinary sciences (69.2 per cent and 66.2 per cent, respectively). While this finding cannot be substantiated with past bibliography, one can assume that this is the case due to the inability to conduct relevant experiments in a remote manner (more labourious experimental approach, greenhouse infrastructure, etc.). With regards to personal mental strain, the same holds for male researchers of Agricultural and veterinary sciences (50 per cent). Those associated with Medical and Health Sciences experienced a burden of almost the same level in terms of the mental strain (49.2 per cent). Concerning family mental strain, male researchers falling under the field of 'Humanities and the Arts' experienced the highest level (52.6 per cent).

3.3 Covid-19 as an opportunity: Researcher priorities

As in any crisis, there is often room for opportunity. Indeed, the majority of the researchers view the pandemic (also) with optimistic eyes. The COVID-19 pandemic is being treated as an opportunity by 59.6 per cent of researchers (Fig. 6—pie chart). Key individual reasons for this are the existence of more time for study and planning future research activities (77.9 per cent), the prospects that are opened through the increase of digital collaboration (63.9 per cent), as well as the possibility of learning new skills (46.2 per cent). Reduction of the energy footprint constituted another reason accounting for 38.7 per cent of researchers. Last, 27.3 per cent and 26.8 per cent of researchers considered COVID-19 effects as an opportunity to engage in new research directions and attend new online courses (MOOCS), respectively (Fig. 6—barplot).

3.4 Science and technology in the public sphere: Researcher opinion

Science and technology are essential to humanity's collective response to the COVID-19 pandemic. Yet the extent to which policy-making is shaped by scientific evidence and by technological possibilities varies across governments and societies and can often

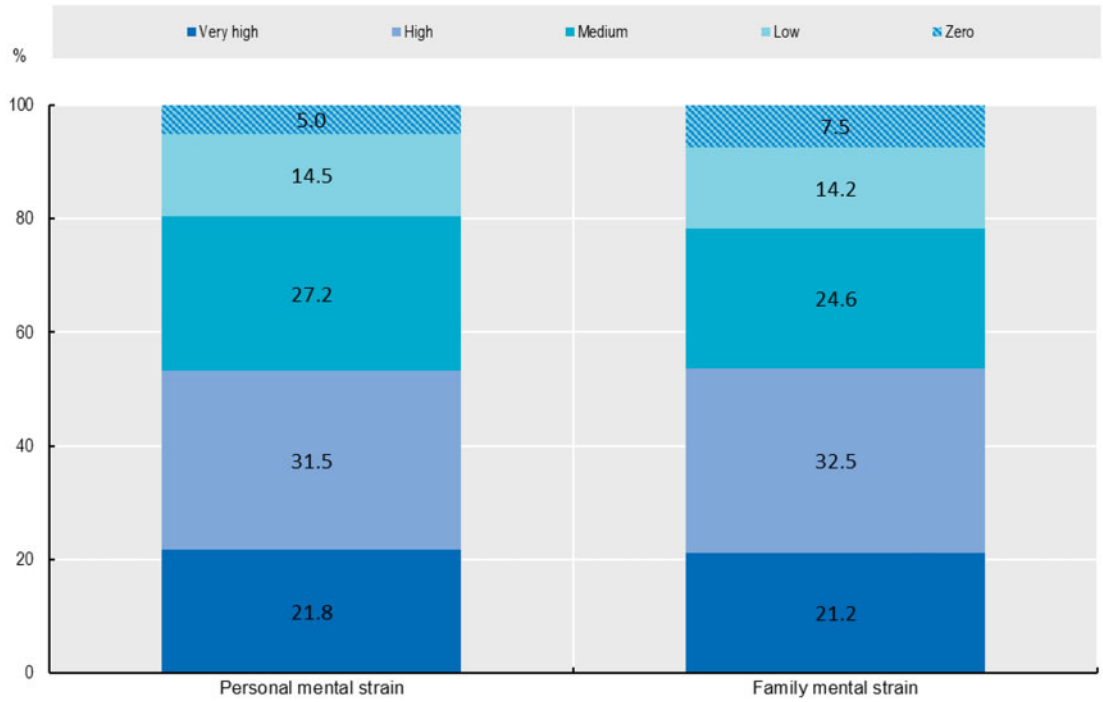

Figure 3. Distribution of respondents' answers (%) regarding COVID-19 effects on (a) personal and (b) family mental strain [Likert scale: very high to zero (1–5)].

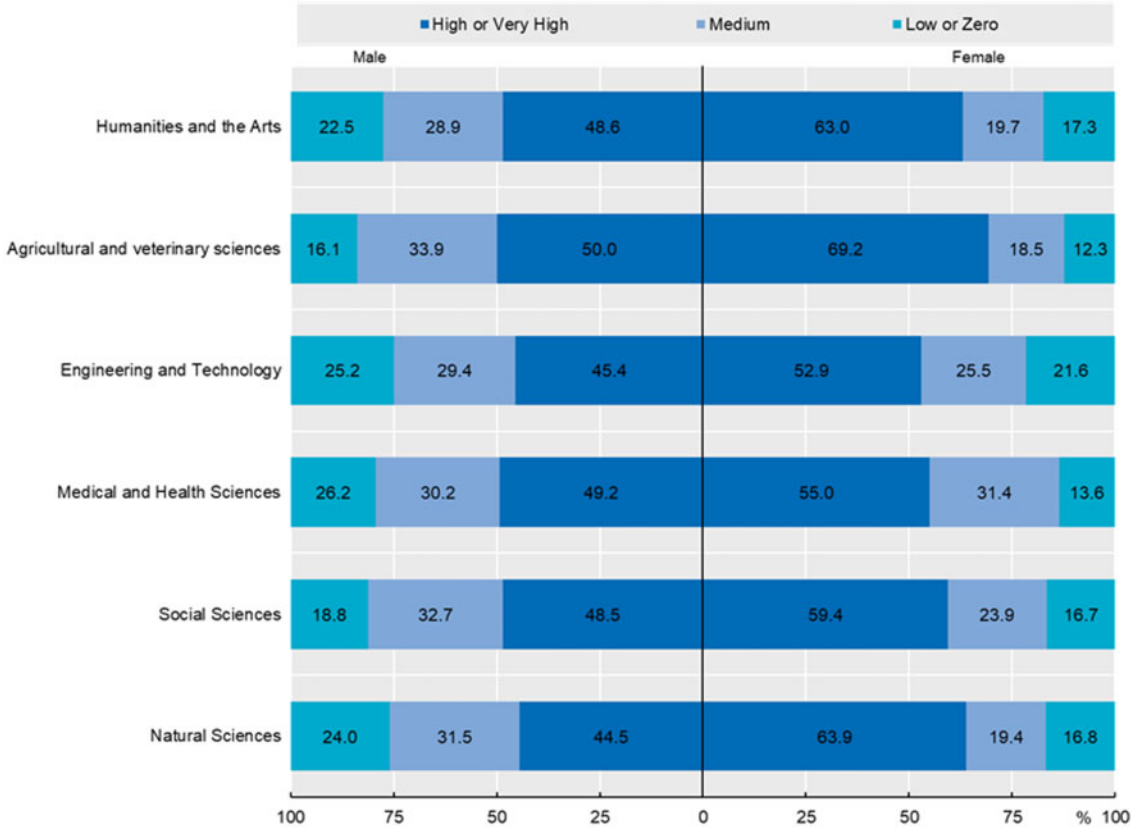

Figure 4. Distribution of respondents' answers (%) regarding COVID-19 effects on personal mental strain according to respondents' sex and field of science [Likert scale: high or very high to low or zero (1–3)].

be limited. At the same time, collaborations across science and technology communities have grown in response to the current crisis, holding promise for enhanced cooperation in the future as well (BRIEF.P 2020).

In times of intense misinformation and fake news, researchers believe that the position of science and technology will be upgraded in the public sphere after the pandemic. Accordingly, 72.4 per cent of the survey's participants believe that science and technology, as a distinct field of human activity, will emerge enhanced from the pandemic in the public sphere. The remaining 27.6 per cent support that science and technology will come out of this pandemic as having a weakened position in the public sphere.

The following Fig. 7 presents the Spearman's correlation coefficients of the variables which describe researchers' mental strain (personal mental strain, family mental strain), views on the pandemic (pandemic as an opportunity), as well as standpoints on the position of science and technology in the public sphere (enhanced Science and Technology). Personal and family mental strain appear to have the strongest, positive correlation between them ($\rho = 0.58$). This is reasonable, since, considering the pandemic effects, personal mental strain may imply family mental strain and vice versa. On the other hand, both personal and family mental strain are negatively correlated with both the variables 'pandemic as an opportunity' and 'enhanced Science and Technology' (-0.31 and -0.13, respectively). This signifies that researchers that experienced either personal or family mental strain have given dissimilar (negative) answers in terms of whether they viewed pandemic as an opportunity or believe that science and technology, as a distinct field of human activity, will emerge enhanced from the pandemic in the public sphere. However, the variables 'pandemic as an opportunity' and 'enhanced Science and Technology' have a positive correlation coefficient $\rho = 0.32$. This indicates that researchers who viewed the pandemic as an opportunity have given similar (positive) answers in terms of whether they believe that science and technology, as a distinct field of human activity, will emerge enhanced from the pandemic in the public sphere.

4. Comparisons and plausible interpretations with EUROFOUND and OECD surveys

In addition to presenting the data of the conducted survey, a comparison with existing reports and analysis was chosen. This includes exploring cross-country responses so as to relate our survey findings with research outcomes of other surveys. Herein, findings of two other surveys are utilized for comparison. These surveys relate to the impact of COVID-19 effects on two different populations; workers (Eurofound 2020a) and scientists (OECD 2020e), during a specific period of time. The manner through which these comparisons are presented is the following. First, the comparability between the two studies and ours focusing on issues of population number, employment class, etc. is examined. Then, certain points of convergence pertaining to the comparison follow. Here, plausible similarities among the subject surveys are discussed. Obviously, not all of the questions of the study fall within the conceptual scope of the comparable studies. This is the case for those handful that are being presented hereafter.

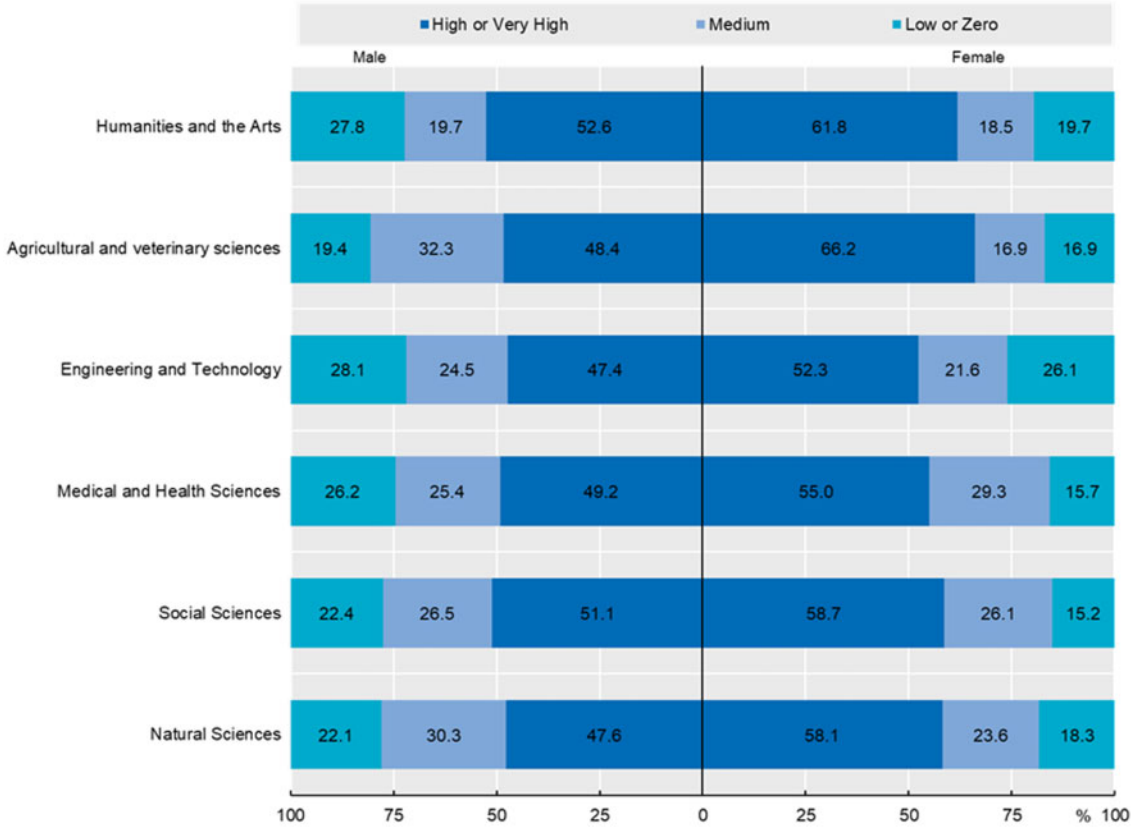

Figure 5. Distribution of respondents' answers (%) regarding COVID-19 effects on family mental strain according to respondents' sex and field of science. [Likert scale: high or very high to low or zero (1–3)].

4.1 Survey general comparisons

4.1.1 Comparability issues. Points of convergence and divergence

4.1.1.1 Eurofound. Both survey data concern almost the same time period (Table 1). However, the two survey samples differ. Eurofound (2020a) survey, inter alia, examines COVID-19 impact on Greek workers (people across various age groups and life situations), whereas EKT's focuses on Greek researchers (see definition of researchers in Section 2.2). The two samples do not differ as much in terms of quantity (EKT's $N = 2{,}323$ and Eurofound's $N = 3{,}068$). Also, both have a national context, addressing population of the nationality, Greeks.

The country-specific aspect of the target population (Greeks) as well as the time period that both surveys were conducted (almost the same timeframe) constitute reasons for meaningful comparisons.

4.1.1.2 OECD. Both surveys (EKT and OECD) were initiated at the same date (15 April 2020). However, OECDs lasted a longer period of time (until 22 June 2020). EKT's respondents amount to 2,323 on the national level, whereas OECDs amounts to 1,100. At first view, it points to comparable sets, yet the latter refers to the international level, having been answered by individuals in eighty countries. This is a significant difference in terms of representativeness. That is, (1) the size of the target population (1,100 respondents) and (2) the target population itself (respondents of eighty different countries) complicate any inference opting to focus on a national level.

Also, the target population of OECD's flash survey (OECD 2020e) consists of scientists or 'any other individuals with an interest in science or science policy'. Moreover, concerning the former, OECD adopted a lenient definition of a scientist as 'correspond[ing] to individuals that identify themselves as scientists'. This is rather a subjective account. In contrast, EKT's target population consists of Greek researchers defined as PhD candidates, postdoctoral researchers, groups of young researchers and academic teachers, all of the above having been given research funding in light of their typical academic classification.

Despite the evident quantitative (size) and conceptual (interpretation) difference of the two target population of EKT and OECD surveys, taking into account the limited amount of research studying relevant context, specific assumptions had to be made.

To bridge the conceptual gap between both target groups, with reference to the OECD survey, only the results relevant to the 'scientists—individuals that identify themselves as scientists' category were selected as a reference point for comparison. Any other result relevant to individuals with an interest in science or science policy was not considered comparable.

As regards to the difference in the quantity of the sample, any further generalization (either on national or international level) that may derive from the comparison outcomes should be interpreted with caution.

4.2 Covid-19 effects on personal and family mental well-being

Figure 3 results indicate that 53.3 per cent of Greek researchers experienced very high or high personal mental strain. In Eurofound (2020a), 'Fig 3. *WHO-5 mental well-being index by country*', which measures workers' well-being on a scale of 0–100 results, shows

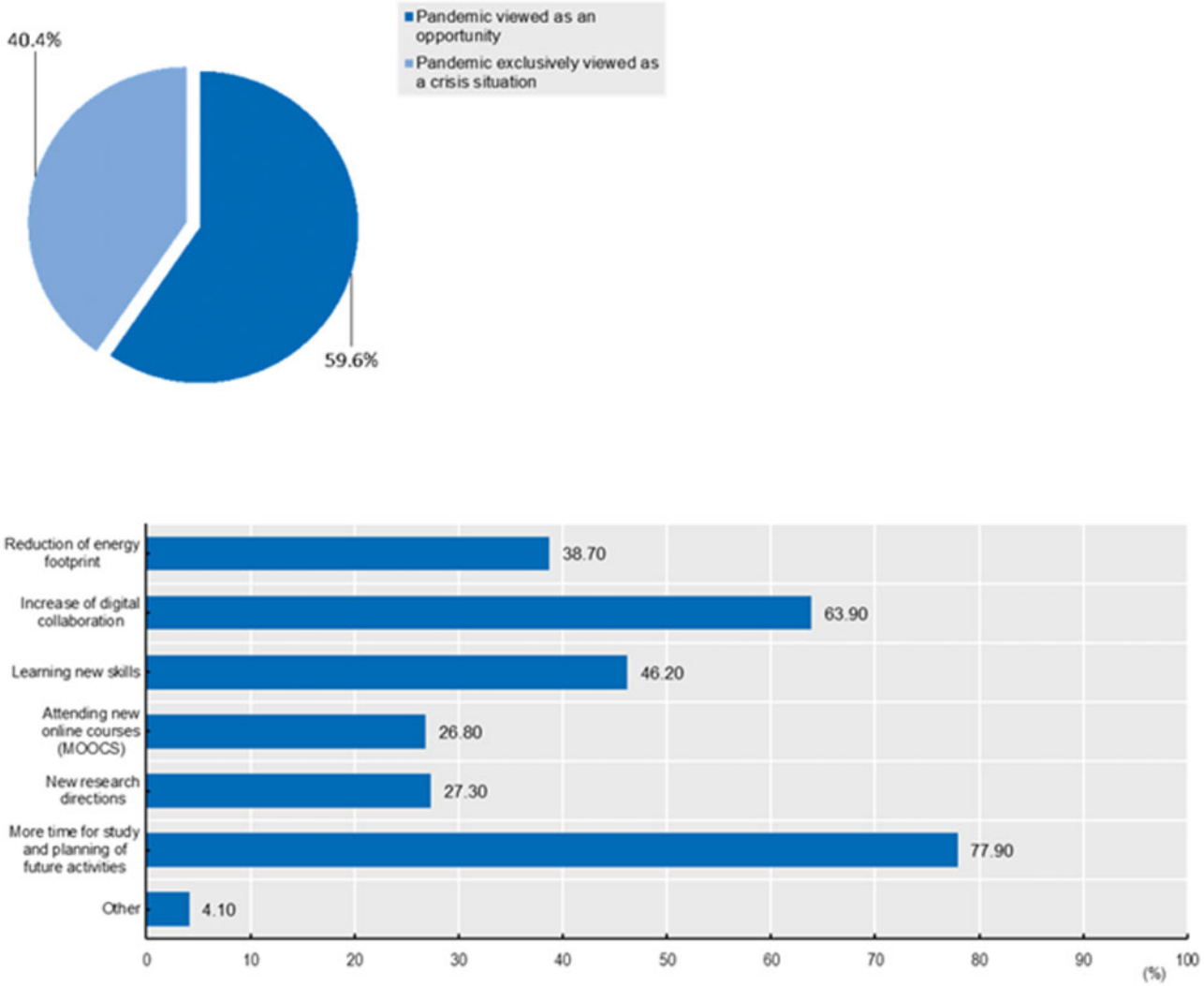

Figure 6. Distribution of respondents' answers (%) regarding whether COVID-19 can be 'viewed exclusively as a crisis situation' or 'viewed also as an opportunity' [Pie chart]. Frequency distribution (%) of selected reasons by researchers that viewed the pandemic 'also as an opportunity' [Barplot].

that mental well-being in Greece scored 56. This score is the lowest compared with other European countries suggesting a sufficient burden in terms of the mental strain experienced. The average EU27 score concerning workers' mental well-being is 59. It can be argued that both surveys agree upon the fact that COVID-19 pandemic has serious effects on the psychological state and well-being of one (researchers) as well as the other (workers) population.

With regards to researcher family mental strain, Fig. 3 results indicate that 53.7 per cent of Greek researchers experienced very high or high family mental strain. In Eurofound (2020a), 'Fig 14. *Difficulties making ends meet by employment status, EU27 (%)*' presents the extent to which households have difficulties making ends meet varies greatly between countries. The proportion reporting great difficulty is highest in Greece (24 per cent) with respect to other European countries. The average EU27 portion reporting great difficulty is around 10 per cent. Also, in this case both surveys agree upon the fact that COVID-19 pandemic has serious effects on the psychological state and well-being with regards to the family environment of researchers on the one hand and workers on the other.

4.3 Covid-19 effects on working time

Figure's 4 barplot results indicate that 77.9 per cent of researchers viewed the COVID-19 pandemic effects as an opportunity in terms of 'More time for study and planning of future research activities'. Eurofound (2020a) survey findings conclude that 'In Greece, about half of all workers said their working time had decreased "a lot"'. Specifically, observing the results in 'Fig 6. *Changes in working time during the COVID-19 pandemic by country (%)*', Greece is on the top of the list compared with the other European in terms of significant decrease in working time. Here, in relation to EU27, below 40 per cent of workers said their working time had decreased 'a lot'.

However, exploring OECD's survey findings, nearly 20 per cent of responses from scientists reported a reduction in the intensity of their work (*Highlights* section, OECD 2020e) and less than 20 per cent stated that they experienced or expect to experience an increase in terms of 'Time available for research' (Q4A, OECD 2020e). Apparently, taking into account EKT and Eurofound survey results, the amount of 'gained' working time, from researchers' standpoint, should preferably be exploited in further studying and planning of future research activities.

EKT's findings on COVID-19 pandemic effects on the management of time availability appear not to comply with OECDs. The fact that EKT's survey focuses on Greek researchers while OECD's target population relates to eighty different countries could constitute a plausible reason to explain this disparity.

4.4 Covid-19 effects on work arrangement

Figure 3's barplot results indicate that 63.9 per cent of researchers viewed the COVID-19 pandemic effects as an opportunity in terms of 'Increase of digital collaboration'. In parallel, Eurofound (2020a) survey findings ('Fig 6. *Proportion of workers who started teleworking as a result of COVID-19 by country (%)*') indicate that below 30 per cent of workers in Greece started teleworking as a result of COVID-19. Such a result stands below the average portion of the EU27 working population who started teleworking as a result of COVID-19 (above 35 per cent).

Researchers view COVID-19 pandemic effects as an opportunity to increase digital collaboration. At the same time, the minority of workers started teleworking as a result of COVID-19. However, since the target population of Eurofound (2020a) survey, workers are defined in a generic way as 'people across various age groups and life situations' (Eurofound 2020b), this interpretations stand on very thin ice and as such one cannot safely make further a ssumptions/interpretations.

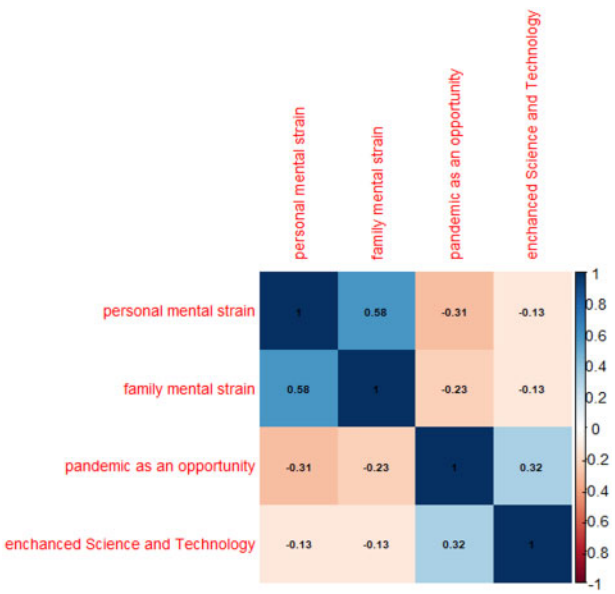

Figure 7. Spearman's correlation matrix among the variables 'personal mental strain', 'family mental strain', 'pandemic as an opportunity', and 'enhanced Science and Technology'.

With regards to OECD's survey findings, over 70 per cent of responses indicate a shift to home working. Specifically, scientists' impressions point towards an increased use of digital tools for research and access to scientific information and data as a consequence of the current crisis (OECD 2020e). Such an outcome is in line with Greek researchers' standpoint that view the COVID-19 effects as a chance to 'Increase digital collaboration' (Fig. 6).

4.5 Covid-19 effects on science and technology status in the public sphere

The majority (72.4 per cent) of researchers believe that the position of science and technology will be upgraded in the public sphere after the pandemic. From the same perspective, OECD 2020 flash survey (OECD 2020e) deduces that 'the responses collected thus far are overall positive about the general prospects for the status of science after the crisis. Respondents expect science to see its reputation strengthening and foresee a greater use and integration of different strands of scientific expertise in policy advice as well as stronger collaboration and exchange of scientific information.' However, as it is stressed, a minority of scientists' responses expect a change in collaboration and engagement in policy makers.

5. Conclusion—next steps

With this survey and the subsequent study, EKT attempted to monitor the effects the COVID-19 pandemic and the ensuing lockdown and social distancing measures have had on the research activities as well the private lives of the researchers. According to the authors' understanding, the scale of the studied population of researchers is certainly the highest in the Greek context and among the highest globally, thus making this study among the first to provide comprehensive data on a critical part of the research continuum—that of its people.

The findings indicate that female researchers experienced a higher level of personal as well as family mental strain with respect to male researchers. Specifically, the highest burden of personal and family mental strain was inflicted upon female researchers of Agricultural and veterinary sciences. Moreover, it appears that researchers that indicate personal and/or family mental strain have been most negative in terms of viewing the pandemic as an opportunity or believe that science and technology, as a distinct field of human activity, will emerge enhanced from the pandemic in the public sphere. Nonetheless, the greatest portion of the researchers (72.4 per cent) think that the fields of science and technology will be enhanced as a result of the COVID-19 pandemic. Providing such evidence for this population group presents a great interest within the context of science and technology policy making. In addition, such considerations can help policy makers in performing evidence-based policies.

Table 1. Target population and time frame of the compared surveys.

Organization	EKT	Eurofound	OECD
Target population	2,323 Greek researchers	3,068 Greek workers[a]	1,100 responses[b]
Time frame	15 April–5 May 2020	9–30 April 2020	15 April–22 June 2020

[a]The questions pertain to people across various age groups and life situations (Eurofound 2020b).

[b]The survey invited scientists or any other individuals with an interest in science or science policy. In total, 1,100 responses from nearly eighty countries have been collected. Sixty-five per cent of responses correspond to individuals that identify themselves as scientists ($N = 715$), with the rest comprising science policy advisors (15%—$N = 165$), professionals involved in science (10%—$N = 110$), individuals carrying out science-related administrative work (5%—$N = 55$), and science communicators (5%—$N = 55$) (OECD 2020e).

Significantly, characteristics such as rationality, well-rounded argumentation, evidence, and a continuous reevaluation of data—characteristics inherent to the science enterprise—will help raise the bar of the public dialogue and rely on more comprehensive policies based on evidence, in essence enhancing the footing of democracy itself.

The research community is a key pillar in the country's technological, economic, and growth path. Its critical contribution to the discovery of new knowledge, its transformation into technology, and its ability to cooperate with both the public and private sectors to turn knowledge into innovation are such aspects, highlighting its importance. Consequently, the above findings could be a vital factor in formulating policy to mitigate the negative and enhance the positive dimensions identified by EKT's research concerning the COVID-19 pandemic.

In relation to the compared surveys, it appears that COVID-19 had a significant impact on Greek individuals, both researchers' and workers' psychosocial life. Apparently, such effects had an impact not only on their personal but also their family environment. Also, working time was significantly reduced during the peak of the COVID-19 pandemic active cases (Worldometers 2020). Indeed, Greek researchers viewed the pandemic as an opportunity for more time for study and planning of future research activities (Fig. 6) while Greece, among European countries, tops the list with respect to the decrease in working time (Fig. 6, Eurofound 2020a).

Providing new evidence on the effects the pandemic had on the highly educated human capital is important inasmuch it provides input for policy makers to build upon related policy answers and initiatives on a range of issues that concern scientists both as human individuals and as knowledge assets. This paper aspires to have contributed towards this direction, thus feeding into a virtuous policy loop.

In terms of next steps, the authors plan to present more data of the conducted survey in a research academic format. Such data and findings have been identified within the premises of the already published report (see footnote #3 and EKT 2020) and would present academic interest. For example and in line with other studies (Andersen et al. 2020; Amano-Patiño 2020; Malisch et al. 2020), our research has shown that women researchers, given their multiple roles, face greater burdens than men. The same goes for issues pertaining R&D-enabling digital infrastructure. Also, upon the publication of other relevant studies, comparability between datasets could identify potentially interesting patterns.

Conflict of interest statement. None declared.

Notes

1. It is impossible to provide a comprehensive account of the relative initiatives. What can be pointed out, though, is the bibliometric account of this rapid ascent, see Chahrour (2020); Lou (2020); and Hossain (2020).
2. see end of page: https://plos.org/covid-19/.
3. We thank Tatyana Deryugina, Associate Professor at the University of Illinois at Urbana–Champaign and co-organizer of the survey for letting us know of the survey's timetable. As of 30 June 2020, they were still in the collection phase.
4. https://metrics.ekt.gr/publications/402.
5. https://ec.europa.eu/eurostat/databrowser/view/tsc00001/default/table?lang=en%20%2F%20online%20data%20code:%20TSC00001.
6. Provisional 2019 data can be found here: https://metrics.ekt.gr/publications/438.
7. http://report08.metrics.ekt.gr/el/chapter2.1, graph 2.1.
8. https://ec.europa.eu/research/horizon2020/index.cfm?pg=country-profiles-detail&ctry=Greece, accessed on 30 November 2020.
9. For more info refer to https://metrics.ekt.gr/publications/358 (in Greek).
10. https://www.didaktorika.gr/eadd/?locale=en.

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