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Article

Representation of Women in Slovak Science and Research: An Analysis Based on the CRIS System Data

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Abstract: The article presents an intention to examine the possibilities of processing data on the representation of women in science and research from data collected in Slovakia as part of the Gender Equality Plan. The methodology follows the declared intention and consists of three steps. The first step is the identification of sources of sex-disaggregated data from the field of science and research in the Slovak Republic. Then follows the examination of the state of the art of tracking data in the identified data sources. The analysis of available data and the processing of the results is the next step. The share of women in Slovak science and research is demonstrated by the composition of project teams and by the statistical data of the supplementary statistical survey of research and development potential, which are collected through the national information system for research, development, and innovation, named SK CRIS. The result is a detailed analysis of the position of women in Slovak science and research, classified by research area and academic career stage. Based on the research conducted and the results achieved, we underline the importance of building national information systems in science and research. Data from these systems can significantly contribute to the creation and parameterization of science policy, including the principles of gender equality.

Keywords: gender equality; women in science; women in research; gender data; data analysis; current research information system; SKCRIS; Slovakia

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1. Introduction

The achievement of gender equality is one of the main goals of building the new European Research Area (ERA). In the 2006–2010 Roadmap for equality between women and men [1], the European Commission sets the achievement of gender equality in science and research as an important objective. At the same time, it becomes a cross-cutting priority of the 2030 Agenda for Sustainable Development. [2] The European Commission's strategy for gender equality between women and men for the period 2020–2025 [3] defines the vision, political goals and measures to achieve concrete progress in the field of gender equality, and to achieve the goals of sustainable development.

As an EU member country, Slovakia follows European science policies and strategic documents, such as the Pact for Research and Innovation [4] and the Communication of the Committee of the European Commission and the Committee of Regions [5] and dedicates systematic efforts to achieving the goals of the European Research Area. The Slovak Republic is one of the signatory countries of the Declaration of Gender Equality in Research and Innovation in Ljubljana [6], which aims to overcome existing gender inequalities and support fair and inclusive policies in the field of research and innovation.

The Slovak Centre for Scientific and Technical Information (CVTI SR), as the national information center for science, technology, innovation, and education in the Slovak Republic, fully supports the Ljubljana declaration and is committed to contributing to incorporate the perspective of gender equality into the content of science, research and innovation.

The intention of creating a plan for gender equality at the CVTI SR institutional level [7] was the starting point for the analysis of the research and development (R&D) environment from the perspective of gender equality. The task primarily resulted from the political request of the European Commission in relation to the Horizon Europe program. The gender equality plan has become a criterion for eligibility to finance successful project proposals since 1 January 2022. CVTI SR is a host institution of the Slovak National Contact Points for the European Commission's framework program for research and innovation, Horizon Europe. National Contact Points are the main support structure for Horizon Europe on national level. Their role is to provide advice, practical information, and assistance to potential applicants and beneficiaries on all aspects of participation in the Horizon Europe.

Since September 2021, CVTI SR has provided professional consulting support in the elaboration and implementation of gender equality plans for Slovak scientific and research institutions and Horizon Europe applicants.

One of the main goals of the CVTI SR gender equality plan is to contribute to the promotion of gender equality in science and research in Slovakia. In order to reach this goal, we focused primarily on the usage of available data in research information databases that could be consequently used to map the initial state of the Slovak R&D ecosystem. According to this objective, the article is not focused on all objectives of concept of gender equality in science and research. We focused on reaching a sex-balanced representation of women in all fields and at all hierarchical levels. We oriented on data collected and presented separately on men and women, which means sex-disaggregated data [8]. Data or statistics that go beyond simply disaggregating data according to sex in Slovakia are not available.

The article presents the intention to examine the possibilities of processing data on the representation of women in science and research from data collected in Slovakia. The share of women in Slovak science and research is demonstrated by the composition of project teams, and on the statistical data of the supplementary statistical survey of research and development potential, which are collected through the nationwide information system for research, development and innovation, named SK CRIS. The result is a detailed analysis of the position of women in Slovak science and research, by research area and by academic career stage.

2. Materials and Methods

The issue of gender equality, including the support of gender equality in science, research, and innovation, has been developed in many scientific disciplines for several decades. Philosophy, psychology, and sociology pose questions about what gender (in)equality is, how it manifests itself, what its consequences are, and especially how to minimize or eliminate it [9–11].

We define gender equality as 'Equality between women and men (gender equality)': this refers to the equal rights, responsibilities, and opportunities of women and men and girls and boys. Equality does not mean that women and men will become the same, but that women's rights, responsibilities, and opportunities will not depend on whether they are born male or female. Gender equality implies that the interests, needs, and priorities of both women and men are taken into consideration, recognizing the diversity of distinct groups of women and men. Gender equality is not a women's issue but should fully involve men and women. The equality between women and men is understood both as a human rights issue and as a prerequisite and indicator of sustainable people-centered development [9].

In this article, gender equality is not considered a social construct, but it means the equality of women and men (sex equality). The reason for the simplification is that Slovak legislation recognizes two sexes, man and woman. The term gender is in Slovak language mostly used in the sense of origin, lineage. According to this, the available data do not take into account gender as a social construct, but only as a sex. Our data, analyzed in the same way, refer to women and men. So, when speaking about the Slovak ecosystem in the European context, we use the term "sex/gender data".

Gender equality is characterized by an intersectional aspect, and it is considered a multidimensional phenomenon. The link between human values and gender equality is the subject of extensive research. Previous research has built on this multidimensionality and explored the relative importance of human values varied through the different dimensions of the gender equality index (GEI), namely work, money, knowledge, time power, and health [10].

In the field of science and research, gender (better sex) equality issues are reflected, especially in equal opportunities. Despite decades of research and intervention, female scientists receive fewer opportunities and less recognition than their male counterparts, and women are less likely than men to occupy leadership roles or to work in fields where mathematics is intensive, such as physics and engineering [11]. Of course, we take into account that it is not possible to reduce this equality to equal opportunities. Finally, the European concept of gender equality in science and research addresses broader objectives, concerning gender balance on all levels and all fields, structural change to support women career, the integration of the gender dimension in the content of research, teaching and innovation, and of course general requirements of gender equality for society.

The goal is, for example, to achieve equal remuneration for men and women in comparable positions. The proportion of female managers should correspond to the proportion of female students. A 50% share of women should be achieved at all levels from studies to scientific positions, in all scientific disciplines, including those historically categorized as "male". Another requirement is an objective assessment of individual professional performance, regardless of gender. A further aspect to be emphasized is a positive link between parenthood and scientific career: decision to build a scientific career should not be negatively influenced by parenthood, and conversely, the choice to become a parent should not be negatively influenced by a scientific career, which applies to both sexes. Based on this fact, there is an intention to ensure that women and men dedicate the same amount of time to childcare and housework [11].

The matter of the position of women in science and research is extremely current and is investigated globally across several scientific disciplines, as evidenced by several notable scientific events. One of them was the International Congress "The Biochemistry Global Summit Lisboa 2022" in Portugal (https://2022Congress.FEBS-IUBMB-PABMB.org, accessed on 8 August 2022), organized in cooperation with international biochemical societies within the IUBMB (The International Union of Biochemistry and Molecular Biology) and FEBS (The Federation of European Biochemical Societies) and PABMB (The Pan-American Association for Biochemistry and Molecular Biology). The special section "FEBS Special Session on Gender Issue in Science" featured lectures on current topics: "Woman and leader: to be or not to be"; "Being a Woman in Science in the 20th Century and Beyond"; "Women in Science: What is the problem?' Is the situation changing?"; and "Gender and Science in Brazil". The main goal of the discussed topics was not only to arouse interest in the issue of equal opportunities, especially in the sectors of science, research, and education in the Life Science area, but also to provide a realistic picture of the current state of women in these sectors inside and outside the EU.

European scientific teams make an effort to include their research findings in national and European policies. However, this process seems to be problematic. A 2014 study found resistance to gender equality initiatives in EU research policy within the Directorate General for Research and Innovation and concluded that there are barriers to effective gender mainstreaming [12].

Mapping the ecosystem and ascertaining the current situation is necessary for formulating any strategy or policy proposal. We primarily intend to initiate an effective process, analyze, and evaluate relevant data. However, it should be emphasized that the data analysis is only the first step. "Calculating the share of women and men in the subject area (which is currently the most widespread) is not sufficient. This approach enables us to identify the issue (e.g., lower representation of women in science), to describe its current state, but it is not possible to identify the origin of this obstacle, how the current state has developed, what factors have conditioned it, and to identify its wider social context and impact." [13].

Data on sex/gender equality and sex/gender-relevant data have been collected for several decades. Gender equality statistics from the 1990s [14] revealed the following facts:

- Women represent about 50% of first-degree students in many countries of the world;
- The percentage of female full professors was exceptionally low worldwide: mostly below 15%, and with a slow increase in the proportion of female professors;
- There are significant differences in the proportion of female students in scientific disciplines;
- Women tend to disappear from academic life, even before they get jobs in R&D;
- The higher the position in the institutional hierarchy, the lower the percentage of women;
- Men are appointed to academic positions to a greater extent compared to female candidates.

According to the 2017 Elsevier [15] report on gender equality—the world leader in the field of data collection of publications—women represent 40% of research capacities in various fields of science and technology but constitute only 20% of all researchers in the fields of energy, engineering, mathematics, physics, and astronomy. Women publish their work [15] or collaborate internationally less than men and are underrepresented among inventors [16]. Similarly, there are gender differences in technology transfer and commercialization. More men than women publish and patent their ideas and research despite an increase in female representatives in universities in recent years [17].

Several studies and surveys have been conducted in this area on a national level in several countries. They concern gender equality in the academic environment (Sweden [18]) and in science (Spain [19], Lithuania [20], and Portugal [21]). Although the Spanish study concerned science in general, in Lithuania, they focused on the selected field of information science. Using data from Portugal [20], Elsevier illustrated the gender representation of male and female authors in publishing activities.

Currently, the She Figures yearbook [15] can serve as a data source on gender aspects of science in Slovakia. It processes basic statistical data based on EUROSTAT data. These are, for example, data on the share of women in the number of doctoral students, the number of workers in general, and various scientific disciplines and sectors of the national economy, including the academic sector. EUROSTAT data come from surveys by the Slovak Republic Statistical Office. The office publishes a table on the indicators of equality between women and men in science and technology with the number and share of women and men in science and research in general and by level of education for individual years [22].

The She Figures yearbook also contains gender data on publishing based on Scopus data realized by Elsevier and gender data on innovation activities based on PATSTAT data and selected data on women's grant success.

We observe that due to its broad and general character, the yearbook provides only a basic overview. The reason is the processing of data at the European level, where it is necessary to select indicators that may be comparable to each other regarding the differences in categorizations and data monitoring in individual countries.

Due to this fact, our intention was to examine the possibilities of processing data on the representation of women in science and research in a more detailed manner and based on data collected in Slovakia.

The methodology comes from objective 3.3 of the CVTI SR gender equality plan, which is the examination of options for the collection and publication of sex/gender-disaggregated data on science and research in the Slovak Republic (within the existing data collections of universities and other research institutions). The methodology consists of the following steps:

1 Identification of sources of sex/gender-disaggregated data in the field of science and research at the Slovak level.
2 Determination of the status of tracking sex/gender-disaggregated data in the systems identified in Point 1.
3 Analysis of data and processing of results.

3. Results

3.1. Sources of Gender Data

CVTI SR within its competence manages several national registers processing data on science and research and provides the technical support to R&D institutions.

The first of the registers is the Central Repository of Theses and Dissertations [23]. This register has been in operation since 2009, when an amendment to the Higher Education Act was adopted, making the usage of this register mandatory for Slovakian universities. It includes the antiplagiarism system for checking the originality of the final theses (bachelor, diploma, and dissertation) and qualification (rigorous and habilitation) theses deposited in the register. An annual increase in the repository is approximately 80 thousand items of bachelor's, master's, dissertation, and habilitation theses [24].

The second is the Central Register of Publication Activity [25] of the Slovak Universities. The Central Register of Publication Activities (CREPČ) and the Central Register of Artistic Activities (CREUČ) were built as a development project of the Ministry of Education, Science, Research, and Sport of the Slovak Republic in 2007–2008. The aim of the registers is a comprehensive automated registration of publishing and artistic activities and the creation of a unique information source for the professional and wide public. The data from the registers help the ministry in the process of allocating public funds to the state and public universities [26].

The third of the registers is the research, development, and innovation information system (SK CRIS) [27], which ensures the collection, processing, provision, and use of data on research, development, and innovation supported by public sources. SK CRIS contains a national registry of R&D projects, a registry of researchers, and a registry of R&D organizations as well as information on research results and the laboratory infrastructure. The system has been in operation since 2013 [28].

3.2. Status of the Gender Data Tracking

In our study, we investigated whether and in what way it is possible to obtain sex/gender data from the previously identified systems. The process consisted of analysis of the data structures and discussions of the procedures and processes of data acquisition, standards, and legislation used by these systems.

While investigating sex/gender data tracking in information systems that support science, we encountered a problem with the implementation of legislation regarding the protection of personal data, since these data are part of personal data. Act 18/2018 Coll. On the protection of personal data, Ref. [29] defines the principle that personal data may only be obtained for a specifically determined, explicitly stated, and authorized purpose and may not be further processed in a manner that is incompatible with this purpose. In principle, unless another specific law requires the recording of precisely specified personal data, these data can only be collected with the consent of a specific person. Since 2018, when the legislation on protection of personal data entered into force, the laws governing the collection of data on science and research have therefore been gradually amended in such a way as to exhaustively define the collected personal data.

So far, the collection of sex/gender data has not been required or regulated by any regulation; therefore, it is not tracked in bibliographic databases. However, it should be noted that the tracking of gender data, even in science support systems, is in line with the EU recommendations and is therefore in the public interest. The law [29] says that the processing of personal data is governed by the law if it is necessary to perform a task conducted in the public interest or exercise the public authority entrusted to the operator.

The situation is different when processing data in the SK CRIS information system. In this case, the tracking of sex/gender data has already been permitted by the relevant law [30] since 2022, but the implementation of EU standards, especially the use of the CERIF data format for the field of science information, is essential.

CRIS and CERIF—Standardization for Research Information

Research information management systems are designed to assess research performance and to contribute to the steady improvement of research. These systems, also called current research information systems (CRIS), have been described as software for the aggregation, curation, and utilization of metadata about research activities [31]. The development of current research information systems (CRIS) has a 40-year history. A CRIS typically contains information on projects, persons, organizational units, funding programs, research outputs (products, patents, and publications), facilities and equipment, and events. The Common European Research Information Format (CERIF), the data format for research information, is being adopted quite widely and it encourages interoperation [32].

In particular, the use of the CERIF data format within SK CRIS enabled the collection of gender data in the period before the Personal Data Protection Act came into force. CERIF [33] is recommended by the European Commission and developed on the basis of the international organization for research information, EuroCRIS [34].

The CERIF data format is based on the data model that allows the representation of metadata of research entities, their activities, interconnections, and their results. It enables the processing of research information in adequate quality, and its archiving, access, and mutual exchange. It supports the transfer of knowledge to a wide range of subjects: researchers, managers, creators of research strategies, publishers of scientific publications, media, and the general public.

The CERIF elements have a defined basic structure, semantics, and bindings and are divided into five hierarchically arranged categories.

- Core entities.
- 2nd-level entities.
- Link entities.
- Language-related entities.
- Classification entities—semantic layer.

The format defines four basic entities (modules of the information system):

- Persons: scientists and research experts; personnel database.
- Projects.
- Subjects: research and development organizations, their services, and infrastructure.
- Results: mainly publications, but also patents, products, and events [35].

The CERIF entities and the possibilities of their interconnection can be found in Figure 1.

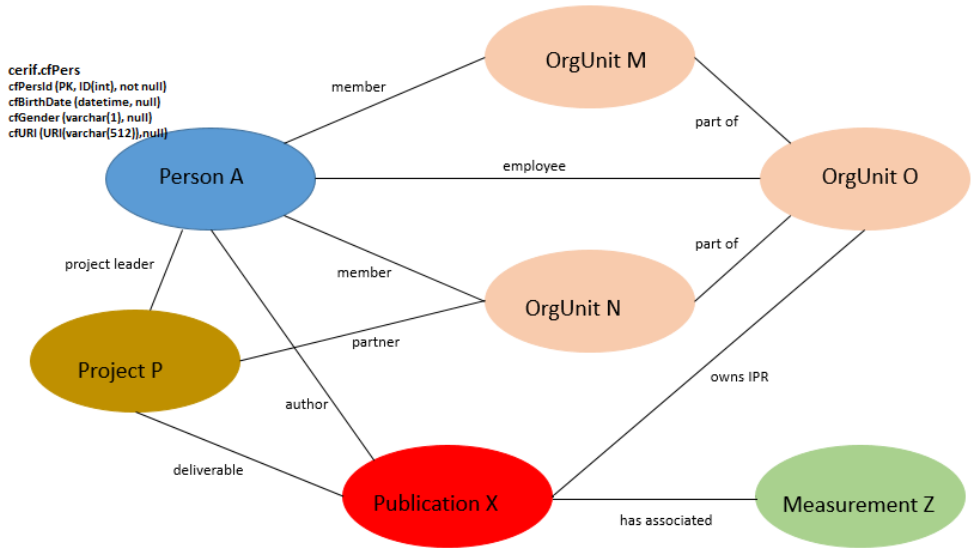

Figure 1. CERIF Objects and their links [36].

The CERIF format within the entity researcher contains a *gender* item, the completion of which is the first prerequisite for the implementation of any analyses related to gender equality. Figure 1 also shows the structure of the researcher's database table in SK CRIS. This table is the main, but not the only table that contains researcher's data. Through the primary key *cfPersId* are connected tables with the name, description of the research activity in text, keywords, classification, and connection tables linking the researcher with other entities.

3.3. Data Analysis and Processing of Results

3.3.1. Record of Gender Data in SK CRIS

From a methodological point of view, it is necessary to mention the method of recording sex disaggregated data in SK CRIS. The SK CRIS information system contains data from more than 36,000 Slovak researchers. The range of data in SK CRIS is illustrated in Figure 2.

Figure 2. Main page of SK CRIS—number of records.

Researchers' data have been continuously coming into the system since the launch of the first version of the system in 2008. If the gender data in the researcher's database record are not available, the data curator can determine the gender based on the structure of the first name and last name in the absolute majority of records. In Slovakia, most women use an inflected surname. When the surname is not inflected (in masculine form), the first name is usually the indicator. Within SK CRIS, we were unable to determine the gender of approximately 30 persons from the 36,000 records mentioned above, which means that it is not a statistically substantial number.

We, therefore, consider it technically possible and desirable in the future to enrich the system with gender data in an analogous way and then to analyze selected data on publication activity. The CREPČ database or Web of Science Core Collection would be

considered. However, it would probably be appropriate to limit the analyzed data by time interval, scientific area, and other necessary metadata to obtain an adequate sample suitable for processing and analysis.

The Ministry of Education, Science, Research and Sport of the Slovak Republic requires also the evidence of research teams, linkage of researchers to projects they are involved in, within the projects register. The demand for gender equality and equal opportunities for all applies to all research teams at all levels [4].

In the analysis, we therefore based the data on the researcher's gender and at the same time on the data on the project research teams. An example of a research project record with the mentioned research team is illustrated in Figure 3. The entities project and researcher are interlinked, and the user interface allows clicking on related records, in this case, from the record of the project to the record of the researcher, a member of the project team.

Project detail

Project name	A pilot study of the selective effects of a new generation of RNA interfering agents at the cellular level
Project code	1/0069/20
Duration	01/01/20 - 12/31/23
Abstract	The proposed project is based on the in-depth understanding of the current scientific and clinical knowledge of chronic myelogenous leukemia (CML) and the therapeutic regimens based on RNA interference. The project aims at a highly ambitious goal: to explore the selective effect of a novel platform of RNA interfering agents at the cellular level in order to evaluate its therapeutic potential for action without side effects that would result from undesired molecular interactions. From this perspective, the project focuses primarily on an extensive study of cellular internalization, inhibition of the formation of fusion BCR-ABL1 protein, selectivity of RNA interfering agents towards the target mRNA and its effect in cells resistant to currently applied therapeutics.
Keywords	antitumor therapy, CML, selectivity, RNA interfering agents, inhibition of translation, TKI-induced resistance
Appeal name	-
Project budget	97725.0 EUR
Specialisation R&D	Medical Sciences / Principal medical sciences and pharmaceutical sciences / Oncology
Character R&D	basic research
prog. type finance src	VEGA - Universities

Researchers | **Organizations** | **Results** | **Infrastructure** | **Documents**

Árpová Anna	Investigator
Bátorová Angelika	Investigator
Drgoňa Ľuboš	Investigator
Hatalová Antónia	Investigator
Mazancová Petra	Investigator

Figure 3. Detail of the project record with the research team.

The SK CRIS information system also includes a module for an additional statistical survey of the R&D potential recommended for organizations that falls into at least one of the following categories:

- It is registered by the Slovak Republic Statistical Office as a research organization.
- They hold a certificate of competence to perform research and development.
- They are registered in the SK CRIS database, primarily because of the implementation of a research project.

These organizations complete an online form that includes items about the number, age, and gender structure of researchers, as well as the fields of science and technology in which the respective organization conducts research.

When examining the possibility of using the results of a statistical survey, it is necessary to consider in particular the return rate (number of organizations completing the questionnaire) and the quality of the completed data. The return rate of questionnaires is not high, only about 20–30%. Moreover, many research organizations reply that they did not conduct research in the monitored year. Insufficient data quality is also a challenge in some cases. The form contains tools to formally verify the completeness of the form, for example, checksums for tables with the number of employees broken down by age, sex, and subject. However, the formally correct data that seem to be unrealistic are then identified in the control reports. The concrete example is in the tables with data on personal capacities, where very often the reported staff does not correspond to the size of the respondent's organization.

The assumption is that the data from the project teams are more accurate than the statistical data. These data are obtained directly from the systems of the Slovak grant agencies, and before importing through the Web services API, they must undergo substantive validation by the grant agencies. Within the API interface, automatic matching of a member of the research team from the grant agency's system to a researcher registered in the SK CRIS researcher register is also implemented. Data not matched by the system are subsequently manually checked and matched.

In the case of projects submitted by research organizations, data on project teams are usually less complete. They regard international cooperation projects, projects financed from EU structural funds, as well as departmental subsidies from ministries, and various forms of bilateral projects. However, the data on the responsible project investigator or the Slovakian coordinator in international teams are registered in the database or added within the validation of the system data by the operator (CVTI SR).

3.3.2. Data Processing and Results

For the analysis of gender equality in science and research, we used the sample *Projects solved in 2020*. The status of the SK CRIS database is as of 31 May 2022. The data have been continuously updated and may change over time.

In 2020, 4148 projects were implemented. This means that these projects started in 2020 or earlier. At the same time, these projects were completed in 2020 or later. Most of this number were projects financed by the Slovak national grant agencies: APVV (Slovak Research and Development Agency), VEGA (Scientific Grant Agency), and KEGA (Slovak Grant Agency for Culture and Education), which provide the most complete data records on project teams. The database also contains records of EU structural funds projects and international projects, where usually only information on the responsible investigator or guarantors of the activities is available. However, in some cases, no information on the project team was provided.

Data analysis revealed that 13,262 researchers participated in the above-mentioned collection of projects and participated in project teams 28,171 times. On average, one researcher participated in the solution of 2.12 projects.

If we consider each researcher involved in at least one project as a natural person in the mentioned period, and we count him exactly once (regardless of the number of

implemented projects), then the results show a slight predominance of men (52.74%) in the number of compositions of research teams (Table 1):

Table 1. Researchers involved in project implementation.

Number of Researchers	Out of This Women	Percentage Share	Out of This Men	Percentage Share
13,262	6261	47.21%	6994	52.74%

Source: The SKCRIS database.

However, if we consider the fact that several researchers were involved in the solution of more than one project, the ratio of representation of men and women changes to some extent. The number of participants in the project teams indicates that men participated in more projects than women in the monitored period, and the share of men increased by 1.63% (Table 2).

Table 2. Number of researchers participating in project teams.

Number of Participation	Out of This Women	Percentage Share	Out of This Men	Percentage Share
28,171	12,855	45.63%	15,316	54.37%

Source: The SKCRIS database.

In this point, we would like to compare data from project teams with data from the SK CRIS register of researchers. Researchers from the higher education sector, the Slovak Academy of Sciences, and state and business research organizations are continuously registered in this register. The system currently contains more than 36,000 records of persons collected since the start of the system's operation.

It can be concluded that the ratio of representation of women and men in the register (Table 3) roughly corresponds to the results of Table 1, that is, participation in the projects without considering the fact of how many projects the researcher solved in the monitored period.

Table 3. Researchers in the researcher registry.

Number of Researchers	Out of This Women	Percentage Share	Out of This Men	Percentage Share
35,926	17,106	47.61%	18,820	52.39%

Source: The SKCRIS database.

Table 4 shows the ratio of women and men in project teams according to the basic groups of science and technology fields according to the FRASCATI manual or Directive No. 27/2006-R [37] on the system of science and technology fields. The groups are the following: natural sciences (NatSci), engineering and technology (EngTech), medical and health sciences (MedSci), agriculture and veterinary sciences (AgriSci), social sciences (SocSci) and humanities and arts (HumArt). It shows that women are the least involved in engineering scientific projects (32.45% of women) and are the most involved in project teams within the medical sciences (62.16%), social sciences (56.98%) and agricultural sciences (52.03%), where there is an overwhelming majority of women.

The number of researchers involved in the projects divided into science and technology groups (15,636 persons) is higher than the number of researchers involved in the solution of the projects in Table 1 (13,262 persons). The reason is that one researcher could be involved in more projects belonging to different groups of science and technology fields, and therefore can be included in the table more than once.

Table 4. Number of researchers in project teams by gender and groups of science and technology fields.

Group of Sciences	Number of Projects	Number of Researchers	Out of This Women	Percentage Share	Out of This Men	Percentage Share
NatSci	942	3634	1690	46.51%	1944	53.49%
EngTech	1003	4028	1307	32.45%	2721	67.55%
MedSci	429	1752	1089	62.16%	663	37.84%
AgriSci	318	1451	755	52.03%	696	47.97%
SocSci	729	3280	1869	56.98%	1411	43.02%
HumArt	419	1491	735	49.30%	756	50.70%
Not listed	308					
Total	4148	15,636	7445		8191	

Source: The SKCRIS database.

Regarding the age structure of the project teams, these data are currently not available in the SK CRIS system. Although the date of birth item is in the data format, its mandatory completion is not currently required by law. Therefore, in accordance with GDPR rules, we do not systematically monitor it.

The age and gender structure of the researchers is monitored in the framework of the additional statistical survey on R&D potential. We used data for 2020 as our sample.

For 2020 [38], 523 research and development organizations completed questionnaires: universities, SAS institutes, public organizations, non-profit organizations, and business entities. Data collected on research and development capacities are aggregated in Table 5. The table does not include data on the number of researchers with a master's degree (only higher).

The table shows that the share of women in the total number of researchers (columns A and G) is about 45% (44.94%). Among doctoral students (columns B and H), the proportion of women is more than half (50.93%).

Women represent 46.79% of researchers with the third level of higher education under the age of 35 years and 47.52% of researchers with the third level of higher education over the age of 35. An even more significant result against women is obtained when we calculate the share of female associate professors in the total number of associate professors (39.34%) and the share of female professors in the total number of professors (27.42%).

Table 5 is followed by Table 6, which presents the structure of research and development capacities according to the basic groups of the science and technology fields. The comparison (columns A and G) shows that the largest share of women work in medical sciences (56%) and the smallest share in technical sciences (28.12%). More than half of women also work in the field of social sciences (53.23%) and agricultural sciences (51.25%).

The percentages of women by discipline group are summarized in Table 7.

When we compare the percentage of women in project teams in Table 4 with the percentage of female researchers according to the additional statistical survey in Table 7, we find that there is a higher proportion of women in project teams than the statistics indicate. The positive difference in favor of project teams is mostly in the medical and natural sciences, about 6%. The only exception is in the humanities, where the share of women is practically the same in both methods of analysis.

However, we identify the majority of women in the same groups of scientific disciplines, regardless of whether they belong to project teams or are covered by statistical data.

Table 5. Structure of research and development capacities for the year 2020 *.

A	B	C	D	E	F	G	H	I	J	K	L
Total in SR	**Ph.D. Student**	**Ph.D. under 35**	**Ph.D. over 35**	**Associate Professors**	**Professors**	**Of This Women**	**Ph.D. Stud. Women**	**Ph.D. Women under 35**	**Ph.D. Women over 35**	**Assoc. Prof. Women**	**Women Professors**
18,719	3860	2417	7647	3081	1714	8413	1966	1131	3634	1212	470

* Correction compared to the published output report based on an additional data check. Source: [38].

Table 6. Structure of research and development capacities by groups of science and technology fields 2020 *.

Statist.	**A**	**B**	**C**	**D**	**E**	**F**	**G**		**H**		**I**		**J**		**K**		**L**	
Survey Year 2020	**Total SR All**	**Ph.D. Students**	**Ph.D. under 35**	**Ph.D. over 35**	**Associate Prof.**	**Professors**	**Of This Women**	**%**	**Women—Ph.D. Students**	**%**	**Ph.D. under 35**	**%**	**Women Ph.D. over 35**	**%**	**Women Assoc. Prof.**	**%**	**Women Professors**	**%**
NatSci	3433	899	377	1502	402	253	1396	40.66	482	53.62	169	44.83	590	39.28	105	26.12	50	19.76
EngTech	4484	959	644	1626	823	432	1261	28.12	253	26.38	168	26.09	529	32.53	237	28.80	74	17.13
MedSci	3584	626	531	1636	484	307	2007	56.00	422	67.41	333	62.71	924	56.48	225	46.49	103	33.55
AgriSci	960	163	132	431	139	95	492	51.25	109	66.87	70	53.03	228	52.90	59	42.45	26	27.37
SocSci	4302	854	532	1609	878	429	2290	53.23	497	58.20	281	52.82	932	57.92	426	48.52	154	35.90
HumArt	1956	359	201	843	355	198	967	49.44	203	56.55	110	54.73	431	51.13	160	45.07	63	31.82
Total	18,719	3860	2417	7647	3081	1714	8413	44.94	1966	50.93	1131	46.79	3634	47.52	1212	39.34	470	27.42

* Correction compared to the published output report based on an additional data check. Source: [38].

Table 7. Structure of R&D capacities by S&T discipline groups 2020, percentage of women *.

Group of Sciences	**All Researchers**	**Of This Women**	**Percentage of Women by Science Group (%)**	**Percentage of Women in Projects from Table 4 (%)**
NatSci	3433	1396	40.66	46.51
EngTech	4484	1261	28.12	32.45
MedSci	3584	2007	56.00	62.16
AgriSci	960	492	51.25	52.03
SocSci	4302	2290	53.23	56.98
HumArt	1956	967	49.44	49.30
Total	18,719	8413	44.94	

* Correction compared to the published output report based on an additional data check. Source: [38].

4. Discussion

During the conduct of the analysis, we encountered certain limitations. Firstly, gender in this article is not understood as a social construct but, following Slovak legislation, as a biological sex.

Further limitations result from the available data. We focused on the share of women in Slovak science and research, following the objective to reach a gender-balanced representation of women in all fields and at all hierarchical levels.

The limitation is related also to the quality and completeness of the SK CRIS data. We expected the data on the composition of project teams to be more accurate than the statistical data. This is the case, at least in the projects financed by Slovak grant agencies, where verified data are entered into the system. However, for other types of projects, we miss complete data on research teams. Data on these projects are entered by research organizations, and their validation is part of the quality control and data management process. As part of this process, data are often added for projects for which investigators have not entered information. For such projects, usually, only information on the responsible investigator or activity guarantors is available. However, there are also cases of projects where there is no information on the project team.

The challenge is also to set parameters for the analysis of gender data by discipline. The breakdown into the six basic groups of disciplines showed to be likely insufficient, as it is only the first most generally defined level. For next analyses, we recommend also to implement the second level categorization (i.e., for example, natural sciences—mathematical sciences). In the current study, we were restricted to work only with the first level because researchers do not have the option of specifying more than one (dominant) specialization. The same applies to projects. However, we admit that many interdisciplinary specialisms would hardly take such data processing into account. This is the case for projects whose multidisciplinary nature is even more expressive than the multidisciplinary specialization of a single person. Moreover, the composition of the project team may also be multidisciplinary. For instance, a project performed in biological sciences may also include a mathematician, and here we lose the evidence of such involvement. Therefore, a higher precision in identifying the scientific discipline of the project could distort the result of the analysis.

Finally, various limitations can be expected for publication of the database data, even if we state the gender of all authors. The Central Register of Publications does not record all types of research results for the whole Slovak R&D institutions, but only for universities. Similarly, the bibliographic databases do not contain a breakdown of publications according to the six basic groups of fields of science and technology.

5. Conclusions

We analyze sex/gender data on researchers and their project activities from the SK CRIS Research, Development, and Innovation Information System for the year 2020. We compared the results with statistical data for the same year, also collected through SK CRIS. Data for 2021 will be completely collected and verified at the end of 2022.

First, it can be stated that the use of the information system in science and research for the purpose of collecting, storing, publishing, and analytical processing of gender data has proved its worth. Other findings relate to women's participation in science and research, not only in general, but also by scientific discipline. Regarding women's participation overall, we find a gender balance, with women reaching between 45% and 47% of the number of researchers, with figures varying according to the type of analysis carried out. In comparison, the Slovak Republic Statistics Office in 2020 narrowly identified an underrepresentation of women among R&D employees, by only 39% [22].

In the analysis carried out, the highest proportion of women was identified in medical sciences (62% of women in project teams), with a supermajority of women also working in social and agricultural sciences. The significantly lowest proportion of women was in the engineering and technical sciences. We also found vertical segregation of women, the

so-called scissor plot of a typical academic/scientific career, which does not change much over the years [39]. Although a relative gender balance can be observed at the doctoral and assistant professor levels, the share of female associate and full professors in the total number of associate and full professors is already significantly lower.

The analysis made visible the degree of women representation in the ecosystem of science, technology, research and innovation in Slovakia. The identified shortcomings in the involvement of women in science and research correlate with findings in other European countries.

The results show that there is merit in carrying out analyses on an annual basis. Therefore, we plan to analyze these data annually at least to the extent outlined in the paper and to track trends on a time series basis.

In the future, we intend to develop and test a data processing algorithm that would be able to assess women's participation also at the second level of categorization of disciplines. We also plan to process and analyze sex/gender data on publication activity.

Last but not least, we do not consider our institutional gender equality plan to be a static document. We plan its development in accordance with the European concept of gender equality in science and research.

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