Original Research Paper

The first global landscape analysis of multiple sclerosis research funding

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Abstract

Introduction: Multiple sclerosis (MS) is an immune-mediated central nervous system disorder and a growing global health challenge affecting nearly 3 million people worldwide. Incidence and prevalence continue to increase with no known cause or cure. Globally governments and non-profit organizations fund research toward better understanding of and treatments for multiple sclerosis.

Methods: This study identified MS research projects funded between 2021 and 2023 by government and non-profit organization sources. Projects were described by type of scientific approach, Pathways to Cure research category (i.e. Stop, Restore, End), and other key characteristics.

Results: Over 2,300 MS research projects were identified through 16 non-profit MS organizations and 18 government databases. The overall global portfolio of these projects is valued at nearly one and a half billion Euros. The majority of projects were classified in the Stop category (60%). Research collaboration occurs in many forms among the research community; around 272 projects were reported to be co-funded.

Conclusion: Global MS research collaboration will accelerate progress toward increased knowledge, effective treatments, improved health outcomes, and ultimately cures for MS. This landscape analysis highlights the current distribution of MS research investment between topics and begins to suggest where the MS community should focus to increase potential impact for current and future endeavors.

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Introduction

Multiple sclerosis (MS) is an immune-mediated central nervous system disorder and growing global health challenge affecting nearly 3 million people worldwide.[1] In every world region, the incidence and prevalence of MS have been reported to be increasing.[2] While effective disease-modifying treatments for some forms of disease exist, we still don't fully understand the complex causal pathways leading to MS.[3]

Accelerating the development of research breakthroughs leading to MS cures will require strategic investments in areas of high opportunity and increased international collaboration.[1] The 2024 Pathways to Cures Roadmap[1] includes carefully considered recommendations from leaders in MS research and clinical care, as well as people affected by Multiple Sclerosis. The Roadmap[1] describes three MS research pathways: (1) stopping the MS disease process, (2) restoring lost function by reversing damage and symptoms, and (3) ending MS through prevention. These overlapping categories describe where future global research needs to focus in order to achieve MS cures and serves as a guide to coordinate and optimize research investments. Progress toward better coordination can be demonstrated by global initiatives within the MS community including the International Progressive MS Alliance[4] and the global PROMS Initiative.[5] More recently, leading MS organizations representing Australia, Canada, Denmark, France, Germany, Italy, Spain, United Kingdom, the United States as well as the MS International Federation, made a declaration of commitments to a global research strategy to cure MS.[6]

To achieve the global coordination of resources required to accelerate progress on Pathways to Cures, a first step is to have a thorough understanding of current research investment in the three Pathways research focus areas.[1] This study describes the first comprehensive assessment of multiple funding sources of MS research across the world. Analysis of funding patterns will allow researchers and funders to better align resources to areas of high opportunity for accelerating progress toward MS cures. This study aimed to identify trends, gaps and opportunities for collaboration among worldwide government and non-profit organizations in the global MS movement.

Methods

Data for this global MS research landscape analysis was captured in two phases: (1) non-government- and (2) government-funded research. This study followed an investigator-designed protocol that was reviewed and approved by the Global Strategy Scientific Leadership group, made up of scientific staff leadership from MS advocacy organizations. As this study was a systematic review, it did not require an ethical board approval or written informed consent.

For the first phase, funding by non-profit organizations was collected through an online survey and follow-up document (included in supplemental information). The initial survey was sent to individuals representing 55 MS organizations from 45 countries. Through survey responses, and snowball sampling, an additional 14 organizations were identified and asked to complete the survey. Of these organizations, 20 indicated they have an MS research portfolio which includes either research grants ($n=15$), research centers of excellence ($n=6$), medical training programs ($n=7$) or scientific training programs ($n=10$). Organizations with an MS research portfolio were provided a follow-up data collection tool. This tool gathered information about each funded research project that was active during 2021, 2022, and/or 2023. A 3-year time period was selected to allow for a larger representation than a single year. In addition, this time period was selected as the most recent 3-year period with complete funding awarded. The data tool collected information such as project title and abstract, amount of funding (single- or multi-year total), length of project, and location of research. Sixteen (80%) of the 20 organizations with an MS research portfolio completed the follow-up data collection tool.

For the second phase, available online government databases and other public information sources were mined to gather government research funding information. Government-funded MS projects in 73 countries and multi-national entities were searched. To identify MS projects, researchers identified government websites, reviewed published literature, and asked survey respondents for recommendations. Public databases were searched between August and November 2023 using the following search terms (Multiple Sclerosis or Autoimmune disease of the nervous system or Myelin or nervous system disease or axon or EAE). We used the tagged NIH reporter database[7] MS research, condition and disease categories, and received data directly from the United State Department of Defense[8] MS research program. Two members of the research team extracted information from the online databases to complete the data collection tool developed for this project.

Projects were eligible to be included in research portfolios if they were funded by either a non-government or government agency. Pharmaceutical company-funded projects were excluded. While eligible projects may begin prior to 2021 and conclude after 2023, at least part of the research must have taken place in 2021, 2022, and/or 2023. Projects could include research grants, research resources (e.g. biorepositories), fellowships, or workforce training programs. To be included, research must focus on MS or have a direct implication for MS. Projects with MS keywords, but focused on other diseases (e.g. Parkinson's), were excluded.

Duplicates and projects not meeting inclusion criteria were removed. All identified research projects active between 2021 and 2023 were assigned a Pathways to Cures[1] category (e.g. Stopping MS, Restoring Function, and Ending by prevention) as well as a scientific approach (e.g. clinical, translational, and fundamental). A second researcher validated a sample of category assignments. An independent adjudicator resolved discrepancies; interrater reliability was greater than 80%. Funding amounts were provided in local currency and converted to Euros using the 2 January 2023, foreign exchange rate.[9] Descriptive statistics were used to describe the global MS research funding landscape.

Results

Overall, 28 (41%) non-profit MS organizations completed the online survey. The organizations responding to the survey were more likely to be from the Americas, Europe, and the Western Pacific. These organizations also were more likely, than non-responders, to endorse the Global Research Strategy

Table 1. Pathways to cures category.

	Non-government		Government		Overall	
	# of projects	Value (€)	# of projects	Value (€)	# of projects	Value (€)
Stop	721	207,462,645	676	755,618,569	1397	963,081,214
Restore	466	141,222,024	259	184,389,378	725	325,611,402
End	97	21,929,980	100	63,027,512	197	84,957,492
Research Resource	21	8,812,870	6	12,002,218	27	20,815,088
Total	1305	379,427,519	1041	1,015,037,677	2346	1,394,465,196

Framework.[6] Based on Internet searches, the researchers do not believe there are significant MS research investments made by the non-responsive organizations. Furthermore, it is believed that the reporting organizations account for the vast majority of global non-profit MS funded research. Researchers found government-funded research portfolios in eighteen (25%) countries/entities. Several countries were identified as having research taking place in the country, but not funded by the country, and/or had research outside of the scope of this analysis. (e.g. non-MS specific studies, studies prior to 2021).

A total of 2346 MS research projects were identified through 16 non-profit MS organizations and 18 government databases. The global portfolio of research projects is valued at nearly one and a half billion Euros and represents all three Pathways to Cures[1] categories. The majority ($n=1397$, 60%) of projects were classified in the Stop category, followed by Restore ($n=725$, 31%) and End ($n=197$, 8%). A small number of projects ($n=27$, 1%) were described as research resources, projects that supported the research enterprise (e.g. biorepositories and registries). Table 1 provides further breakdown of the proportion of projects and funding amounts by Pathways to Cures[1] categories.

Following the development of a guidebook, researchers classified projects as either clinical, translational, or fundamental research based on project descriptions. Fundamental research projects are those focused on establishing and/or refining scientific theories for a better understanding and prediction of natural phenomena (e.g. rodent cell culture/models). Translational research aims at applying results from fundamental research into results that may directly benefit humans (e.g. human subject studies). Clinical research determines the safety and effectiveness of medications, devices and treatments for human use (e.g. clinical trials). In the non-government research portfolio, the largest proportion of projects used a clinical scientific approach ($n=483$, 37%) as compared to translational ($n=391$, 30%) and fundamental ($n=380$, 29%). Of the government research portfolios, a similar proportion of projects were translational ($n=363$, 35%) and fundamental ($n=379$, 36%), with a smaller proportion ($n=299$, 29%) of clinical projects. (Figure 1)

Collaboration takes place in many forms among the MS research community. Data indicate projects may have multiple funders, multiple research sites within and among countries, or be funded by a country to take place in a different country. Two-hundred seventy-two (12%) projects, a 333,543,424 Euro value, were reported to be co-funded. The majority ($n=185$, 68%) of co-funded projects were funded by non-government organizations. Recipients of MS research funding included academic institutions ($n=1960$, 84%), non-profit organizations ($n=129$, 5%), academic hospitals ($n=64$, 3%), research institutions ($n=48$, 2%), for-profit organizations ($n=33$, 1%), and other unknown entities ($n=112$, 5%).

Project length was available for 94% of projects. Government projects were most likely to last more than 4 years ($n=415$, 40%), while the non-government projects were most likely to last between 2 and 3 years ($n=350$, 27%). There were no significant differences in length of project by Pathways to Cure category ($p>0.05$).

Additional MS-related funding information was provided by several non-governmental organizations. Of the 28 organizations responding to the online survey, nearly half (48%) hold or support an MS patient registry, 22% support a biobank, and 19% support genomic data. While not all of the responding organizations provide MS research grants, nearly all do provide MS-related funding, such as programs for people with MS (59%) and services for people with MS (59%). Examples of programs for people with MS include support groups and educational activities.[10]
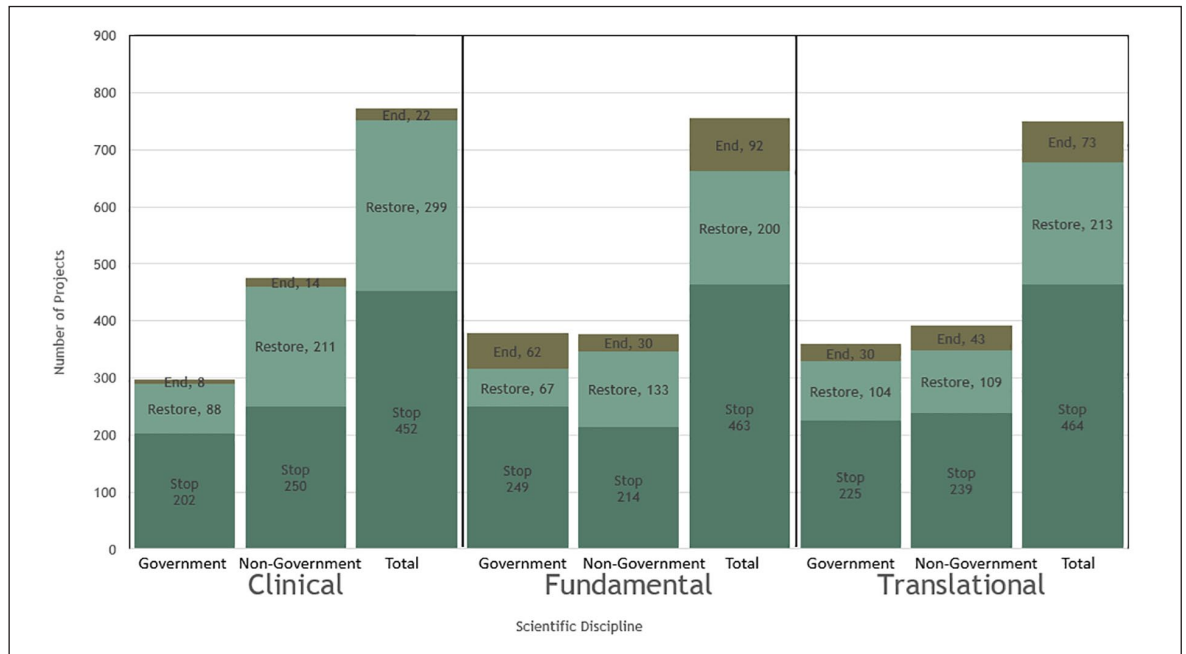
Figure 1. Scientific approach by pathways to cures category and portfolio.

Example services for people with MS include rehabilitation, travel and other assistance activities.[10]

Conclusion

Enhanced global MS research collaboration will accelerate progress toward knowledge, treatments, improved health outcomes, and cures for people with MS. Further transparency of funded research projects will allow for greater coordination between organizations, reducing unnecessary duplication and increasing the impact of research investment. This landscape analysis highlights the current distribution of MS research investment between topics and begins to suggest where the MS community should focus to increase potential impact for current and future endeavors.

The combined 3-year global commitment to MS research is valued at nearly one and a half billion Euros; nearly 500,000 Euros per one thousand people living with MS. Global research investments have enabled multiple therapies and greater disease understanding, but there is still much to learn and develop. Investments to this point have increased the global capacity and ability to make discoveries. The research and workforce infrastructure has been established so breakthroughs can now be made. We are at a critical juncture where increased funding can lead to faster developments and findings.

The largest proportion of projects is focused on advancing the Stop pathway. These projects aim to

detect MS early to achieve a state of no new disease activity or worsening of daily living for the person living with MS. Projects aligned with the Stop pathway may yield detection of the disease in a pre-clinical phase, reduce the burden of symptoms, identify therapies for progressive forms/stages of MS, and lead to development of personalized MS treatment.

A smaller proportion of projects are categorized as End compared to Stop and Restore for both the government and non-government portfolios. The Roadmap[1] defines the End pathway as no new cases of MS through primary or secondary prevention. As such, this is not an unsurprising finding as prevention likely requires additional information about factors that contribute to causing or triggering MS. However, the End pathway is an important component of MS research for both those with and without MS and holds the potential to prevent this global disease.[1]

A more granular look at funded projects could yield key insights that drive research investments in areas of research with especially high opportunities to accelerate progress. It will facilitate a better understanding of gap areas, redundancies and opportunities for new investment and collaborations.

Governments tend to make longer commitments than non-profit organizations, perhaps as a result of government agencies having more stable funding streams that can enable longer-term commitments. With the
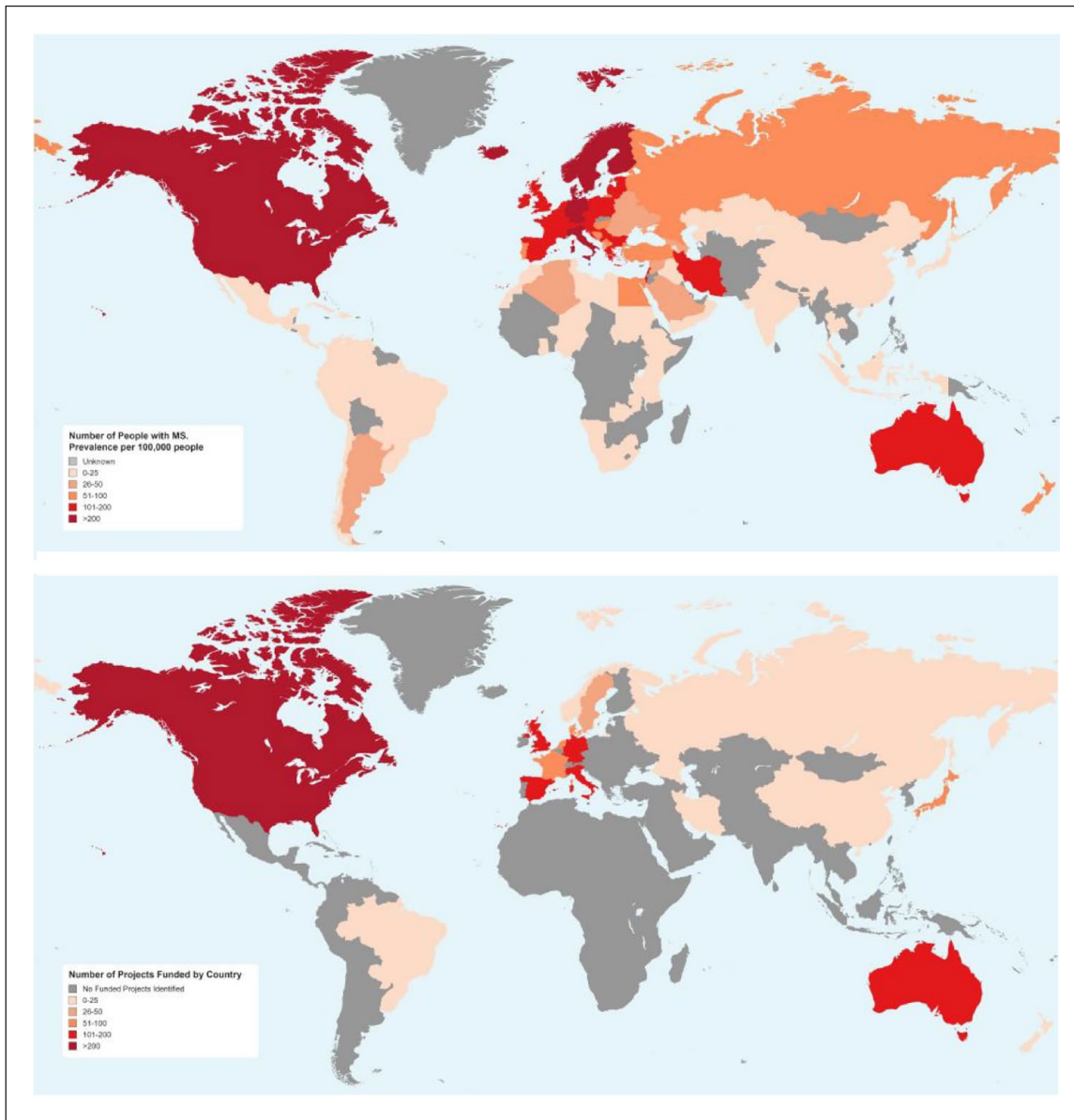
Figure 2. Map of MS prevalence rate and number of projects funded by country.

more predictable and stable funding source, being funded through such sources as taxes, governments might be better suited for funding research resources like biobanks and patient registries which need financing in perpetuity to remain viable.

The prevalence rate of MS in each country trends similarly to the number of projects funded, and amount of funding provided by non-profit and government organizations, areas with higher MS prevalence trend higher funding amounts. (Figure 2) The highest MS prevalence rates are in the European and Americas World Health Organization regions[11] which also yield the largest number of MS projects 806 (34%) and 1282

(55%), respectively. One explanation for this could be that richer countries can both fund research and have the healthcare resources to be able to diagnose MS.[12]

While direct comparison of portfolio values is cautioned, there are trends that differentiate government and non-government-funded projects. First, government portfolios are more evenly distributed between scientific approaches (i.e. clinical, translational, fundamental) compared to non-government portfolios. In addition, co-funding and collaboration of funders is more common among non-government funders. Collaboration among funders helps to accelerate progress and increases the effectiveness of available funds.

This landscape analysis has limitations. First, this analysis is a review of government and non-government funding; research studies funded by biotechnology and pharmaceutical companies were excluded from this analysis. Not all non-government organizations with known research portfolios provided funding data. Also, not all governments had publicly accessible databases, and those with searchable databases did not always include funding data. For example, 14% of the government-funded research projects had no publicly accessible funding information. As such, the actual global research investment in MS is likely higher than reported here. In addition, we caution against the comparison of the government and non-government data as the data collection procedures differed. This led to gaps and unknown values in the data sets. Further, government funding information was often current-year funding while non-government projects were able to provide the full multi-year expense of the projects in their portfolios. Finally, it is important to note that the period reviewed, 2021-2023, is close to the COVID pandemic. While this research did not explore the impact of COVID on MS research funding, it is possible that the three years are not representative of "typical" funding due to lasting pandemic impacts.

This baseline assessment of the global MS funding landscape is a first step toward understanding how the global community invests in MS research and will be further analyzed to understand gaps and opportunities. It is hoped that making this data available will lead to even greater transparency in research funding, which will facilitate greater coordination and alignment of resources. In addition, it should challenge funders to think about the areas of greatest need for people with MS, and how this relates to current levels of investment. Areas of research that may be currently under-invested could provide opportunities for targeted global collaboration. Furthermore, efforts to align with organizations funding research in conditions with related pathophysiology's (e.g. other autoimmune and neurodegenerative diseases) to allow for parallel advances could be explored.

As a group of global research funders, the authors commit to using this insight to shape future research strategies and investments in MS. This research should serve as a call to action for all funders of MS research to enable coordination and collaboration to:

1. Develop and share plans for future research investment with each other and the wider global community;
2. Create joint initiatives to address areas of urgent need for people living with MS;
3. Share the impact of their investment to enable reporting on global progress toward cures; and ultimately
4. Inform the ongoing refinement of the global strategy for MS research.

This will allow us to optimize our impact and hasten progress toward cures for MS.

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Data Availability Statement
Select data that support the findings of this study are available on request from the corresponding author, LR. The data are not publicly available due to restrictions e.g. containing information regarding ongoing and unpublished studies.

Supplemental Material
Supplemental material for this article is available online.

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