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ABSTRACT

To evaluate the management of rare movement disorders (RMD) at the international level and identify care needs to be addressed, the Rare Movement Disorders Study Group of the International Parkinson and Movement Disorders Society (MDS) has conducted an exploratory survey. We sent an online survey to experts in Africa, Asia, Oceania and American continents following the classification of the MDS Regional Sections: Africa, Asia and Oceania (A&O), and Pan-America. We did not include Europe as the European Reference Network for Rare Neurological Diseases recently performed a similar care needs survey across European countries. We obtained responses from experts from 20 African, 26 A&O and 19 Pan-American countries. According to the respondents, only 55% of African countries had movement disorders experts, while these were present in 96% of A&O and 91% of Pan-American. Access to care for patients with RMD was stated difficult in 70% of African, 54% of A&O, and 65% of Pan-American countries. Africa was the region with greatest difficulties in accessing diagnostic tests. However, in Pan-America and A&O, large inequalities were observed between countries with quite variable access to therapeutic options such as deep brain stimulation. The survey results reflect wide variability in the management of RMD and provide evidence that a worldwide care-focused network is highly warranted. Scientific and medical organisations should raise awareness of deficits in managing RMD and care disparities among

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regions. The goals should be to facilitate the training of professionals, establish improvement strategies, and increase support and budgeting for these diseases.

1. Introduction

Rare movement disorders (RMD) comprise many low-prevalence and often complex disorders with limited knowledge and expertise regarding their management [1]. However, in recent years there has been a growing interest in improving awareness and creating specific diagnostic and management recommendations and guidelines [1–3].

Recently, the European Reference Network for Rare Neurological Diseases (ERN-RND) performed one care needs survey across European countries and found significant inequalities in managing RMD [4]. Others have studied the management of rare disorders in regions such as Southeast Asia [5] or specific countries [6]. However, to the best of our knowledge, no study has tried to capture the unmet care needs of RMD worldwide.

The Rare Movement Disorders Study Group (RMDSG; Supplementary Table 1) of the International Parkinson and Movement Disorder Society (MDS), was formed to bring together researchers and healthcare professionals, as well as to standardise the management of RMD and coordinate their research at an international level [7].

We performed an exploratory survey to analyse the management of RMD across African, Asian, Oceanian and American countries and explore the care needs to be addressed. We did not include Europe as European countries have recently been assessed through a similar survey [4].

2. Survey

We designed the survey and sent it from October 2020 to April 2021 to selected experts located internationally, except for Europe [4]. To assess geographic variability, we defined three regions following the classification of the MDS Regional Sections: Africa, Asia and Oceania (A&O), and Pan-America. Participants were pre-selected based on being nationally and/or internationally well-known movement disorder (MD) neurologists (or general neurologists with a special interest in MD) who were familiar with the current care of RMD. We invited to participate one expert from each country, except the United States of America (USA) and Canada, large countries with variations in practice, where 4 and 2 experts, respectively, were asked. The RMD explored in this survey were divided into 4 groups: Group1-Dys: dystonia, paroxysmal dyskinesia, and neurodegeneration with brain iron accumulation (NBIA); Group2-Atx/HSP: ataxias and hereditary spastic paraparesis (HSP); Group3-atypical parkinsonism [AP: progressive supranuclear palsy (PSP), multiple system atrophy (MSA) and corticobasal degeneration (CBD)]; Group4-Chorea: Huntington disease and other choreas. The structured questionnaire was developed based on a slightly modified version of the previously-published European survey [4] and divided into three sections: section I, characterization of the participants; section II, description of the country RMD's management and section III was an open question asking for the three main measures that, in the personal opinion of the participants, should be implemented to improve their management. Neither ethical approval nor written informed consent was required for this study. Please refer to the **Supplementary Methodology file** for more detailed information regarding the methodology of the study.

3. Characterization of the participants

We obtained responses from 20 experts from African countries (45% response rate; representing data for 37% of the 54 countries within Africa); 26 from A&O (63% response rate; representing data for 41% of the A&O countries) and 23 from 19 different Pan-American countries (95% response rate, representing 54% of the 35 American countries) (Supplementary Table 2). Participants were MD specialists who worked either with adult and paediatric patients (36%) or only with adult patients (64%). Their main areas of research interest (multiple choice answer) were clinical research (93%), followed by botulinum toxin therapy (51%) and genetics (43%).

Due to the absence of contact persons or the lack of response from others, we could not assess some countries, and the results might overrepresent the ones with more resources and expertise in these diseases. However, this limitation was somehow expected since previous survey-based studies, some of them exploring care needs of more prevalent diseases (such as Parkinson's), also noted this handicap [8,9].

4. Survey-derived results: weaknesses, inequities and needs in worldwide RMD management

The results showed significant deficiencies and wide-ranging disparities regarding RMD management and care needs across continents and countries within the same region.

According to African experts, access to care for patients with RMD was "difficult" in 70%, "acceptable" in 30%, and none considered it "easy". For some of them, the reasons to classify as "acceptable" was because they thought there were enough neurologists (Egypt) and good coverage for some treatments (Algeria). For A&O experts, access to care was considered "difficult" in 54%, acceptable in 38% and "easy" in 8%. Experts who stated an "easy" (Japan and New Zealand) or "acceptable" care access (Australia, China, Israel, Singapore, South Korea, Russia, Thailand and Vietnam) explained that the availability of a health system with comprehensive coverage of diagnostic tests and treatments, having educational and training programs for healthcare professionals regularly and connecting networks, made the access to specialised assistance easier. For Pan-American experts, access was considered "difficult" in 65%, acceptable in 31% and "easy" in 4%. However, half of the participants from countries with "easy" or "acceptable" accessibility (Canada, USA, Costa Rica, Argentina, Chile) stated that this was very variable depending upon various factors such as location (urban centres with university-level care vs. rural areas), medical insurance systems or socioeconomic factors. Overall, the main explanations of the respondents for difficult access in the different regions were related to inadequate training for healthcare professionals and scarcity of MD specialists; unfamiliarity with these disorders among healthcare providers but also in general populations; deficiencies in health system financial coverage; and limited access to specialised centres, multidisciplinary teams, and diagnostic and therapeutic tools.

4.1. Education

The need to improve education for allied healthcare professionals was a common concern of participants from the three regions assessed. One of the main barriers identified was the lack of MD neurologists and experts in many countries, particularly in Africa. Despite a recent study that has shown a decrease in the countries (17%) without neurologists [10], the ratio (median of 0.03 neurologists/100,000 population) is still far from what the World Health Organization (WHO) recommends (1–5 neurologists per 100,000 habitants) [8,11]. In addition, according to African respondents, only 20% of the countries had MD societies to support these professionals.

Some participants observed that MD specialists were not well distributed across countries but concentrated in the main cities. The latter was attributed to centralism and lack of training and professional opportunities for specialists living in small towns and remote/rural

areas. Although not explicitly studied in RMDs, this may align with what occurs in other medical specialities, including neurology, where substantial geographical variation has been observed [12]. Due to these factors, our survey is likely to cover accessibility in larger cities or university hospitals but may underestimate access to care for people living in remote areas.

Because RMDs are complex and have a low prevalence, their diagnosis is usually complex and requires increased recognition and skilled professionals [1]. Although more than 70% of the Pan-American and more than 60% of A&O respondents reported the availability of RMD experts, there was still a considerable percentage of countries without experts in these diseases, especially in Africa (>50% of countries). Regarding MD and specific training for the different RMDs (Supplementary Table 3), courses and symposiums were generally more frequently available for neurologists and residents than for other healthcare providers and, once more, Africa was the region with lesser opportunities. In the absence of MD experts, it would be very valuable to train general neurologists and primary care physicians by implementing educational programs that improve their awareness of RMD and contribute to early detection and medical care [13].

Finally, according to African experts, another obstacle was the unawareness of neurological disorders in the general population and the attribution in many cases of ill-health to supernatural forces. Dissemination of knowledge across general populations to increase awareness of neurological disorders will be critical in fighting social stigma [14].

The European study [4] identified the need for increased educational activities as a potential measure to improve the management of RMD. Several eastern European states claimed an increase in teaching courses for neurologists and general medical practitioners, and almost all respondents from European countries requested teaching courses for other healthcare providers, including nurses, physiotherapists and speech therapists [4].

4.2. Networking and access to specialised centres

Due to the rarity of these conditions, networks that facilitate access to specialised uniform healthcare, provide an infrastructure for knowledge sharing and enhance the visibility of specialised centres is necessary [2,15]. However, African respondents stated that networking for the different RMDs was available in hardly any of their countries; A&O experts reported it was present in approximately half of their countries, and Pan-American experts indicated it was present in about 60% of theirs (Supplementary Table 4). Additionally, many patients were never visited by a specialised centre during their illness. In this context, several studies have shown that supportive technology such as telemedicine could facilitate the exchange of information and access to knowledge and expertise [16].

4.3. Diagnostic tools

Participants from African countries reported the most significant difficulties with accessing ancillary tests, which require specialised personnel and novel, sophisticated or expensive infrastructure (Fig. 1).

While functional neuroimaging, in general, is not required for the diagnosis of RMD, diagnostic genetic tests are of great importance as more than 70% of RMD are of genetic aetiology [17]. A confirmed molecular diagnosis is critical for genetic counselling and prognostication, and genetic studies are essential to deepen the knowledge of the disease and to develop and ultimately implement specific molecularly-informed disease-modifying therapies. The accessibility of genetic tests, including next-generation sequencing (NGS), was better in A&O and Pan-America than in Africa, although with differences between countries of the same region. From the A&O countries, experts from Bangladesh, Nepal, Georgia, Syria, Mongolia, Kyrgyzstan, Uzbekistan, Kazakhstan and Armenia reported larger difficulties accessing standard and more advanced genetic testing. In the case of Pan-America, experts from Guatemala, Ecuador, Panama and Venezuela. Uruguay, Peru, El Salvador, Bolivia, Costa Rica and the Dominican Republic were others with moderate accessibility to standard tests but limited or no accessibility to NGS. On the contrary, experts reporting easier access were those from Australia, China, Japan, South Korea and Israel in the A&O group and, from Canada, in the Pan-American group.

Recently the RMDSG-MDS designed an online survey to assess worldwide access to genetic tests for MD and factors impacting their utilisation [18]. Similar to the present study, they found limited access to genetic testing, mainly in Africa, whereas access to genetics in North America was easier. They showed that disparities in genetic testing among world regions resulted from various factors, including financial barriers [18]. In the ERN-RND study [4], the availability of the most relevant diagnostic tools for each disorder group was evaluated separately. Although access to genetics in the "HD and other choreas" group was considered easy in a high percentage (85%) of the countries, for the other RMD, approximately half of the countries presented some limitations due mainly to economic reasons and a shortage of geneticists. All

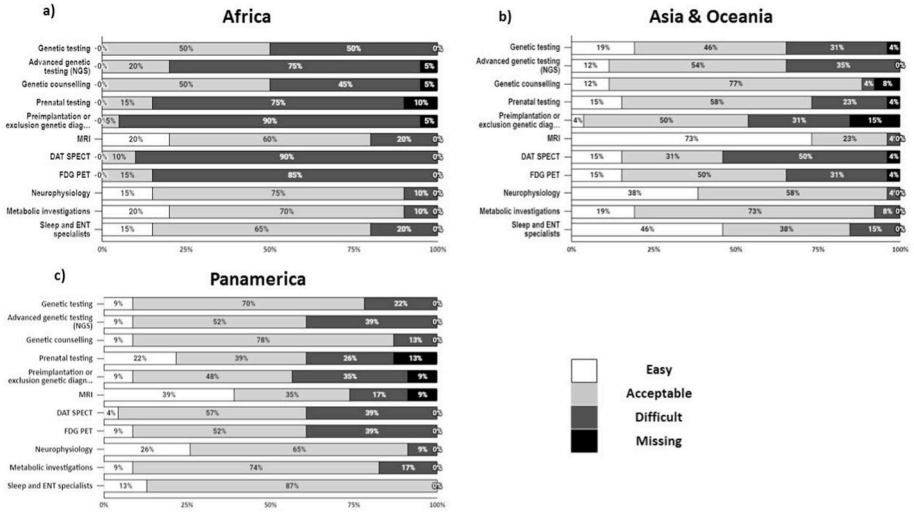

Fig. 1. Access to ancillary tests for RMD across the different regions.
This figure shows the degree of access to the different diagnostic tools in Africa, A&O and Pan-America. In general, Africa presented greater difficulties, followed by Pan-America and A&O.

these studies show that access to diagnostic genetic testing, highly instrumental for a confirmed diagnosis of rare diseases, is not easy in general.

4.4. Treatment

Except for tetrabenazine, oral intake medications (anticholinergic, antiepileptics, benzodiazepines, levodopa, dopamine agonists and neuroleptics) were available in the vast majority of countries (Supplementary Fig. 1). Nevertheless, some studies have reported that the affordability of these medications can be limited, even in countries where they are available, due to high prices and the absence of insurance coverage [8]. Like Europe [4], access to botulinum toxin and deep brain stimulation (DBS) was more challenging in some regions. Respondents who indicated low availability related this to financial issues and lack of expertise in these techniques. In Africa, only experts from Egypt, Morocco, South Africa and Algeria (20% of the countries) considered DBS easy or acceptably available. In A&O and Pan-America, experts from Syria, Mongolia, Kyrgyzstan, Armenia and Uzbekistan, Cuba, Guatemala, Venezuela, Dominican Republic, Ecuador and Paraguay considered DBS was difficult or not available (19% and 26% of countries, respectively).

4.5. Health system and financial coverage

Health system coverage and economic issues were significant and frequent barriers according to the respondents from all regions assessed.

Approximately 690 million people from low and lower-middle income countries experience extreme poverty with deprivation of basic needs [19]. In these countries, although an effort has been made to improve the management of communicable diseases [20], non-communicable diseases (NCDs) continue to be under-recognised, especially those considered rare diseases. In addition, government expenditure on health in these countries is very limited [21]. For example, India spends only 1% of its gross domestic product (GDP) on health, and only a quarter of this is dedicated to NCD [22]. Thus, access to health services often depends upon out-of-pocket household expenditures, leading to dramatic economic consequences and potential impoverishment [21].

In contrast, experts from countries with universal health coverage (UHC) stated that people had equal access to a wide range of medical facilities without financial hardship. UHC does not imply free access to every possible health service for every person but emphasises the importance of access to health services as a fundamental human right [11].

4.6. Countries with higher standard RMD management

Although most countries face many challenges, they have substantial country-specific differences. We defined countries with "high standard management" if experts stated easy or acceptable access to RMD care and easy-acceptable access to all the diagnostic or therapeutic tools assessed. These countries were: the USA, Canada and Argentina for Pan-America; Singapore, Japan, New Zealand, Israel, Australia, China, Saudi Arabia and South Korea from A&O; and none of the African countries reached this criterion.

5. Conclusions

In summary (Table 1), the survey results reflect wide variability in the management of RMD among countries around the world, where health systems, resources, and funding differ widely. The management of these diseases faces difficulties and insufficiencies in most countries. However, it is most precarious in those that need to focus their health policy on providing minimal standards of primary, preventive and acute care and managing diseases with a high epidemiological burden.

Table 1
Summary of the main results.
Results showed significant gaps and wide-ranging disparities regarding RMD management among countries around the world. 70%, 54% and 65% of the experts from Africa, A&O and Pan-America, respectively, considered access to management difficult for patients with RMD. Herein we summarize the main concerns of the respondents for this and the solutions proposed.

Gaps:	Possible solutions:
Unawareness of these disorders.	Scientific and medical organisations should facilitate dissemination of knowledge among allied healthcare professionals and the general population.
Scarcity of MD specialists.	In the absence of MD experts, it would be very valuable to train general neurologists and primary care physicians
Concentration of MD specialists in the main cities.	Increasing training and professional opportunities for specialists in median/small areas. Networking development allowing uniform healthcare and sharing experiences.
Deficient training for healthcare professionals.	Facilitate the training of professionals with the implementation of continuous educational activities. Networks of expertise.
Limited access to specialised centres.	Supportive technology such as telemedicine could facilitate exchange of information and access to knowledge and expertise.
Limited access to diagnostic and therapeutic tools due to financial reasons and shortage of specialists with expertise in specific treatments or techniques.	Increase knowledge and professional skills in advanced therapies and technologies and budgeting for these diseases. Health policy directed to promote universal health coverage.

Asia and Oceania = A&O; MD = movement disorders; RMD = rare movement disorders.

Scientific and medical organisations should raise awareness of the deficits in managing RMD and care disparities among patients to policymakers, society and industry representatives. The goals should be to facilitate the training of professionals, establish improvement strategies, and increase support and budgeting for these diseases. Only fulfilling these goals may eventually decrease the multiple unmet needs of RMD patients.

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Authors' roles

Celia Painous: acquisition of the data (lead), formal analysis (lead), writing – original draft (lead), writing–review and editing (equal). Maria

J Martí: Conceptualization (supporting), acquisition of the data (supporting), writing–original draft (supporting), writing–review and editing (equal). Holm Graessner, Mary Kearney and Emilia Gatto: Conceptualization (supporting), acquisition of the data (supporting), writing–review and editing (equal). Andrea Paola Camargo, Shaimaa Ibrahim El-Jaafary, Daniel Martínez-Ramírez, Oluwadamilola O Ojo, Funmilola T Taiwo, Roopa Rajan, Mario Cornejo-Olivas, Biniyam A Ayele and Houyam Tibar: acquisition of the data (equal) and writing–review and editing (equal). Marina AJ Tijssen: Conceptualization (lead), acquisition of the data (supporting) and writing–review and editing (equal). RMDSG-MDS: Conceptualization (supporting), acquisition of the data (supporting) and writing–review and editing (equal). All the other authors have provided a final approval of the version to be published.

Declaration of competing interest

None of the authors has any conflict of interest relevant to the topic of this manuscript.

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Appendix A. Supplementary data

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