Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019

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Summary

Background Rehabilitation has often been seen as a disability-specific service needed by only few of the population. Despite its individual and societal benefits, rehabilitation has not been prioritised in countries and is under-resourced. We present global, regional, and country data for the number of people who would benefit from rehabilitation at least once during the course of their disabling illness or injury.

Methods To estimate the need for rehabilitation, data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2019 were used to calculate the prevalence and years of life lived with disability (YLDs) of 25 diseases, impairments, or bespoke aggregations of sequelae that were selected as amenable to rehabilitation. All analyses were done at the country level and then aggregated to seven regions: World Bank high-income countries and the six WHO regions (ie, Africa, the Americas, Southeast Asia, Europe, Eastern Mediterranean, and Western Pacific).

Findings Globally, in 2019, 2·41 billion (95% uncertainty interval 2·34–2·50) individuals had conditions that would benefit from rehabilitation, contributing to 310 million [235–392] YLDs. This number had increased by 63% from 1990 to 2019. Regionally, the Western Pacific had the highest need of rehabilitation services (610 million people [588–636] and 83 million YLDs [62–106]). The disease area that contributed most to prevalence was musculoskeletal disorders (1·71 billion people [1·68–1·80]), with low back pain being the most prevalent condition in 134 of the 204 countries analysed.

Interpretation To our knowledge, this is the first study to produce a global estimate of the need for rehabilitation services and to show that at least one in every three people in the world needs rehabilitation at some point in the course of their illness or injury. This number counters the common view of rehabilitation as a service required by only few people. We argue that rehabilitation needs to be brought close to communities as an integral part of primary health care to reach more people in need.

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Introduction

The world's population is ageing and the number of people living with non-communicable diseases and the consequences of injuries is increasing.[1–3] The current demographic and health shifts are contributing to a rapid increase in the number of people experiencing disability or declines in functioning for substantially larger periods of their lives.

These trends should urge health policy planners to prioritise rehabilitation services for several reasons. Rehabilitation, in its essence, is a set of interventions needed when a person is experiencing limitations in everyday physical, mental, and social functioning due to ageing or a health condition, including chronic diseases or disorders, injuries, or trauma.[4] Rehabilitation might be needed by anyone with a health condition who experiences difficulties in, for example, mobility, vision, or cognition. Therefore, its scope is very broad and people with diverse underlying health conditions or impairments might require rehabilitation at some stage of the course of their disease. There is evidence showing that many rehabilitative interventions are cost-effective.[5–8] Low-cost rehabilitation interventions requiring minimal resources have been effective in improving functional outcomes in different health conditions in low-income and lower-middle-income countries and can be used in these settings as successful models of care.[9,10] Rehabilitation can improve functioning outcomes in adults and children with different chronic conditions, such as to manage cognitive decline for people with dementia, improve movement for those with arthritis, and produce motor benefits for children with cerebral palsy.[11–14] Rehabilitation also has the potential to avoid costly

Research in context

Evidence before this study

A scoping review in PubMed based on terms indicative of rehabilitation needs (search string shown in the appendix p 1) was done in 2019 to identify systematic or scoping reviews and meta-analyses that have quantified the number of people in need of rehabilitation services. Articles published between 1980 and 2019 that provided a descriptive analysis or actual numerical estimation of the needs or unmet needs for rehabilitation services by individuals with a health condition or impairment were included. No language restrictions were set in the search. The search yielded 1481 results, of which two narrative reviews provided evidence on substantial unmet needs for rehabilitation in several countries. No article, however, provide an estimation of the number of people globally in need of rehabilitation.

Added value of this study

To our knowledge, this is the first study to provide a global figure of the number of people who would benefit from rehabilitation. Regional data provided in this study show where priority should be given. We have identified and included in the analysis 25 health conditions that are highly prevalent, associated with large amounts of disability, and are amenable to rehabilitation at some point in the course of disease. Data are derived from the Global Burden of Diseases, Injuries, and Risk Factors Study 2019. The GBD study produces the most comprehensive assessment of prevalence, incidence, and years of life lived with disability for more than 300 diseases and injuries, and for all countries from 1990 to 2019.

Implications of all the available evidence

To our knowledge, this is the first study to produce a global estimate of the need for rehabilitation services. Our findings show that one in every three people in the world would benefit from rehabilitation at some point during the course of their illness. This study also provides detailed regional and country information on the disease areas that contribute the most to the rehabilitation needs and sets priorities for countries to act and address those needs. The estimate of 2·45 billion people in need of rehabilitation challenges the common view that only a few people require it. Such a figure can serve as a powerful tool to convince governments to strengthen and integrate rehabilitation in their primary health-care system, as many of the conditions that lead to decreases in functioning and could benefit from rehabilitation can be addressed in primary health care.

See Online for appendix

hospitalisation and reduce hospital length of stay.[15–17] By aiming to optimise functioning, rehabilitation can also support individuals to participate in education and employment and to remain independent at home.[18–20] Advanced technological and digital solutions have become commonplace and are being increasingly applied in rehabilitation. Online programs or assistive technologies (eg, hearing aids) are successfully used by millions of people around the world.[21,22]

Rehabilitation, however, has not been prioritised in countries and is still under-resourced. This situation is not a surprise as rehabilitation is often seen as a fallback strategy when preventive, promotive, or curative interventions fail, and as a disability-specific service needed by only few of the population. Furthermore, rehabilitation has often been incorrectly perceived as an expensive clinical and specialised service provided predominantly at secondary and tertiary care levels.[23]

In this Article, however, we challenge this thinking by estimating the need for rehabilitation by presenting the prevalence and years of life lived with disability (YLDs) of 25 disease causes, impairments, and bespoke aggregations of sequelae that would be amenable to rehabilitation at some point in the course of disease using data from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019.

Methods

Overview

The GBD 2019 study estimated incidence, prevalence, and YLDs by age, sex, year, and location for 354 diseases and injuries, and 3484 sequelae (ie, the disabling consequences of these diseases and injuries). The GBD used a four level, comprehensive cause hierarchy in addition to two levels of sequelae. YLDs are a measure of the burden of non-fatal disease and injury and were calculated by multiplying the prevalence of each sequela by the estimated level of health loss in the form of a disability weight. Disability weights range from 0 (ie, perfect health) to 1 (ie, death) and represent the severity of the disease. These weights were derived from population surveys using pairwise comparison methods between random pairs of health states.[24] The disability weights were defined, measured, and given numerical value to quantify the time lived in non-fatal health states. It needs to be acknowledged that, although death is not difficult to define, non-fatal health states are. However, although there are other existing metrics that quantify disability or combine mortality and disability, there is no widespread acceptance of an alternative to the GBD approach to quantify YLDs or disability-adjusted life-years. All GBD 2019 YLDs estimates were corrected for comorbidity using simulation methods and assumed a multiplicative model for coexisting health states.[1] Results at the level of causes are published and are easily accessible via online data visualisation and download tools, but estimates for bespoke aggregates of causes and sequelae require an additional effort.

Selection of conditions

For the selection of health conditions, we followed a stepwise approach. First, we identified the 20 conditions

with the highest number of associated YLDs. Second, from these, we excluded conditions for which rehabilitation is not essential and is usually indicated as a secondary intervention (eg, dietary iron deficiency or oral disorders). Lastly, a group of experts in the field of rehabilitation was convened by WHO to discuss the current list and add any health conditions for which rehabilitation is a key intervention as part of an overall

	Prevalence				Years of life lived with disability				Average disability weight
	All age (millions)		Age-standardised rate (per 1000)		All age (millions)		Age-standardised rate (per 1000)		
	2019	Percentage change*	2019	Percentage change*	2019	Percentage change*	2019	Percentage change*	2019
Overall total	**2412·0 (2338·0 to 2501·0)**	**63% (61 to 64)†**	**298·0 (289·0 to 309·0)**	**–5·6% (–6·1 to –5·1)†**	**310·0 (235·0 to 392·0)**	**69% (67 to 72)†**	**38·0 (29·0 to 49·0)**	**–5% (–6 to –3·9)†**	**0·13 (0·10 to 0·16)**
Musculoskeletal disorders									
Musculoskeletal disorders (total)	**1714·0 (1632·0 to 1800·0)**	**62% (60 to 64)†**	**210·0 (200·0 to 221·0)**	**–8·8% (–10 to –8·2)†**	**149·0 (108·0 to 199·0)**	**59% (55 to 64)†**	**18·0 (13·0 to 24·0)**	**–11% (–13 to –10)†**	**0·08 (0·06 to 0·11)**
Low back pain	568·0 (505·0 to 641·0)	47% (44 to 51)†	70·0 (62·0 to 79·0)	–16% (–17 to –16)†	64·0 (45·0 to 85·0)	47% (43 to 51)†	7·8 (5·5 to 10·0)	–16% (–17 to –16)†	0·11 (0·08 to 0·15)
Neck pain	223·0 (179·0 to 281·0)	79% (70 to 87)†	27·0 (22·0 to 34·0)	–0·45 % (–2·6 to 1·7)	22·0 (15·0 to 32·0)	78% (69 to 87)†	2·7 (1·8 to 3·8)	–0·31% (–2·5 to 1·8)	0·10 (0·07 to 0·14)
Fractures	436·0 (411·0 to 465·0)	69% (67 to 71)†	54·0 (51·0 to 57·0)	–6·9% (–7·8 to –6·0)†	26·0 (18·0 to 36·0)	66% (63 to 68)†	3·2 (2·2 to 4·4)	–8·3% (9·5 to –7·2)†	0·06 (0·04 to 0·08)
Other injuries	305·0 (282·0 to 336·0)	43% (40 to 46)†	38·0 (35·0 to 41·0)	–17% (–18 to –15)†	11·0 (7·5 to 15·0)	25% (19 to 31)†	1·3 (0·9 to 1·8)	–24% (–27 to –21)†	0·03 (0·02 to 0·05)
Osteoarthritis	344·0 (275·0 to 414·0)	114% (112 to 117)†	41·0 (33·0 to 50·0)	3·1 % (1·8 to 4·2)†	19·0 (10·0 to 38·0)	115% (112 to 117)†	2·3 (1·2 to 4·5)	3·3% (2 to 4·6)†	0·05 (0·03 to 0·1)
Amputation	176·0 (164·0 to 190·0)	52% (50 to 55)†	22·0 (20·0 to 23·0)	–13% (–14 to –12)†	5·5 (3·8 to 7·7)	36% (29 to 44)†	0·7 (0·5to 1·0)	–23% (–27 to –18)†	0·03 (0·02 to 0·04)
Rheumatoid arthritis	13·0 (12·0 to 15·0)	106% (104 to 109)†	1·6 (1·5 to 1·8)	8·1% (7·5 to 8·6)†	2·4 (1·7 to 3·3)	105% (102 to 108)†	0·3 (0·2 to 0·4)	8·3% (7·3 to 9·3)†	0·18 (0·13 to 0·24)
Neurological disorders									
Neurological disorders (total)	**255·0 (242·0 to 268·0)**	**106% (103 to 110)†**	**32·0 (31·0 to 34·0)**	**10% (8·4 to 12)†**	**51·0 (37·0 to 65·0)**	**104% (100 to 109)†**	**6·4 (4·7 to 8·2)**	**11% (8·5 to 13)†**	**0·20 (0·15 to 0·25)**
Cerebral palsy	50·0 (44·0 to 57·0)	159% (138 to 183)†	6·6 (5·8 to 7·6)	94% (78 to 111)†	11·0 (7·4 to 15·0)	155% (134 to 178)†	1·4 (1·0 to 1·9)	91% (76 to 108)†	0·21 (0·15 to 0·28)
Stroke	86·0 (79·0 to 94·0)	85% (82 to 88)†	11·0 (10·0 to 12·0)	–6·1% (–7·3 to –4·9)†	18·0 (13·0 to 23·0)	89% (85 to 93)†	2·2 (1·6 to 2·8)	–4·7% (–6·1 to –3·3)†	0·21 (0·15 to 0·26)
Traumatic brain injury	49·0 (47·0 to 51·0)	80% (78 to 82)†	6·0 (5·7 to 6·3)	–0·01% (–1·1 to 1·2)	7·1 (5·0 to 10·0)	79% (77 to 82)†	0·9 (0·6 to 1·2)	0·16% (–1 to 1·3)	0·14 (0·1 to 0·2)
Alzheimer's disease and dementia	52·0 (44·0 to 59·0)	161% (156 to 166)†	6·8 (5·9 to 7·8)	5·7% (4·3 to 6·9)†	7·4 (5·2 to 10·0)	165% (159 to 171)†	1·0 (0·7 to 1·3)	5·5% (4 to 6·8)†	0·14 (0·11 to 0·18)
Spinal cord injury	21·0 (19·0 to 24·0)	82% (74 to 87)†	2·5 (2·3 to 2·9)	5·8 % (2·7 to 10)†	6·2 (4·5 to 8·2)	65% (56 to 72)†	0·8 (0·6 to 1·0)	–1·6% (–5·6 to 3·3)	0·30 (0·22 to 0·38)
Parkinson's disease	3·9 (3·3 to 4·7)	156% (150 to 161)†	0·5 (0·4 to 0·6)	16% (13 to 18)†	1·2 (0·8 to 1·6)	155% (149 to 161)†	0·2 (0·1 to 0·2)	16% (13 to 19)†	0·30 (0·21 to 0·39)
Multiple sclerosis	1·4 (1·2 to 1·5)	72% (66 to 77)†	0·2 (0·1 to 0·2)	–6·1% (–8·7 to –3·8)†	0·5 (0·3 to 0·6)	71% (65 to 77)†	0·1 (0·04 to 0·07)	–5·8% (–8·6 to –2·9)†	0·33 (0·24 to 0·42)
Motor neuron disease	0·2 (0·2 to 0·3)	69% (62 to 76)†	0·03 (0·02 to 0·03)	1·9% (0·61 to 3·4)†	0·1 (0·0 to 0·1)	69% (62 to 76)†	0·01 (0 to 0·01)	1·9% (0·57 to 3·3)†	0·25 (0·17 to 0·32)
Guillain-Barré syndrome	0·1 (0·1 to 0·1)	67% (57 to 77)†	0·01 (0·01 to 0·02)	6·6 % (3·6 to 10)†	0·03 (0·02 to 0·04)	67% (57 to 77)†	0 (0 to 0·01)	6·5% (3·6 to 9·5)†	0·30 (0·20 to 0·41)
Sensory impairments									
Sensory impairments (total)	**677·0 (631·0 to 723·0)**	**77% (74 to 81)†**	**84·0 (79 to 90)**	**–4·5% (–5 to –4)†**	**45·0 (31·0 to 62·0)**	**70% (65 to 74)†**	**5·7 (3·9 to 7·7)**	**–9·4% (–11 to –7·9)†**	**0·07 (0·05 to 0·09)**
Hearing loss	403·0 (357·0 to 449·0)	79% (74 to 84)†	51·0 (45·0 to 56·0)	–5·4% (–6·2 to –4·8)†	24·0 (16·0 to 33·0)	69% (61 to 76)†	3·0 (2·0 to 4·2)	–7·3% (–8·3 to –6·3)†	0·06 (0·04 to 0·08)
Vision loss	329·0 (302·0 to 358·0)	80% (77 to 83)†	41·0 (38·0 to 44·0)	–3·8% (–4·5 to –3·1)†	21·0 (15·0 to 30·0)	71% (68 to 74)†	2·7 (1·9 to 3·7)	–12% (–14 to –9·5)†	0·06 (0·05 to 0·09)

(Table continues on next page)

	Prevalence				Years of life lived with disability				Average disability weight
	All age (millions)		Age-standardised rate (per 1000)		All age (millions)		Age-standardised rate (per 1000)		
	2019	Percentage change*	2019	Percentage change*	2019	Percentage change*	2019	Percentage change*	2019
(Continued from previous page)									
Mental disorders									
Mental disorders (total)	**187·0 (147·0 to 229·0)**	**40% (36 to 47)†**	**24·0 (19 to 30)**	**0·52% (–2·1 to 4·2)**	**29·0 (22·0 to 37·0)**	**53% (49 to 58)†**	**3·7 (2·8 to 4·7)**	**1·7% (0·06 to 3·5)†**	**0·16 (0·12 to 0·20)**
Developmental intellectual disability	137·0 (97·0 to 177·0)	37% (32 to 46)†	18·0 (13·0 to 23·0)	1·2% (–2·5 to 7·1)	10·0 (6·1 to 14·0)	44% (37 to 54)†	1·3 (0·8 to 1·9)	6·5% (1·3 to 13)†	0·07 (0·05 to 0·1)
Schizophrenia	24·0 (20·0 to 27·0)	66% (63 to 69)†	2·9 (2·5 to 3·3)	–0·88% (–1·7 to –0·13)†	15·0 (11·0 to 19·0)	65% (62 to 69)†	1·8 (1·3 to 2·3)	–0·57% (–1·6 to 0·38)	0·64 (0·49 to 0·76)
Autism spectrum disorders	28·0 (24·0 to 34·0)	39% (39 to 40)†	3·7 (3·1 to 4·4)	–0·93% (–1·3 to –0·61)†	4·3 (2·8 to 6·2)	39% (38 to 40)†	0·6 (0·4 to 0·8)	–0·76% (–1·4 to –0·16)†	0·15 (0·11 to 0·21)
Chronic respiratory diseases									
Chronic respiratory diseases (total)	**118·0 (107·0 to 130·0)**	**89% (85 to 93)†**	**15·0 (13·0 to 16·0)**	**–6% (–7·7 to –4·1)†**	**20·0 (17·0 to 22·0)**	**89% (85 to 94)†**	**2·5 (2·1 to 2·8)**	**–4·8% (–6·6 to –3)†**	**0·17 (0·14 to 0·19)**
Chronic obstructive pulmonary disease	118·0 (107·0 to 130·0)	89% (85 to 93)†	15·0 (13·0 to 16·0)	–6% (–7·7 to –4·1)†	20·0 (17·0 to 22·0)	89% (85 to 94)†	2·5 (2·1 to 2·8)	–4·8% (–6·6 to –3)†	0·17 (0·14 to 0·19)
Cardiovascular diseases									
Cardiovascular diseases (total)	**37·0 (30·0 to 44·0)**	**106% (99 to 113)†**	**4·6 (3·9 to 5·6)**	**–7·2% (–10 to –4)†**	**4·2 (2·7 to 6)**	**106% (99 to 114)†**	**0·5 (0·4 to 0·8)**	**–6·9% (–10 to –3·7)†**	**0·11 (0·08 to 0·16)**
Heart failure	35·0 (29·0 to 43·0)	107% (99 to 115)†	4·5 (3·7 to 5·4)	–6·9% (–10 to –3·5)†	4·1 (2·6 to 5·8)	107% (99 to 115)†	0·5 (0·3 to 0·7)	6·7% (–10 to –3·3)†	0·11 (0·08 to 0·16)
Acute myocardial infarction	1·3 (1·1 to 1·5)	82% (80 to 84)†	0·2 (0·1 to 0·2)	–15% (–16 to –14)†	0·1 (0·1 to 0·2)	83% (79 to 86)†	0·01 (0·01 to 0·02)	–14% (–16 to –13)†	0·09 (0·06 to 0·12)
Neoplasms									
Neoplasms (total)	**18·0 (17·0 to 19·0)**	**118% (104 to 132)†**	**2·2 (2·0 to 2·3)**	**4·7% (–2·2 to 12)**	**1·9 (1·4 to 2·6)**	**129% (114 to 144)†**	**0·2 (0·2 to 0·3)**	**15% (7·5 to 22)†**	**0·11 (0·08 to 0·14)**

*Percentage change from 1990 to 2019. †Statistically significant.

Table: **Global prevalence and years of life lived with disability for health conditions in need of rehabilitation, all-age counts, and age-standardised rates for 2019, percentage change since 1990, and average disability weight for 2019**

management plan. 25 health conditions were selected for the final analysis.

In addition, the proportion of YLDs associated with non-communicable diseases that the selected health conditions are responsible for was calculated after excluding some disease categories (ie, digestive diseases, urogenital diseases, diabetes, skin disorders, headaches, substance use disorders, asthma, epilepsy, oral disorders, and other mental disorders [except for schizophrenia, autism spectrum disorder, and intellectual disability]) for which rehabilitation is not one of the primary interventions. The 25 health conditions comprised 77% of the YLDs. Furthermore, the injuries (ie, amputation, fractures, traumatic brain injury, spinal cord injury, and other injuries) included in our list of 25 health conditions also comprised 89% of all injury YLDs. A detailed description of each health condition and their sequelae, as well as the GBD methods for estimating prevalence and YLDs for each of these, is shown in the appendix (pp 2–166).

25 selected conditions were grouped and presented into seven aggregate disease and injury categories, following the GBD standard categorisation of diseases (table). The causes given in the GBD were classified into four levels. At level 1, there were three large cause groupings: (1) communicable, maternal, and neonatal conditions and nutritional deficiencies, (2) non-communicable diseases, and (3) injuries. At level 2 there were 21 disease and injury categories (eg, cardiovascular diseases, musculoskeletal conditions, and neurological diseases). The highest level of detail in causes is provided at levels 3 and 4. In level 3, for example, conditions such as stroke, chronic obstructive pulmonary disease (COPD), or schizophrenia were grouped. In the table, the seven aggregate categories reflect level 2 and the individual health conditions under each aggregate category indicate level 3.

Many of the sequelae included in this analysis are part of an impairment with many underlying diseases and injuries. For example, the GBD has not previously published any estimate for cerebral palsy. For this purpose, all sequelae of neonatal disorders and infectious diseases with moderate to severe motor impairment were identified and aggregated as an estimate of cerebral palsy.

Mild health states and motor impairment, borderline intellectual disability, hearing loss less than 35 decibels, mild vision loss, and minor injuries were excluded,

assuming they would be less likely to require rehabilitation. For cancer, the diagnosis and primary therapy phase of all cancers, as well as colon and rectum cancer with stoma, larynx cancer with laryngectomy, and breast cancer with mastectomy were included.

Comorbidity

One person can have multiple non-fatal health conditions. Within a GBD cause of disease or injury, however, the sequelae are mutually exclusive. For example, with the GBD cause of autism spectrum disorder, each person has only one of the following sequelae: autism with borderline, mild, moderate, severe, profound, or no intellectual disability. To get the total number of cases and YLDs for autism spectrum disorder, we summed across all of the eligible sequelae.

For aggregate conditions, we estimated the number of individuals with one or more of the set of conditions. The comorbidity simulations quantify the number of people with multiple outcomes based on independent probabilities. As we simulated artificial populations of 20000 people in each age, sex, location, and year category, we could quantify individuals who had any of the conditions quantified without overcounting. More specifically, for the general GBD comorbidity simulation, we created a hypothetical cohort of 20000 individuals for each age, sex, year, and country (or subnational unit). The probability that any individual was afflicted by a GBD disease or sequela was determined by the prevalence of each. Thus, we assigned independent probabilities to determine the number (ie, two, three, four, or more) of diseases or sequelae that occurred in the same individual in that age, sex, year, and country category. After having created 20000 individuals we could compute for aggregate categories for people who had at least one of these. To calculate the prevalence of people with any of the diseases denoted as A, B, or C, the following formula was applied:

$$p_{ABC}=1-(1-p_A)(1-p_B)(1-p_C)$$

P_{ABC} is the proportion of the population with diseases A, B, and C. We then multiplied by population estimates for each location, sex, age group, and year to get counts. YLDs were already corrected for comorbidity, so these values are summed without any correction.

Some sequelae fell into multiple health conditions. These cases were included in each most-detailed category but only once in the parent category. For example, a person with the sequela "autism spectrum disorder with moderate developmental intellectual disability" would be counted in both "autism spectrum disorders" and "developmental intellectual disability" but only once in "mental disorders" and in the total rehabilitation prevalence count. Similarly, a patient with heart failure due to COPD was counted in both "heart failure" and "chronic obstructive pulmonary disease" among health conditions, and "cardiovascular diseases" and "chronic respiratory diseases" among disease areas. However, when we estimated the number of people who could potentially benefit from rehabilitation, we counted this example as a single person.

Sequelae were each mapped to a health state with an associated disability weight,[24] valuing the severity of the sequela. Most diseases had sequelae across a spectrum of severity. To indicate the average severity between diseases we computed the average disability weight by dividing total YLDs for a disease by its prevalence. Some sequelae were a combination of health states, such as severe COPD and moderate heart failure, or severe motor impairment with blindness and seizures. For those sequelae in the GBD, a multiplicative function was applied to the disability weights for each of the comorbid health states. To avoid inflating YLDs for some of the categories in our analysis, we could not use the routinely reported YLDs in the GBD. For instance, in the examples of severe motor impairment and blindness, we did not want to include the disability component of this combined health state, which was due to blindness, if we were quantifying cerebral palsy. In those instances, we estimated the comorbidity corrected disability weight for each sex, age, year, and location combination by dividing YLDs by prevalence for the sequela that were for severe motor impairment only. We then multiplied the prevalence of the combined health state by that disability weight value to get the correct YLDs value for the motor impairment component only.

We did all analyses at the country level for the 204 countries included in the GBD 2019 study. We then aggregated to seven regions: World Bank high-income countries and all six of the WHO regions, excluding the high-income countries from each region.[25] In the GBD project, uncertainty was estimated by generating 1000 draws of every estimate. The bespoke aggregations for this study were done at the draw level, taking the 2·5th and 97·5th percentiles to generate the 95% uncertainty interval (UI).

Role of the funding source

The funder of the study had no role in the study design, data collection, data analysis, data interpretation, or the writing of the report. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Globally in 2019, 2·41 billion (95% UI 2·34–2·50) individuals had conditions that would benefit at some point during the course of disease from rehabilitation services, contributing to 310 million (235–392) YLDs (table). This number had increased by 63% (61–64), from 1·48 billion (1·43–1·54) in 1990 (appendix p 168). The age-standardised prevalence and YLDs rates showed modest declines since 1990, indicating that the large increase in cases is due to population growth and population ageing.

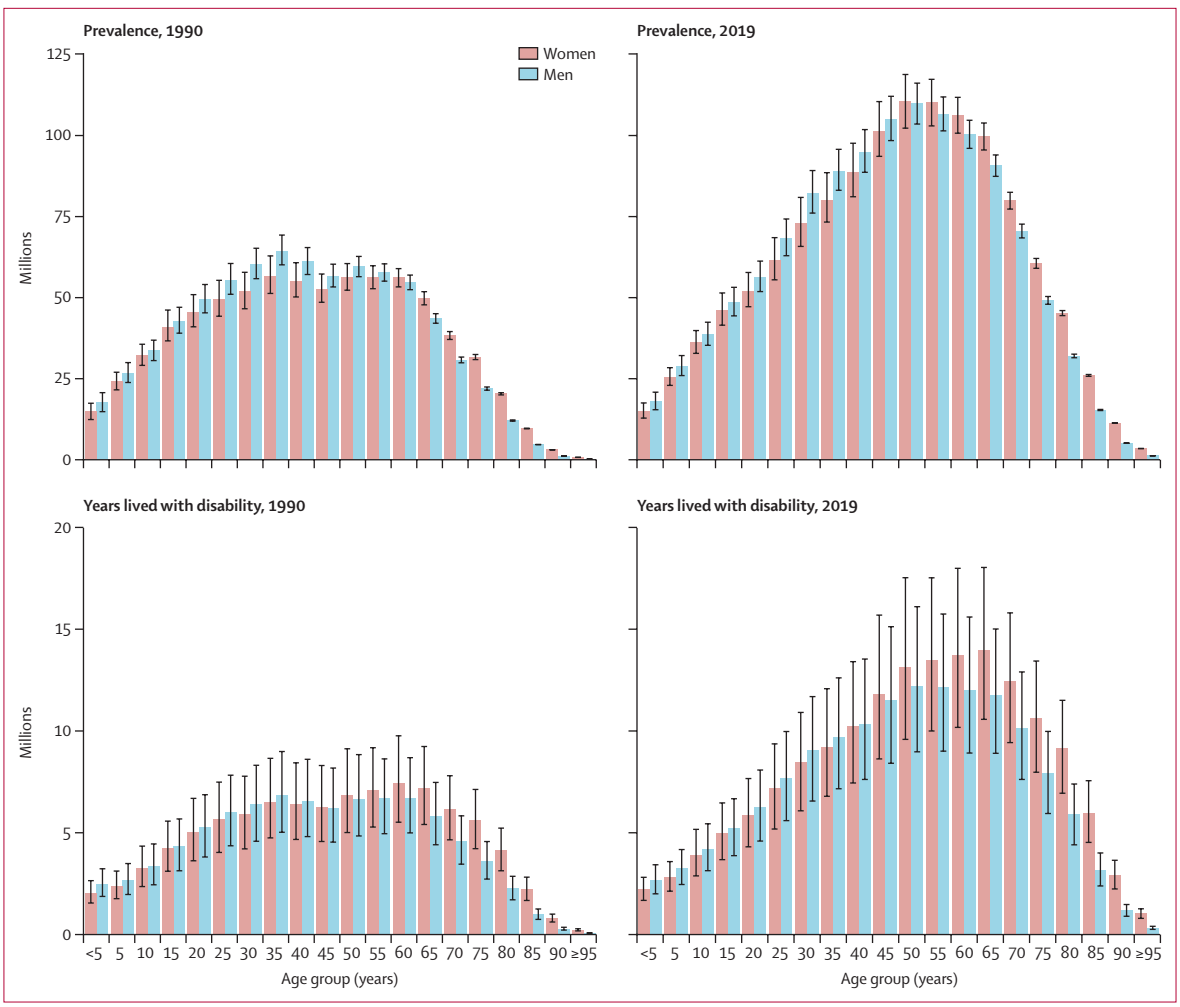

Figure 1: **Global number of prevalent cases with conditions that would benefit from rehabilitation and the corresponding years of life lived with disability by age and sex with 95% uncertainty intervals, 1990 and 2019**

The prevalence was nearly equal in men (1·19 billion [95% UI 1·15–1·23]) and women (1·22 billion [1·18–1·27]), but women had more YLDs (163 million [124–206]) than men (146 million [110–186]). Globally, the counts of both YLDs and prevalence were highest for people aged 50–70 years and lowest in people aged 95 years and older (figure 1).

Globally, over 1600 million adults aged 15–64 years have a condition that would benefit from rehabilitation in 2019, with musculoskeletal disorders contributing to approximately two-thirds of this number (figure 2). In children younger than 15 years, sensory impairments, mental disorders, and musculoskeletal disorders accounted for 91% of the 162·3 million prevalent cases. For people older than 65 years, musculoskeletal disorders, neurological disorders, sensory impairments, and chronic respiratory diseases were the largest contributors to the need for rehabilitation, while mental disorders and musculoskeletal disorders accounted for a smaller proportion than in adults younger than 65 years. Causal distribution of need for rehabilitation by age group and WHO region can be found in the appendix (p 167).

Among WHO regions, the Western Pacific region had the highest need of rehabilitation services (610 million people [95% UI 588–636] and 83 million [62–106] YLDs), followed by the Southeast Asia region (593 million people [571–618] and 77 million [58–97] YLDs), World Bank high-income countries (530 million people [515–548] and 70 million [53–90] YLDs), the European region (373 million people [362–386] and 45 million [34–58] YLDs), the region of the Americas (310 million people [301–321] and 35 million [26–45] YLDs), the Africa region (214 million people [206–224] and 27 million [20–34] YLDs), and the Eastern Mediterranean region (182 million people [174–192] and 22 million [17–28] YLDs). Region-specific and country-specific results are included in the appendix (p 168).

The European region had the highest age-standardised prevalence of 34% (95% UI 33–35) and YLDs

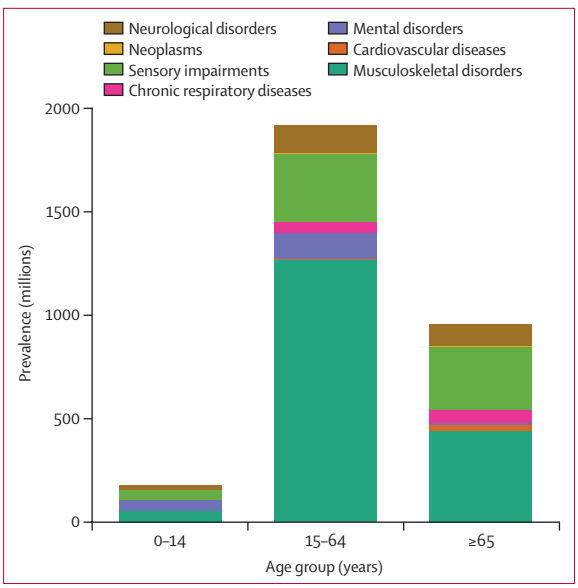

Figure 2: **Disease categories of prevalent conditions that would benefit from rehabilitation globally, by three age groups, 2019**

rate of 0·040 (0·030–0·051) YLDs per person. The Western Pacific region had the lowest prevalence of 26% (25–27), and the region of the Americas had the lowest YLDs rate of 0·034 (0·025–0·043) YLDs per person (figure 3).

The disease area with the highest contribution to prevalence was musculoskeletal disorders (1·71 billion people [95% UI 1·63–1·80] and 149 million [108–199] YLDs; table, figure 3). Among musculoskeletal disorders, low back pain caused the highest burden, with 568 million people (505–640) and 64 million (45–85) YLDs globally. In fact, low back pain was the leading health condition contributing to the need for rehabilitation services in 134 of the 204 countries analysed (figure 4). The second largest disease area was sensory impairments (677 million people [631–723] and 45 million [31–62] YLDs), which is split between vision loss (329 million people [302–358] and 21 million [15–30] YLDs) and hearing loss (403 million people [357–449] and 24 million [16–33] YLDs). The third largest group was neurological disorders (255 million people [242–268] and 51 million [37–65] YLDs), in which stroke represented the highest need for rehabilitation (86 million people [95% UI 79–94] and 18 million [13–23] YLDs).

There are noticeable differences between prevalence and YLDs. Conditions with higher disability weights contributed more to YLDs than others. For example, vision loss had a prevalence of 329 million (95% UI 302–358) but contributed only 21 million (15–30) YLDs because it had a low average disability weight of 0·06 (0·05–0·09), whereas cerebral palsy had a prevalence of 50 million (44–57) but contributed 11 million (7–15) YLDs because it had an average disability weight of 0·21 (0·15–0·28).

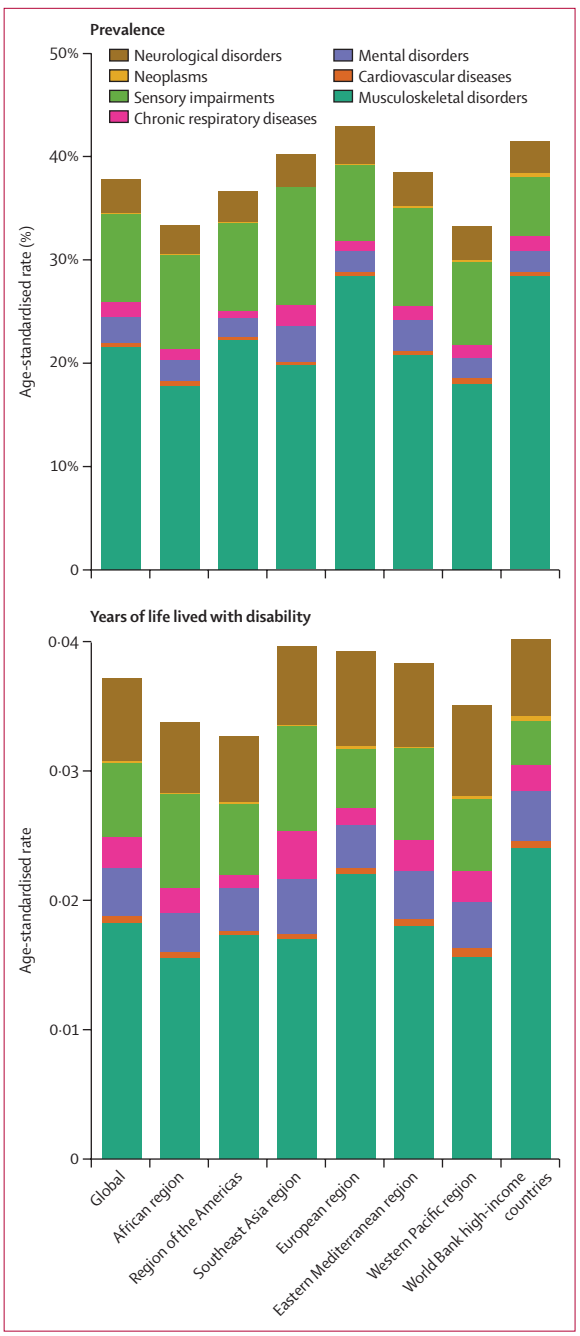

Figure 3: **Age-standardised prevalence rate of conditions that would benefit from rehabilitation and corresponding age-standardised YLDs rate for each major rehabilitation category, globally and by WHO region, 2019**
For both prevalence and YLDs, the total height of the bars is higher than the age-standardised rates, corresponding to total need for rehabilitation. Each coloured section represents the age-standardised prevalence of individuals with at least one condition in this rehabilitation category or the corresponding age-standardised YLD rate. When we aggregated to all rehabilitation, we accounted for individuals with conditions in more than one category. YLDs=years of life lived with disability.

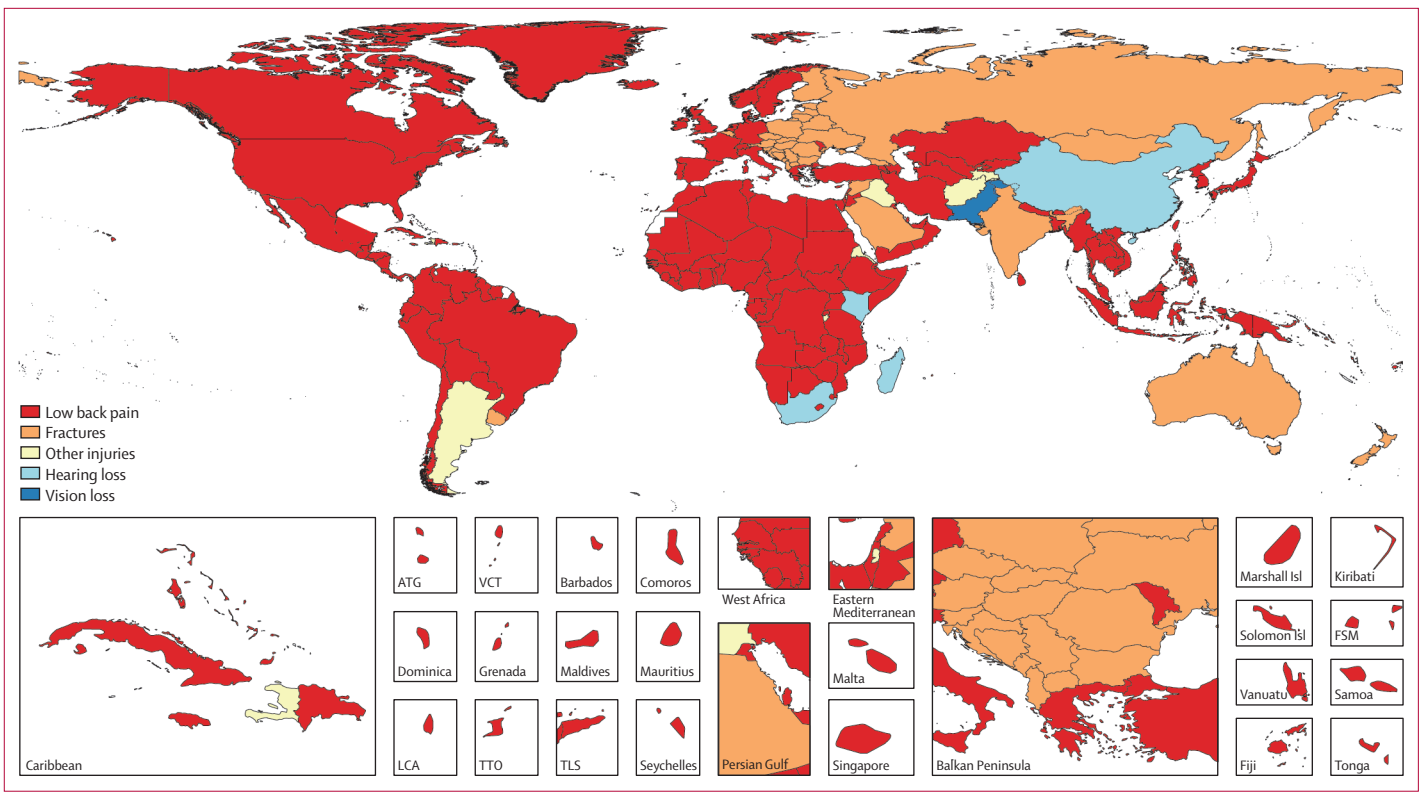

***Figure 4*: Map of leading health conditions requiring rehabilitation in each country, 2019**
Each country's colour corresponds to the health condition with the highest number of individuals requiring rehabilitation. ATG=Antigua and Barbuda. FSM=Federated States of Micronesia. LCA=Saint Lucia. Marshall Isl=Marshall Islands. Solomon Isl=Solomon Islands. TLS=Timor-Leste. TTO=Trinidad and Tobago. VCT=Saint Vincent and the Grenadines.

Discussion

Summary of main findings

To our knowledge, this is the first study to produce a global estimate of the need for rehabilitation services. Our findings show that 2·41 billion people (95% UI 2·34–2·50) could benefit from rehabilitation services. This finding means that at least one in every three people in the world needs rehabilitation at some point during the course of their disease or injury. This result counters the common view of rehabilitation as a service for the few. It is also worth noting that our results were an underestimation, as only 25 conditions were selected in the analysis based on their prevalence, associated high levels of disability, and amenability to rehabilitation. People with milder symptoms who were excluded, or individuals with other communicable or non-communicable diseases, as well as older adults (ie, adults aged >65 years) with decreases in functioning without a specific underlying disease might also eventually benefit from rehabilitation services. Even though this list might not seem exhaustive, the selected 25 conditions contributed to a significant percentage of all YLDs associated with chronic conditions and injuries that will benefit from rehabilitation.

The highest contribution to the need for rehabilitation comes from musculoskeletal disorders. Musculoskeletal conditions are among the largest contributors to the need for rehabilitation services among children and account for approximately two-thirds of all prevalent cases in adults. Approximately 1·71 billion people (95% UI 1·63–1·80) have musculoskeletal conditions, with low back pain being the main contributor to the overall burden. In fact, low back pain is the leading health condition contributing to the need for rehabilitation services in 134 of 204 countries analysed. Because of population increases and ageing, the number of people with disability from low back pain is rapidly increasing. In adults, low back pain is the main reason for a premature exit out of the workforce. A study from Australia showed that there was 87% less wealth accumulation in individuals who have retired early because of low back problems than in those who had remained in full-time employment with no health condition, controlling for age, sex, and education.[26] The societal impact of early retirement in terms of direct health-care costs and indirect (ie, work absenteeism or productivity loss) costs is enormous.[27] Projections show that the number of people with low back pain will increase in the future, and even more rapidly in low-income and middle-income countries.[27]

Sensory impairments, including hearing and vision loss, are the second biggest contributor to rehabilitation needs in terms of number of people. They are among the

largest contributors to the need for rehabilitation in children aged under 15 and older adults. This result can be largely attributed to the growing increase in prevalence of health conditions like myopia among school-aged children, and increases in the number of older adults with age-related conditions (eg, presbyopia, glaucoma, age-related macular degeneration, and age-related hearing loss due to global population growth and ageing).[28] More than 730 million people require rehabilitation, which might be in the form of provision of assistive devices (eg, spectacles for vision loss and hearing aids or cochlear implants for hearing loss) or services like speech and language therapy and vision rehabilitation. Vision impairment and blindness caused by many major eye conditions (eg, glaucoma and age-related macular degeneration) often cannot be cured, so rehabilitation is the main available strategy. In terms of hearing loss, it has been calculated that if everyone in need of a hearing aid used one, the disability associated with the condition would be reduced by 59%.[29]

A high number of people with cerebral palsy require rehabilitation services. 50 million people (95% UI 44–57) with cerebral palsy, accounting for 11 million (7·4–15·0) YLDs, require long-term rehabilitative care. For vision and hearing loss, use of spectacles or hearing aids can substantially improve the disability level of those in need, and this change would require one or a few encounters with rehabilitation specialists. In the case of cerebral palsy, the services involve long-term care from primary-care physicians and specialists in neurology and rehabilitation. The life expectancy of individuals with cerebral palsy in high-income countries often approaches that of the general population, and rehabilitation interventions could be beneficial throughout the life span.[30] Rehabilitation care encompasses various approaches and techniques, from the very conservative (eg, muscle strengthening, manual stretching, and massage) to the more complex (eg, motor learning-based care or conductive education). Recently, the focus of rehabilitation interventions shifted to neurological rehabilitation in response to increasing evidence for neuroplasticity.[31]

Another group of conditions that contributes largely to the overall need of rehabilitation is injuries. Almost 1 billion people live with the consequences of fractures, amputations, spinal cord injury, traumatic brain injury, or other injuries. The GBD 2019 data only included patients who either warranted inpatient care or other health care. For many of these patients, especially those living with long-term consequences of the injury, rehabilitation is essential. Normally, the YLDs from injuries are largest between the ages of 20 and 69 years,[1] which encompasses the working age population, promoting the importance of investing in rehabilitation to gain individual and societal benefits.

The number of YLDs associated with all health conditions has increased substantially, with a 69% increase seen since 1990. As we have assumed the same distribution of disability in the population across countries and regions over the years, reasons for this increase can be searched by analysing the changes in the prevalence of conditions. These changes can vary substantially across conditions and be explained by epidemiological and demographic transitions, such as increases in the population, increased ageing of the population, or the effect of different environmental or lifestyle factors.

Need to scale up rehabilitation services in primary care

Rehabilitation has often been construed to be a very specialised and expensive service for the few, but our findings challenge this view as we show that rehabilitation is needed by 2·41 billion people who have a wide variety of health conditions. In addition, there is emerging evidence that many of the people affected by the COVID-19 pandemic have long-term consequences regardless of the disease severity or length of hospitalisation, and it is clear that many of them will be living with different sequelae after the acute phase of COVID-19, thus increasing the demand for rehabilitation services globally.[32,33] The only possible way to scale up rehabilitation to reach all those in need is through its integration into the health system and, specifically, for rehabilitation services to be strengthened at the primary care level. Our findings, combined with the changing global demographic and health trends, place new and major demands on health and social systems, increasing the need for strong primary care. As the increase in prevalence of non-communicable diseases and population ageing continues, the number of people who would benefit from rehabilitation close to their homes will also increase. In addition, primary care is an especially important platform for the identification and referral of children with developmental, cognitive, and other congenital conditions, as these children might never enter the hospital system and need long-term rehabilitation.

Strengthened primary care is key to overcoming the enormous gap in provision of rehabilitation services, especially in many low-income and middle-income countries that still conceive health systems as so-called sick care systems. Primary care should be the setting where diagnosis of most health conditions, identification of problems in functioning, referral to specialised service delivery platforms, and adherence to treatment plans need to occur. Promoting these functions of primary care will ensure that a life-course and integrated perspective on care is achieved, thus improving the functioning and quality of life of the population. In addition to health benefits, rehabilitation provided in primary care also leads to broader social benefits. Early intervention provided at primary care can substantially reduce the prevalence and delay the onset of disabling effects of chronic conditions in adults and children, such as managing cognitive decline for people with dementia, maintaining movement for people with arthritis, and optimising functioning for children with cerebral palsy.[11–13] Furthermore, rehabilitation

provided close to people's homes helps them do better and remain in education and the workforce, as well as remain independent for longer, leading to substantial cost benefits for both the individual and society.[34,35] People with chronic health conditions require long-term rehabilitation services which, if not accessible at the primary care level, can leave them behind. Also, as populations are expected to age, the need for long-term care is going to increase, especially in low-resource settings where already a large part of the world's ageing population lives. Rehabilitation should be integrated as an essential strategy in long-term care, as its main goal is to improve limitations in everyday functioning due to ageing or underlying health conditions.

Evidence of the benefits of integrating rehabilitation in primary care is still weak. There are examples of effective community-based rehabilitation programmes where general practitioners have been trained successfully in delivering rehabilitation services by a specialised workforce.[36] In addition, countries like Chile, Fiji, and Canada have already made successful steps to integrating rehabilitation services into primary care.[37–39] When health systems move forward towards integrating rehabilitation into primary care, it will be of utmost importance to embed research and generate evidence.

There are two main implications of including rehabilitation at the primary health-care level. First, the traditional workforce in primary care settings (eg, general practitioners, primary care nurses, and community health workers) need to be trained in assessing rehabilitation needs and in the delivery of rehabilitation interventions that address common health problems, such as back pain, COPD, or cardiac disease.[40–42] Second, rehabilitation specialists (eg, physiotherapists, occupational therapists, and speech and language therapists) should be included in the primary care workforce. Several simple actions can be taken to ensure this inclusion in communities: rehabilitation competencies can be integrated into general practitioners' training and certification in accordance with the needs of the population, degree programmes for rehabilitation disciplines can be included in universities, rehabilitation personnel should be paid competitive salaries and have opportunities for career progression, and tele-rehabilitation—the delivery of health-care services via information and communication technologies—can be introduced to support general practitioners.[43–45] Besides general practitioners, other relevant health-care professionals, policy makers, and people who require rehabilitation services should also be educated and empowered to be an integral part of this process.

Even though this Article shows the huge need for rehabilitation and can be used to draw attention to the importance of rehabilitation, challenges remain to make policy makers see the need to invest in rehabilitation services given the diversity of rehabilitation interventions. As shown in the appendix (p 169), the available rehabilitation interventions, and their effectiveness, vary substantially depending on the patient's underlying health condition. For some patients, short-term interventions or provision of simple assistive technology solutions (eg, hearing aids or spectacles) can substantially improve an individual's functioning, but other long-lasting conditions (eg, cerebral palsy) might require long-term or even lifelong rehabilitation services. Rehabilitation interventions might also vary in terms of associated costs and acceptability. To overcome this challenge and make rehabilitation a political priority, rehabilitation stakeholders need to unite behind the common concept of functioning. Optimising functioning is the ultimate objective of rehabilitation, regardless of who the beneficiary is, who delivers it, or the context in which rehabilitation is delivered. Moreover, optimising functioning is also instrumental to a patient's wellbeing, regardless of the underlying health condition. Functioning is also WHO's third health indicator, alongside mortality and morbidity. In an ageing world where more and more people live longer due to advances in preventive strategies and medical interventions, but often with more disability, functioning needs urgent attention from political leaders and presents a unique opportunity for advocacy.

Limitations

This Article has several important limitations to consider. We must consider all of the limitations presented by the GBD study, which are highlighted elsewhere.[1] Notably, where there are no primary data, estimates rely on predictive covariates and geographical proximity to countries with data. When including diseases and sequelae, we selected any that could benefit from rehabilitation at any point during disease or illness, which does not mean that all 2·45 billion people have acute need for rehabilitation. Results must be interpreted accordingly. For cerebral palsy, we estimated total prevalence by aggregating each of the sequalae, including moderate or severe motor impairment, rather than estimating cerebral palsy on the basis of registries or prevalence studies. Data exist to meta-analyse the epidemiology of cerebral palsy. In the future, we plan to do so and then constrain our cause-specific estimates of cerebral palsy outcomes of other diseases to the total estimates.

Disability weights reflect the severity of a disease and are needed to quantify health losses relating to non-fatal outcomes, expressed as YLDs. The standardisation and global comparison of disability weights can be seen as a limitation because of cultural, educational, environmental, and demographic differences across populations. In this study, the average disability weight is the product of the severity distribution data with the disability weights for each level of severity. In previous large-scale disability weights studies,[46] we found a high correlation in answers between the various country survey sites and the internet survey panel, despite very large differences in socioeconomic status and level of education. We have postulated that responding to direct questions on health loss rather

than wider welfare loss makes valuations of health states less socially determined. Several ongoing disability weight studies in different countries will shed further light on the topic.

Furthermore, assuming an independent distribution of co-occurring diseases within the population, there is a possibility that our study might have overestimated prevalence. For some of the included causes, we expected a higher probability of overlapping diseases, but sufficiently detailed individual level information is unavailable to quantify this. Finally, we recognise that the available evidence on the effectiveness of rehabilitation interventions for particular health conditions is scarce and low in quality. We have provided a comprehensive table in the appendix (p 169) with the latest evidence-based effectiveness studies on rehabilitation for each of the 25 selected health conditions.

Contributors

AC, SC, KK, and TV conceptualised the manuscript. TV, KC, and SWH directly accessed and verified the data, undertook all statistical analyses, and interpreted the data. KC, SWH, and KK wrote the manuscript. AC, SC, and TV reviewed, commented on, and critically revised the manuscript for important intellectual content. All authors approved the final version of the manuscript to be published. All authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors had access to the data and accept responsibility for submitting the article for publication.

Declaration of interests

KC and SWH report personal fees from WHO, during the conduct of the study. All other authors declare no competing interests.

Data sharing

We are building a bespoke visualisation tool, which will be available to access in January, 2021 [URL: https://vizhub.healthdata.org/rehabilitation/]. The tool will allow users to view all the results in maps, bar charts, and line charts for a country or world region of interest and by detail of prevalence, years of life lived with disability, age, sex, and year. The tool will also allow users to download any of the data that go into a graph or map. The functionality will be very similar to the general GBD Compare tool.

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Editorial note: the *Lancet* Group takes a neutral position with respect to territorial claims in published maps and institutional affiliations.

References

1 GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396:** 1204–22.

2 WHO. World report on ageing and health. Geneva: World Health Organization, 2015.

3 Chatterji S, Byles J, Cutler D, Seeman T, Verdes E. Health, functioning, and disability in older adults—present status and future implications. *Lancet* 2015; **385:** 563–75.

4 Cieza A. Rehabilitation the health strategy of the 21st century, really? *Arch Phys Med Rehabil* 2019; **100:** 2212–14.

5 Shields GE, Wells A, Doherty P, Heagerty A, Buck D, Davies LM. Cost-effectiveness of cardiac rehabilitation: a systematic review. *Heart* 2018; **104:** 1403–10.

6 Howard-Wilsher S, Irvine L, Fan H, et al. Systematic overview of economic evaluations of health-related rehabilitation. *Disabil Health J* 2016; **9:** 11–25.

7 Lin CWC, Haas M, Maher CG, Machado LA, van Tulder MW. Cost-effectiveness of guideline-endorsed treatments for low back pain: a systematic review. *Eur Spine J* 2011; **20:** 1024–38.

8 Miyamoto GC, Lin CC, Cabral CMN, van Dongen JM, van Tulder MW. Cost-effectiveness of exercise therapy in the treatment of non-specific neck pain and low back pain: a systematic review with meta-analysis. *Br J Sports Med* 2019; **53:** 172–81.

9 Dee M, Lennon O, O'Sullivan C. A systematic review of physical rehabilitation interventions for stroke in low and lower-middle income countries. *Disabil Rehabil* 2020; **42:** 473–501.

10 Oldridge NB, Pakosh MT, Thomas RJ. Cardiac rehabilitation in low- and middle-income countries: a review on cost and cost-effectiveness. *Int Health* 2016; **8:** 77–82.

11 Nguyen C, Lefèvre-Colau MM, Poiraudeau S, Rannou F. Rehabilitation (exercise and strength training) and osteoarthritis: a critical narrative review. *Ann Phys Rehabil Med* 2016; **59:** 190–95.

12 WHO. Risk reduction of cognitive decline and dementia: WHO guidelines. 2019. https://www.who.int/mental_health/neurology/dementia/guidelines_risk_reduction/en/ (accessed Oct 4, 2020).

13 Damiano DL. Rehabilitative therapies in cerebral palsy: the good, the not as good, and the possible. *J Child Neurol* 2009; **24:** 1200–04.

14 Moreau NG, Bodkin AW, Bjornson K, Hobbs A, Soileau M, Lahasky K. Effectiveness of rehabilitation interventions to improve gait speed in children with cerebral palsy: systematic review and meta-analysis. *Phys Ther* 2016; **96:** 1938–54.

15 Katajisto M, Laitinen T. Estimating the effectiveness of pulmonary rehabilitation for COPD exacerbations: reduction of hospital inpatient days during the following year. *Int J Chron Obstruct Pulmon Dis* 2017; **12:** 2763–69.

16 Thomas E, Lotfaliany M, Grace SL, et al. Effect of cardiac rehabilitation on 24-month all-cause hospital readmissions: a prospective cohort study. *Eur J Cardiovasc Nurs* 2019; **18:** 234–44.

17 Stucki G, Stier-Jarmer M, Grill E, Melvin J. Rationale and principles of early rehabilitation care after an acute injury or illness. *Disabil Rehabil* 2005; **27:** 353–59.

18 Arbesman M, Logsdon DW. Occupational therapy interventions for employment and education for adults with serious mental illness: a systematic review. *Am J Occup Ther* 2011; **65:** 238–46.

19 Désiron HA, de Rijk A, Van Hoof E, Donceel P. Occupational therapy and return to work: a systematic literature review. *BMC Public Health* 2011; **11:** 615.

20 Prvu Bettger JA, Stineman MG. Effectiveness of multidisciplinary rehabilitation services in postacute care: state-of-the-science. A review. *Arch Phys Med Rehabil* 2007; **88:** 1526–34.

21 Sarfo FS, Ulasavets U, Opare-Sem OK, Ovbiagele B. Tele-rehabilitation after stroke: an updated systematic review of the literature. *J Stroke Cerebrovasc Dis* 2018; **27:** 2306–18.

22 Ferguson MA, Kitterick PT, Chong LY, Edmondson-Jones M, Barker F, Hoare DJ. Hearing aids for mild to moderate hearing loss in adults. *Cochrane Database Syst Rev* 2017; **9:** CD012023.

23 Stucki G, Bickenbach J, Gutenbrunner C, Melvin J. Rehabilitation: the health strategy of the 21st century. *J Rehabil Med* 2018; **50:** 309–16.

24 Salomon JA, Haagsma JA, Davis A, et al. Disability weights for the Global Burden of Disease 2013 study. *Lancet Glob Health* 2015; **3:** e712–23.

25 WHO. World health statistics 2019: monitoring health for the SDGs. Annex C: WHO regional groupings. 2017. https://www.who.int/gho/publications/world_health_statistics/2017/EN_WHS2017_AnnexC.pdf?ua=1 (accessed Oct 4, 2020).

26 Schofield D, Kelly S, Shrestha R, Callander E, Passey M, Percival R. The impact of back problems on retirement wealth. *Pain* 2012; **153:** 203–10.

27 Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *Lancet* 2018; **391:** 2356–67.

28 WHO. World Report on Vision. Geneva, Switzerland: World Health Organization, 2019.

29 Orji A, Kamenov K, Dirac M, Davis A, Chadha S, Vos T. Global and regional needs, unmet needs and access to hearing aids. *Int J Audiol* 2020; **59:** 166–72.

30 Blair E, Langdon K, McIntyre S, Lawrence D, Watson L. Survival and mortality in cerebral palsy: observations to the sixth decade from a data linkage study of a total population register and National Death Index. *BMC Neurol* 2019; **19:** 111.

31 Aisen ML, Kerkovich D, Mast J, et al. Cerebral palsy: clinical care and neurological rehabilitation. *Lancet Neurol* 2011; **10:** 844–52.

32 Halpin SJ, McIvor C, Whyatt G, et al. Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: a cross-sectional evaluation. *J Med Virol* 2020; published online July 30. https://doi.org/10.1002/jmv.26368.

33 Negrini F, De Sire A, Andrenelli E, Lazzarini SG, Patrini M, Ceravolo MG. Rehabilitation and COVID-19: the Cochrane Rehabilitation 2020 rapid living systematic review. Update as of July 31st, 2020. *Eur J Phys Rehabil Med* 2020; published online Sept 1. https://doi.org/10.23736/S1973-9087.20.06539-9.

34 Ni M, Brown LG, Lawler D, et al. The rehabilitation enhancing aging through connected health (REACH) study: study protocol for a quasi-experimental clinical trial. *BMC Geriatr* 2017; **17:** 221.

35 Persson J, Bernfort L, Wåhlin C, Öberg B, Ekberg K. Costs of production loss and primary health care interventions for return-to-work of sick-listed workers in Sweden. *Disabil Rehabil* 2015; **37:** 771–76.

36 Jianjun Yu, Yongshan Hu, Wu Y, et al. The effects of community-based rehabilitation on stroke patients in China: a single-blind, randomized controlled multicentre trial. *Clin Rehabil* 2009; **23:** 408–17.

37 WHO Regional Office for the Western Pacific. Evaluation of Fiji's Mobile Rehabilitation Service. Philippines: World Health Organization, 2017.

38 Ministerio de Salud Chile. Model de Gestion Red de Rehabilitacion. Chile: Gobierno de Chile, 2018. https://www.minsal.cl/programa-de-salud-2018-2022/ (accessed Oct 4, 2020).

39 Ontario Physiotherapy Association. Physiotherapy in primary health care. 2017. https://opa.on.ca/wp-content/uploads/Physiotherapists-Primary-Health-Care.pdf (accessed Nov 16, 2020).

40 Heiberg KE, Bruun-Olsen V, Bergland A. The effects of habitual functional training on physical functioning in patients after hip fracture: the protocol of the HIPFRAC study. *BMC Geriatr* 2017; **17:** 23.

41 Sjöström-Strand A, Ivarsson B, Sjöberg T. Primary health care resources for rehabilitation and secondary prevention after myocardial infarction—a questionnaire survey. *Scand J Caring Sci* 2013; **27:** 260–66.

42 Sundh J, Lindgren H, Hasselgren M, et al. Pulmonary rehabilitation in COPD—available resources and utilization in Swedish primary and secondary care. *Int J Chron Obstruct Pulmon Dis* 2017; **12:** 1695–704.

43 Peretti A, Amenta F, Tayebati SK, Nittari G, Mahdi SS. Telerehabilitation: review of the state-of-the-art and areas of application. *JMIR Rehabil Assist Technol* 2017; **4:** e7.

44 Frederix I, Solmi F, Piepoli MF, Dendale P. Cardiac telerehabilitation: a novel cost-efficient care delivery strategy that can induce long-term health benefits. *Eur J Prev Cardiol* 2017; **24:** 1708–17.

45 Nelson M, Russell T, Crossley K, Bourke M, McPhail S. Cost-effectiveness of telerehabilitation versus traditional care after total hip replacement: a trial-based economic evaluation. *J Telemed Telecare* 2019; published online Sept 17. https://doi.org/10.1177/1357633X19869796.

46 Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. *Lancet* 2012; **380:** 2129–43.