Postmodern Openings
ISSN: 2068-0236 | e-ISSN: 2069-9387
Covered in: Web of Science (WOS); EBSCO; ERIH+; Google Scholar; Index Copernicus; Ideas RePeC; Econpapers; Socionet; CEEOL; Ulrich ProQuest; Cabell, Journalseek; Scipio; Philpapers; SHERPA/RoMEO repositories; KVK; WorldCat; CrossRef; CrossCheck

2022, Volume 13, Issue 4, pages: 294-334 | https://doi.org/10.18662/po/13.4/519
Submitted: June 10th, 2022 | *Accepted for publication:* July 26th, 2022

Perception of Open Science in the Scientific Community of the Republic of Moldova

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Abstract: Open Science becomes the basic concept in organizing and conducting the research and development process. The opening of the process of research and communication of science is supported and promoted both at the international level and at the national level in many countries through science policies and actions.
At present, no Open Science policy is approved at the national level in the Republic of Moldova, but there are actions, undertaken by various organizations or within some projects, that promote this concept. And recently, the national authority in the field of science policy has been concerned about the promotion of Open Science principles in the country.
Policy development and implementation of Open Science principles is difficult without involving all stakeholders and without knowledge of the current situation, both in terms of technical and legislative issues, and especially in terms of awareness of the need and willingness of people to contribute to this process. In this context, we set out to carry out this study, taking into account the insufficient level of debates and analyzes on Open Science subject carried out in the Republic of Moldova. Its purpose is to determine the attitude, the level of awareness and involvement in issues related to Open Science and its elements in the Republic of Moldova, which will serve to develop Open Science policies and instruments at national and institutional levels.

Keywords: *Open Science; Open Access; Open Data; scientific community; Republic of Moldova.*

How to cite: Țurcan, N., Cuciureanu, G., Cujba, R., Lupu, V., Cheradi, N., & Cojocaru, I. (2022). Perception of Open Science in the Scientific Community of the Republic of Moldova. *Postmodern Openings, 13*(4), 294-334. https://doi.org/10.18662/po/13.4/519

1. Introduction

Open Science (OS) becomes the basic concept in organizing and conducting the research and development process. OS is based on the idea that the sharing of knowledge and data in the research system as soon as possible and the involvement in the research process of all concerned social actors (industry, authorities, citizens, etc.) ensures higher creativity, scientific productivity, trust in science and use of research results in society (European Commission, 2020).

The opening of research process and science communication are supported and promoted at the international level, by the European Union (European Commission, 2012, 2018, 2019; Council of the European Union, 2016), the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2021), the Organization for Economic Co-operation and Development (OECD, 2006) and other major organizations (Coalition S, 2019; EUA, 2022; ISC, 2021), as well as at the national level through science policies and actions (Sveinsdottir et al al., 2021). The implementation of OS policies is more advanced in the European space, where various mechanisms and tools have been created at the EU level to support it: the European OS Policy Platform (European Commission, 2020), the European Open Science Cloud (European Commission, 2016), the provisions of Framework Programmes for Research and Innovation (European Commission, 2021). It seems that the transition to OS is also stimulated by the COVID-19 pandemic, which revealed the need for access and exchange of scientific information as soon as possible and better collaboration between science and decision makers (ERAC, 2020; UNESCO, 2021; ASM, 2021).

At present, no OS policy is approved at the national level in the Republic of Moldova, but there are activities to promote this concept undertaken by various organizations or within projects, such as the Information Society Development Institute (IDSI), which developed the *Declaration on Open Science in the Republic of Moldova* (2018) and the *National Bibliometric Instrument* (https://ibn.idsi.md/en/), the largest Open Access digital library in the Republic of Moldova; the Association of Librarians of the Republic of Moldova, which developed the *Declaration on Open Access to Information* (ABRM, 2009) and supports the development of institutional repositories; the MINERVA project (*Strengthening research management and open science capacities of HEIs in Moldova and Armenia, 2018*), which aims to develop the national legislation and institutional policies related to Open Science. And recently, the national authority in the field of science policy has been concerned about the promotion of OS principles. Thus, the *National*

Roadmap for the integration of the Republic of Moldova into the European Research Area for the years 2019-2021 (Guvernul Republicii Moldova, 2018) includes 'Ensuring efficient and long-term access to information and publications funded by public money (promoting the concept of Open Science)'. *The Activity Plan of the Ministry of Education and Research for 2022* (Ministerul Educaţiei şi Cercetării, 2021) provides for the 'Development of the concept of the strategic document on Open Science in the Republic of Moldova'.

Policy development and implementation of OS principles is difficult without involving all stakeholders and without knowledge of the current situation, both in terms of technical and legislative issues, and especially in terms of awareness of the need and willingness of people to contribute to this process. Given that OS is a new way of research, it is clear that a change of attitude is needed in the academic community, as well as in policies and funding. In this context, it is very important to be aware of people's opinions, knowledge and skills related to OS. At the same time, OS is a concept that encompasses a lot of elements related to research and development activities, including Open Access (OA), open data, open sources, new generations of metrics, open education, open review, citizen science (European Commission, 2019). This indicates the importance of taking into account the perceptions, ideas, opinions and knowledge of researchers and other actors in the research system regarding different aspects of OS, as only in this way it would be possible to develop and use different OS policies and tools to improve research.

In this context, we set out to carry out this study, taking into account the insufficient level of debates and analyzes on OS subject in the Republic of Moldova. Its purpose is to determine the attitude, the level of awareness and involvement in issues related to OS and its elements in the Republic of Moldova, which will serve to develop OS policies and instruments at national and institutional levels.

2. Literature Review

In the recent years, there has been increasing interest in the scientific community for the study of Open Science (Banks et al., 2019). However, in the fragmented scientific and political environment, there is still a lack of global understanding of the significance, opportunities and challenges of OS (UNESCO, 2020). The UNESCO *Towards Global Consensus on Open Science* (2020) survey on views related to the UNESCO Open Science Recommendation found out that more than half of participants said that they were involved in OS practices, but 46% of respondents consider that OS did not have a clear definition for them. For the 2687 respondents from

133 countries, the most relevant aspects of OS are OA to scientific publications, open data, open educational resources (OER), science communication. The respondents emphasized that OS should go beyond OA and enable the integration of openness throughout the research cycle, through practices such as open methodology, open source, open peer review, open education, alternative research evaluation metrics and citizen science.

One of the concerns of the EUA (European University Association) related to OS is the regular conduct of surveys on this issue, which focus on the strategies and activities of European universities. The EUA survey *From principles to practices: Open Science at Europe's universities 2020-2021* (Morais et al., 2021) recorded 272 valid responses from higher education institutions in 36 European countries. Although more than half (59%) of the surveyed institutions estimated the strategic importance of OS as very big or high, the gap between importance and implementation is much larger in the areas related to data (research data management, FAIR data and data sharing), compared to OA to publications.

Most of the analyzed studies based on surveys cover all fields of science, but there are also studies focused on specific areas: psychology (Abele-Brehm et al., 2019), agriculture (Williams et al., 2019) or social sciences (Christensen et al., 2020). The most researched elements of OS seem to be OA (e.g., Segado-Boj et al., 2018; Rodriguez, 2014; Stanton & Liew, 2012; Ostaszewski, 2014) and open data (e.g., Abdullahi & Noorhidawati, 2021; Ostaszewski, 2014), less open evaluation and next-generation/altimetry indicators (Segado-Boj et al., 2018), and most studies generally address OS (e.g., Pardo Martínez & Poveda, 2018; Ostaszewski, 2014; Berezko et al., 2021; Schöpfel et al., 2016).

The recent studies suggest that the OS approach is relatively new and it will require much to learn about how to exploit its principles and practices to all types of research, and some aspects of OS may be easier to apply to some disciplines than to others (LaPlante et al., 2021). OS practices have not yet been adopted to large scale: one of the causes is that researchers are unsure of how sharing their work will affect their career (McKiernan et al., 2016). However, studies show that there is a growing awareness of OS practices in various disciplines. For example, the *State of Social Science* survey (2020) provides a comprehensive assessment of awareness, attitudes toward perceived norms, and the adoption of OS practices in a broad representative sample of scientists from four disciplines of social sciences: economics, political sciences, psychology and sociology. The results show a significant increase in adoption: since 2017, more than 80% of researchers have used at

least one of OS practices, compared to a quarter a decade earlier. Other studies also suggest the increasing adoption of OS practices, but highlight a number of important impediments (Paret et al., 2021). The authors of the study *Open science challenges, benefits and tips in early career and beyond* summarize 3 main benefits that early career researchers can gain when working with open scientific methods and, perhaps more importantly, how OS methods make scientists more confident in the scientific work (Allen & Mehler, 2019). However, other studies find that respondents' knowledge of OS and open data is still surprisingly modest, except for OA publishing, but they realize the need for more information, skills and support from their institutions. However, the interest in OS policies and initiatives is still quite limited (Rossel, 2018). The visibility and possibility of a higher citation are almost universally recognized as OS assets (Čolović & Pajić, 2017).

The implementation of OS principles and practices in various disciplines, institutions and countries has influenced the number of studies that are focused on examining the attitudes and perceptions of OS. Openness, OA, and open access publishing are often used interchangeably to describe the multiple benefits of OS, both perceived and anticipated ones. The results of the studies emphasize that open practices have not yet been fully implemented in higher education. Even though open-ended activities are undertaken, such as encouraging students to share content and co-create resources, those activities are not yet common (Heck et al., 2020). The results of the studies suggest that increased and concerted effort of various stakeholders is needed to make significant gains in adopting OS practices at the national level. While the isolated effort of small advocacy groups contributes to the awareness and development of skills, their realization is limited by the lack of resources or limited support (Mwangi et al., 2021).

A number of researches have been deliberately directed beyond the narrow concept of OA (Lacey et al., 2020; Thoegersen & Borlund, 2022; Pardo et al., 2018) to the broader objective of open science to see how such a practice could bring greater benefits to society.

Several studies report a higher interest in OA and favourable interest in open access publishing (Nobes & Harris, 2019; Ostaszewski, 2014; Segado-Boj et al., 2018; Stanton & Liew, 2012; Schöpfel et al., 2016). However, studies examining the use of OS practices confirm the polarity in addressing OA in various areas (Dalton et al., 2020), and show that awareness and use of these practices is often low in the social sciences such as psychology and economics (LaPlante et al., 2021), while researchers in exact sciences publish more in OA (Ostaszewski, 2014). Those engaged in mathematics, physics and informatics seem to be more open to self-archive

than those involved in biology, earth sciences and chemistry. And those engaged in biology seem to have more experience in and a better attitude towards OA publishing and payment of publication fees than those involved in mathematics or social sciences and humanities (Schöpfel et al., 2016). There are also some surprising results of surveys, such as that researchers in the arts and human sciences would be more positive towards OS (Ostaszewski, 2014). Overall, awareness of OA increased during the pandemic (Turgut et al., 2021).

Open Access publishing is a paradigm shift in scientific communication practices. Opinions on attitudes towards various aspects of OA publishing are important and should be included into any successful OA publishing model. The most appreciated services related to OA publishing were rigorous and fast peer review, fast publishing and promotion of post-publication papers (Rowley et al., 2017). Survey participants are satisfied with the non-commercial reuse of OA works, but are very negative about the commercial reuse, adaptations and inclusion in anthologies (Rowley et al., 2017). At the same time, responses assessing the perception of Article Processing Charges (APC) show that while most respondents support the OA concept, most believe that fees are too high and should not fall on authors (Halevi & Walsh, 2021). Poor peer review or poor quality of OA journals is a concern of many researchers, as there are fears of publication in predatory journals (Williams et al., 2019).

The assessment of opinions on publishing in OA of contradictory or ambiguous results showed that, although researchers greatly appreciate the publication of 'negative' results, they often do not publish their own ones. The authors invoke the lack of time and the perception that 'negative' results will not be cited as much as 'positive' ones (Echevarría et al., 2021).

Studies show that researchers' attitudes towards data sharing and reuse have been generally positive (Hrynaszkiewicz et al., 2021; Abele-Brehm et al., 2019; Houtkoop et al., 2018). However, several surveys have found out that there are common problems or concerns of researchers regarding data sharing. In practice, scientists have been concerned about sharing their own research data, such as the likelihood of misuse of data and the need for proper citation and recognition (Tenopir et al., 2018). Still, data sharing can increase the profitability of research projects, allowing other researchers to perform secondary analyzes or combine these data with their own ones to explore new relationships (Spallek et al., 2019). At the same time, several previous studies note the need for training in data management for researchers (Wallis et al., 2013; Koltay, 2015), the need for increased

awareness of the requirements for data sharing in OA (Carlson et al., 2011), training in RDM (Ünal et al., 2019).

Participants in open peer review surveys support the principles of open evaluation (Ross-Hellauer et al., 2017; Kim et al., 2020) and express their agreement with and support for a reliable evaluation system (Delikoura & Kouis, 2021). Respondents have a more positive attitude towards open and non-anonymous review, specifically highlighting the benefits of open and transparent academic discussions (Besançon et al., 2020). However, the authors of academic journals are more cautious about open evaluation and various metrics compared to OA (Segado-Boj et al., 2018).

Some studies have highlighted: 1) age and gender differences: women and young researchers would be more reluctant to open review (Segado-Boj et al., 2018); higher age leads to fewer publications on OA, younger age – more favourable towards OS, women have a lower awareness of OS, but are more favourable towards OS (Ostaszewski, 2014); favourability and awareness of OS is higher in researchers in the early stages of their careers (Berezko et al., 2021), but the attitude of these researchers is more categorical (positive or negative) (Abele-Brehm et al., 2019); 2) research sector differences: staff at research institutes know less about OS than those at universities (Ostaszewski, 2014); or 3) geographical regions differences: researchers in Western Europe would be the most informed about OS, and those from Eastern Europe – the least informed ones (they are also more engaged in competition than in collaboration in publishing the results) (Berezko et al., 2021).

3. Purpose and Objectives of the Study

Hence, the analysis of the attitudes and perceptions of researchers and other actors in the research process, by using surveys, target different aspects of OS and have increased in intensity along with the development of this concept. Given the insufficiency of such studies in the Republic of Moldova, we opted for a survey covering the entire academic community and addressed most aspects of OS.

Thus, the purpose of the study was to understand the attitude and identify the awareness of OS practices by the scientific community in the Republic of Moldova. The survey aimed at achieving the following general objectives:

- Investigating the familiarity with the concept of OS and participating in OS actions;
- Analysis of researchers' perceptions of the openness of science, including research data;

- Identification of OS training services and actions.

General hypothesis of the study: in the research and development system of the Republic of Moldova the knowledge of the OS phenomenon and the availability to accept OS is limited.

4. Methodology

4.1. Survey Research

According to the purpose of the study, the survey research was applied that "is a systematic set of methods used to gather information to generate knowledge and to help make decisions" (Lavrakas, 2012, p. XXXV). It includes gathering of data related to attitudes, behaviours and incidence of events.

4.1.1. Study Area and Population

The population covered by the survey research has involved university researchers and pedagogical staff, researchers from research institutions, as well as administrative and management staff from universities and research institutions, academic fellows (doctoral and post-doctoral students), as well as library professionals from academic and research libraries. The data provided by the national statistical system of the Republic of Moldova were used to determine the size of the researched population (Statistical Yearbook of the Republic of Moldova, 2021). The study population comprises 9108 researchers, pedagogical staff of higher education institutions, academic fellows and academic and research librarians.

We used several channels to reach researchers. This strategy implied:

a) direct email from the Ministry of Education and Research to the head of research institutions and universities in order to encourage the widest dissemination of the Questionnaire among the scientific and academic community;

b) promoted Facebook posts;

c) a post on the web-site of IDSI;

d) emails to contact persons who distributed the survey on our behalf.

4.1.2. Sampling Technique, Sample Size and Data Collection

To achieve a suitable sample size from this population, we used a probabilistic sample to ensure that every member of the population has a chance of being selected.

Stratified random sampling was applied for the study. The strengths of the stratified random sampling include all important subpopulation and precision. This sampling technique is suitable when entire population is divided into strata (or subgroups) that do not overlap, but represent the entire population, so as to ensure that every section is adequately represented (Taherdoost, 2016). A random sample is taken from each subgroup to represent the entire population and randomly select individuals. From a population size of 9108, a sample of 369 was determined based on Krejcie and Morgan calculations (Krejcie & Morgan, 1970).

The survey was opened by 685 persons, 153 were excluded (*See 3.3. Materials and Methods*). The final sample comprised **n** = 532 participants (confidence level = 95%, margin of error = 4.12%). The sample size is finally presented in Table 1.

Table 1. Number of questionnaires distributed for each subgroup

Characteristics of the sample (subgroups)	Population	Stratified sampling	Useful responses
Researchers (including senior management of research institutions)	2907	2907/9108 x 369 = 118	101
Pedagogical staff (including senior management of higher education institutions)	4114	4114/9108 x 369 = 166	330
Academic fellows (doctoral and post-doctoral students)	1721	1721/9108 x 369 = 70	51
Academic and research librarians	366	366/9108 x 369 = 15	32
Other categories	-	-	18
Total	**9108**	**369**	**532**

Source: Authors' conception

4.1.3. Materials and Methods

The quantitative data were collected through a survey. The reasons for using the online questionnaire in that research were as follows:

- possibility to reach a large and institutionally dispersed community (at a relatively low cost);
- possibility to collect data from a larger sample than it would be possible (compared to other data collection techniques);
- possibility to ensure the confidentiality of the data due to the anonymous answers to the questionnaire;

- possibility to determine from the very beginning the way of analysing data, due to coding before the distribution of the questionnaires;
- possibility to use specialized software (SurveyMonkey) to prepare the questionnaire, collect data and analyse the results.

The survey was conducted using SurveyMonkey and was open to all Moldovan researchers wishing to participate in it.

We conducted a document analysis first to study some previous surveys on OS (UNESCO, 2020; Morais, 2021; CRECIM, n.d.). Same items in our questionnaire were adopted from previous surveys and were aligned with objectives of this research. The questions were adapted through a pilot study to validate the feasibility of the study (2017), to test trial methods and procedures (Bell et al., 2018), to meet the understanding of the later targeted large respondents before the distribution (Mahfooz & Othman, 2021) and to estimate the time required to complete the survey.

The questionnaire was composed of five sections with 27 questions. Section 1 focused on respondent socio-demographic information. Sections 2-5 assessed the meaning and practices of Open Science, Open Science Policy, the opening of science, promotion and training on OS. At the end of the questionnaire, the respondents were asked to summarise their views on OS.

The questionnaire contains single-response, multiple-response, multiple-choice questions, rating scale response and Likert scales with a 5-scale response mode. Each question also provided the ability for the respondents to add other options or choices with free text descriptions. The questionnaire has one open question, asking researchers to give their views on the obstacles toward the development of OS practices in their institution and in the Republic of Moldova.

4.1.4. Survey Administration

The strategy encouraging participation in the survey included emailing from the Ministry of Education and Research to the heads of research institutions and universities for the widest dissemination of the questionnaire among Moldovan scientific and academic community. Another mode of promotion of the study and motivation to fill in the survey was communication with researchers, university personnel, academic fellows and librarians of different universities and research institutions.

The survey included background information that explained its purpose, the definition of Open Science, background information on the study, privacy notice, contact information, the time required to complete the survey (on average 20-25 min.) and the submission deadline.

The survey was available online from 25 October 2021 until 6 December 2021. Of the total 685 individuals that accessed questionnaire, 532 people responded to the survey, representing a response rate of 77.7% (532/685 = 0.777). A survey is considered acceptable, if it achieves at least a 70% response rate or an 80% rate (Leslie, 1972). According to other opinions, acceptable response rates range from 40% to 75% across different areas (Sataloff & Vontela, 2021). At the same time, the response rates to online surveys are nearly always very much lower than those obtained when using on-paper surveys (Nulty, 2008). Thus, the response rate is "an important measure to consider when assessing the quality of survey research, because a low response rate reduces the sample size and the power of a study, and increases potential bias" (Sataloff & Vontela, 2021, p. 683).

Uncompleted answers of 153 responses were removed (only the sociodemographic questions were answered). Of the 532 valid responses, 423 were complete (79,5%), having provided answers for all survey items. All valid responses were included in the analysis.

5. Results and Discussion

5.1. Sociodemographic Characteristics

A national representative sample of 532 respondents participated in this study. Of the total number 68.61% (365) were women and 31.39% (167) were men. About one third of the respondents were between thirty-five and forty-four years old (30.64%) and forty-five and fifty-four years old (30.08%). The majority of the respondents worked for a higher education institution or research organisation (79.89% and 16.54%, respectively), and 2.07% were from National / Republican Libraries and Information Centres (see Table 2). A total of 20.49% held management positions or represented the administrative staff of research institutions and universities.

Table 2. Demographics of survey participants'

Variable	Level	Frequency	Percentage
Gender	Female	365	68.61
	Male	167	31.39
Age	18-24 years old	7	1.32
	24-34 years old	70	13.16
	35-44 years old	163	30.64
	45-54 years old	160	30.08
	55-64 years old	96	18.05
	>65 years old	36	6.77

Variable	Level	Frequency	Percentage
Type of organization	Research institution	88	16.54
	Higher education institution	425	79.89
	National / Republican libraries, information centres	12	2.26
	Regulatory authority / government	4	0.75
	NGO, Business	3	0.56
Current position	Administrative and management staff	109	20.49
	Researchers	71	13.35
	Pedagogical staff in higher education institutions	262	49.25
	Academic fellows (doctoral and post-doctoral students)	51	9.59
	Librarians	32	6.02
	Other position	7	1.32

Source: Own elaboration based on the survey results

According to the Classification of Scientific Specialties approved by the Government of the Republic of Moldova, in 2013 there were 37 different scientific branches grouped into six wider scientific fields: Natural Science (NS), Engineering Sciences and Technologies (ES&T), Medical Sciences (MS), Agricultural Sciences (AS), Social and Economic Sciences (S&ES), and Humanities (HUM). Over a half of the respondents (51.69%) were involved in non-science disciplines (social and economic sciences or humanities), science disciplines accounted for 48.31% respondents. Figure 1 shows the composition of our sample by field.

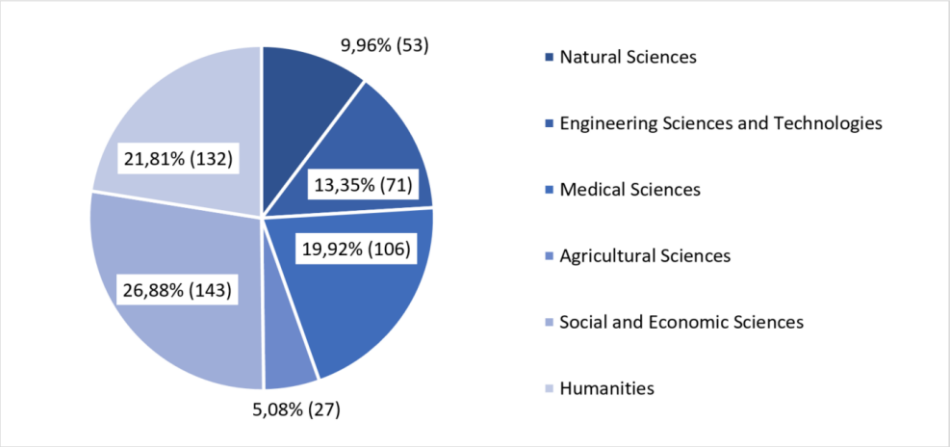

Figure 1. Percentage distribution of survey participants according to their field of expertise (*n*=532)
Source: Elaborated by authors based on the survey results

5.2. Meaning and Practices of Open Science among Moldovan Researchers

The questions in this section focused on the analysis of researchers' knowledge, practices, and general perceptions of OS. In the first question the respondents were asked to describe their involvement in OS movement.

The results showed that 85.15% of the respondents are familiar with Open Science practices, practice and promote OS (Figure 2). Over a half of the respondents (51.88%) indicated their involvement in OS, either by practicing or promoting OS practices, or by both performing and actively promoting OS practices. Only 14.10% of the respondents are not at all familiar with the concept and practices of OS. At the same time, although the respondents have some knowledge of Open Science, about a third of them are not involved in OS practices. These data suggest the need for a range of actions on the part of universities, research institutions, scientific and academic libraries to promote and train services and practices based on OS principles.

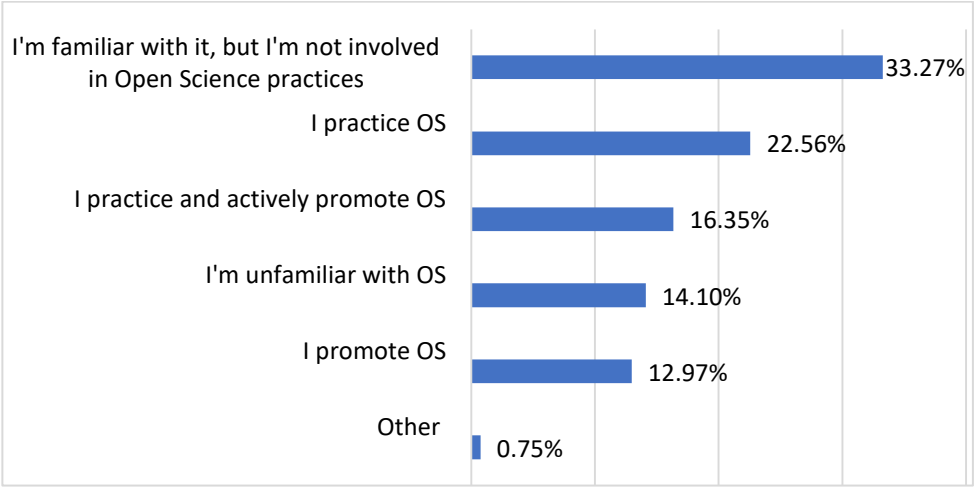

Figure 2. How familiar Moldovan researchers are with the Open Science concept (*n*=532)
Source: Elaborated by authors based on the survey results

The respondents were asked to assess the extent to which they are involved in various aspects of OS practices (Figure 3). Among the survey participants, most of the respondents regularly practice disseminating information to scientists (51.69%), OA publishing (40.23%) and communicating with the general public (32.71%). Some respondents noted that although they do not currently practice certain aspects of OS, in the near future they plan to practice them. These actions included, inter alia: collaboration with funders (30.45%), ethical aspects of science and research integrity (26.32 %), public participation and/or various stakeholders in research (25.56%), etc. The respondents noted a number of activities related to OS, which they do not practice at all, the largest share making up actions of: gender equality (23.68%), collaboration with industry (23.68%), collaboration with funders (25.65%), etc.

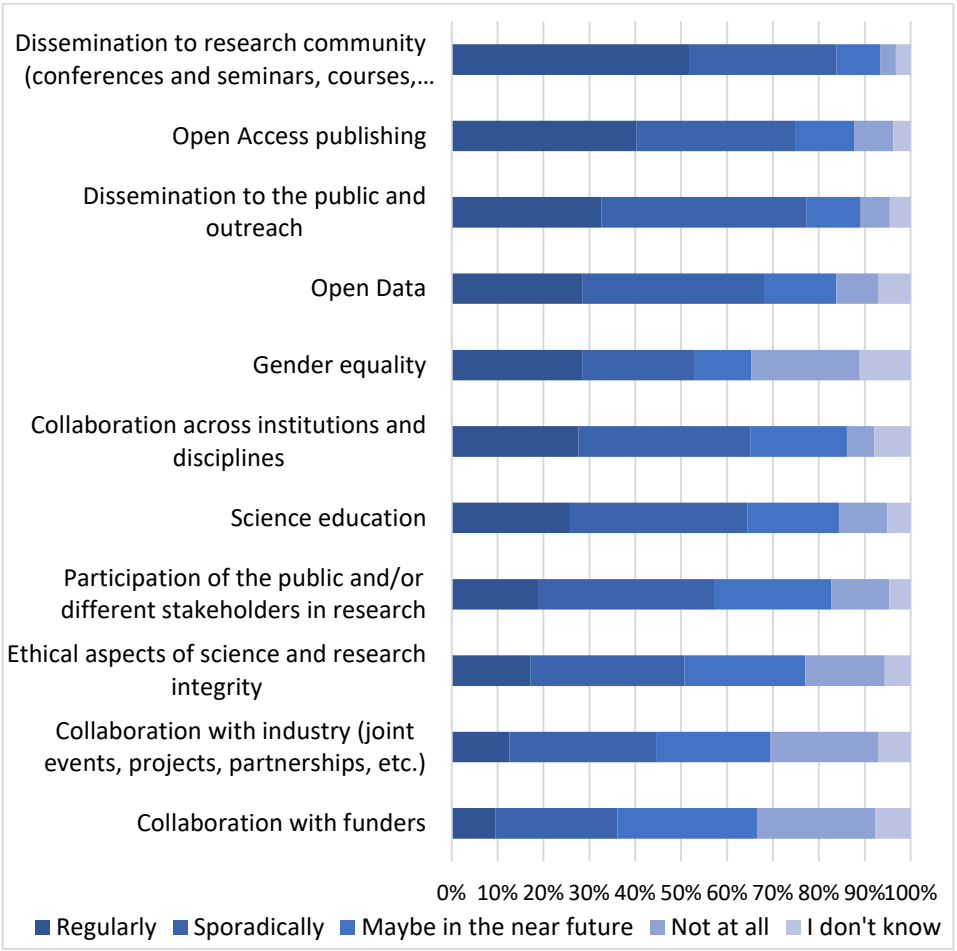

Figure 3. The respondents' replies regarding participation in OS activities/actions (*n*=532)
Source: Own elaboration based on the survey results

Another important aspect is the application by researchers of various OS elements. The respondents were asked to rate different OS aspects according to their relevance (Table 3). Open Access to scientific journals, OER, open access to research data and information, promotion and communication of science are the most important aspects of OS mentioned by the respondents. Although the respondents were fairly supportive of all aspects of OS (mean score > 3) except crowd sourcing (mean score < 3), for some aspects of OS the standard deviation is large (open notebooks, open infrastructures, crowd sourcing, citizen science, links with indigenous and local knowledge, co-design of research projects), which shows that the

population of that group is not very homogeneous in terms of opinions. Interestingly, these OS practices also illustrated the largest variation in scores. Some respondents were very familiar with these practices, while others did not know what they meant or did not have enough information, knowledge and implications in the components of OS.

The results on the evaluation of various aspects of OS are similar for all scientific fields (Table 4), suggesting a direct relationship between knowledge and use in OS.

Table 3. Respondents' replies on the most relevant aspects of Open Science

Open Science aspects	Mean score	Standard deviation	*n*
Open Access to scientific journals	3.75	0.738	532
Open Access to data	3.65	0.814	532
Open notebooks	3.34	1.112	532
Open Access to educational resources	3.73	0.713	532
Open source	3,50	0.999	532
Open infrastructures (Open labs/Open hardware)	3.42	1.070	532
Open innovation	3.50	0.987	532
Open evaluation	3.44	1.006	532
Open collaborations	3.60	0.918	532
Crowd sourcing	2.58	1.610	532
Co-design of research projects	3.36	1.081	532
Citizen science	3.08	1.255	532
Links with indigenous and local knowledge	3.12	1.246	532
Science outreach and communication	3.69	0.738	532

Notes: 4 points scale (1 = not important, 4 = very important)
Source: Own elaboration based on the survey results

Table 4. The most relevant aspects of Open Science in different fields

	Natural Science	Engineering Sciences and Technologies	Medical Sciences	Agricultural Sciences	Social and Economic Sciences	Humanities
Open Access to scientific journals	90.57%	87.32%	86.79%	85.19%	85.31%	86.36%
Open Access to data	71.70%	67.61%	83.02%	85.19%	78.32%	87.12%
Open notebooks	50.94%	47.89%	78.30%	81.48%	60.14%	67.42%

Open Access to educational resources	83.02%	84.51%	86.79%	92.59%	75.52%	85.61%
Open source	73.58%	71.83%	72.64%	85.19%	65.03%	76.52%
Open infrastructures (Open labs/Open hardware)	71.70%	69.01%	74.53%	88.89%	60.84%	65.91%
Open innovation	71.70%	59.15%	78.30%	88.89%	66.43%	81.06%
Open evaluation	71.70%	56.34%	72.64%	88.89%	58.74%	73.48%
Open collaborations	79.25%	74.65%	78.30%	92.59%	69.23%	87.88%
Crowd sourcing	30.19%	35.21%	47.17%	48.15%	42.66%	45.45%
Co-design of research projects	64.15%	56.34%	74.53%	62.96%	57.34%	65.91%
Citizen science	41.51%	36.62%	57.55%	59.26%	53.85%	56.82%
Links with indigenous and local knowledge	49.06%	46.48%	57.55%	66.67%	51.75%	56.82%
Science outreach and communication	84.91%	80.28%	83.02%	88.89%	78.32%	84.85%

Notes: (*n*=532)
Source: Own elaboration based on the survey results

The survey participants noted the OS impact on the entire life cycle of the research process (Figure 4). At the same time, the respondents fully agreed that the OS impact is manifested in better visibility and accessibility of Moldovan researchers' publications (64.85%) and better chances for researchers' publications to be cited (63.53%).

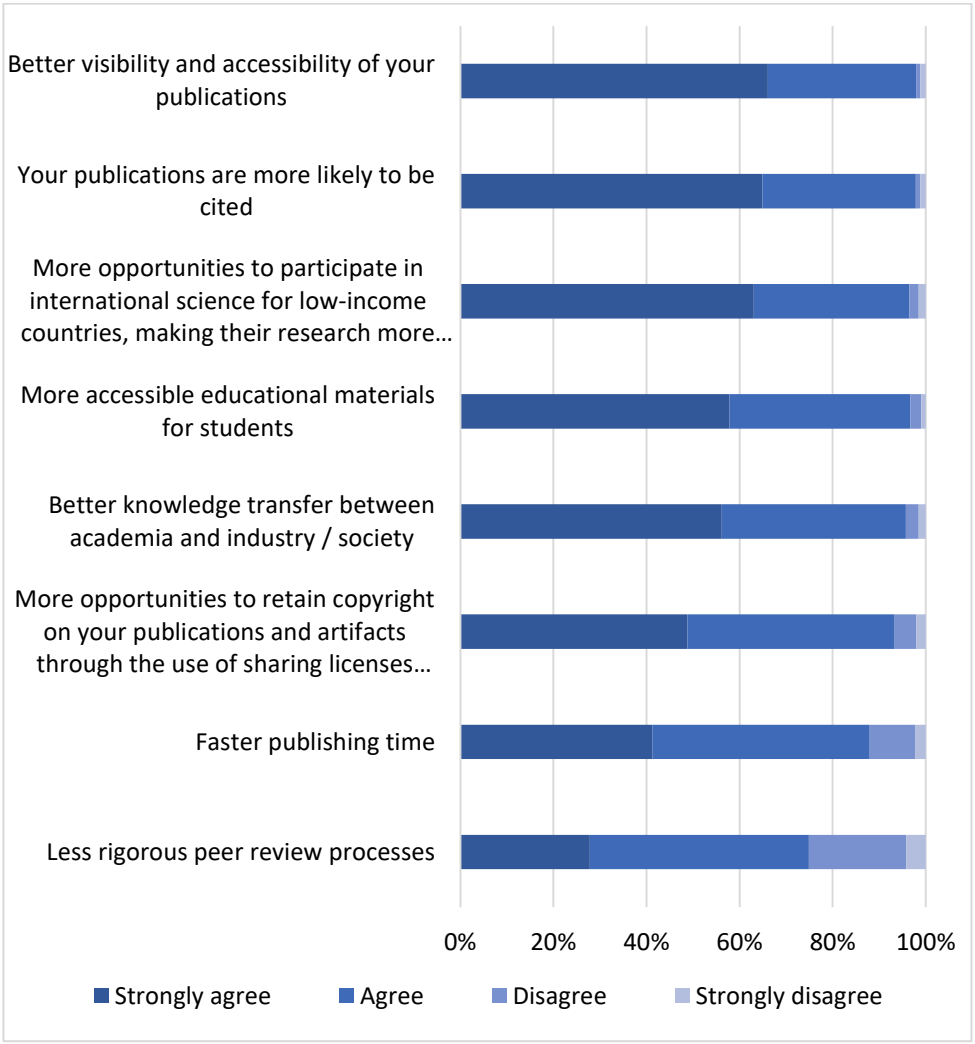

Figure 4. The respondents' opinion regarding the Open Science impact on research (*n*=532)
Source: Own elaboration based on the survey results

The average of responses showed that the top three scores for the impact of OS (potential range of 1 to 4) were "Better visibility and accessibility of your publications" (3.56 ± 0.747 OS), "Your publications are more likely to be cited" (3.54 ± 0.763 OS) and "More opportunities to participate in international science for low-income countries, making their research more visible" (3.45 ± 0.884 OS), all falling into the visibility phase of the open science life cycle (Table 5). The lowest mean score was for "Less

rigorous peer review processes" (2.68 ± 1,183 OS), and the second lowest one was for "Faster publishing time" (3.01 ± 1.123 OS).

In this respect the high mean score of better knowledge transfer between academia and industry / society is significant (3.37 ± 0.898 OS), suggesting that the respondents consider very important the transfer of knowledge, research results, and their implementation, while OS practices have a direct impact on this process.

Table 5. The impact of Open Science on research

Impact of Open Science on research	Mean score	Standard deviation	*n*
Better visibility and accessibility of your publications	3.56	0.747	532
Your publications are more likely to be cited	3.54	0.763	532
More opportunities to retain copyright to your publications and artefacts by using sharing licenses (e.g., Creative Commons)	3.15	1.090	532
Less rigorous peer review processes	2.68	1.183	532
Faster publishing time	3.01	1.123	532
More accessible educational materials for students	3.43	0.828	532
Better knowledge transfer between academia and industry / society	3.37	0.898	532
More opportunities to participate in international science for low-income countries, making their research more visible	3.45	0.884	532

Notes: 4 points scale (1 = strongly disagree, 4 = strongly agree)
Source: Own elaboration based on the survey results

5.3. Researchers' Attitude towards Openness and Exchange of Research Data

A key component of OS is open research data, the importance of which has grown along with the mandatory requirements put forward by funding agencies for potential grant recipients to ensure access to generated research data, as well as the requirements of several journal editors, which also oblige authors to share their data publicly. Although this field is not actively explored by the scientific community in the Republic of Moldova, the survey included some questions regarding the research data.

As regards science openness, we asked the participants to decide to whom the science should be open (Table 6). In the opinion of the respondents, science should be open to funders and policy makers, industry and companies, scientists in the same field, as well as those involved in other fields (mean score > 4). There are some reservations about the openness of research results to citizens, civil and community organizations, stakeholders, for example, patients (mean score < 4). The standard deviation for these categories of public is large, which shows that the population of that group is not very homogeneous in terms of opinions.

Table 6. Opinions on to whom should science be opened

Statement	Mean score	Standard deviation
Open to scientists in the same field / discipline	4.71	0.634
Open to scientists from other fields / disciplines	4.41	0.855
Open to all citizens	3.84	1.245
Open to civil and community organizations	3.84	1.171
Open to interested groups (e.g. patients)	3.95	1.160
Open to funders and policy makers	4.32	0.974
Open to industry and companies	4.16	1.015

Notes: (*n*=443), *5 points scale (1 = should not be opened, 5 = should be very opened)*
Source: Own elaboration based on the survey results

According to Moldovan researchers, science should be open for several reasons (Figure 5): for data exchange, procedures and/or optimizing science (58.92% strongly agree), access for all to scientific results, methods, software, etc., regardless of economic capacity or institutional affiliation (53.50% strongly agree); OS is aligned with the principles of research integrity (51.92% strongly agree). Thus, researchers perceive that science should be open to ensure efficiency and fairness, as well as it should be aligned with ethical principles.

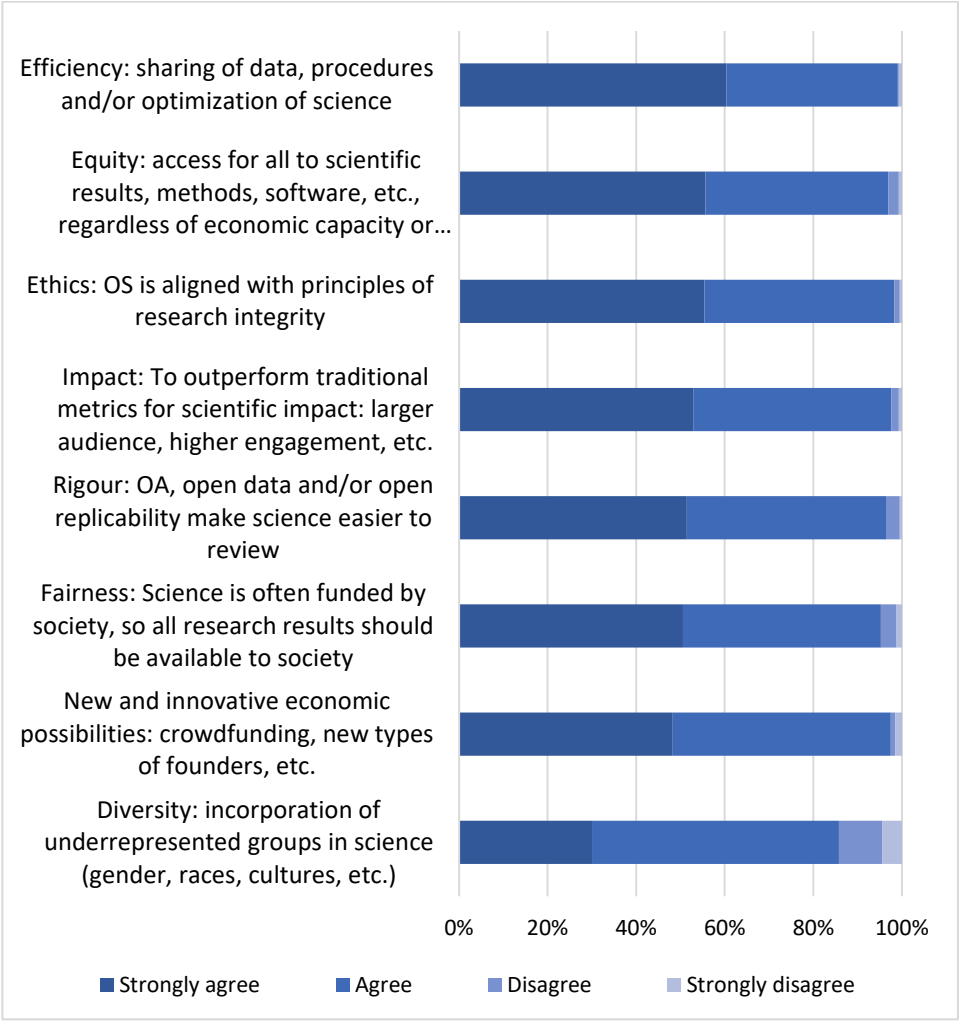

Figure 5. Opinion regarding why science should be open (*n*=443)
Source: Own elaboration based on the survey results

As regards the causes that would determine the closure of science identified by Moldovan researchers (Figure 6), it is not a priority now, as currently there are more important priorities in the scientific community (39.50% strongly disagree; 43.57% disagree); only applied science would benefit from OS and would be to the detriment of basic research (22.80% strongly disagree; 40.18% disagree); society is not prepared to participate in science (22.57% strongly disagree; 36.79% disagree); society cannot make decisions or a useful contribution without understanding science/scientific

process (21.44% strongly disagree; 37.25% disagree). Thus, researchers perceive that it is important for both science and society to know what the achievements in the field of science are, and the fears related to the lack of public understanding, the risks for basic research, the existence of other more important priorities in the scientific community, etc. there are no reasons to limit OA to research results.

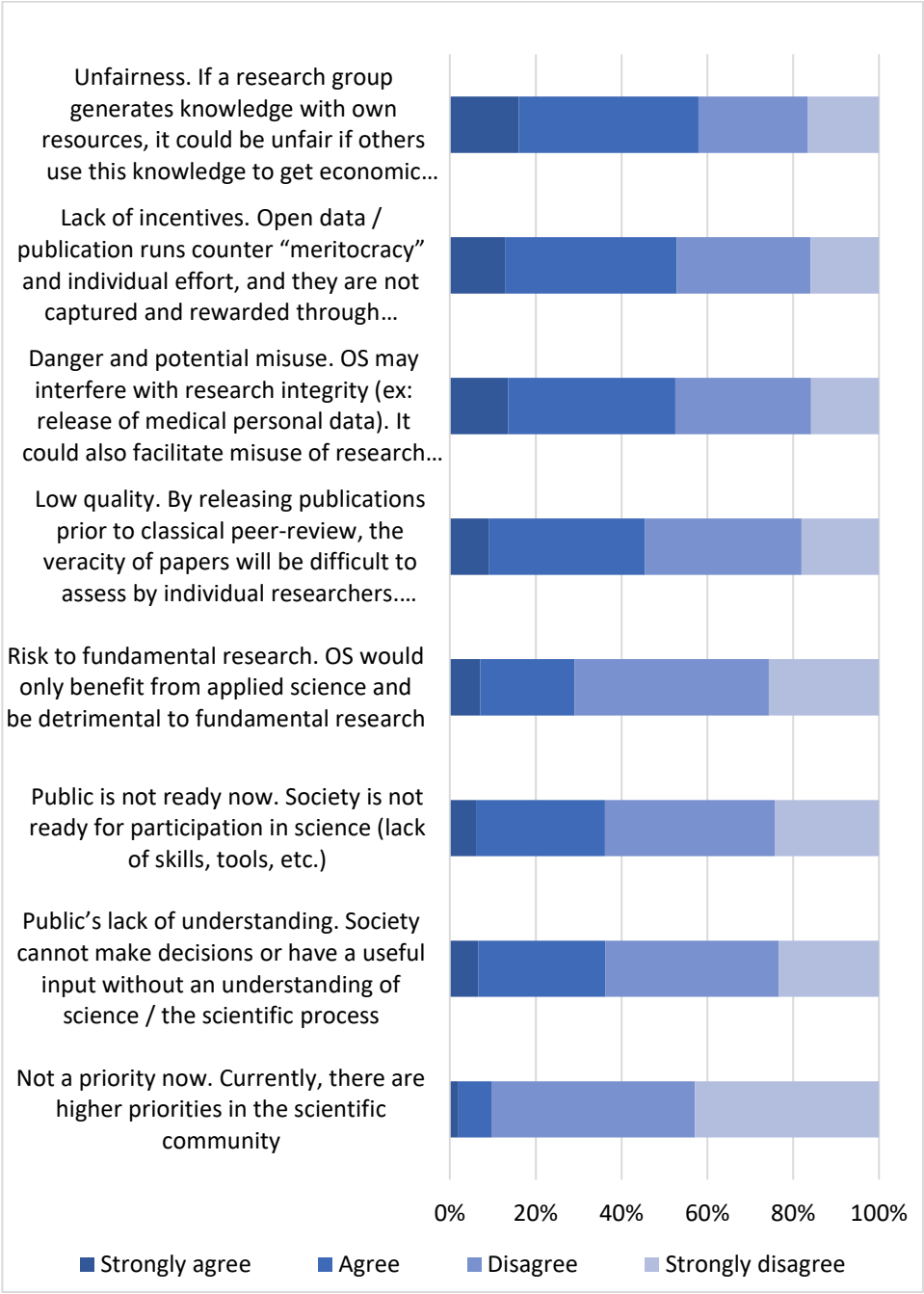

Figure 6. Opinion regarding why science not should be open (*n*=443)
Source: Own elaboration based on the survey results

The results of the survey on the openness of research data show that the vast majority of the respondents (about 85% on average) are aware of the benefits of open research data, agreeing that open data can help increase citations and reuse of studies, acceptance of papers in a journal of highest quality, improved evaluation and verification of research results (Figure 7). The disagreement over data openness (on average on all questions) was manifested by an insignificant segment of researchers, the highest percentage being in the field of natural and engineering sciences.

Therefore, it is found out that the listed characteristics enjoy favourable assessments. The first two answers have the same mean score (3.35). For the contribution of the open data to the increase of chances of citing studies, the mean score is 3.32, and for the positive influence of open data on the chances of reusing studies a score of 3.26 was reached. Thus, the survey participants noteced that open data provide great opportunities and positively influences the access, visibility and reuse of research results.

At the same time, the interpretation of this result could suggest that researchers are aware of the complexity of research activities and seem to be aware that open data requires efficient data management, involving technical and software infrastructure, human and financial resources, special skills and abilities, etc. Only 16% of the respondents stated that they did not have enough information to provide their opinion on the data opening effort.

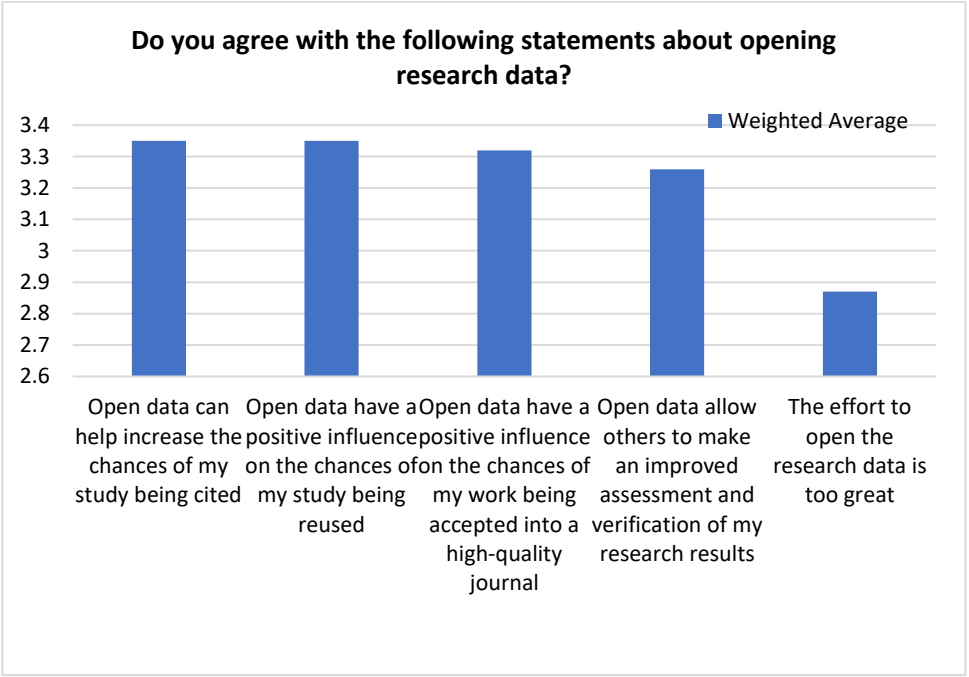

Figure 7. Opinion regarding opening research data (*n*=443)
Notes: 4 points scale (1 = strongly disagree, 4 = strongly agree)
Source: Own elaboration based on the survey results

The respondents proved through their responses that there is a different understanding of data exchange issues and challenges, providing a wide range of opinions.

Although most respondents are aware of the benefits of open data, researchers mentioned a number of challenges and fears that reduce their desire and discourage them from sharing data (Figure 8). The main challenge in exchanging data for researchers is copyright and licensing, supported by 55.53% (*n* = 443). This could be influenced by the fear that their intellectual property rights to data may be breached, and the knowledge about the licensing of any rights to their data may lack. There is also a great concern about the incorrect use of data (40.41%; *n* = 179). An increased number of survey respondents reported that the data could contain sensitive and/or personal information (36.34%; *n* = 161). Reluctance to share data is influenced by respondents' uncertainty about their rights to share data (29.80%; *n* = 132), repositories to use (27.09%; *n* = 120), and concerns about organizing data in a presentable and useful way (22.35%; *n* = 99). Only 21.44% (*n* = 95) of the respondents have no concerns in this regard.

The fear of reusing research data, such as different interpretation of data from other laboratories (20.77%; *n* = 92), as well as the doubt that other researchers could not repeat the findings of research (10.84%; *n* = 48) fall within this context. These results prove a lack of adequate knowledge of rights, data sharing tools, open digital data warehouses, where they could store their data, etc. Thus, the biggest concerns regarding the exchange and sharing of research data relate to the rights and fair use of these data.

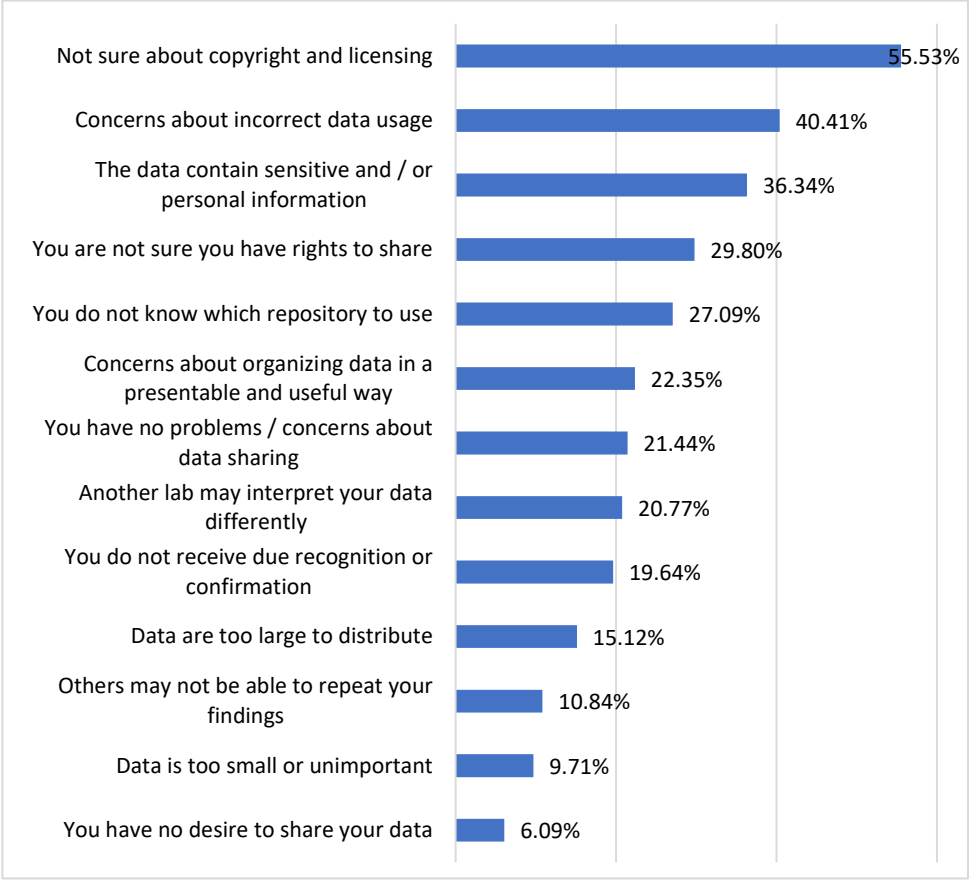

Figure 8. Respondents' attitude towards data exchange (*n*=443)
Source: Own elaboration based on the survey results

5.4. Promotion of and Training on Open Science

For the transition to OS, as well as the implementation of its practices at institutional level, allowing research with a high degree of

transparency, collegiality and integrity, researchers need adequate skill building and professional development at all phases of their career. At the same time, services and training activities related to OS are needed within research institutions.

The survey included several questions on the services and training provided by university libraries and research departments for the implementation of OS practices, as well as the development of the skills of researchers required for OS.

Given the usefulness of services aimed at developing OS skills, the survey participants were asked what services they use, offered by the library/research department of the institution. About 90% of the respondents noted that they use one or several services provided by institutional structures to build skills and develop practices related to OS.

The data presented in Figure 19 show that the most consumed services offered by academic and scientific libraries are related to archiving publications in OA institutional repositories (65.57%); assistance in creating personal profiles of researchers, scientists and teachers in Google Scholar, ORCiD, Scopus ID and on other platforms (58.78%); participation in various information and training activities on issues related to OS practices (56.21%); calling for consultations and specifying information on OA, research data, OA policies of funders, citation or alternative metrics, etc. (51.29%).

However, 11.71% (n = 50) of the survey participants did not know that there were OS services, and 10.30% (n = 44) did not use OS services. We believe that this number of respondents is quite impressive, taking into account that the institutional policies advocating OA models were developed almost a decade ago.

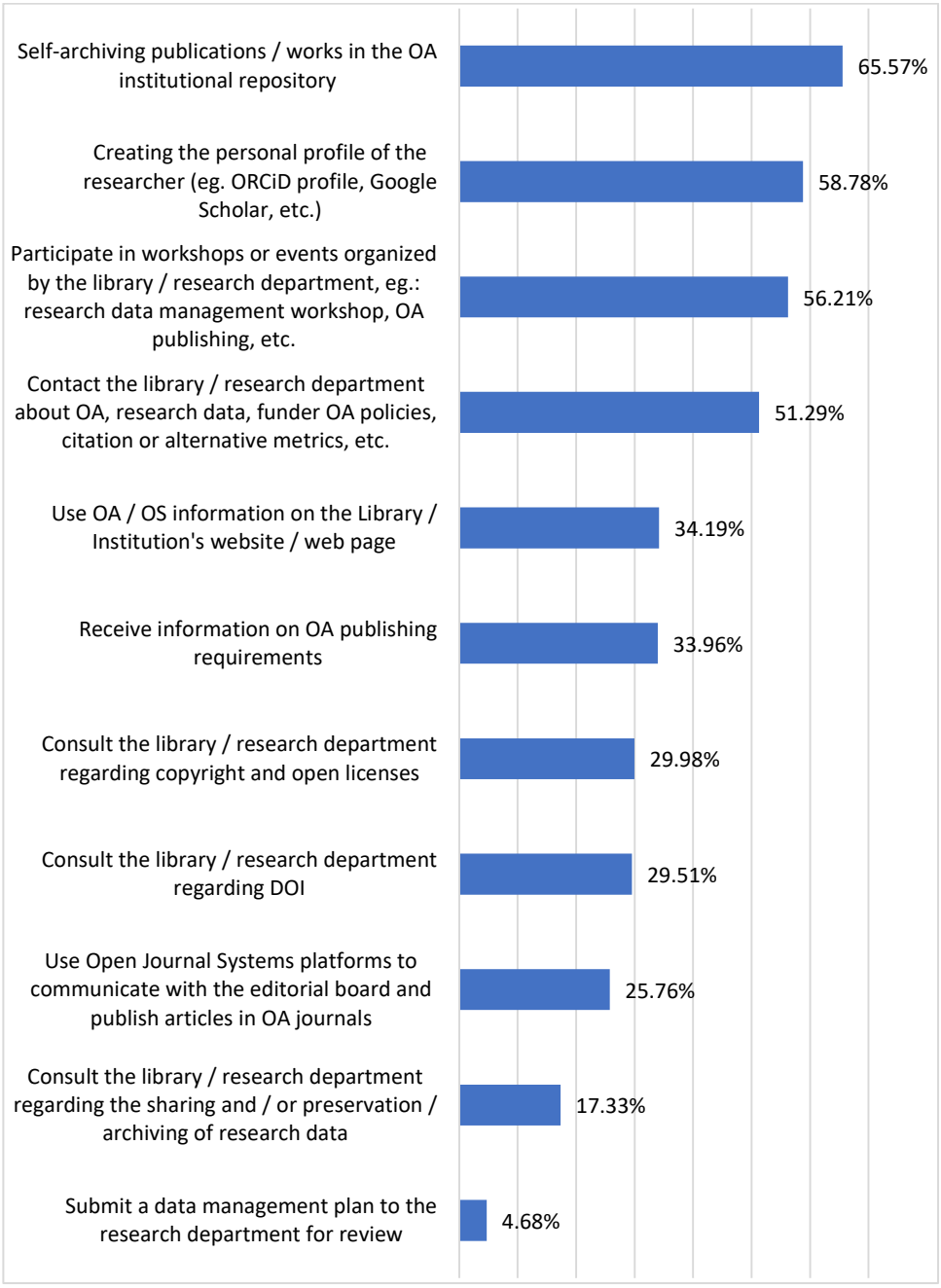

Figure 9. Use of Open Science services provided by the library / research department (*n*=427)
Source: Own elaboration based on the survey results

As regards the general skills required at the institutional level for the transition to OS and for which cources were organized, most respondents indicated trainings on publishing and disseminating OA researches (n = 262; 61.36%). Also, over a third of the respondents noted that their affiliated institutions organized trainings on research and data management (n = 158; 37%), science communication to the general public (n = 152; 35.6%) and research projects and research results evaluation (n = 151; 35.36%).

Other issues for trainings such as research integrity, public involvement in research, collaboration and networking, etc. were mentioned as important for certain discipline, professional development and stages of research (Figure 10). However, 14.99% (n = 64) of the surveyed persons noted that they did not know about the organization of OS trainings, and 7.49% (n = 32) of the respondents do not participate in OS cources. Another 2.11% (n = 9) strongly stated that there are no OS trainings in their institutions. We assume that an independent evaluation of the quality, satisfaction and impact of the services provided by the OS promoting institutional departments is needed in order to find optimal solutions for making this activity more efficient.

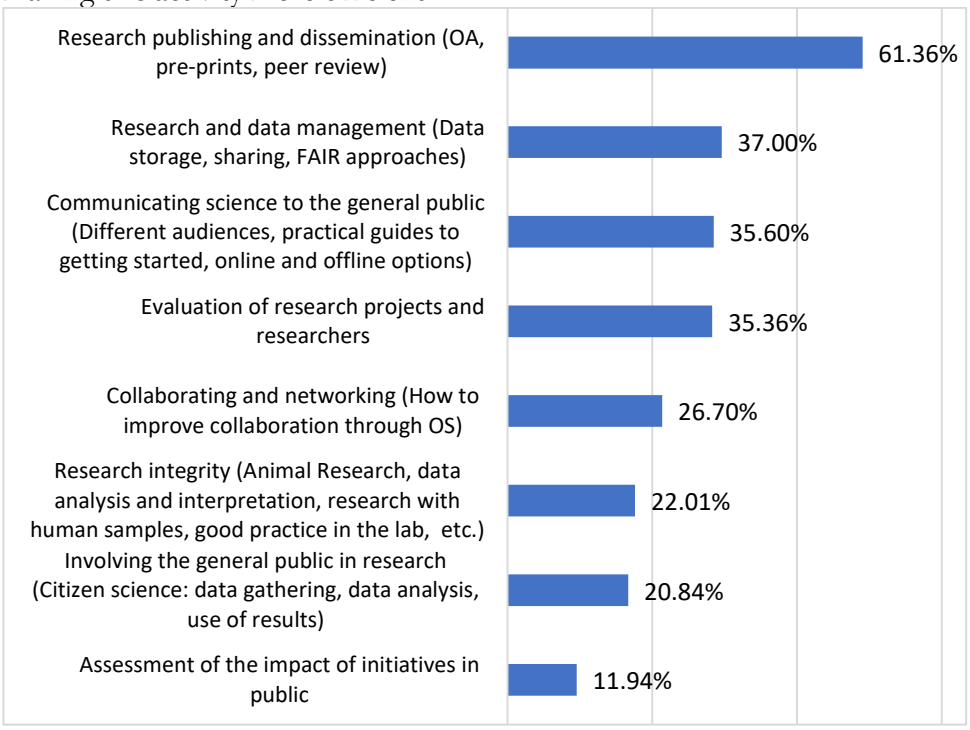

Figure 10. Trainings related to Open Science (n=427)
Source: Own elaboration based on the survey results

Further analysis of the needs for training and skill building in OS practices showed that survey participants requested to receive more information on various services and tools related to OS (Table 7). The first three positions in the respondents' mentioned preferences were technical guidance on how to prepare data for archiving in a repository of publications or open data (59.95%); assistance in preparing digital materials and software code for open archiving (55.5%); support in OA publishing (47.07%); guidance on copyright issues, data confidentiality and other issues related to open research practices (46.84%).

Comparison of scientific results showed that there are some differences in the respondents' opinions, with the exception of technical guidance on how to prepare data for archiving in a repository or other open platforms, which obtained one of the highest scores (position 1 and 2).

Analyzing and interpreting the survey data, we caught the basic ideas about the wider promotion of OS. Research and innovation institutions shall play an important role in OS development, based on the needs of researchers and the support of specialized departments, simplifying institutional procedures related to archiving research results, evaluating science, training members of the scientific community, etc.

Table 7. Participants' opinion on methods related to Open Science about which they would like to receive more information

Answer Options	Responses	
	%	*n*
Technical guidance on how to prepare data for archiving in a public repository (open data)	59.95%	256
How to prepare digital materials and software code for open archiving	55.50%	237
How to apply copyright law, data privacy and commercial laws when adopting open research practices	46.84%	200
How to publish a preprint	35.83%	153
How to prepare open educational materials	45.90%	196
How to prepare your PhD thesis for Open Access sharing	31.38%	134
How to guide your students in preparing their thesis and data for open sharing	40.75%	174
How to choose and apply an open license (for example, a Creative Commons license)	30.68%	131
How to publish a monograph in Open Access	46.60%	199
How to create a data management plan	33.49%	143
How to publish an article in Open Access	47.07%	201
Guidance for research and data management	31.38%	134

Answer Options	Responses	
How to recognize a predatory publisher or a pseudo-scientific journal	44.96%	192
How to recognize an innovative publisher or a platform that supports open research practices	32.55%	139
How to find and use open licensed works	30.44%	130
How to self-archive your paper and / or research data in an Open Access repository (institutional, thematic, international one)	29.98%	128
How to get a DOI for your paper (publication, preprint, etc.)	36.53%	156
How to index your work in the National Bibliometric Instrument and / or other databases	35.13%	150
How to create and manage your personal researcher profile (eg. ORCiD, Google Scholar, etc.)	27.17%	116
How to search for information in the National Bibliometric Instrument	23.65%	101
How and what modern and innovative scientific communication tools to use	32.79%	140
Other (please specify)	1.64%	7

Notes: (*n*=427)
Source: Own elaboration based on the survey results

Institutional roles also include the introduction of mandatory data archiving policies and the development of important documents for operational management. Most respondents have enough knowledge of OS, the main source of information being science departments and libraries. However, almost a third of the respondents do not know enough about OS practices.

The survey ended with a question concerning the general point of view regarding OS (Figure 11). The results showed that the respondents think that OS is a benefit and an opportunity for science. Unsurprisingly, the respondents consider that "Open Science is an excellent opportunity for science, mostly with benefits" (*n* = 176; 41.61%), "Open Science is an opportunity for science, with the benefits outweighing the disadvantages" (*n* = 111; 26.24%) and "Open Science is mostly positive for science, it has benefits, but it also has some disadvantages" (*n* = 112; 26.48%). Instead, few respondents consider OS to be a bureaucratic burden, an alarming prospect or a real threat to science (*n* =24; 5.67%).

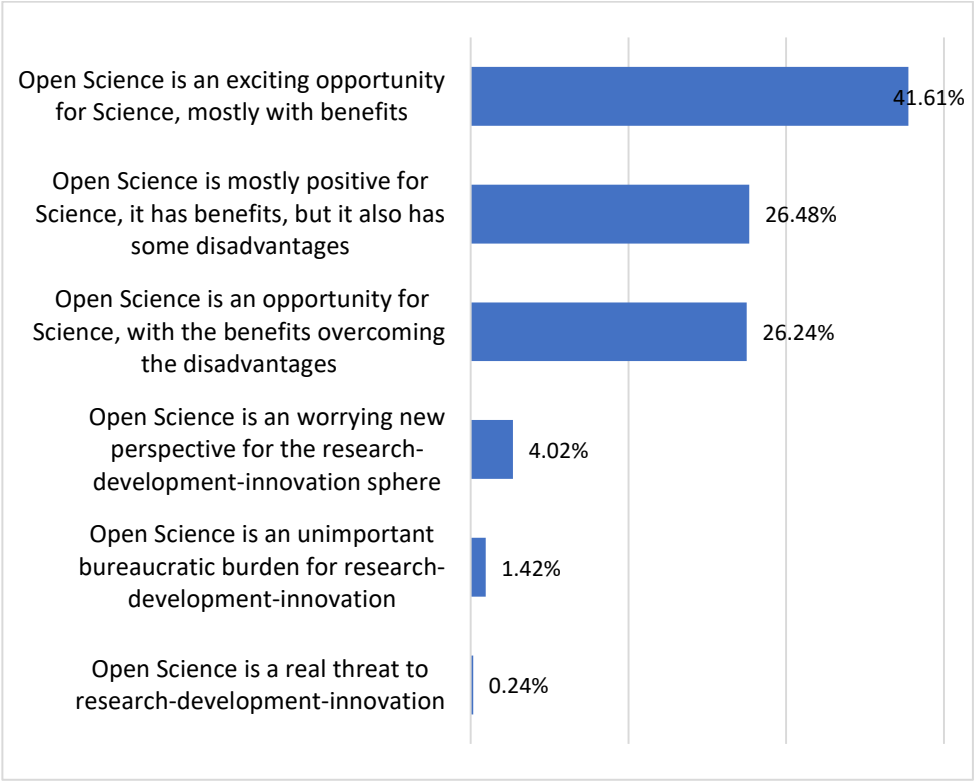

Figure 11. The respondents' summarised views on Open Science (*n*=423)
Source: Own elaboration based on the survey results

6. Conclusions

This study analyzed the perceptions, attitudes, experiences and knowledge of Open Science among researchers in the Republic of Moldova through an online survey that used a probabilistic sampling strategy, which allowed us to ensure the representativeness of the study.

A total of 532 responses were received, with a 95% confidence level and a 4.12% margin of error.

Most respondents are familiar with and promote Open Science practices. Researchers indicated that they are most involved in OS by disseminating information to scientists, publishing in Open Access and communicating with the general public. On the contrary, our results point out that a number of activities related to Open Science, such as gender equality, working with industry and funders, are practiced rarely or not practiced at all.

The study showed that OA to scientific journals, OER, OA to research data and information, promotion and communication of science are considered the most important aspects of Open Science.

The results of the study also showed that in the opinion of the respondents, OS has an impact on the entire research process life cycle, but most of all it manifests in a better visibility and accessibility of Moldovan researchers' publications, and offers greater chances for their publications to be cited.

Although, according to the respondents, science should be open to funders and policy makers, scientists, industry and companies, there are some reservations about opening research results to citizens, civil society organizations and specific stakeholders, for example, patients.

At the same time, the scientific community and academia in the Republic of Moldova are ready to pass on responsibilities for the implementation of Open Science to other actors in the field, and are less willing to assume some responsibilities individually.

Most Moldovan researchers believe that science should be open to data exchange, procedures and/or optimization of science, access for all to scientific results, methods, software, etc., because OS is aligned with the principles of research integrity. At the same time, some respondents believe that science should not be open, because it is not a priority now, society is not ready to participate in science and cannot make decisions or make a useful contribution without an understanding of science/research process.

The survey showed that researchers' attitudes towards data exchange and sharing were generally positive. The vast majority of respondents are aware of the benefits of open research data, agreeing that open data can help increasing citations and reusing studies, accepting papers in a high quality journal, improving evaluation and verification of research results. At the same time, respondents still have some concerns and fears about copyright and licensing, sharing openly their data, as well as the misuse of research data.

The study showed that the most consumed services offered by academic and scientific libraries are related to archiving publications in OA repositories, assistance in creating personal profiles in Google Scholar, ORCiD, Scopus ID and other platforms, participation in various information and training activities on issues related to OS practices.

Although the survey participants benefit from various trainings on OS practices, the need to diversify subjects and training activities was mentioned for the building of certain skills depending on the discipline and professional development for certain stages of the research process.

The analyses of the needs for training and skill building related to OS practices showed that the survey participants requested more information on various services and tools related to OS: technical guidance on how to prepare data for archiving in a publication or open data repository, help in preparing digital materials and open source software for open archiving, support in OA publishing, guidance on copyright issues, research integrity, public involvement in research, collaboration and networking, data confidentiality, and other topics related to open research practices, etc.

The results of our study show that the majority of respondents consider that "Open Science is an excellent opportunity for science, mostly with benefits".

The results of the stydy confirm our hypotheses about the existence of certain limits in knowing the phenomenon and the willingness to accept OS. Solving the identified problems will require correcting institutional strategies, more actively promoting training and guidance materials, and paying more attention to individual and practical consultations.

The new models of scientific communication will improve the access to data and information, will ensure the efficient use of digital content in the future, will contribute to the quality of academic research through the development of digital culture in the field of research.

Acknowledgments

This work was supported by the grant from the National Agency for Research and Development of the Republic of Moldova 21.70105.40ȘD 'Boosting engagement of the Republic of Moldova in Open Science: methodological and applied support'.

Contribution of authors: Nelly Țurcan – project administration, conceptualization, literature review, methodology, data curation, supervision, writing – original draf, concluding part of the article; Gheorghe Cuciureanu – conceptualization, literature review, writing – review & editing; Rodica Cujba – data gathering and processing, formal analysis, writing – review & editing, concluding part of the article; Viorica Lupu – data gathering and processing, formal analysis, writing – review & editing; Natalia Cheradi – literature review, formal analysis, writing – review & editing; Igor Cojocaru – methodology, formal analysis, writing – review & editing.

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