THE

INEQUITIES

OF MENTAL HEALTH RESEARCH FUNDING

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International Alliance of
Mental Health Research Funders

About the International Alliance of Mental Health Research Funders

The **IAMHRF** is a global network of the world's largest and most innovative funders of mental health research. It aspires to harmonize and coordinate mental health research funding and, through its achievements, ultimately benefit patients and families. Through a series of targeted activities, it leverages individual efforts to increase their impact beyond what each funder could achieve on its own. It acts as the convener, curator and catalyzer of global mental health research investments.

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Contents

1 Executive summary

One in four people in the world will be affected by a mental disorder at some point in their life, and mental health problems are currently the leading cause of global morbidity. Effectively addressing and understanding this vast unmet need requires research that spans basic research, all the way through to clinical/applied research. Research deepens our knowledge of mental ill-health and its underlying mechanisms and allows us to understand which interventions are effective and for whom.

"About US$3.7 billion a year is spent on mental health research worldwide, equivalent to less than 50 cents per person."

By setting funding levels and designing funding programs, policymakers and funders directly influence what kind of research is being conducted, where and by whom, and at what scale. But our understanding of the distribution of mental health research funding is limited, potentially undermining the effectiveness of such investments. This report attempts to fill that gap for the first time by mapping the global mental health research funding landscape.

The International Alliance of Mental Health Research Funders (IAMHRF) has analyzed over 75,000 research grants awarded by nearly 350 funders from over 35 countries, revealing for the first time the extent and nature of mental health research funding. The analysis shows that:

- **About US$3.7 billion a year is spent on mental health research worldwide, equivalent to less than 50 cents per person.**
- **Mental health research spend is characterized by various inequities:**

1. ***Most mental health research funding is awarded by and spent in high-income countries***. Of the total investment of US$18.5 billion between 2015 and 2019, 98.6% came from high-income countries compared to 1.4% from low- and middle-income countries. This disparity partly reflects the distribution of funders, as 332 of the 345 funders who supported mental health research were from high-income countries.

"Both cancer research and infectious disease research received more than twice as much global investment as mental health research."

2. ***Research into mental health is underfunded compared to other (physical) diseases.*** Both cancer research (19.0%) and infectious disease research (17.5%) received more than twice as much global investment as mental health research (7.4%). However, mental health research received more investment than research into metabolic diseases (3.9%) and respiratory conditions (2.3%). Dementias were excluded from the definition of mental health used in this study and are instead included in the neurological research category (13.2%).

3. ***Specific fields of mental health research – notably self-harm and suicide, eating, conduct, obsessive-compulsive and personality disorders – are relatively underfunded compared to other fields such as substance use and dependence, and depression.*** Research related to substance use and dependence received the most funds at an approximate average of US$700 million per year (or 19% of the total), followed by depression with close to US$320 million per year (or 9%). Eating, conduct, obsessive-compulsive and personality disorders, and self-harm each received under US$25 million per year, or less than 1% of the total expenditure. Self-harm and suicide account for over half of all *years of life lost* due to mental illness, yet the analysis shows it received one of the lowest levels of funding.

4. ***The majority of mental health research investment is on basic research, rather than clinical/applied research.*** Over half (56%) of funded mental health research was in basic discovery science. By contrast, the studies into prevention, diagnosis, and treatment of mental health conditions were significantly underfunded, jointly accounting for just 17% of global investments. Of particular concern is the lack of investments into prevention, which accounted for less than 7% of investments, and the evaluation of treatments, which would include randomized controlled trials (RCTs), only received 12% of funding.

5. ***The young are not the focus of mental health research investments, despite anticipated long-term benefits of intervening at this age.*** Most investments in mental health research funding were focused on adults and compared with young people (33%) and the elderly (5%). This is significant because around 75% of all mental illnesses manifest by the age of 24 years, and the onset of most mood, personality, eating and substance use conditions occur within a small timeframe between adolescence and young adulthood.

"The young are not the focus of mental health research investments, despite anticipated long-term benefits of intervening at this age."

- **Mental health research funding that occurs as part of funding into other comorbid conditions is difficult to measure and analyze.**

- **Different regions in the world have different defining characteristics:**

1. ***Australia and New Zealand*** was the only region with a significant increase in funding between 2015 and 2019.
2. ***Canada*** had the smallest median grant value among the examined regions, indicating a smaller project size on average.
3. ***European*** funding was spread relatively evenly across the top five mental health conditions (depression, autism spectrum disorders, substance use and dependence, schizophrenia and psychosis).
4. Over three-quarters of research spend in and by ***low- and middle-income countries*** was on basic research, with limited domestic investment in applied research.
5. Over one-quarter of ***United Kingdom*** mental health research funding came from philanthropy and charity fundraising sources, the highest of any region.
6. The ***United States*** invested proportionately more than any other region in substance use and dependence research compared to other conditions.

Several important lessons were learnt from this baseline analysis, including:

- **Mental health research is underfunded compared to other disease areas, in the context of disease burden.** This gap should be reduced with additional funding, rather than redistribution of existing funding sources.

- **The analysis of sociodemographic characteristics, such as gender and race, is inhibited by a lack of reporting.** Funders (and academics) should be clearer in grant summaries, specifically noting which sociodemographic group the research is addressing.

- **The analysis of comorbidities proved to be challenging and unsatisfactory.** More robust approaches for recording, reporting and analyzing comorbidity research should be developed.

- **Increased transparency and data sharing would improve our understanding of the mental health research landscape.** The low level of funding observed in some sectors may, in part, be due to incomplete data collection and/or a culture that is not accustomed to the of sharing data among non-public organizations.

2 Introduction

Mental health affects us all. One in four people in the world will be affected by a mental disorder at some point in their life [1]. Around 450 million people currently live with such conditions worldwide, placing mental disorders among the leading causes of ill-health and disability [2].

Addressing this vast unmet need requires research, firstly, to guide an understanding of the basic biomedical, psychological and social processes that lead to mental ill-health, and secondly, to discover implementable and affordable interventions that can either prevent such ill-health or provide effective treatment options. But research requires funding, which can be scarce and subject to competing endeavors — everything from road building to healthcare, including mental healthcare. For this reason, those responsible for allocating research funds need to be cognizant of the impact of their policies on the future of the mental health of the world's population. By setting funding levels and designing funding programs, policymakers and funders directly influence what kind of research is being conducted, where and by whom, and at what scale. Unfortunately, our understanding of how mental health research funding is distributed is limited, potentially undermining such investments' effectiveness.

"Our understanding of how mental health research funding is distributed is limited, potentially undermining the effectiveness of investments."

This report attempts to fill that gap by mapping the global mental health research funding landscape. As such, it is the first time that funding patterns for mental health research have been described at an international level. The first part of the report provides more detail on the motivation for this study, the need for collating robust evidence on mental health research funding, and the approaches taken. Part two then provides the study's key findings, structured around a series of inequities identified in the funding data. The final section offers some reflections on the future direction of this type of study, including some of its limitations and the critical need for funders to be willing to share data in the future. This report is envisaged as the first in a series of studies that map the landscape of mental health research investments, with future studies updating the work presented here.

3 The International Alliance of Mental Health Research Funders unites funders on a shared mental health research agenda to save lives, improve treatments and care for patients and their families

With over 30 member and partner organizations from around the world, including many non-English speaking organizations and organizations based in low- and middle-income countries, the International Alliance for Mental Health Research Funders (IAMHRF) was founded to increase the impact of research investments.[a] Its diverse membership makes the IAMHRF a unique alliance, and one that is ideally placed to develop an equitable mental health research agenda. A list of members is provided in Appendix A.

"With over 30 member and partner organizations from around the world...the International Alliance for Mental Health Research Funders (IAMHRF) was founded to increase the impact of research investments."

Today, the ambitions of the IAMHRF are to:

- Achieve significant coordination and alignment of research agendas and strategies across the mental health sector.
- Make research and innovation an integral part of all efforts to promote mental health advocacy, fight stigma and develop effective new treatments and models of care.

Whilst the IAMHRF is focused on research funding, it is important to acknowledge that research is but one part of a wider mental health ecosystem. The mental health ecosystem is comprised of a wide variety of stakeholder groups – including those who deliver mental health services and advocacy groups – each contributing to improving outcomes for people afflicted by mental ill-health. Mental health research funders are a vital component of this ecosystem as the discoveries and innovations that they support are critical for our understanding of mental illness and the development of better interventions and care. Unfortunately, fragmentation and siloed operations have been a hallmark of the mental health ecosystem for decades. The current COVID-19 crisis has laid bare the extreme need for better mental health provision and coordination around the world.

"Mental health research funders are a vital component of this ecosystem, as the discoveries and innovations that they support are critical for our understanding of mental illness and the development of better interventions and care."

Ultimately, the mental health and wellbeing of citizens depend on the engagement of all key players and the astute coordination of their efforts. This is the unique proposition of the IAMHRF: to unite research funders and build bridges to other key stakeholder groups to create an integrated mental health ecosystem that improves the livelihood of those 450 million people who suffer from mental ill-health.

This is the first study to focus on global mental health research investments, and it will complement and improve our understanding of the mental health research system. The allocation of research funding can benefit significantly from both a landscape view of what kind of research is being conducted and from a robust analysis of what has led to desired outcomes and impacts. In turn, these analyses can help advocacy initiatives and demonstrate accountability to taxpayers and donors. Capturing and mapping data on the inputs, processes, outputs, outcomes and impacts of research is crucial for these analyses. This need is even more pressing in fields with a great diversity of science and opinion, such as mental health [3].

[a] The IAMHRF was founded in 2010 as an informal collaborative of four mental health research funders from Canada, the United States, and the United Kingdom. It is managed by the Graham Boeckh Foundation (GBF).

4 Revealing the extent and nature of mental health research funding on a global scale for the first time

Whilst this project is the first of its kind, inasmuch as it provides a global description of mental health research funding, it builds on pioneering work by the UK Clinical Research Collaboration (UKCRC), the UK charity MQ: Transforming mental health, and the European Commission sponsored ROAMER[b] project, in developing approaches to capture and map research investments. The UKCRC publishes regular reports on health research spending, categorized using the Health Research Classification System (HRCS), which includes mental health as a category [4]. MQ, a mental health research charity, further explored this mental health category in a series of analyses (2015, 2019) examining UK funding data through the lens of specific mental health conditions [5, 6]. In these studies, MQ developed a novel method for automatic categorization of mental health research using natural language processing on a large international research database of grant funding, Dimensions, developed and maintained by Digital Science [7]. Some level of international comparison was made possible by a study conducted as part of the ROAMER project, which collated mental health research funding from major funders in four countries – Finland, France, Spain and the UK [8].

"The first challenge faced by the IAMHRF members was to define what is meant by 'mental health research'."

In agreeing to support this project, the first challenge faced by the IAMHRF members was to define what is meant by 'mental health research'. Defining any research field is fraught with difficulties and is inevitably a nebulous process. The IAMHRF, therefore, formed an advisory committee (see Appendix B), to help with confirmation of definitions and study design. The rationale for the chosen definition was that it was used in the previous studies by the UK charity MQ [6], and that it was largely aligned with the conditions listed under mental, behavioral, and neurodevelopmental disorders in the International Classification of Diseases (ICD-11) with the addition of suicide and self-harm, and in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). This means that research into normal psychology, cognition and behavior is in scope, including perception, memory, attention, learning, and social interaction. Basic biomedical studies of the nervous system's normal functioning are included if they study cognition or behavior in some way. Critically, out of the scope of the adopted definition is research into neurological and neurodegenerative diseases such as Alzheimer's disease, and research that is of general health relevance (e.g., research into 'health and wellbeing', 'mental and physical health', research into health behaviors such as diet, and physical exercise).

"Critically, out of the scope of the adopted definition is research into neurological and neurodegenerative diseases such as Alzheimer's disease."

[b] ROAMER stands for A Roadmap for Mental Health Research in Europe.

5 The IAMHRF undertook an international study using natural language processing to analyze over 75,000 research grants awarded by nearly 350 funders from over 35 countries

Once a definition of what constitutes mental health research was agreed, the second challenge faced by the IAMHRF was to identify a dataset that collated research grants. Here, the IAMHRF adopted the approach developed by MQ in partnering with Dimensions, part of the Digital Science group. Dimensions is a database that links a range of scholarly information, including research grants, publications, datasets, patents, and policy documents. Of specific interest for the current project was the database of over 5 million grants from over 500 funders and the approach developed by Digital Science to categorize grants. Using natural language processing and machine learning, Digital Science automatically assigns a consistent set of categories to all documents, based on existing classifications systems from different countries. To maximize the number of mental health grants identified, and as described in the methodological Appendix C and accompanying paper [9], three approaches were used:

"The second challenge faced by the IAMHRF was to identify a dataset that collated research grants."

- **HRCS**
  The first was based on the use of the UKCRC HRCS, which looks closely at the nature/type of the research in different fields, including mental health, and further categorizes funding into eight codes ranging from basic discovery science to prevention research.

- **RCDC**
  The second was based on the Research, Condition, and Disease Categorization (RCDC), a classification scheme used by the US National Institutes of Health (NIH) that focuses on biological function involved in human behavior across many levels of information from molecular to systems to self-assessment which contains several categories relevant to mental health (as described in Table C.1 in Appendix C).[c]

- **MQ**
  The third was the system developed by MQ in their 2015 and 2019 reports. This system is based on ICD-10 and DSM-5 codes related to mental health, and it allows the field to be broken down into 17 subcategories, as well as providing a number of queries for identifying grants that did not fall into any of these subcategories (as described in Table C.1 in Appendix C).

"The IAMHRF put out a call to its members and other relevant funders asking them to submit or update their funded research grants."

To ensure that the Dimensions database had good coverage from mental health research funders, the IAMHRF put out a call to its members and other relevant funders asking them to submit or update their funded research grants to Dimensions. This resulted in four funders updating their data and a further 16 providing information for the first time.

[c] The categories were: 'Anorexia', 'Anxiety Disorders', 'Attention Deficit Disorder (ADD)', 'Autism', 'Bipolar Disorder', 'Child Abuse and Neglect Research', 'Depression', 'Eating Disorders', 'Major Depressive Disorder', 'Post-Traumatic Stress Disorder (PTSD)', 'Schizophrenia', 'Screening And Brief Intervention For Substance Abuse', 'Serious Mental Illness', 'Suicide', 'Suicide Prevention', 'Mental Health'. Note that there is significant overlap between these categories.

Once the search algorithms were developed and the database was updated, it was then possible to identify mental health research grants in the Dimensions database and begin to analyze that subset of data. Over 75,000 research grants awarded by just under 350 funders from over 35 countries between 2015 to 2019 were identified. This accounted for about 4% of the 1.8 million grants active between 2015 and 2019 that are cataloged in the Dimensions database. As detailed in Appendix C and the associated journal publication [9], each of these grants was then further analyzed with information on award size (amount funded), geography (the location of both funder and awardee), characteristics of research participants (age groups), type of research (basic to applied), subcategories of mental health (e.g., schizophrenia or substance use), and source of funding (government, charity, etc.). In addition, the scale of mental health research funding to various measures of disease burden was examined and compared to other diseases such as cancer and cardiovascular disease.

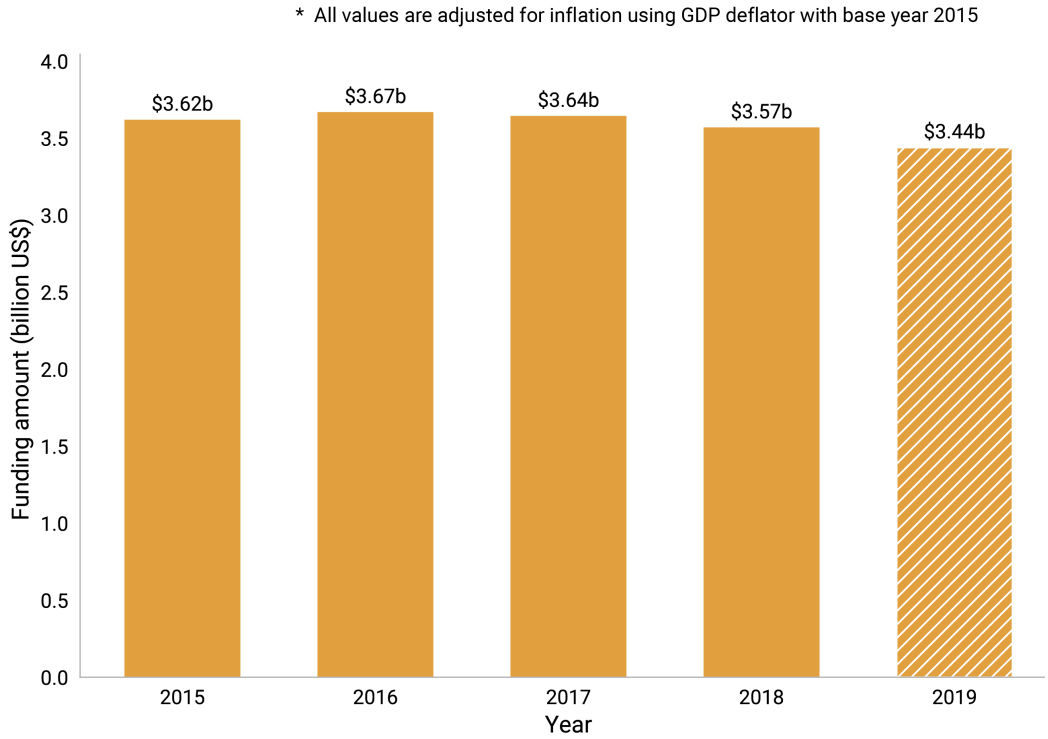
"Over 75,000 research grants awarded by just under 350 funders from over 35 countries between 2015 to 2019 were identified."

6 About US$3.7 billion a year is spent on mental health research worldwide, equivalent to less than 50 cents per person

Of the 75,956 research grants that were active between 2015 and 2019, 65,271 (or 86%) included information on the amount of funding awarded. This totaled US$18.5 billion over the five-year period or US$3.7 billion a year. Given a global population of 7.7 billion people in 2019, this equates to a paltry 50 cents per person per year invested in mental health research. As Figure 1 illustrates, the amount of research funding was relatively stable over the five years that were analyzed, even after adjusting for inflation. The slightly lower funding amount observed in 2019 was likely due to delayed reporting, and hence is shaded in the figure. The median award size was US$187,000, with 2.7% (1,762) of awards less than $10,000 and 0.6% (380) larger than US$10 million.

"Given a global population of 7.7 billion people in 2019, this equates to a paltry 50 cents per person per year invested in mental health research."

Figure 1: Global investments in mental health research in real terms. (Data for 2019 may be an underestimate due to lags in reporting)



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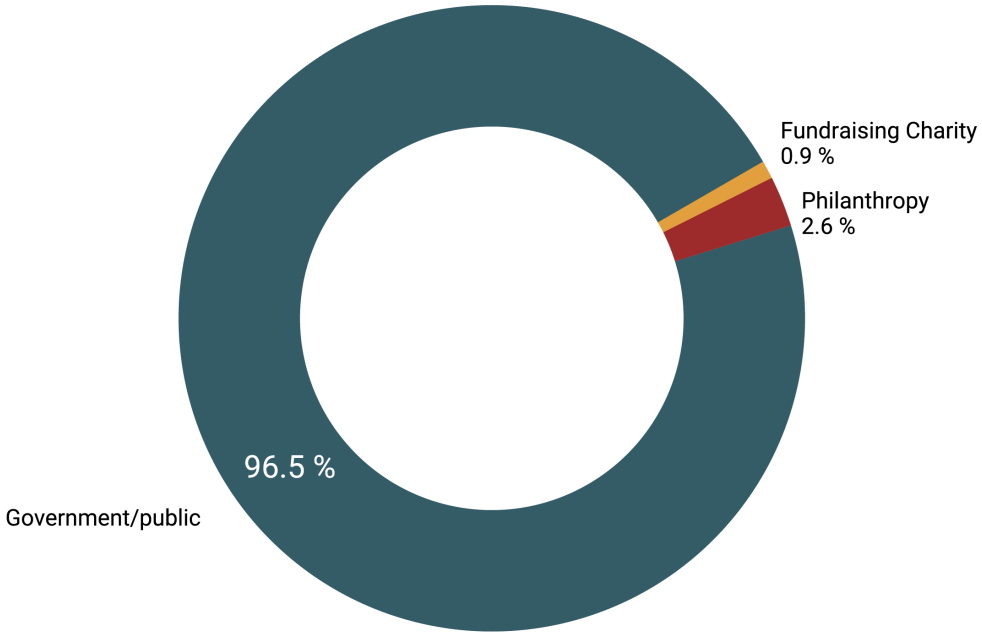
6.1 Over 95% of mental health research funding comes from government

The major contributor to mental health research funding worldwide is governments. As illustrated in Figure 2, over 95% of funding originated from public sources. This was true for all regions except the UK, where philanthropy and charities contribute around a quarter of research investments. Elsewhere, under 5% of funding came from philanthropy and fundraising charities. The low level of funding from other sectors may, in part, be due to incomplete data collection and/or a culture that is not used to the sharing of data among non-public organizations.

Figure 2: Global investments in mental health research by source of funding



6.2 There are important differences in the pattern of mental health research funding by region

The map in Figure 3 provides some key information for each of the geographical regions examined, including the total amount of research spending, the burden of mental ill-health (as measured through *years lived with disability* and *years of life lost* (described in further detail below), and unique characteristics of that funding. For example, as already noted, in the UK one-quarter of funding comes from philanthropy and charity fundraising, whilst Australia and New Zealand (ANZ) is the only region that saw a sustained increase in funding between 2015 and 2019. The median size of research grants in Canada was smaller than in all other regions, suggesting that the country's investments in mental health may be fragmented, whereas, perhaps surprisingly, LMICs made the highest proportionate investment in basic research.

"Australia and New Zealand is the only region that saw a sustained increase in funding between 2015 and 2019."

Figure 3: Summary of key characteristics of the global mental health research investments by region

Canada

Canada had the smallest median value of grant of the regions examined

Research spending per year :	$113.9 million
Median grant size:	$52,000
% awarded by government:	98
% awarded to basic research:	55
Top 2 MH conditions:	1. Depression (9.0%) 2. Substance use (8.6%)
Burden of mental health:	938,543 YLDs 317,586 YLLS

United Kingdom

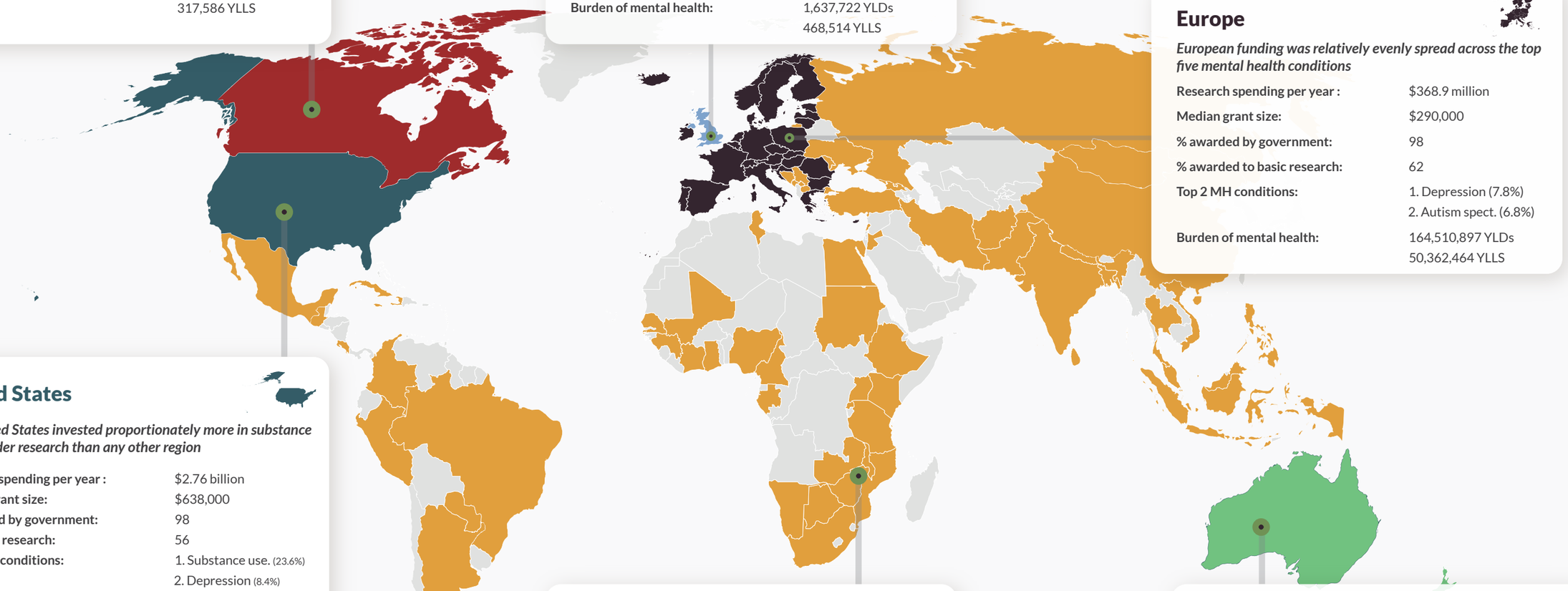
Over a quarter of United Kingdom mental health research funding came from philanthropy and charity fundraising sources

Research spending per year :	$237.1 million
Median grant size:	$404,000
% awarded by government:	74
% awarded to basic research:	46
Top 2 MH conditions:	1. Depression (9.6%) 2. Psychosis (7.4%)
Burden of mental health:	1,637,722 YLDs 468,514 YLLS

Europe

European funding was relatively evenly spread across the top five mental health conditions

Research spending per year :	$368.9 million
Median grant size:	$290,000
% awarded by government:	98
% awarded to basic research:	62
Top 2 MH conditions:	1. Depression (7.8%) 2. Autism spect. (6.8%)
Burden of mental health:	164,510,897 YLDs 50,362,464 YLLS



United States

The United States invested proportionately more in substance use disorder research than any other region

Research spending per year :	$2.76 billion
Median grant size:	$638,000
% awarded by government:	98
% to basic research:	56
Top 2 MH conditions:	1. Substance use. (23.6%) 2. Depression (8.4%)
Burden of mental health:	10,409,579 YLDs 5,491,087 YLLS

Low-middle income countries

Over three quarters of research spend in and by LMICs was on basic research, with limited domestic research investment for applied research

Domestic research spending per year:	$52.2 million
Median grant size:	$79,000
% awarded by government:	98
% to basic research:	76
Top 2 MH conditions:	1. Depression (12.8%) 2. Substance use (5.1%)
Burden of mental health:	123,503,539 YLDs 35,446,014 YLLS

Australia & New Zealand

Australia & New Zealand was the only region with a significant increase in funding between 2015 and 2019

Research spending per year :	$83.2 million
Median grant size:	$353,000
% awarded by government:	97
% to basic research:	49
Top 2 MH conditions:	1. Depression (13.0%) 2. Substance use (7.9%)
Burden of mental health:	803,646 YLDs 230,405 YLLS

7 Mental health research spend is characterized by various inequities

The principal finding of this analysis of global investment in mental health research funding is that it is characterized by **five systemic inequities**:

1. Most mental health research funding is awarded by and spent in high-income countries.
2. Research into mental health is underfunded compared to other (physical) diseases.
3. Specific fields of mental health research – notably suicide and self-harm, eating, conduct, obsessive-compulsive and personality disorders – are relatively underfunded compared to other fields such as substance use and dependence, and depression.
4. The majority of mental health research investment is on basic research, rather than on clinical/applied research.
5. The young are not the focus of mental health research investments, despite the anticipated long-term benefits of early intervention.

"Mental health research funding is characterized by five systemic inequities."

"Per capita per year investment in mental health research in the US is 1000-times greater than in LMICs."

Each of these inequities is examined below, including a detailed description of the data, comparison with other analyses where they exist, and any caveats that need to be considered when interpreting the data.

7.1 Inequity 1: Most mental health research funding is awarded by and spent in high-income countries

As previously illustrated in Figure 3, most mental health research investments are made by funders in high-income countries (HICs), as defined by the World Bank [10]. Of the total five-year investment of US$18.5 billion, 98.6% came from these high-income countries compared to 1.4% from LMICs. This partly reflects the distribution of funders on the database, where 332 of the 345 funders who support mental health research are from HICs. Moreover, as illustrated in Figure 4, the vast majority of that funding was received by HICs (97.6%), while LMICs received just 2.4% of global research investments. Despite some overseas investment, which should be welcomed, the extreme geographical inequity of the distribution of funding per capita by region is clear, as illustrated in Figure 5. Per capita per year investment in mental health research in the US is 1000-times greater than in LMICs.

Figure 4: Global investments in mental health research by country (2015-2019) – first (blue) map is where the funding originates, the second (green) map is where the funding is received

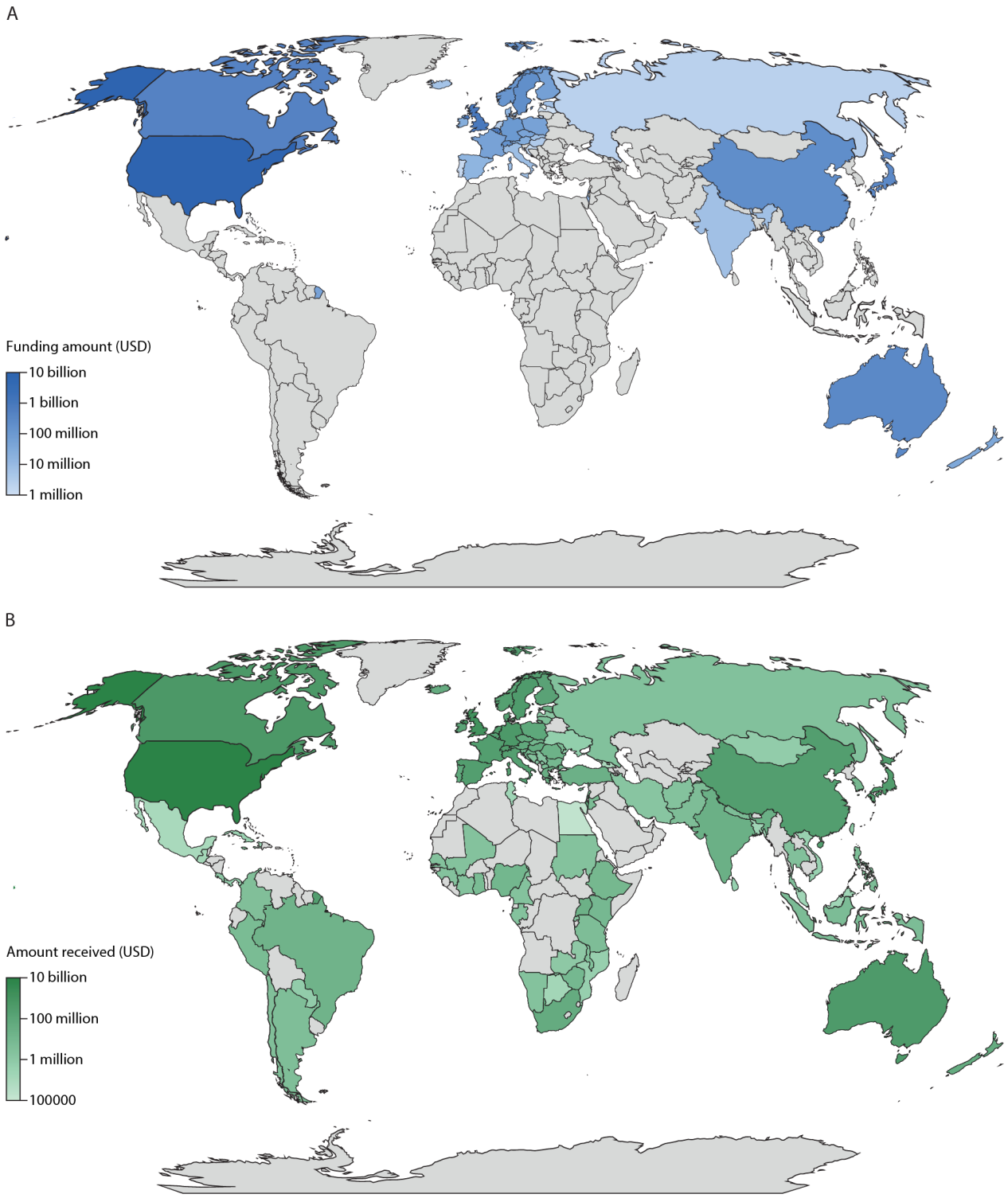


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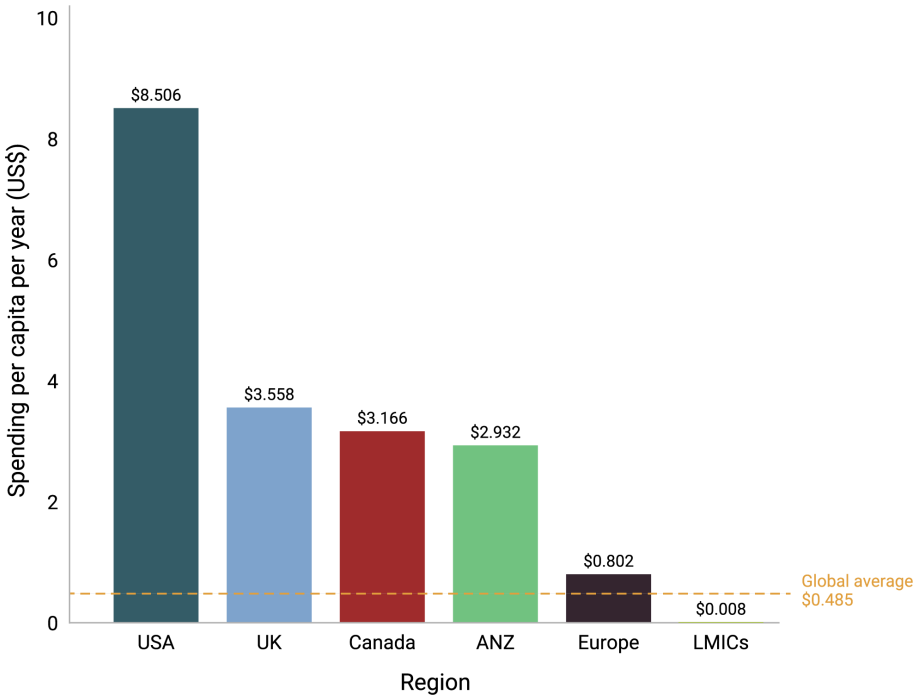
Figure 5: Global investments in mental health research by region



This pattern confirms previous findings that the '10/90 gap' observed in total global investments in health R&D (both public and private sector) also occurs in mental health research [11]. The notion of a 10/90 gap was adopted by the Global Forum for Health Research in the 1990s to highlight the observation that less than 10% of worldwide resources devoted to health research were put towards health in LMICs, where over 90% of all preventable deaths occurred [12]. More recently, [13] estimated that in 2009, US$240 billion was spent on health R&D, of which US$214 billion (90%) was invested in HICs [13]. Based on their analysis, the authors concluded that "the persistent nature of the gap between health R&D needs and the R&D that is presently funded and undertaken calls for managed approaches to the allocation of scarce health research resources." This is significant because the prevalence of different mental health conditions varies by region [14].

"There are important cultural differences in the way that mental health is conceived, classified, and treated in different regions of the world."

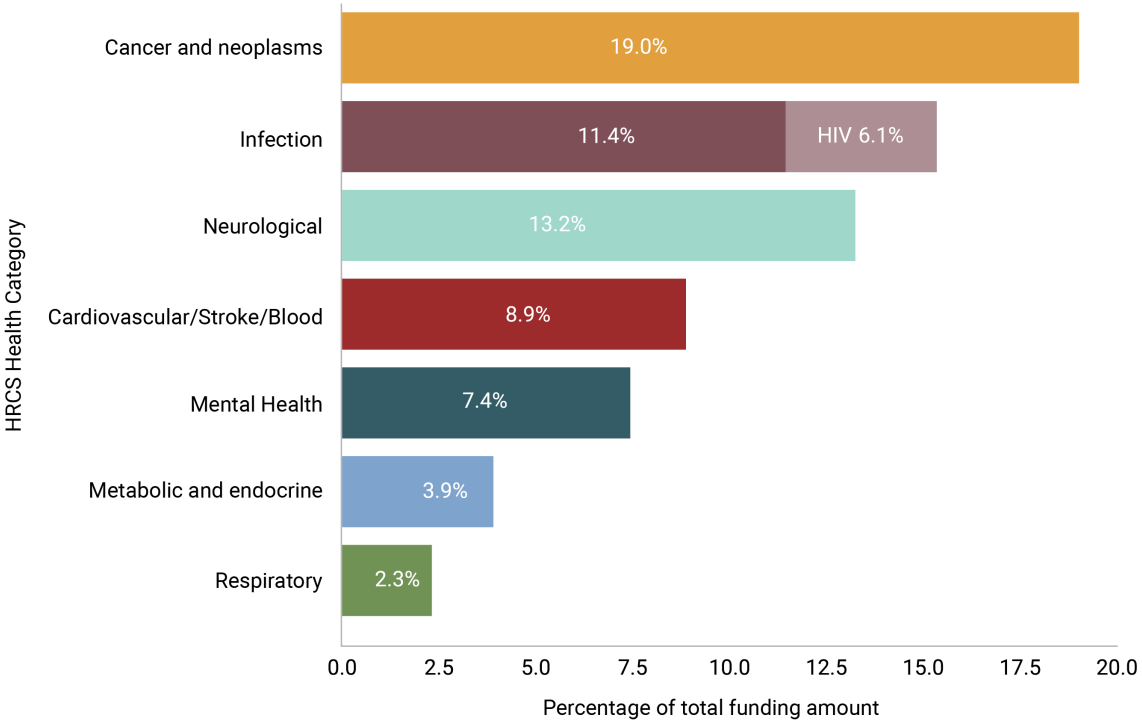
A further complication in interpreting these regional differences in the data is that there are important cultural differences in the way that mental health is conceived, classified, and treated in different regions of the world [15]. For example, a condition may be recognized as a mental illness in one region and not in another. This is significant for, in the current analysis, a HIC definition of mental health has been applied universally. Therefore, in addition to highlighting the underfunding of mental health research in LMICs, it is important to acknowledge that these nuanced cultural differences may not be adequately represented in this analysis. A final point to recognize is that the 'flow' of funding and knowledge is not exclusively from HICs to LMICs. The friendship bench is an extraordinary example of an idea that was developed in Zimbabwe but has subsequently been evaluated and adopted in high-resource settings [16, 17]. In other words, varying resource constraints, differences in health systems, and cultural differences mean that mental health classifications and strategies for prevention and intervention cannot simply be generalized across these fundamentally different contexts. Furthermore, the potential for significant contributions from LMICs must be recognized since severe resource constraints have previously been shown to lead to innovative and cost-effective solutions.

7.2 Inequity 2: Research into mental health is underfunded compared to other (physical) diseases

Figure 6 compares the proportion of mental health research funding with other fields of health research, as determined by analysis of the Dimensions database.[d] The benchmark fields were selected by the advisory committee and illustrate that cancer and neoplasms research and infections research, globally, received more than twice as much investment as mental health research, but that mental health research received more investment than research into metabolic and endocrine diseases and respiratory conditions. The neurological category includes the dementias that were excluded from the definition of mental health used in this study.

"Cancer and neoplasms research and infections research, globally, received more than twice as much investment as mental health research."

Figure 6: Global investments in mental health research compared to other diseases



It is instructive to analyze how research spend relates to the burden of disease, although, as with all benchmarking, such analysis needs to be handled cautiously. To illuminate this further, two key indicators were used – *years lived with disability* (YLD) and *years of life lost* (YLL). *Years lived with disability* measures the number of years someone lives with a disease, taking into account the severity of the illness. As such, it is a measure of the burden of morbidity in a population. By comparison, *years of life lost* (YLL) measures the impact of death caused by a particular condition and is therefore a measure of premature mortality. Although not used in this report, these two indicators are often combined to measure *disability-adjusted life years* (DALYs) to produce a combined measure of the disease's overall burden.

A challenge faced in the current study is that data on the global burden of disease (GBD), which is regularly updated by the Institute for Health Metrics and Evaluation (IHME) (http://www.healthdata.org), uses a different definition for mental health. As explained in the

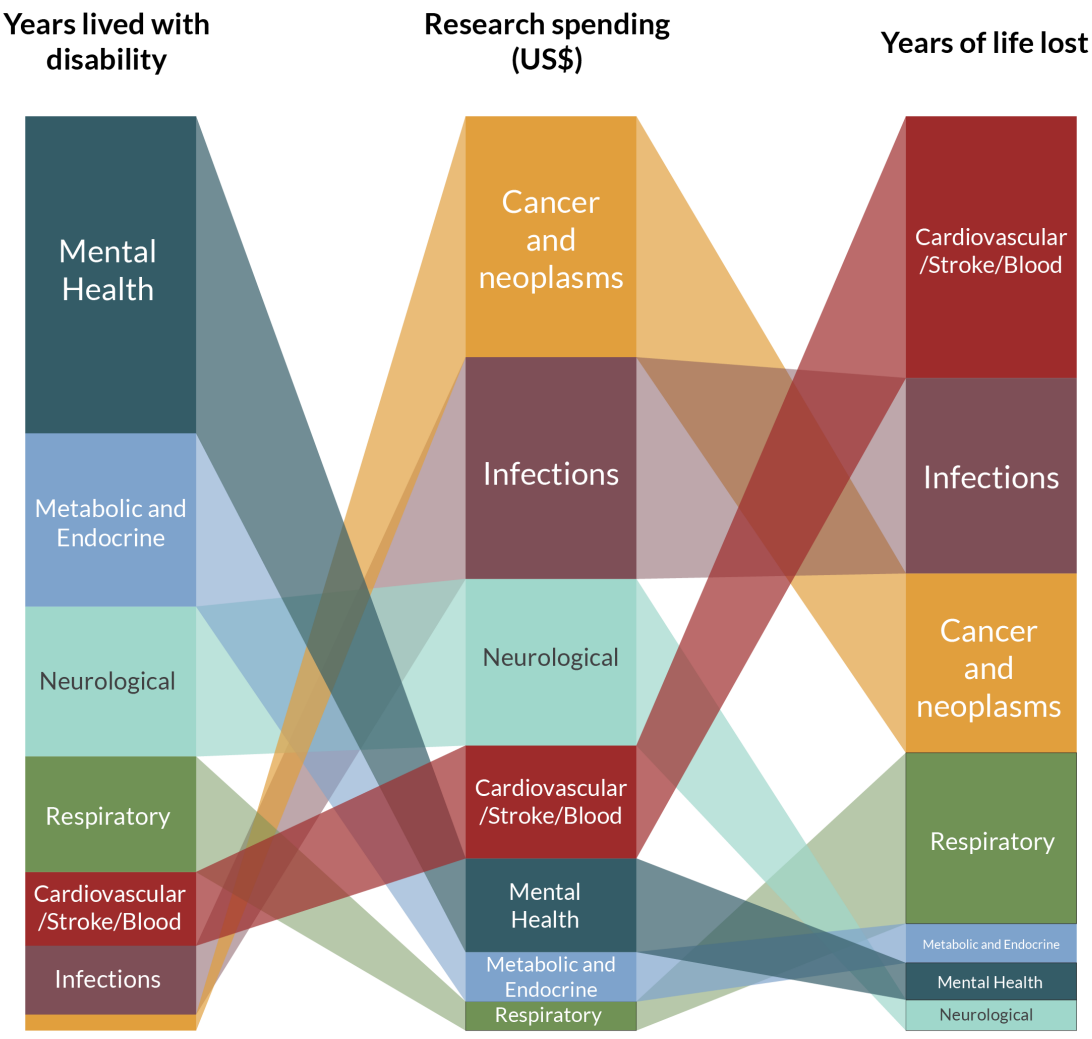
[d] See Appendix C for a detailed description of the methodology.

methodological Appendix C, the IMHE GBD 2017 query tool [18] was used to search for specific conditions aligned with the definition of mental health research used in this report. This meant excluding burden data for Alzheimer's and other neurological conditions, while including substance use and self-harm (which are not within IHME's definition of mental health).

Using this approach, it was possible to examine whether the level of funding for different disease areas was equitable with respect to disease burden, as summarized in Figure 7. The left-hand side of Figure 7 provides the number of YLD, benchmarked against other diseases. This reveals that globally, mental health conditions account for an estimated 20% of all morbidity burden. By comparison, the right-hand side provides the number of YLL, and here the mortality burden is 3%. This illustrates one of the unique characteristics of mental illness: it is a disease that severely impacts your morbidity (and mortality indirectly through poorer physical health) but, with clear exceptions such as suicide, does not kill you directly.[e] In contrast, cardiovascular and related disease fatalities account for 20% of YLL (right-hand side of Figure 7), compared to lower levels of severity adjusted morbidity at 4% (left-hand side of Figure 7).

"While cancer research received US$775 for every *year lived with disability* that it causes, mental health research received only US$15."

Figure 7: Burden of disease for selected health research categories compared to amount spent on research



The most striking finding is that, unlike other disease areas, mental health research is underfunded relative to its share of morbidity burden. For example, while cancer research received US$755 for every YLD, mental health research received only US$15, as summarized in Table 1.

These findings need to be interpreted with care, yet it is clear that when one uses estimates of morbidity burden, such as the number of YLD, there are clear inequities in the distribution of research funds by field of investigation. From a policy viewpoint, this raises the tricky question of whether such investments should be redistributed to create some degree of parity, which by design would mean there are winners and losers, or whether additional funding should be invested in mental health research to ensure an equitable distribution of funding.

"There are clear inequities in the distribution of research funds by field of investigation."

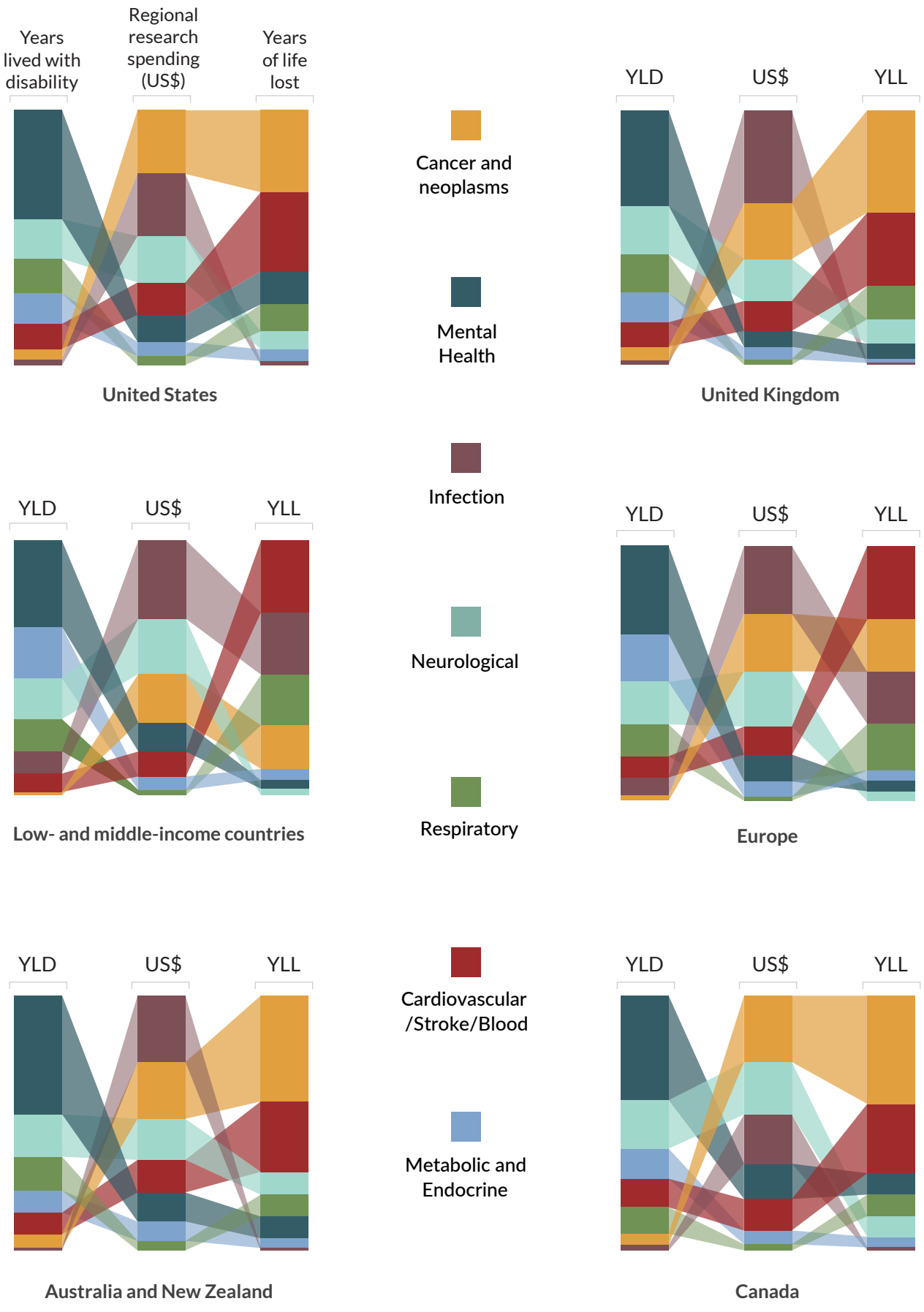
Table 1: Ratio of annual research investments to *years lived with disability* (YLD) and *years of life lost* (YLL)

HRCS categories	US$ invested per YLD	US$ invested per YLL
Cancer and neoplasms	755	26
Neurological	56	108
Infections	161	22
Cardiovascular, blood and stroke	77	8
Mental health	15	49
Metabolic and Endocrine	14	24
Respiratory	13	3

Patterns of disease burden and research funding vary by region, as illustrated in Figure 8 – and described in Annex D. Though mental health is a principal cause of YLD (morbidity) across all regions, there is a geographical variation for YLL (mortality). Cancer and neoplasms are the leading cause of YLL in the US, UK, Australia and New Zealand, and Canada, as opposed to Cardiovascular / Stroke / Blood in LMICs and Europe. Mental health was consistently underfunded (center columns) compared to its morbidity burden (left columns) across all of the regions analyzed.

[e] Indeed, it has been argued that the global burden of mental illness is underestimated due to five main causes: overlap between psychiatric and neurological disorders; the grouping of suicide and self-harm as a separate category; the conflation of all chronic pain syndromes with musculoskeletal disorders; exclusion of personality disorders from disease burden calculations; and inadequate consideration of the contribution of severe mental illness to mortality from associated causes.[19]

Figure 8: Regional disease burden caused by selected health categories, compared to research spending

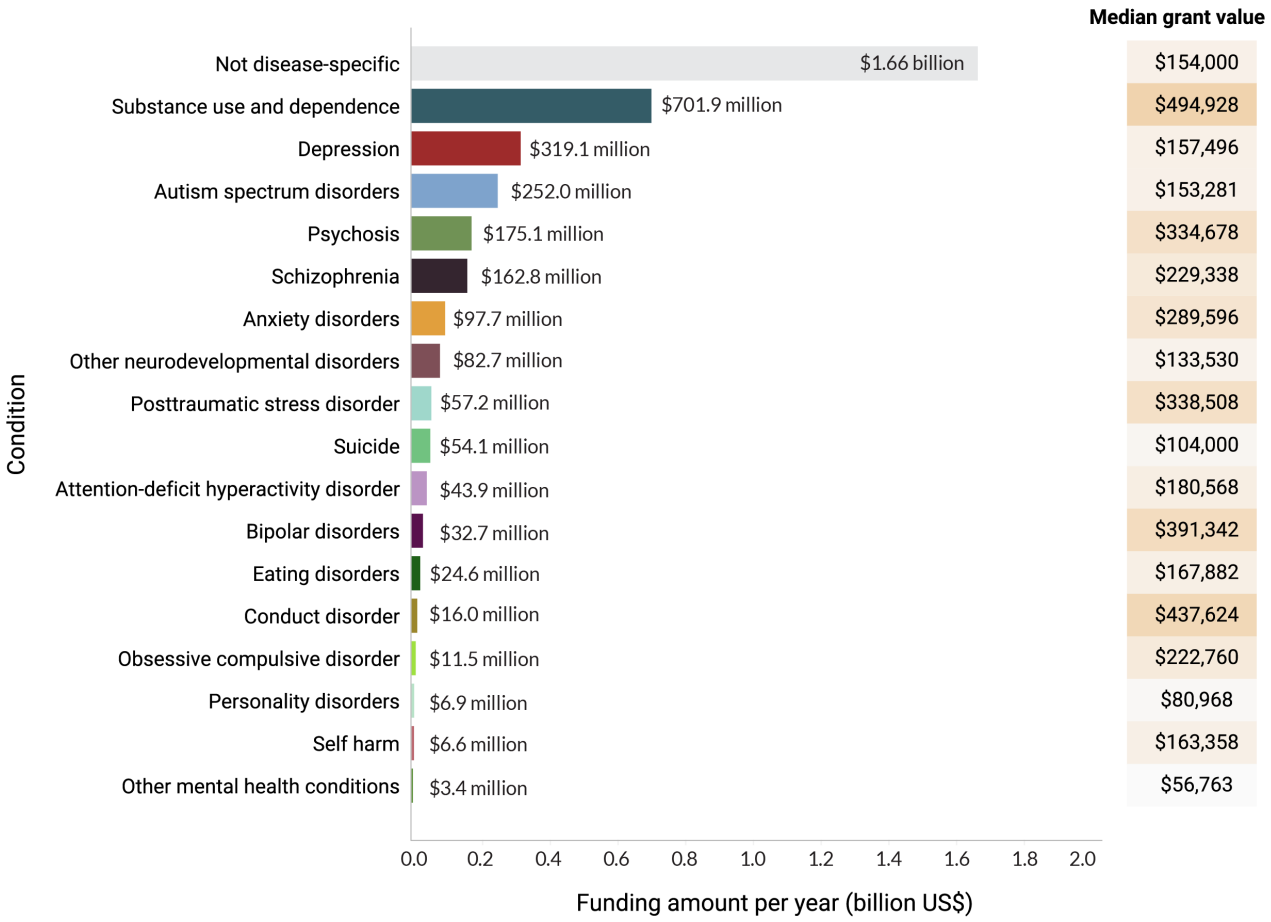


7.3 Inequity 3: Specific fields of mental health research – notably suicide and self-harm, eating, conduct, obsessive-compulsive and personality disorders – are relatively underfunded compared to other fields such as substance use and dependence, and depression

The MQ classification system identified 17 condition-specific categories, alongside two categories for research relevant to mental health in general, facilitating a better understanding of how research investments align with current mental health care. For the purpose of this analysis, grants that do not fall into any of the condition-specific categories are combined into a single category called 'not disease-specific'. This category comprises most grants for research into health services organization, healthy function, risk factors and prevention, as well as studies relevant to many mental health conditions at once such as centres and research infrastructure. As illustrated in Figure 9, just under half of the funds went to research classified as not disease-specific, meaning that it could not be attributed to any of the 17 disease-specific categories. Research related to substance use and dependence received the most funds, averaging around US$700 million per year (or 19% of the total), followed by depression with approximately US$320 million per year (or 9%). At the other end of the spectrum, eating, conduct, obsessive-compulsive and personality disorders, and self-harm each received under US$25 million per year, or less than 1% of the total expenditure.

"More striking is the underfunding of self-harm and suicide, which, despite causing over half of *years of life lost* to mental illness, receive only a small fraction of mental health research funding."

Figure 9: Global investments in mental health research by condition



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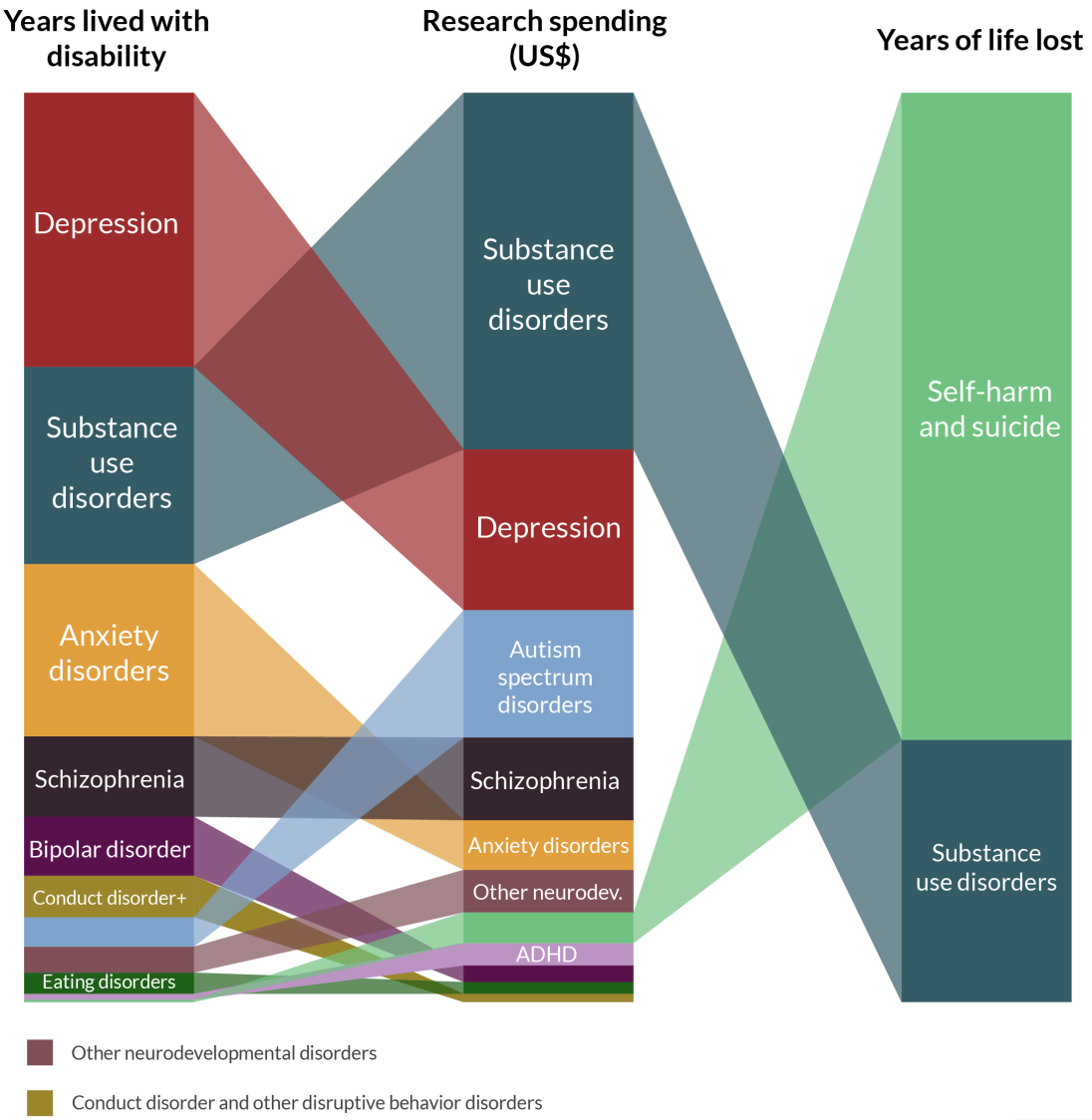
This inequity is even starker in the context of the burden of disease, as measured through YLD and YLL in Figure 10. Depression and substance use account for the highest levels of morbidity burden, which, to a degree, justify current levels of research investment. More striking is the underfunding of self-harm and suicide, which, despite causing over half of *years of life lost* to mental illness, receive only a small fraction of mental health research funding. This figure may be of specific use to current funders of mental health research when identifying gaps that can be effectively addressed.

Figure 10: Burden of disease for selected conditions compared to amount spent on research



7.4 Inequity 4: The majority of mental health research investment is on basic research, rather than on clinical/applied research

The Dimensions database captures research activity using the HRCS Research Activity Codes (RACs), that uses an eight-point scale to classify research along a basic to clinical/applied axis. The activity codes are automatically assigned to health-related grants by a machine-learning algorithm. As illustrated in Figure 11, the majority (56%) of funded mental health research is basic, that is codes 1 (underpinning) and 2 (aetiology). This pattern is similar to that reported for the UK for both mental health research by MQ (46%) and for all research by UKCRC (52%). By contrast, the studies into prevention, detection, and developing treatments (codes 3, 4 and 5) for mental health conditions are significantly underfunded, jointly accounting for 17% of global investments. Of particular concern is the lack of investments into prevention, which account for less than 7% of funding. The final three codes (6, 7 and 8) cover applied research, including the evaluation of treatments (code 6), which encompasses randomized controlled trials (RCTs). Together, these codes account for 12% of funding. However, as illustrated in Figure 12, there are important regional differences. For example, the percentage of funding invested in basic research ranges from 75% in LMICs to 47% in Australia & New Zealand and the UK.

"Studies into prevention, detection, and developing treatments for mental health conditions are significantly underfunded."

The balance of funding between basic and clinical research is one that has been debated in science policy for over 75 years. One argument put forward is that you cannot anticipate the outcomes of basic research due to its unpredictable and serendipitous nature, and the long time it takes for research to translate from bench to bedside. This theory was adopted by Vannevar Bush in his influential 1945 report, The Scientific Frontier, where he stated that "as long as they are vigorous and healthy and their scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge to those who can apply it to practical problems in Government, in industry, or elsewhere" [20]. The contrasting argument is that 85% of research investments are wasted, and that this is partly due to over-investment in basic research [21]. This is supported by the observation that most findings in basic research that appear to be promising either turn out to be false positives or exaggerations. For example, in a study that examined 25,000 papers from six leading basic science journals between 1979 and 1983, 101 included claims that new discoveries had clear clinical potential. Yet, only five resulted in interventions with licensed clinical use by 2003, and only one of those was in regular use [22]. Similarly, in a detailed qualitative study examining how basic mental health research translates into applications, it was concluded that clinical research has had a larger impact on patient care than basic research over the 20 years since the research was undertaken [23].

Figure 11: Annual global investments in mental health research by Research Activity Code (RAC)

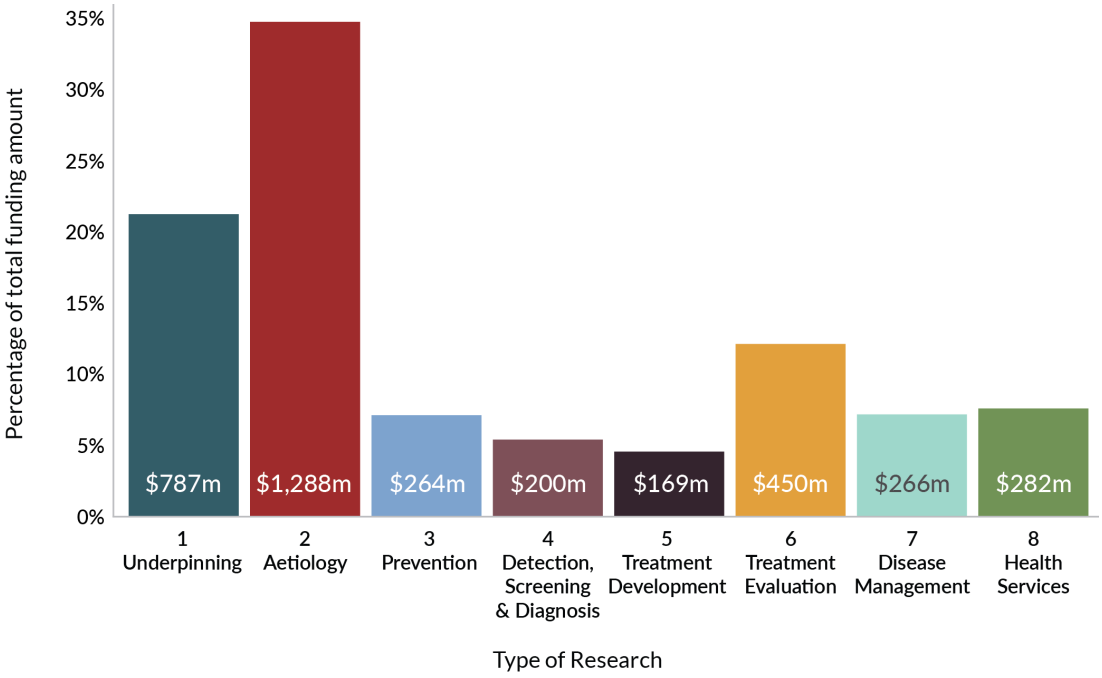


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Figure 12: Regional investments in mental health research by Research Activity Code (RAC)

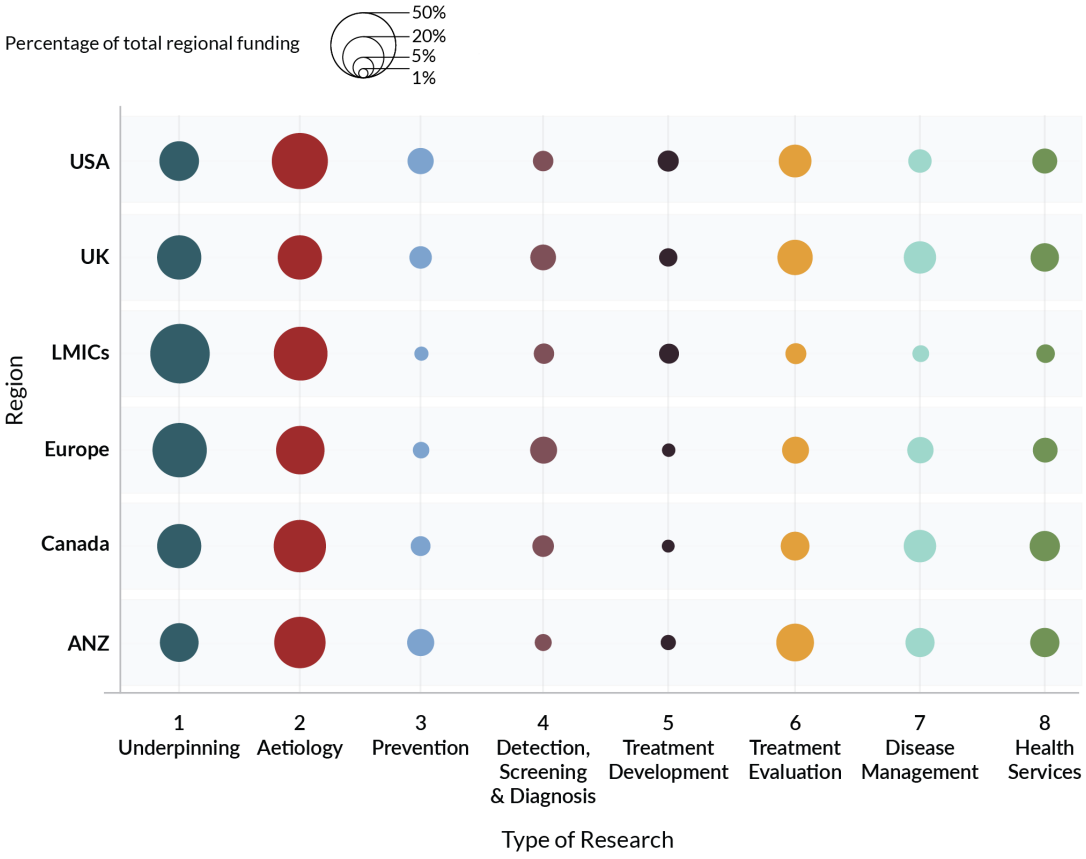


Figure 13 breaks down the type of research by various mental health conditions. At the bottom of the figure, RACs 1 and 2 were combined for basic research, 3, 4 and 5 for translational research and 6, 7 and 8 for applied research. What is evident from this analysis is that schizophrenia has the highest proportion ofinvestments into basic research (at 67%) while, perhaps not surprisingly, self-harm has the highest proportion of applied research (66%). But perhaps the most salient observation is again how little funding there is for prevention research, except for prevention research into suicide and conduct disorder.

Figure 13: Cross tabulation of the percentage of funding of different mental health conditions by Research Activity Code (RAC)

	Research Activity Code (RAC)	Anxiety disorders	Attention-deficit hyperactivity disorder	Autism spectrum disorders	Bipolar disorders	Conduct disorder	Depression	Eating disorders	Not disease-specific	Obsessive compulsive disorder	Other mental health conditions	Other neurodevelopmental disorders	Personality disorders	Posttraumatic stress disorder	Psychosis	Schizophrenia	Self-harm	Substance use and dependence	Suicide
		Mental Health Condition																	
Basic	1 Underpinning	16	8	17	3	7	9	13	36	20	25	16	2	6	5	15	0	10	1
Basic	2 Aetiology	38	45	50	57	55	36	49	27	47	37	37	37	32	46	53	25	35	33
Translational	3 Prevention	1	8	2	0	19	5	5	8	0	2	3	14	1	2	1	7	9	21
Translational	4 Detection, Screening and Diagnosis	4	7	12	10	1	5	3	5	16	21	8	3	4	11	6	1	2	8
Translational	5 Development of Treatments	5	8	2	3	0	3	4	2	4	0	6	3	3	4	9	0	12	0
Applied	6 Evaluation of Treatments	27	14	8	12	12	26	16	6	12	8	5	32	33	19	11	27	16	13
Applied	7 Management of Diseases	6	8	4	9	3	11	7	8	0	1	9	8	11	9	4	19	5	17
Applied	8 Health Services	2	2	4	5	3	5	3	8	1	5	16	1	10	5	2	20	11	7
	Total Basic (RAC 1 & 2)	55	53	67	61	62	45	62	63	67	62	53	39	38	52	67	26	45	34
	Total Translational (RAC 3, 4 & 5)	10	23	17	13	21	13	12	16	20	23	17	20	8	16	16	8	23	29
	Total Applied (RAC 6, 7 & 8)	35	24	16	26	17	42	26	21	13	15	30	41	54	32	17	66	32	37

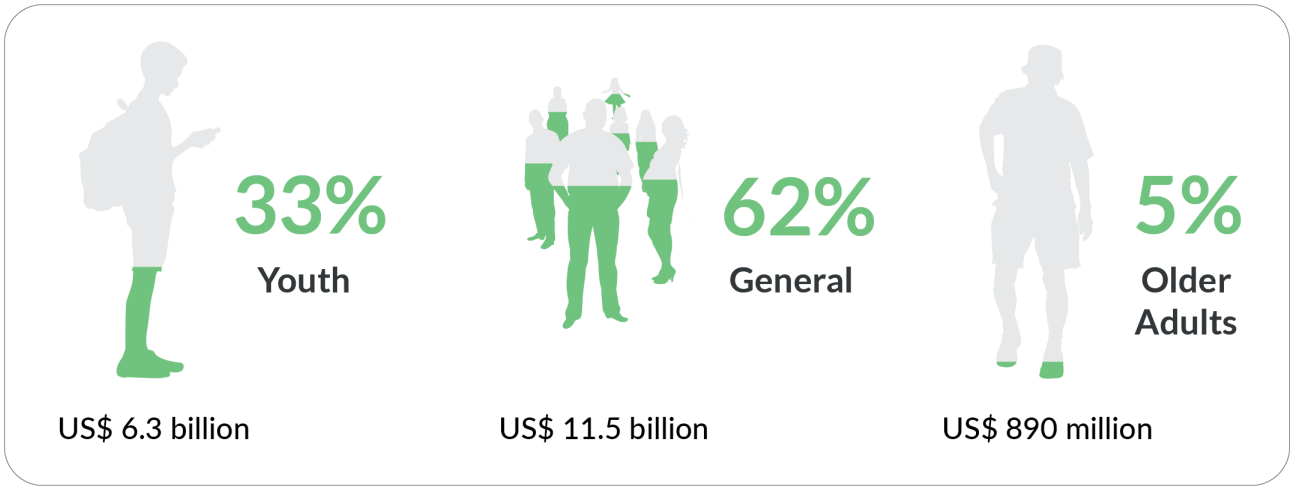
7.5 Inequity 5: The young are not the focus of mental health research investments, despite anticipated long-term benefits of intervening at this age

Age is an essential consideration in mental health, as the prevalence and characteristics of many disorders vary significantly across the lifespan [24]. Research can reveal effective strategies for treating mental health problems in different age groups, even presenting the opportunity to halt disorders before they develop into lifelong afflictions [25].

Around 75% of all mental disorder cases manifest by the age of 24 years, and the onset of most mood, personality, eating and substance use conditions occur within a small frame of time between adolescence and young adulthood [26]. Experiencing mental health problems during this critical period of development can cause huge impairments in a young person's education, employment opportunities and life outcomes. In the past decade, the benefits of early invention in mental health have become well established, with youth mental health services widely regarded as crucial to any successful mental health system [27, 28]. Figure 14 shows that most investments in mental health research funding are focused on the general population, rather than on young people (33%) and the elderly (5%). Therefore, research funding may undervalue the impact of eliminating adult mental health problems by intervening at a young age.

> "Around 75% of all mental disorder cases manifest by the age of 24 years, often within a small frame of time between adolescence and young adulthood."

Figure 14: Distribution of research funding by age groups



However, there are three caveats to these observations. First, as described above, the definition of mental health used in this study excluded neurodegenerative diseases of the elderly, such as Alzheimer's. This may, in part, explain the relatively low levels of funding for this age group. Second, the allocation of research grants to these age groups is based on automated text mining of grant titles and abstracts. This algorithm looked specifically for keywords related to the young and the elderly and, where these could not be identified, assumed that the research studied the general adult population. Thus, the amount of grants corresponding to this cohort might have been overestimated. Finally, other sociodemographic characteristics – such as gender and race/ethnicity – cannot be analyzed as they are often not reported in the abstracts of grant applications. This is clearly an issue that funders (and academics) should consider addressing in the future, as knowledge of the extent, if any, of mental health funding inequity associated with sociodemographic variables is crucial to fully understanding mental ill-health.

8 Mental health research funding that occurs as part of funding into other comorbid conditions is difficult to measure and analyze

At the outset of the project, the advisory committee was keen to explore the relationship between mental and physical health by looking at research that involved comorbidities – in this case, when two conditions occur at the same time, namely a mental health condition and another physical health condition such as cancer. This is because most of the decreased life expectancy related to mental ill-health is due to higher incidence and worse outcomes for comorbid physical illnesses [29].[f] For example, the risk of developing cardiometabolic disease increases by 1.4-2.0 times for those with mental health conditions compared with the general population [29]. The relationship is bidirectional, as physical conditions are also associated with a greater risk of developing mental illness. Possible reasons for why physical health is worse among people with poor mental health range from patient distrust of the health system, discrimination, diagnostic overshadowing, and poor coordination of care, to side effects of psychiatric medications, and less healthy lifestyles [30, 29].

"Physical health is worse among people with poor mental health."

Lacking a clear precedent for identifying research grants into comorbidity, a number of approaches were trialed (see Appendix C) with the following strategy adopted: mental health research grants that were additionally tagged as focused on a physical health condition (using all HRCS codes available on Dimensions except "neuroscience")[g] and whose RAC was 2 or higher (i.e., not "Underpinning Research", which looks at healthy function and is thus less likely to focus on comorbidities).

As described in the methodological Appendix C, a manual review shows that not all grants with relevance to several conditions have comorbidity of these conditions in focus. While we cannot say with confidence that all of the research identified investigates co-morbid mental and physical health, it nevertheless gives an indication of where the project scope encompasses both, and for which physical health conditions.

"The most studied comorbidities were infectious diseases, cardiovascular, stroke and blood disorders, and reproductive health."

As illustrated in Figure 15, less than 15% of the grants were coded as looking at mental health and another health category. Figure 16 shows the comorbid health categories that are being investigated alongside mental health. The most studied comorbidities were infectious disease (US$1.18 billion, which would include e.g., mental health and HIV and studies on infectious disease risk in substance use), cardiovascular / stroke / blood (US$720 million, which included studies probing a link between depression and heart failure and problems with nerves regulating the heart in schizophrenia) and reproductive health and childbirth (US$560 million, e.g., studies on perinatal exposure, postnatal depression).

[f] It is also worth noting that the burden of disease analysis does not count mental illness' contribution to deaths by other causes.

[g] Neuroscience is not used to tag comorbidity research in this analysis as we conjectured a lot of brain research with relevance to mental health would be tagged neuroscience on Dimensions. Counting all of these grants towards comorbidities would likely cause a huge quantity of false positives in this analysis. Note that, by design, this approach misses grants addressing comorbid neurological and mental health conditions - for example, depression in Parkinson's patients.

Figure 15: Global investments in mental health involving other health research

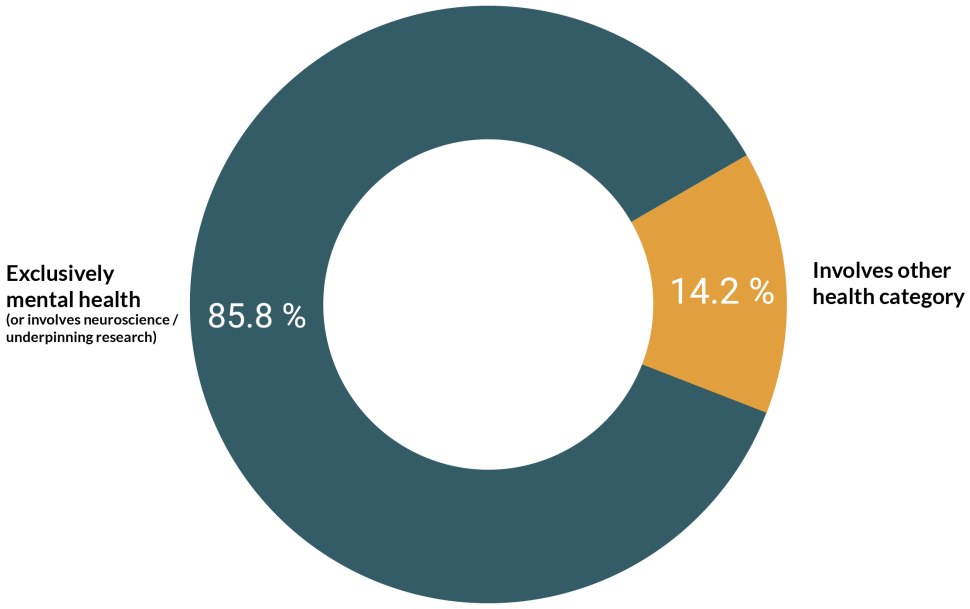
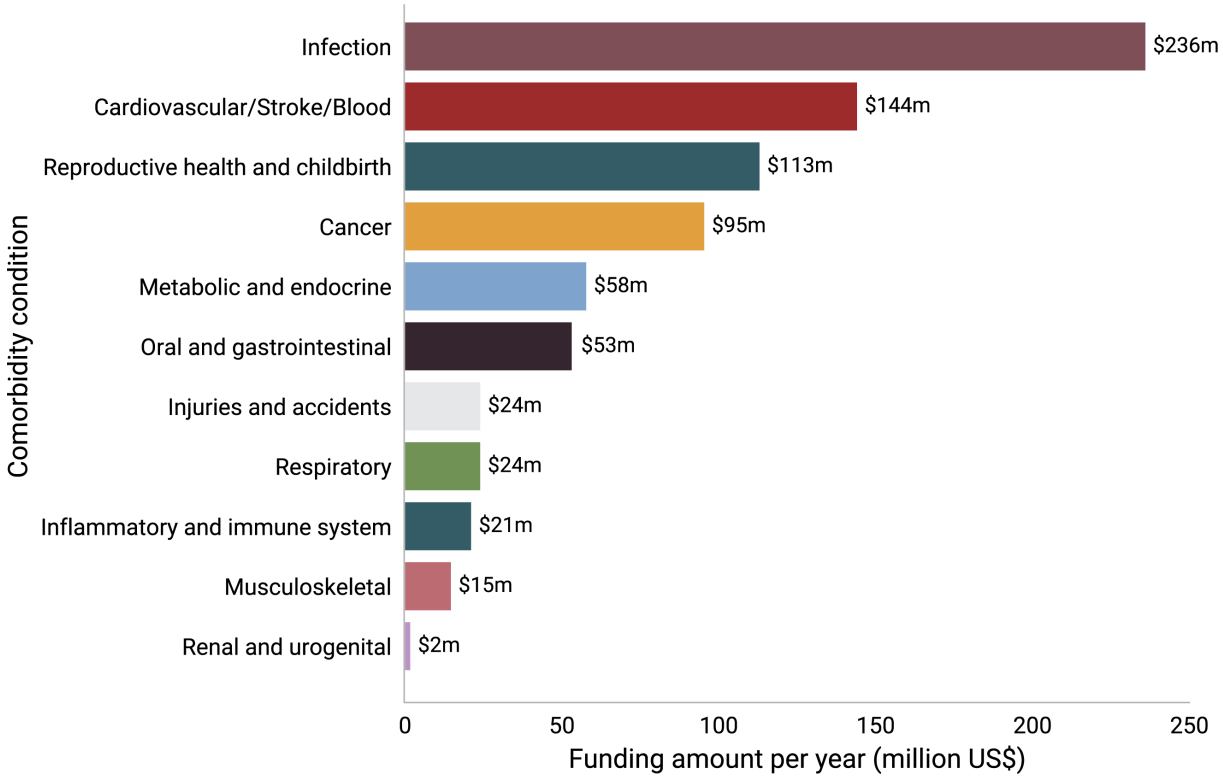


Figure 16: Global investment in mental health research by comorbidities



9 Closing Reflections

Using grant data and automated classification tools from the Dimensions database, this report's analysis presents the first-ever quantitative picture of global mental health research funding. In undertaking the analysis, a number of key lessons arise, both from a policy viewpoint and a methodological perspective. For example, it is evident from this analysis that mental health research is underfunded compared to other disease areas.

From a policy viewpoint, this raises the tricky question of whether mental health research should be given a higher priority, and if so, whether research investments should be redistributed to create some degree of parity. This would mean that, by design, there would be winners and losers. Or, should additional funding be invested in mental health research to ensure an equitable distribution of funding? There is some evidence that certain research funding sectors, including philanthropists, are reluctant to invest in mental health. A recent report by Future Generation and EY surveyed private funders in Australia to better understand why they are not investing more in mental health services and research [31]. They identified six reasons: mental illness is complex and the mental health sector is convoluted; there is significant duplication across mental health delivery; most mental health charities have little profile and their messages do not resonate; measurement of outcomes is a requirement for funding; lack of awareness of their place in the mental health sector; and there are not enough leaders encouraging other funders to invest in mental health. It is hoped that the analysis presented here will give donors some reassurance that future contributions are needed, worthwhile and impactful.

"It is evident from this analysis that mental health research is underfunded compared to other disease areas."

That said, in making a case for further investments in mental health research, it is important to be mindful of and acknowledge that the data presented in this report is biased toward the priorities of those funders who shared their data. Contributions from both philanthropy and industry may be under-reported due to incomplete data collection and/or a culture that is not accustomed to sharing data among non-public organizations. In the future, it is hoped that these issues of data transparency and sharing can be overcome as the importance of the type of analysis presented in this report is fully understood.

There were two further methodological issues encountered in the analysis. Firstly, sociodemographic characteristics – such as gender and race/ethnicity – could not be reported as they are often not described in the abstracts of grant applications. This is clearly something that funders and academics should consider addressing in the future. When it comes to other sociodemographic variables, understanding the extent of funding inequities, if they exist, is undoubtedly of public interest, as has been highlighted during the Covid-19 pandemic. The second methodological issue was encountered in the analysis of comorbidities, which, as noted earlier, proved unsatisfactory due to the automated approaches adopted. A more robust approach for recording, reporting and analyzing comorbidities needs to be developed.

"In delivering on these pledges, the IAMHRF and its members can begin to address the inequity of mental health research funding."

But most importantly, the quantitative analysis of global research grant funding demonstrated several inequities that need to be addressed. To ensure that progress is made in reducing these inequities, the IAMHRF pledges to:

Next Steps

- Disseminate this report widely, to various stakeholders across the mental health sector.
- Convene research funders and mental health stakeholder groups to ensure the data presented here are used to inform priority-setting globally.
- Encourage further reflection and dialogue around the inequities exposed by the analysis presented in this report.
- Advocate for greater data sharing amongst research funders from all sectors.
- Refine existing mental health classifications, paying heed to the diversity of cultural contexts and the voice of experts with lived experience.
- Update the landscape analysis presented in this report as mental health research definitions and investments evolve. In delivering on these pledges, the IAMHRF and its members can begin to address the inequity of mental health research funding.

A List of IAMHRF members (current and past)

Aim Youth Mental Health (USA)

Canadian Institutes of Health Research (Canada)

Cooper Investors (Australia)

Fonds de Recherche du Québec – Santé (Canada)

Graham Boeckh Foundation (Canada)

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Janssen

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Lundbeck Foundation (Denmark)

MaiTri Foundation (Australia)

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Meeting for Minds (Australia, Israel, Switzerland, France)

Mental Health Research Canada (Canada)

Movember (Australia)

MQ (UK)

NHS National Institute for Health Research (UK)

National Institute of Mental Health (USA)

One Mind (USA)

Philippe & Maria Halphen Foundation (France)

Society for Mental Health Research (Australia)

The Raintree Foundation (India)

Trygfonden (Denmark)

UKRI - Medical Research Council (UK)

Wellcome Trust (UK)

ZonMw (Netherlands)

Disclaimer - The views and opinions expressed in this report do not constitute endorsement or recommendation by IAMRHF members.

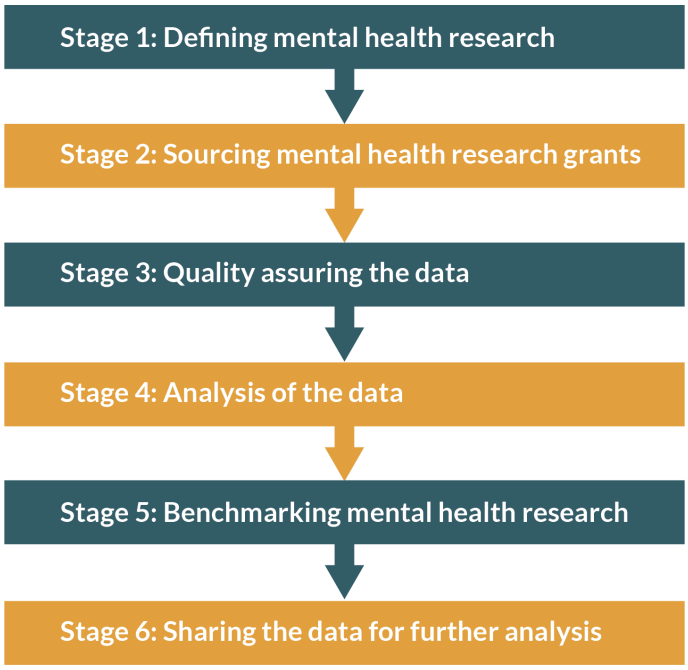
B Advisory Committee members

- **Canada**:
    - Ed Mantler (Mental Health Commission Canada)
    - Nicole Bardikoff (Grand Challenges Canada)
- **US**:
    - Cynthia Joyce (MQ Foundation)
    - Bishakha Mona (Science Philanthropy Alliance)
- **UK**:
    - Miranda Wolpert, Beck Smith (Wellcome Trust)
- **Europe**:
    - Ana Nieto, Sara Brazys, Milan Popovic (all European Commission)
    - Isabelle Durand-Zaleski (University of Paris XII)
- **India**:
    - Shahid Jameel, Suveera Dhup (WT/DBT India Alliance)
- **Australia**:
    - Marcus Nicol (National Mental Health Commission)

C Methodological approach

As illustrated in the flow chart in Figure C.1, this study had six distinct stages, which are described below in more detail.

Figure C.1: Overview of methodological approach



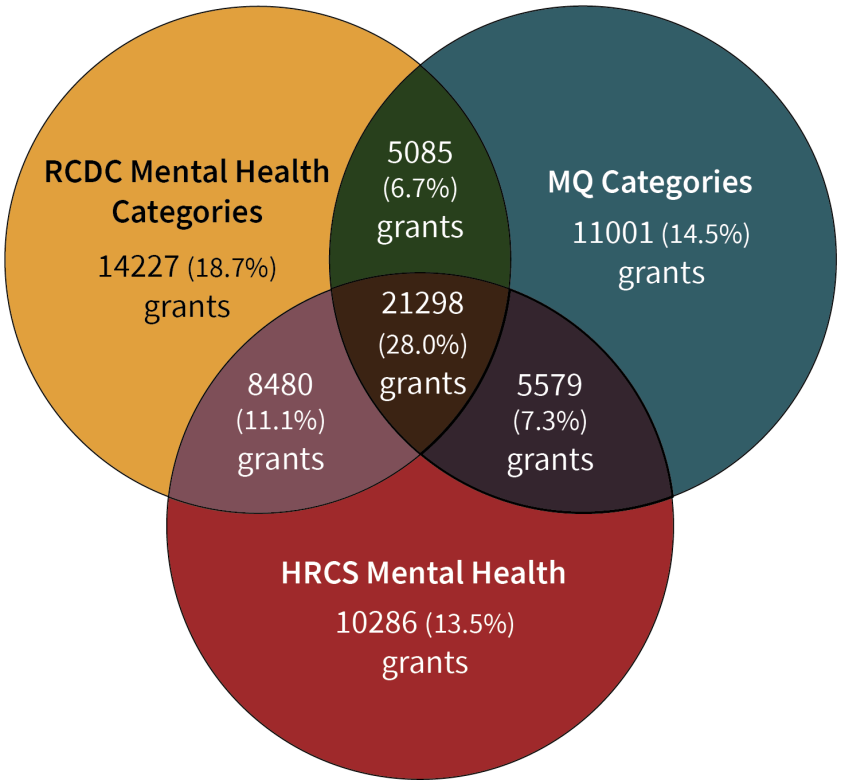
C.1 Stage 1: Defining mental health research

This study followed the definition and subcategories outlined in MQ's 2019 analysis of mental health research funding [6]. Inclusion criteria were aligned with the conditions listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and under mental, behavioral, and neurodevelopmental disorders in the International Classification of Diseases (ICD-11), with the addition of suicide and self-harm. Research into normal psychology, cognition and behavior is also in scope, including perception, memory, attention, learning, and social interaction. Basic studies of the normal functioning of the nervous system are included if they study cognition or behavior in some way. Out of scope of this analysis is research into neurological and neurodegenerative diseases such as Alzheimer's disease, and research that is of general health relevance (e.g., research into 'health and wellbeing', 'mental and physical health', research into health behaviors such as diet, and physical exercise).

To operationalize this definition, and as summarized in Figure C.2, three overlapping categories were used to identify mental health research grants from the Dimensions database. Digital Science has generated machine learning algorithms to assign relevance scores for the Research, Condition, and Disease Categorization system (RCDC, https://era.nih.gov/about-era/nih-and-grantor/other/rcdc.htm) from the US National Institutes for Health (NIH) as well as the UK Health Research Classification System (HRCS, https://hrcsonline.net/) to all grants in the database. HRCS has a 'Mental Health' category that is aligned with the definitions outlined above. RCDC contains several categories relevant to mental health (as listed below in Table C.1). In

addition, the search queries originally developed by MQ were used, which comprise 17 condition-specific search queries, as well as 11 queries designed to capture research that is relevant to mental health in general.

Figure C.2: Grants retrieved by natural language processing categories



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C.2 Stage 2: Sourcing mental health research grants

The source data for the analysis presented in this report was from the Dimensions database created by Digital Science. Dimensions is a database that links a range of scholarly information, including over 5 million research grants (and 1.8 million active research grants between 2015 and 2019) from over 500 funders. By using existing research classifications systems, supplemented with natural language processing and machine learning-based approaches, research grants can be automatically assigned a consistent set of categories such as 'mental health research'. To maximize participation in the study, the IAMHRF launched a call to 44 ofits members and partners, and to the Health Research Alliance (HRA, https://www.healthra.org/) in January 2020, announcing the plan for this study and supporting organizations to submit data for the first time to the Dimensions database or to update existing data. As a result, 16 organizations from seven countries (seven members of the IAMHRF, four members of the HRA, and five additional funders) made their data accessible for the first time. Of the 13 IAMHRF members whose data were already in Dimensions, nine felt their data was up to date and four updated or added to their information.

C.3 Stage 3: Quality assuring the data

The quality of both the approach to identifying mental health research grants and the characteristics of those research grants were tested. Standard metrics in information retrieval are precision and recall [32].

Precision is defined as the fraction of the retrieved items that are relevant (thus equivalent to positive predictive value in diagnostics), whereas recall is defined as the fraction of relevant items that are retrieved out of all relevant items (thus equivalent to sensitivity). Precision and recall were approximated in several complementary ways. Firstly, a random subset (N = 325) of all grants included in the analysis were reviewed, which gives an estimate of precision. Secondly, how well the approach captures data from funders whose remit is closely aligned to the definitions used in this study (Brain and Behavior Research Foundation, MQ, Graham Boeckh Foundation, N = 835) was tested. Finally, a selective sample (N = 500, of which 103 relevant to mental health) of grants were reviewed that was constructed to contain a larger proportion of grants from non-English speaking countries. None of these approaches is free from bias, but in conjunction, they give a good sense of the accuracy of the approach. In the random sample drawn from all grants included in this analysis, precision was estimated at 76%, which, although acceptable, could be improved in future iterations. Recall of a set of grants from three funders that purely fund mental health research was near perfect with 99%. In a third sample that was weighted to be more representative of the global funding activity, recall of mental health grants was 67%. Thus, it is likely that grants with clear relevance to mental health will be captured with a high level of accuracy, while in those on the periphery, there will be a significant number of false positives and false negatives. It is not clear whether the overall amounts are more likely to be over- or under-estimated. A detailed description of the accuracy analysis is given in [9].

In addition, as very large grants tend to have ambiguous abstracts and are often difficult to classify, all grants with funding amounts above US$10m were manually reviewed, and any mistakes made by the automated classification of these grants were corrected. Of these 497 grants, 117 were manually identified as not relevant to mental health and excluded, which is in line with the observed precision. Additionally, for these large grants, where necessary, mental health conditions, other health areas and age categories were manually reassigned.

C.4 Stage 4: Analysis of data

The search strategy identified 75,956 research grants that were classified as research on mental health. Each of these grants were then characterised by:

1. **Start and end dates**
2. **Amount of funding**
3. **Source of funding**
4. **Country of origin and country of spend**
5. **Mental health condition**
6. **Type of research** (i.e., basic to clinical, using HRCS Research Activity Codes)
7. **Age focus of research**
8. **HRCS Health categories**

The approach taken for each of these is described below:

Amount of funding. Research grants awarded in a given year commonly span across several years. In order to compute the sum of spending on mental health research during our timeframe of interest, funding amounts were distributed evenly across their active years. We then counted only the fraction of the amounts allocated between 2015 to 2019. Grants that are relevant to more than one health area were split evenly between pertinent categories, and only the share attributed to mental health was counted. This approach is in line with the UK Health Research Classification System [33] and the International Cancer Research Partnership [34] in splitting between health categories and using active years. When assigning funds to mental health subcategories, the amounts were split evenly between disease-specific subcategories. Currency conversions use the average annual rate for the grant's start year (https://www.bea.gov/).

Source of funding. Each of the 345 funders of mental health research were manually classified according to their dominant source of funds as government/public, philanthropy, or fundraising charity. Public funders are government agencies or non-profit organizations that disburse federal, state, or local government grants. Philanthropy includes non-governmental, non-profit organizations funded through donations from a single or very few major donors, sometimes historically resulting in endowments today. Fundraising charities raise funds from the general public in the form of a larger number of smaller donations. One private for-profit industry funder and one publisher could not be classified according to these definitions and were referred to as 'other' (although not reported here).

Country of origin and country of spend. Countries presented in this study are classified according to geographical regions and economic statistics, as defined by the World Bank [10]. All countries that did not fall into the category of High-Income Countries (HIC) were classified as Low- and Middle- Income Countries (LMIC). Following the European Commission's recommendations, Europe was defined to include the 27 countries of the European Union plus Liechtenstein, Norway, Iceland, and Switzerland. Country of origin is the country where the funder is located (with Belgium being used for European Commission funding), and the country of spend is the location(s) of research institution(s) receiving the grant.

Mental health condition. The MQ classification system defines 17 condition-specific categories, alongside two categories for research relevant to mental health in general [7]. For the purpose of this analysis, grants that do not fall into any of the condition-specific categories are combined into a single category, entitled 'not disease-specific'. This category comprises most grants for research into health services organization, healthy function, risk factors, and prevention, as well as studies relevant to many mental health conditions at once, such as centres, and research infrastructure. Table C.1 lists all approaches used to retrieve data, and how they relate to the different subcategories.

Type of research (i.e., basic to clinical). Research was classified on a translational spectrum using the HRCS Research Activity Codes (RACs). This is a system of eight top-level codes, with more detailed sub-classifications. HRCS RACs are available on Dimensions and automatically assigned to health-related grants by a machine learning algorithm that allows for zero, one, or multiple assignments. A proportion of the retrieved grants (47%) were not assigned HRCS RACs by the default model, usually because the relevance score assigned by

the algorithm did not reach a given confidence threshold. To improve usability for this study and to ensure all grants had a RAC assigned, the RAC with the highest relevance score was assigned even if this was below the threshold used in the standard implementation.

Table C.1: Queries used to identify mental health research grants and their relation to subcategories

	Subcategory	Rules for inclusion	
1	Not disease-specific	Any grants not included in any of the specific categories below, and included in HRCS Mental Health, RCDC Mental Health, RCDC Child Abuse and Neglect Research, or any of the 11 non-disease-specific MQ categories.	
		The following represents an OR relationship, i.e., a grant is counted towards a specific category ifit falls into any one of the categories listed against it.	
		MQ Category	RCDC Categories
2	Attention-deficit hyperactivity disorder	ADHD	Attention Deficit Disorder (ADD)
3	Anxiety Disorders	Anxiety disorders	Anxiety Disorders
4	Autism spectrum disorders	Autism	Autism
5	Bipolar disorders	Bipolar Disorders	Bipolar Disorder
5	Conduct disorder	Conduct Disorder	
7	Depression	Depression	Depression, Major Depressive Disorder
8	Eating disorders	Eating disorders	Anorexia, Eating Disorders
9	Obsessive compulsive disorder	Obsessive Compulsive Disorder	
10	Other mental health conditions	Other mental health conditions	
11	Other neurodevelopmental disorders	Other neurodevelopmental disorders	
12	Personality disorders	Personality Disorders	
13	Posttraumatic stress disorder	Posttraumatic Stress Disorder	Post-Traumatic Stress Disorder (PTSD)
14	Psychosis	Psychosis	Serious mental illness
15	Schizophrenia	Schizophrenia	Schizophrenia
16	Substance use and dependence	Substance use and dependence	Alcoholism*, Alcohol Use and Health*, Drug Abuse (NIDA only), Prescription Drug Abuse, Screening And Brief Intervention For Substance Abuse, Substance Abuse*, Substance Abuse Prevention* *not all substance use research is within scope, therefore not all grants with these labels will be included in the analysis but only those identified as 'mental health' by one of the other categories
17	Self harm	Self-Harm	
18	Suicide	Suicide	Suicide Prevention

Table reproduced with permission from *The Lancet Psychiatry*

Age focus of research. Using a natural language processing algorithm developed by Digital Science, research grants in Dimensions are coded as being focused on young people or the elderly. Those grants that are unassigned on this algorithm are assumed in our analysis to be focused on the 'general population' cohort.

Comorbidities. From the outset of this study, research into mental health and physical comorbidities was of keen interest to stakeholders given the tendency for poor mental health to accompany worse physical health outcomes and vice versa. However, grants addressing comorbidities were not easy to identify while remaining within the scope of this study. We considered two approaches to finding grants relevant to physical and mental comorbidities: natural language processing using HRCS health categories and keyword search.

Comorbidity was defined broadly to exclude only research where one disorder was targeted or where the grant examined multiple disorders that were neither connected nor affecting the same patient.

We hypothesized that grants identified by machine learning as belonging to more than one HRCS health category would have a high probability of addressing comorbidities. We refined this approach somewhat by not considering the "neurological" category because grants studying a single condition are very often identified as both "neurological" and "mental health" research. Furthermore, grants in underpinning research are often tagged with multiple health categories because they are potentially relevant to multiple areas of disease, so we excluded any grants in RAC category 1 from this analysis. We, therefore, estimated the fraction of grants investigating mental health alongside physical health conditions by identifying grants that are part of the mental health set, and meet the categorization threshold for a health area other than mental health or neurological research and had a RAC category of 2 ("aetiology") or higher.

As an alternative strategy for identifying comorbidity grants, we applied a keyword search to all of the grant titles and abstracts looking for terms related to comorbidities.[h]

To assess the performance of these two strategies, we manually reviewed two random samples, one for each strategy.

Manual review of 357 grants identified as about 'comorbidities' following the strategy using HRCS codes revealed that 52% of the sample truly pertained to mental health and physical comorbidity. We also manually reviewed a random sample of grants retrieved by a keyword search for terms related to comorbidity. Of these, only 34% were related to mental health and a physical comorbidity.

Ultimately, we chose to use the strategy based on HRCS machine learning categories due to its better accuracy. While we cannot say with confidence that this research investigates co-morbid mental and physical health, it nevertheless gives an indication of where the project scope encompasses both, and which physical health conditions are involved. This is an area of analysis that could greatly benefit from further refinement, which was unfortunately outside the scope of this study.

C.5 Stage 5: Benchmarking mental health research funding against other characteristics

In addition to characterizing the actual health research grants identified in Dimensions, comparisons were made against other research areas indexed on Dimensions, for example, cancer and the global burden of disease for mental health and other conditions.

The burden of disease data was obtained using the Institute for Health Metrics and Evaluation's (IHME) Global Burden of Disease (GBD) Results Tool. All searches were conducted using the year 2017. A custom search was used to select causes of death and non-fatal causes on the GBD database that were consistent with the HRCS health categories. The classification methodology was adapted from the UK Clinical Research Collaboration [4] with the addition of substance use

[h] Search terms: comorbid* OR co-morbid* OR multimorbid* OR multi-morbid* OR poly-morbid* OR poly-morbid* OR cooccur* OR co-occur* OR coexist* OR co-exist* OR complicat* OR polymorbid* OR poly-morbid* OR multipatholog* OR multi-patholog* OR poly-patholog* OR poly-patholog* OR multidiagnos* OR multidisor* [35]

disorders and self-harm as disorders of mental health (see Table C.2). Totals for *years lived with disability* and *years of life lost* in each HRCS category were obtained by adding together the values for their respective GBD causes.

Similarly, the comparison of spending and burden between specific mental health conditions was achieved by matching MQ Mental Health Categories with GBD Causes (see Table C.3). Although the categories were generally well aligned, the absence of GBD data on personality disorders, post-traumatic stress disorder and obsessive-compulsive disorders prevented us from including these conditions in our burden analysis. Regional population estimates were also obtained from the IHME GBD 2017 study in order to calculate per-capita spending on mental health [36].

Table C.2: Mapping HRCS health categories to Global Burden of Disease (GBD) causes

HRCS category	GBD cause
Cancer	B.1 Neoplasms
Cardiovascular/Stroke/Blood	B.2 Cardiovascular diseases
Infection	A.1 HIV/AIDS and sexually transmitted infections
	A.3 Enteric infections
	A.4 Neglected tropical diseases and malaria
	A.5 Other infectious diseases
Mental health	B.6 Mental disorders
	B.7 Substance use disorders
	C.3.1 Self-harm
Metabolic and Endocrine	A.7 Nutritional deficiencies
	B.8.1 Diabetes mellitus
	B.12.5 Endocrine, metabolic, blood, and immune disorders
Neurological	B.5 Neurological disorders
Respiratory	A.2 Respiratory infections and tuberculosis
	B.3 Chronic respiratory diseases

Table C.3: Mapping of MQ Mental Health Categories onto Global Burden of Disease (GBD) causes

MQ Mental Health Category	GBD Cause
Schizophrenia	B.6.1 Schizophrenia
Depression	B.6.2 Depressive disorders
Bipolar disorders	B.6.3 Bipolar disorder
Anxiety disorders	B.6.4 Anxiety disorders
Eating disorders	B.6.5 Eating disorders
Autism spectrum disorders	B.6.6 Autism spectrum disorders
Attention-deficit/hyperactivity disorder	B.6.7 Attention-deficit/hyperactivity disorder
Conduct disorder and other disruptive behavior disorders	B.6.8 Conduct disorder
Other Neurodevelopmental Disorders	6.9 Idiopathic developmental intellectual disability
Substance use disorders	B.7 Substance use disorders
Self-harm and suicide	C.3.1 Self-harm

C.6 Stage 6: Sharing the data for further analysis

The quality-assured data were analyzed as described in this report and in the accompanying paper [9]. The intention is to use this as a baseline set of analyses that can then be updated in future years. A curated dataset will be available to IAMHRF members, study sponsors, and other eligible organizations.

D Regional analysis

The following pages present regional analyses for Australia & New Zealand (ANZ), Canada, Europe, Low- and middle-income countries (LMICs), the United Kingdom (UK) and the United States (US). For each region, the most salient features from the data are identified, briefly examined, and then visualized in 5-10 relevant figures. To aid interpretation, a similar set of data variables are studied for each region. Still, where necessary, such as to comment on a specific feature of that region, additional analysis may be included. The underlying data are available for eligible organizations.

D.1 Australia & New Zealand

As illustrated in Figure D.1, Australia & New Zealand was the only region where there was a significant – 27% – increase in funding over the period, albeit with the largest rises occurring in the most recent years, for which the data may be less reliable. Nevertheless, adjusting for inflation, this is notable when compared with the other regions. Another interesting characteristic is that mental health research investments in Australia and New Zealand, similar to the UK, are more strongly focused on applied RACs (i.e., 6 - Evaluation of treatments, 7-Management of treatments and 8 - Health services). Over a third (37% - Figure D.4) of research investments were allocated to these three codes in Australia & New Zealand, with a similar figure in the UK (36%). In comparison to 12% in LMICs, 23% in Europe and 26% in the US. Canada also had a relatively high proportion at 33%.

Figure D.1: Trends in mental health research funding in Australia & New Zealand, adjusted for inflation

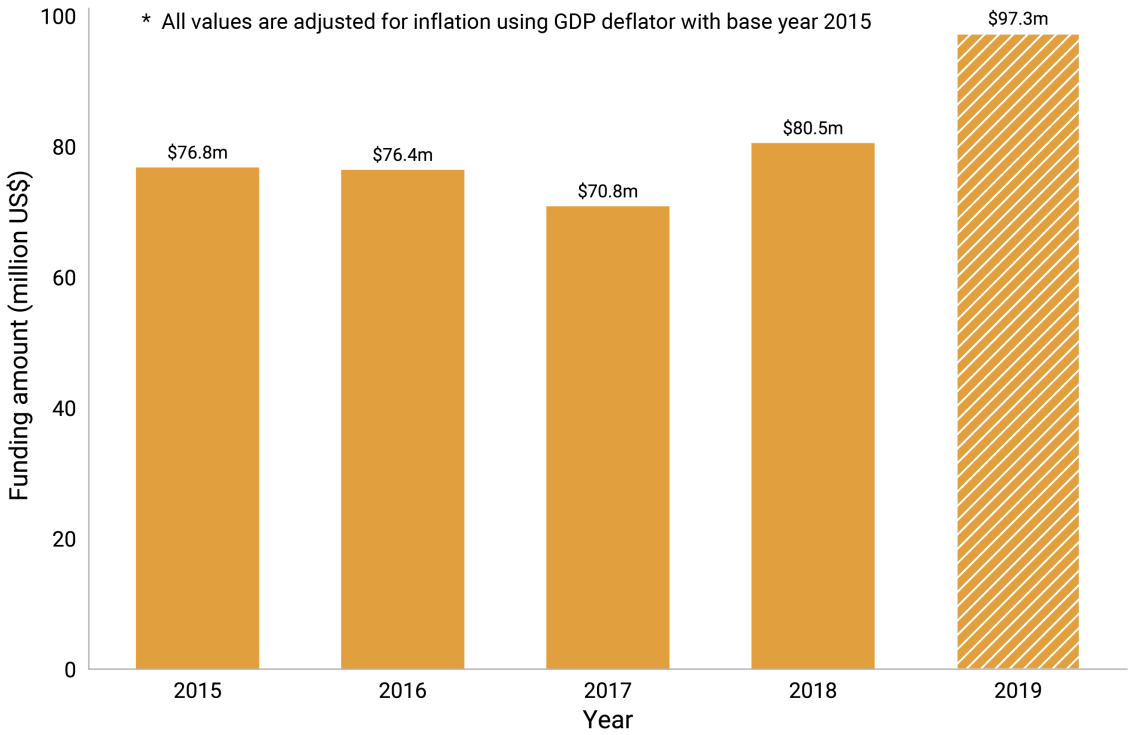


Figure D.2: Mental health research funding in Australia & New Zealand by source of funding

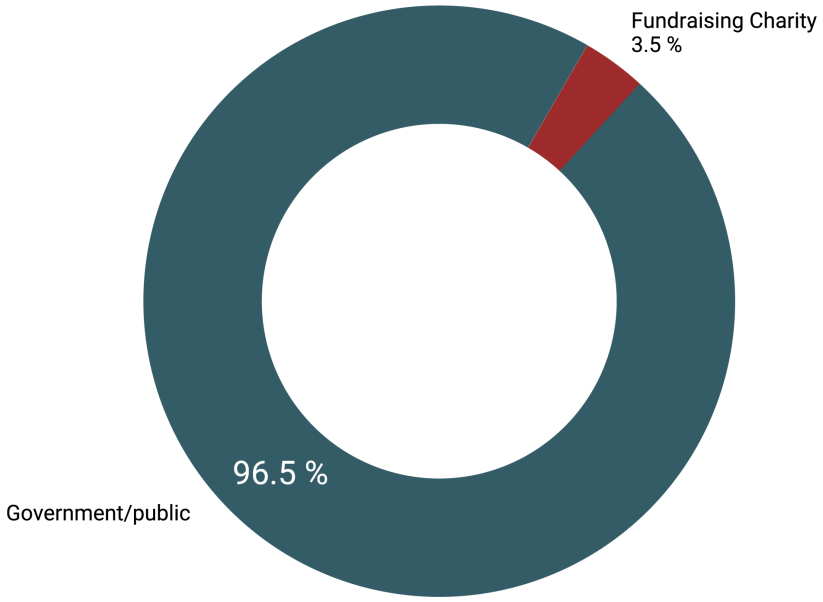


Figure D.3: Mental health research funding in in Australia & New Zealand by specific mental health conditions

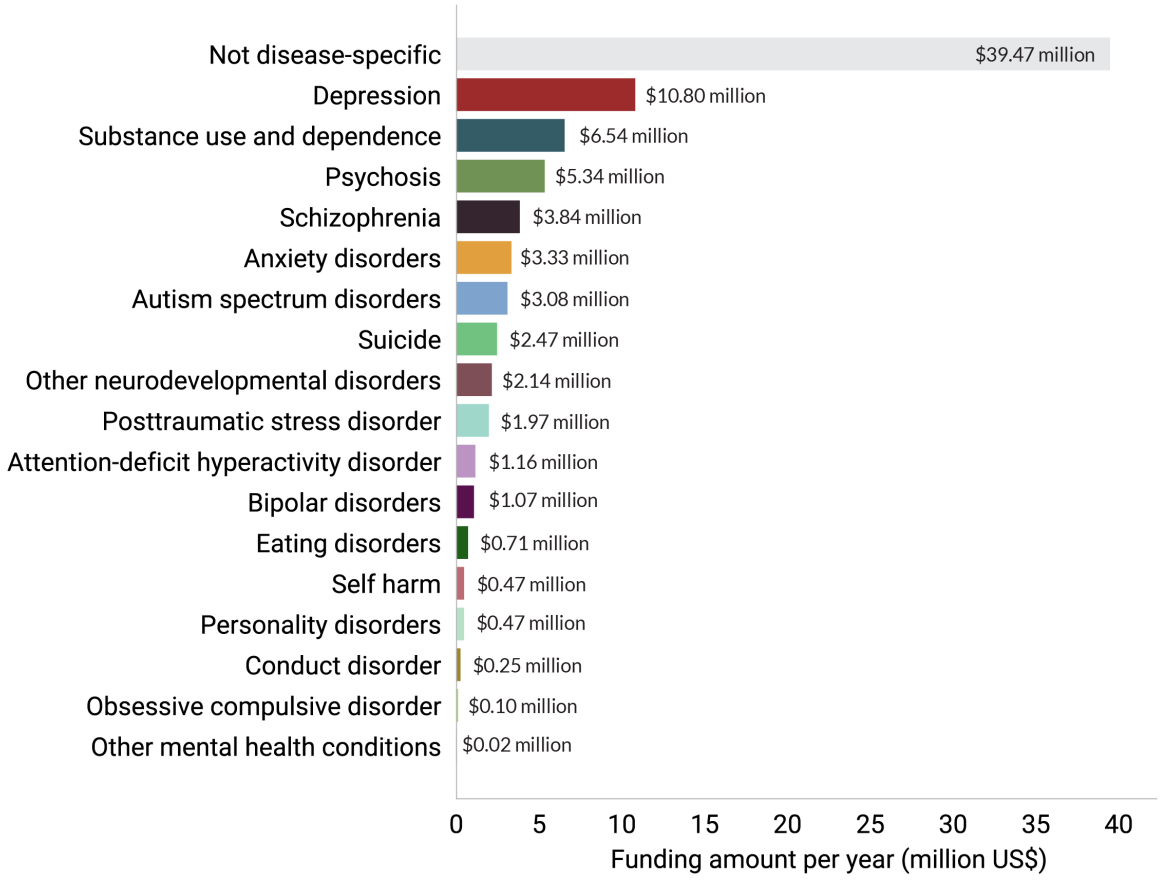


Figure D.4: Distribution of annual mental health research funding in Australia & New Zealand by Research Activity Code (RAC)

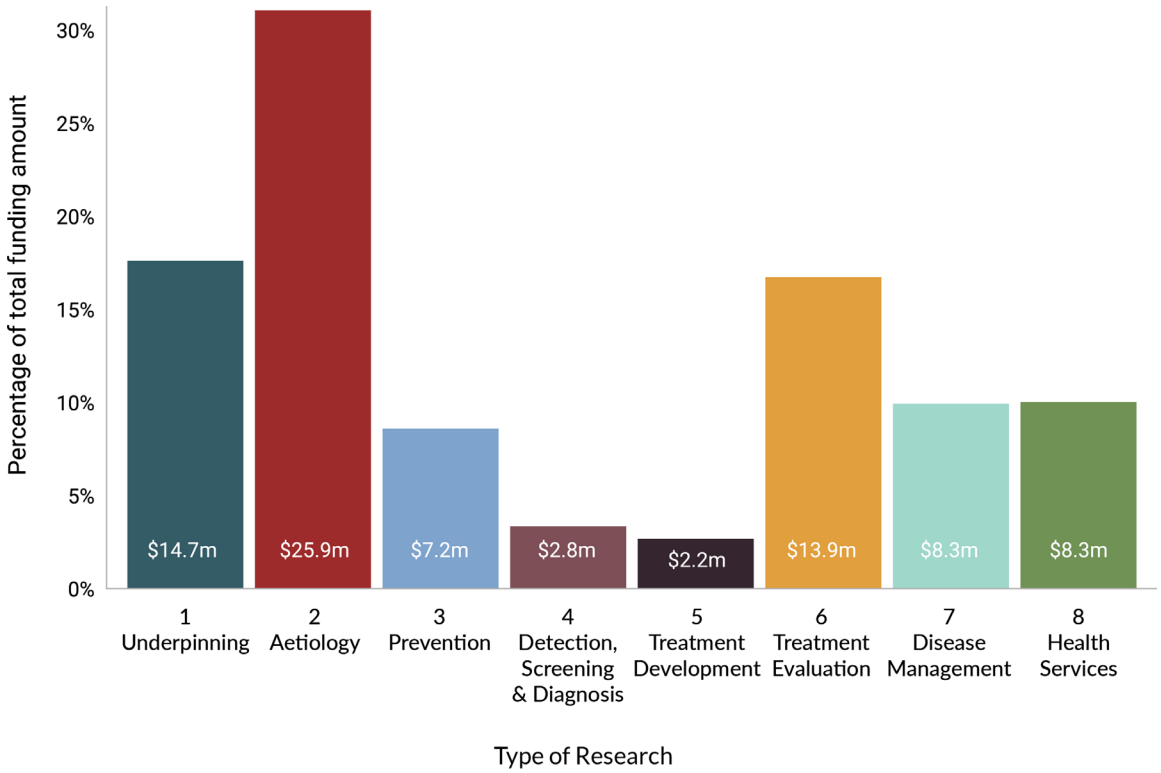
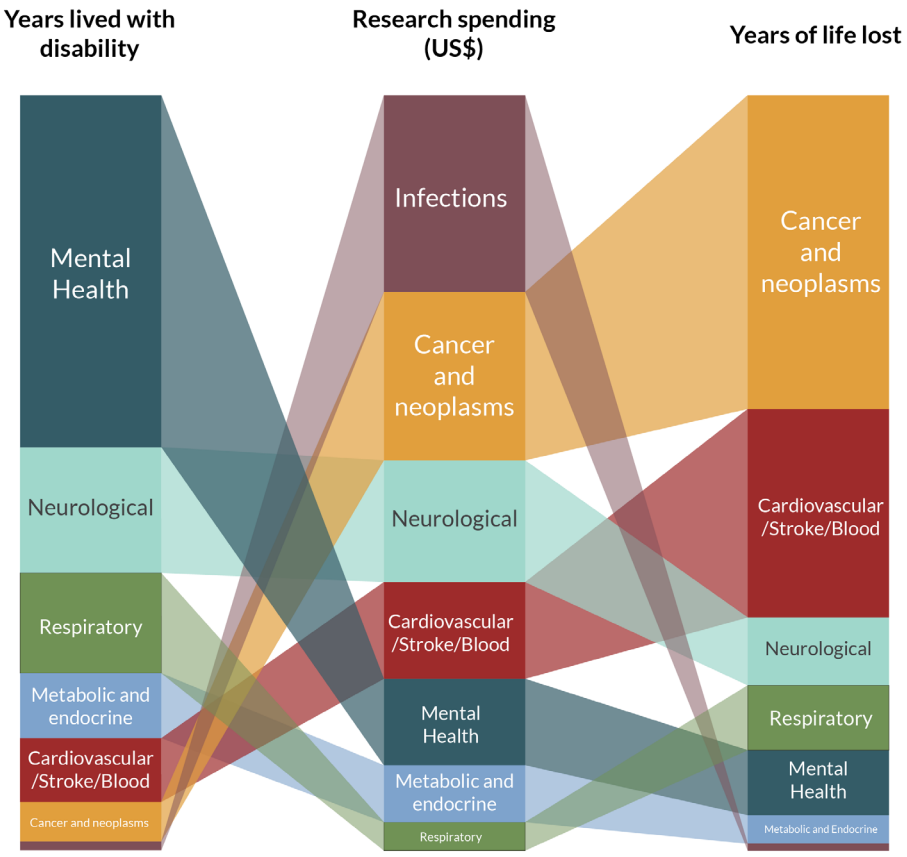


Figure D.5: Research funding in Australia & New Zealand for selected fields, including mental health, compared to measures of burden of disease



D.2 Canada

As already noted, Canada is one of four regions with declining spend on mental health research over the period examined (Figure D.6). The other stand-out characteristic of mental health research funding in Canada is that the diminishing pot of funding is spread over a large number of grant holders meaning that Canada has the smallest median value of grant of the regions examined. As illustrated in Table D.1, the median grant size in Canada (across the period analyzed) was US$52,000, which is one-twelfth of the size of the grant awarded in the US, one-eighth of that in the UK and one-sixth of that in Europe. It is even lower than the median size of the grant awarded in LMICs. As a result, 10% of all grants awarded in Canada are worth less than US$10,000 compared to 3.6% in Europe, 2.3% in the UK, and 0.5% in the US.

"Canada has the smallest median value of grant of the regions examined."

Figure D.6: Trends in mental health research funding in Canada, adjusted for inflation

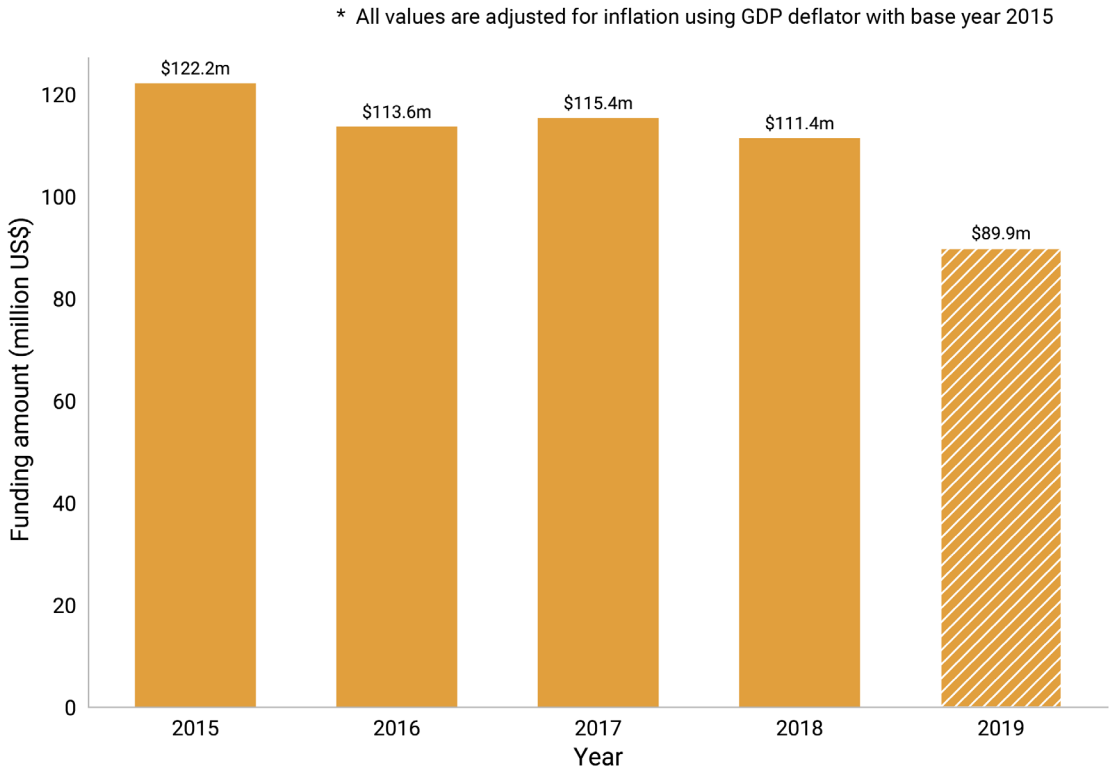


Table D.1: Size of grant by region

Region	Median grant size (US$)	Number of grants	Number of grants worth less than US$10,000	Share of grants worth less than US$10,000 (%)
ANZ	353,008	1,643	19	1.2
Canada	52,093	8,990	899	10.0
Europe	290,065	11,025	394	3.6
LMICs	78,730	8,711	69	0.8
UK	404,192	4,578	107	2.3
US	638,187	29,285	152	0.5

Figure D.7: Mental health research funding in Canada by source of funding

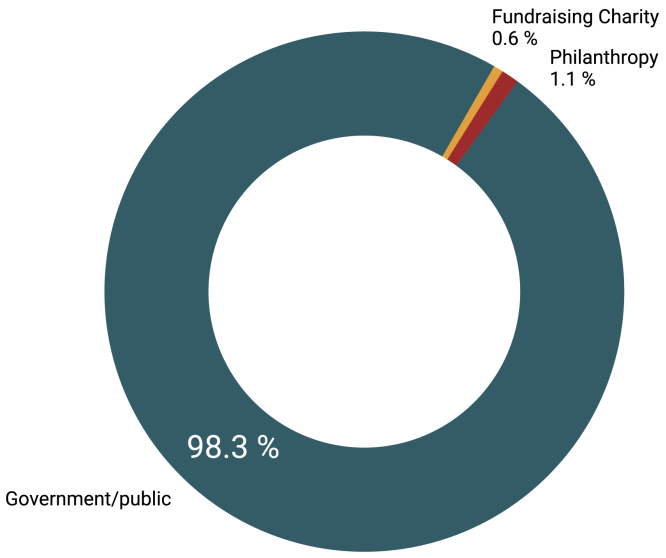


Figure D.8: Mental health research funding in Canada by specific mental health conditions

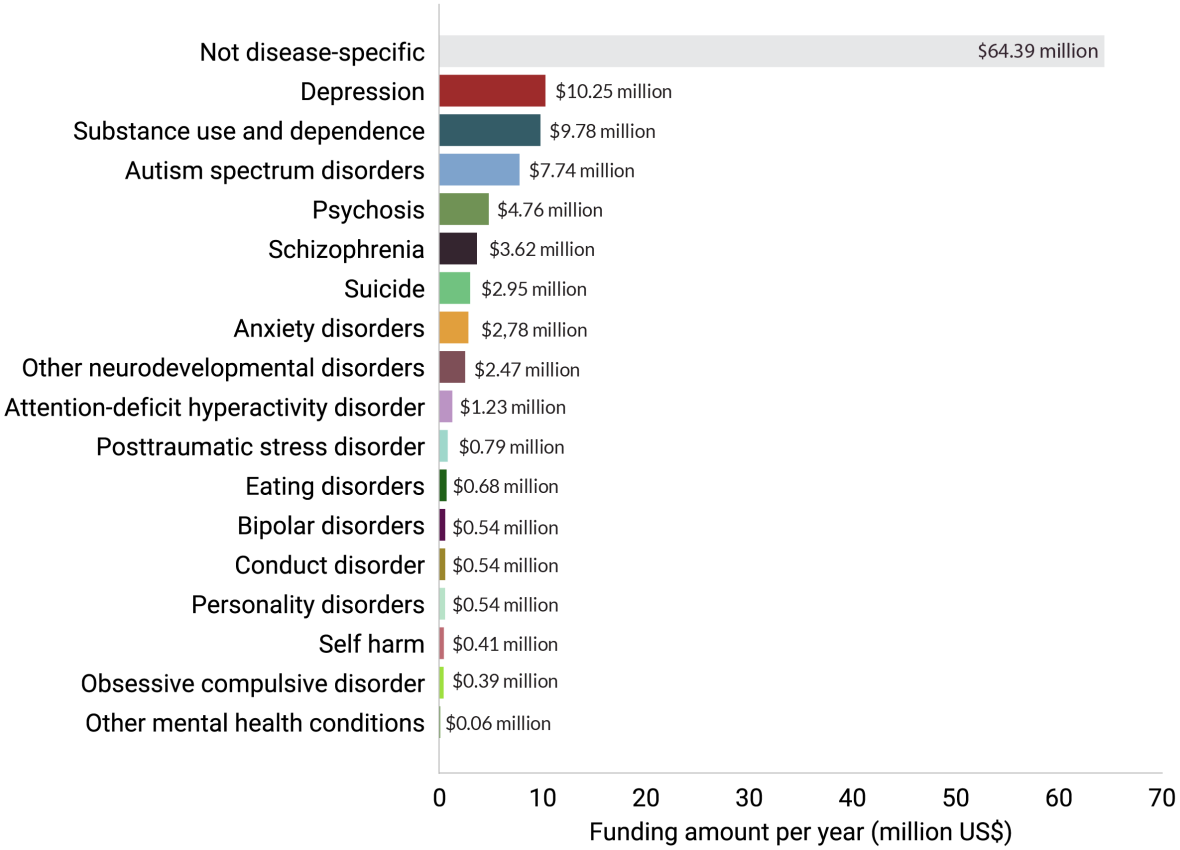


Figure D.9: Distribution of annual mental health research funding in Canada by Research Activity Code (RAC)

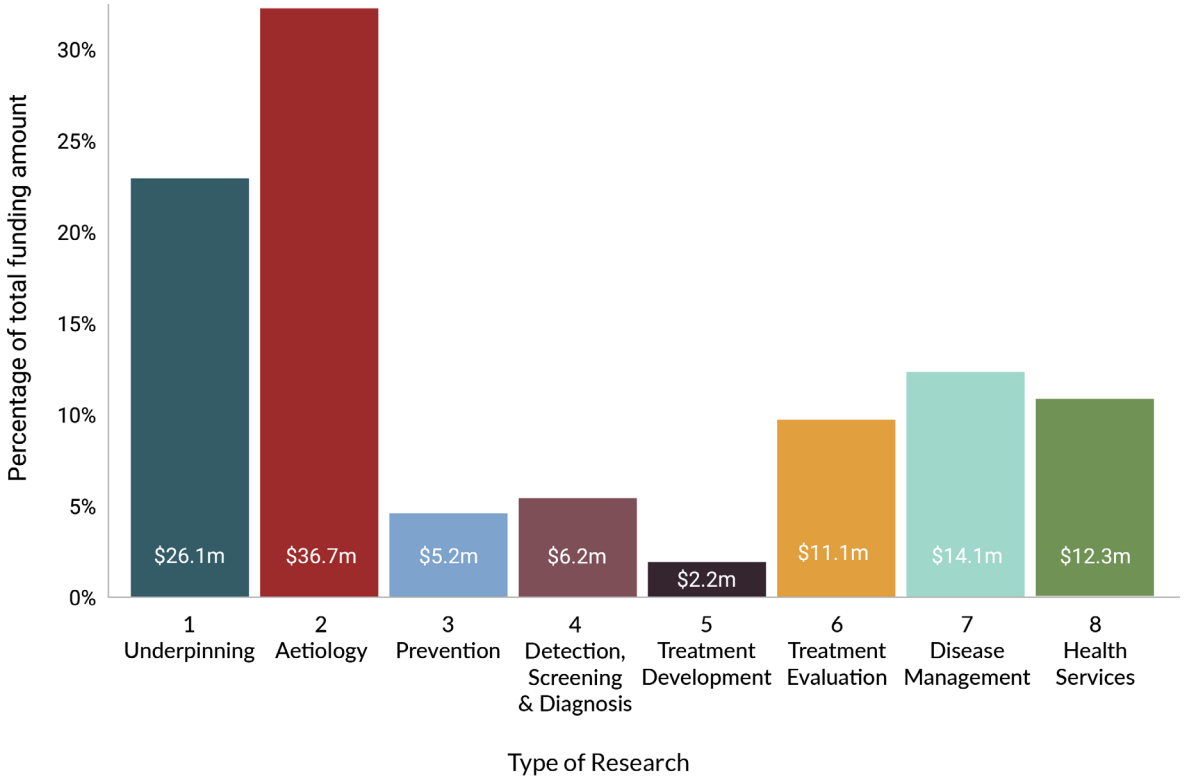
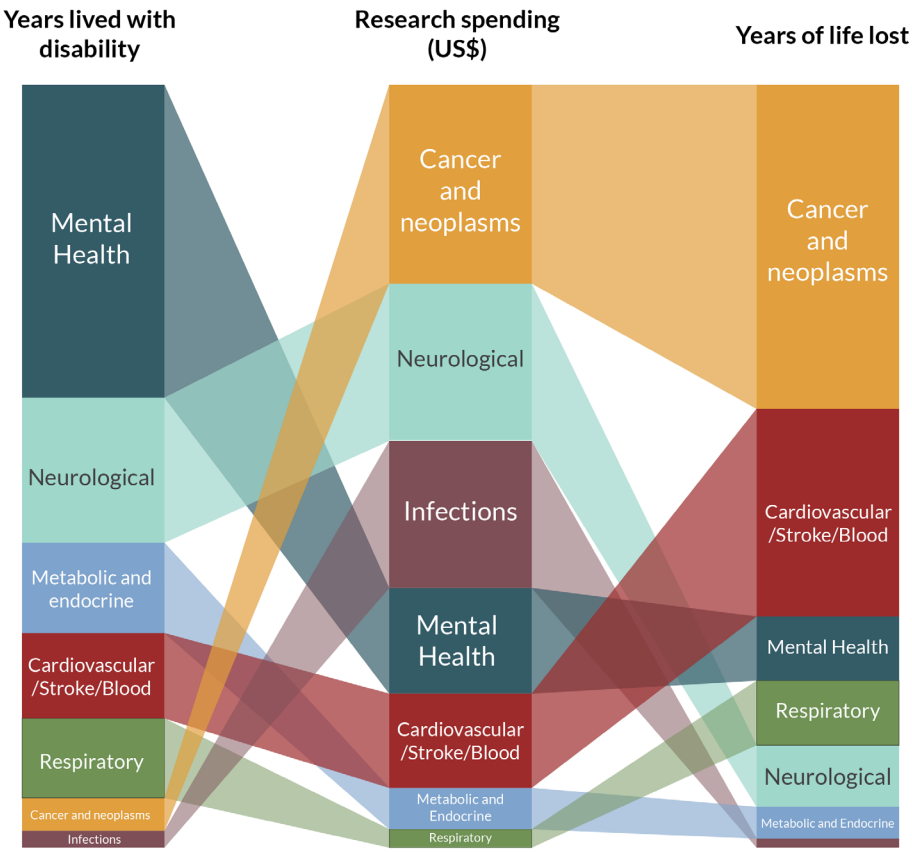


Figure D.10: Research funding in Canada for selected fields, including mental health, compared to measures of burden of disease



D.3 Europe

A particularity of the European data is the funding of the European Commission, which comes from European Union member states at varying proportions. European Commission funding makes up about 12% of total European grants and 47% of funding in mental health research. A notable feature of European funding is the relatively even spread of investments across the top five conditions as illustrated in Figure D.13. For example, the top-ranking condition in Europe, Depression, receives just over twice as much funding as the fifth ranking condition, Schizophrenia. By comparison, for global investments in mental health research, the ratio was 4.31, excluding the 'not disease-specific' category (Table D.2).

"A notable feature of European funding is the relatively even spread of investments across the top five conditions."

Figure D.11: Trends in mental health research funding in Europe, adjusted for inflation

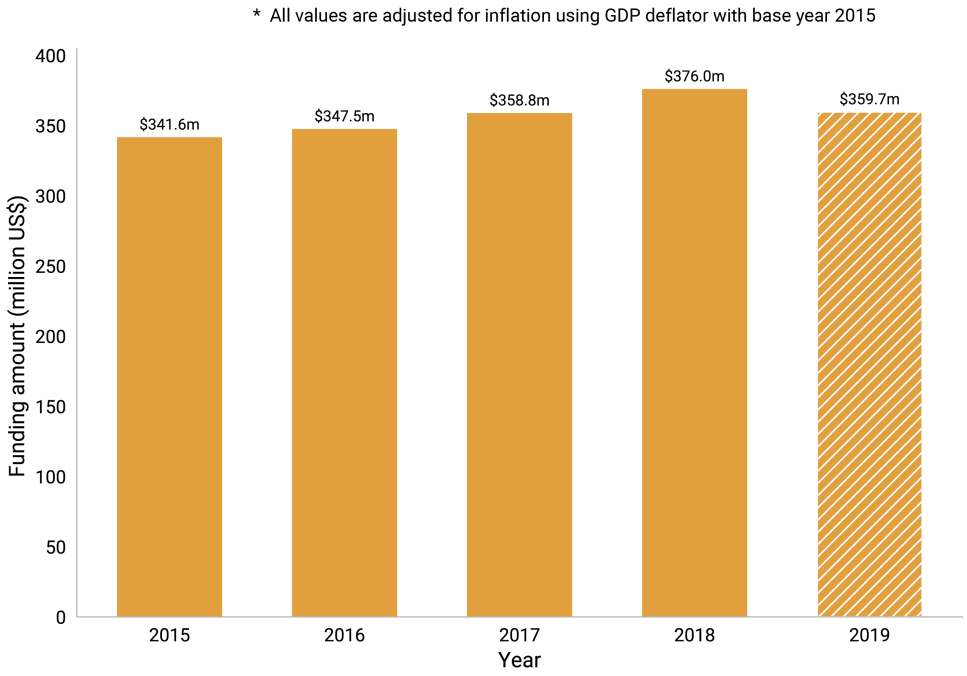


Figure D.12: Mental health research funding in Europe by source of funding

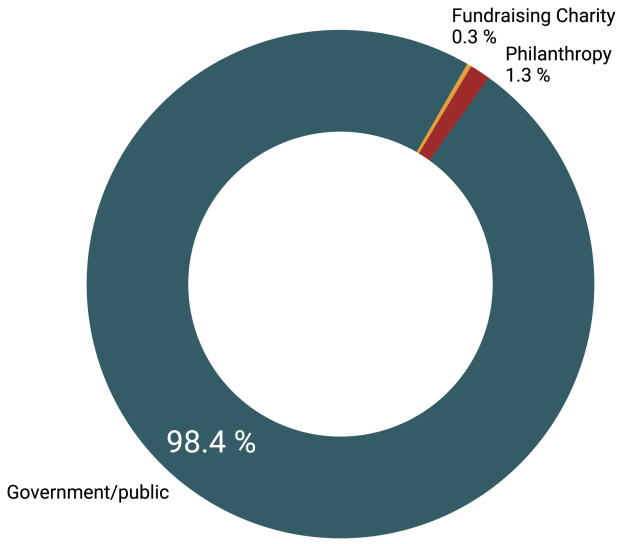


Figure D.13: Mental health research funding in Europe by specific mental health conditions

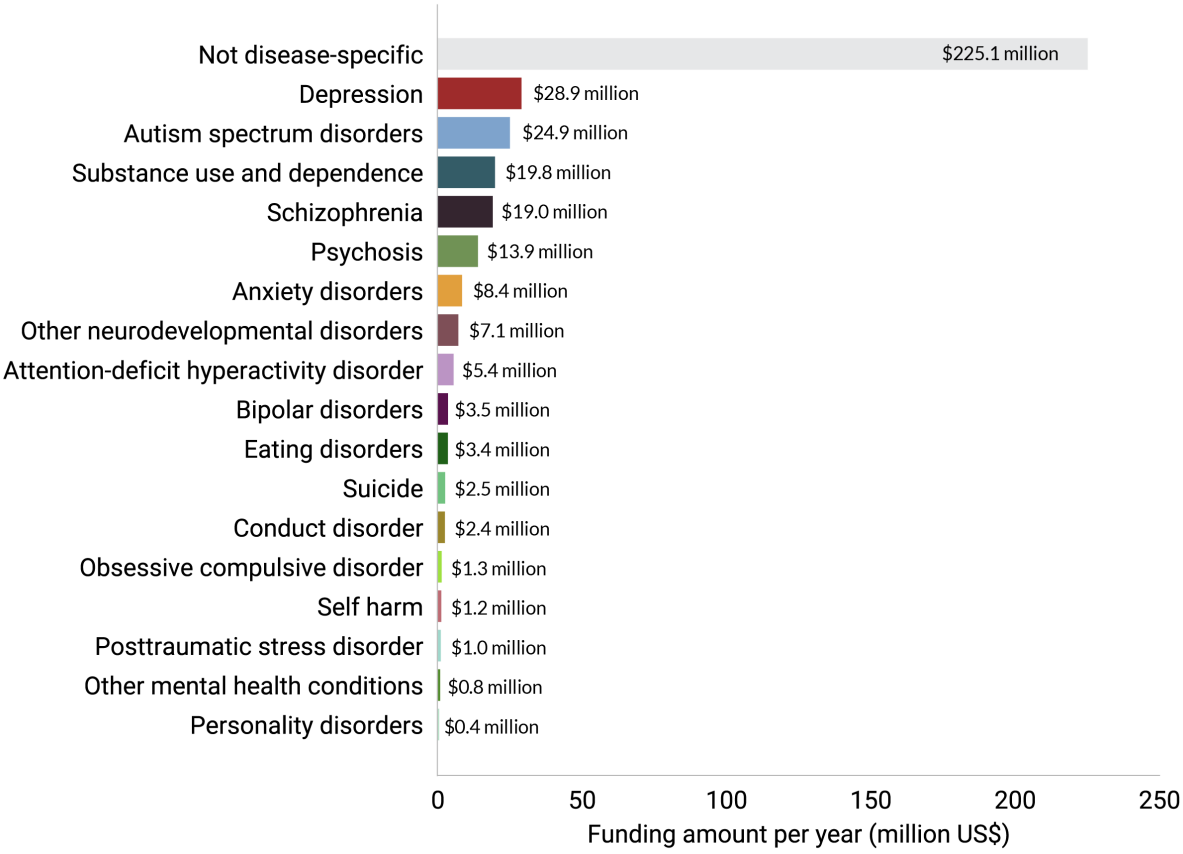


Table D.2: Range of regional investments for top five conditions, excluding the 'not disease-specific' category

Region	Ratio of investment in top ranked condition versus 5th ranked (excluding the 'not disease-specific' category)	Top five conditions
ANZ	3.24	1. Depression, 2. Substance use and dependence 3. Psychosis, 4. Schizophrenia, 5. Anxiety disorders
Canada	2.83	1. Depression, 2. Substance use and dependence 3. Autism spectrum disorders, 4. Psychosis, 5. Schizophrenia.
Europe	2.09	1. Depression, 2. Autism spectrum disorders 3. Substance use and dependence, 4. Schizophrenia, 5. Psychosis
LMICs (received)	3.39	1. Depression, 2. Autism spectrum disorders, 3. Substance use and dependence, 4. Schizophrenia, 5. Psychosis
UK	2.34	1. Depression, 2. Psychosis, 3. Schizophrenia 4. Substance use and dependence, 5. Autism spectrum disorders.
US	5.59	1. Substance use and dependence, 2. Depression 3. Autism spectrum disorders, 4. Psychosis, 5. Schizophrenia
Global	4.31	1. Substance use and dependence, 2. Depression, 3. Autism spectrum disorders, 4. Psychosis, 5. Schizophrenia

Figure D.14: Distribution of annual mental health research funding in Europe by Research Activity Code (RAC)

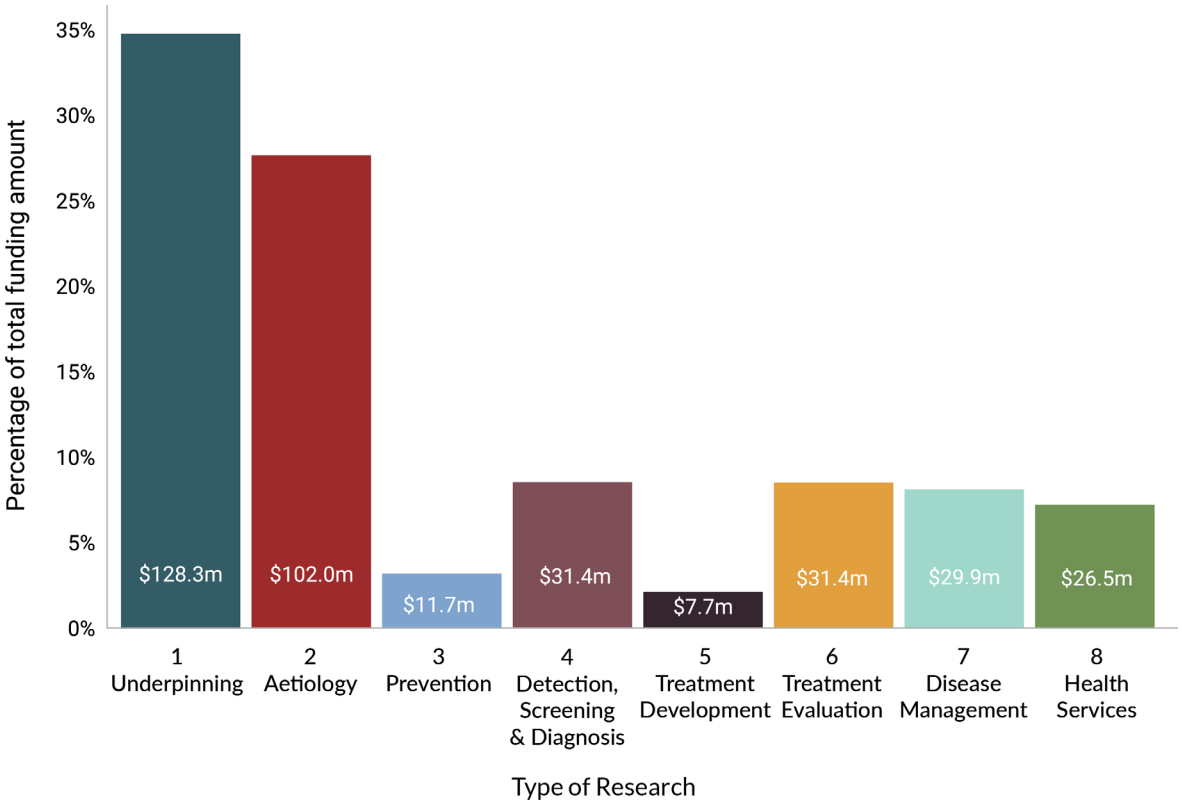


Figure D.15: Research funding in Europe for selected fields, including mental health, compared to measures of burden of disease

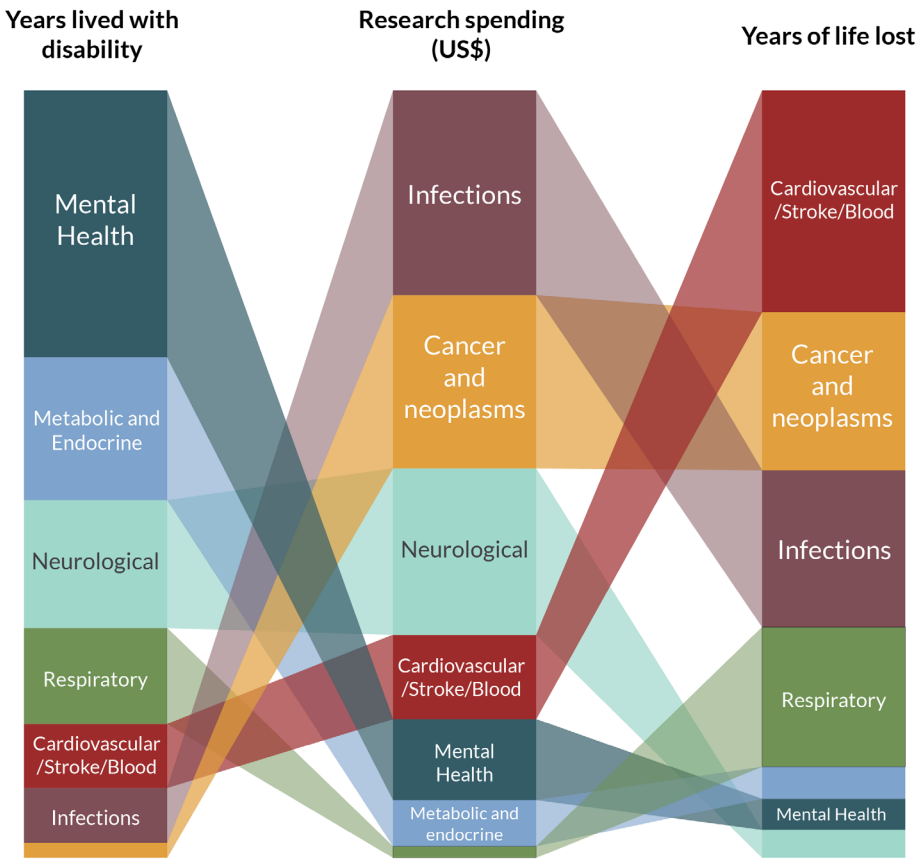
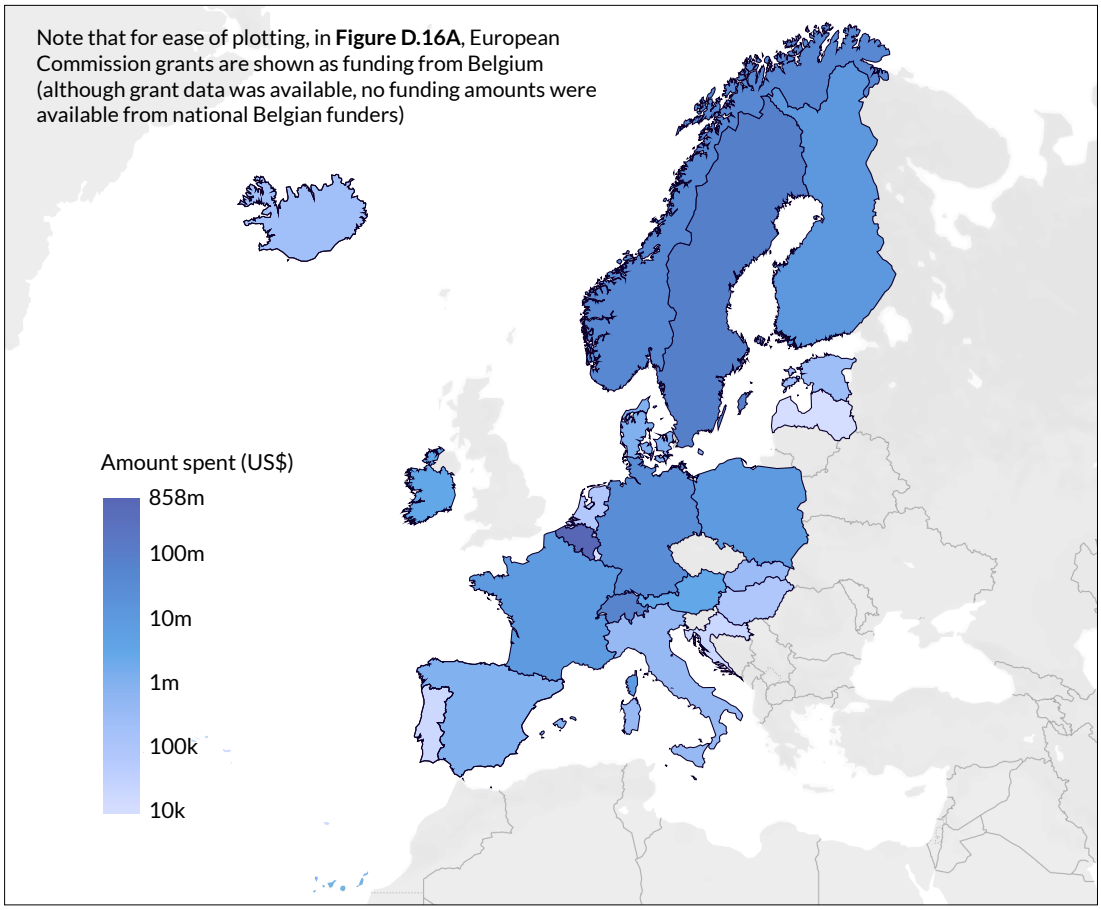
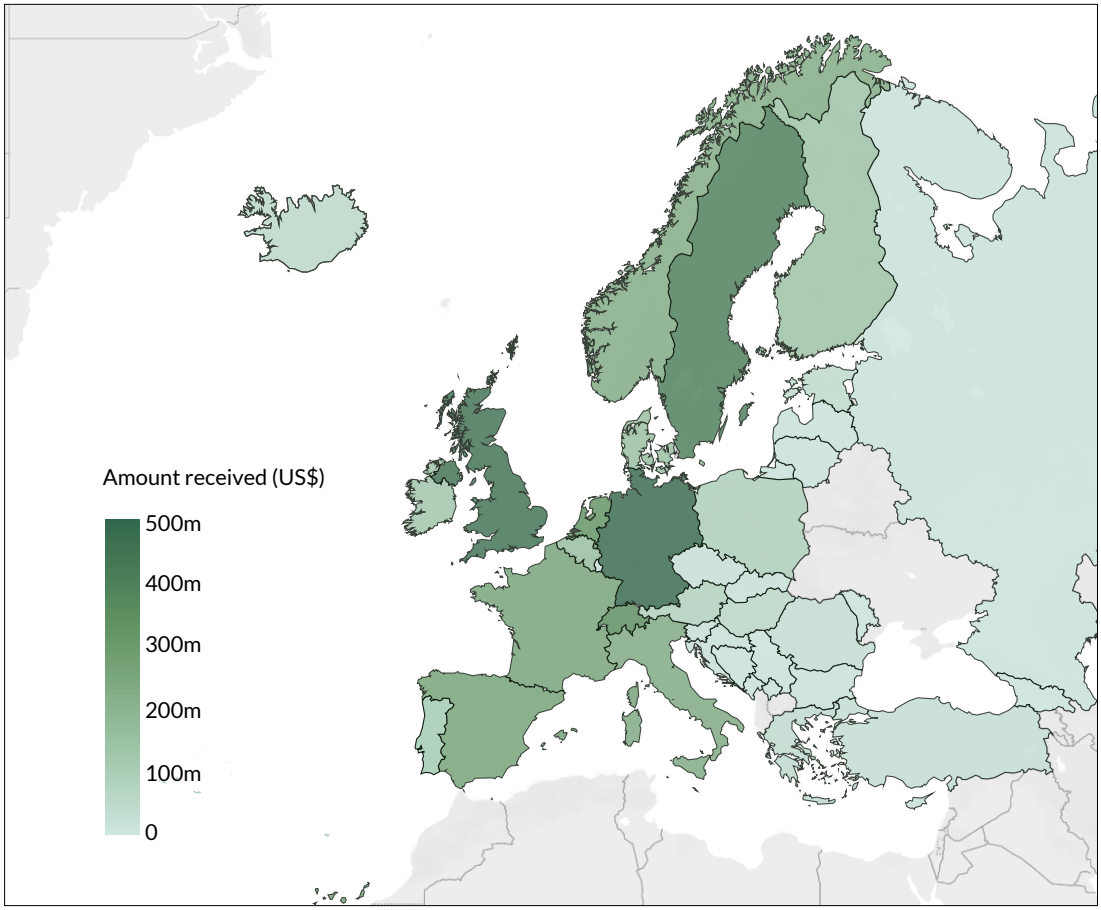


Figure D.16: European investments in mental health research by country (2015-2019)
– first (blue) map is where the funding originates, the second (green) map is where the funding is received

A



B



D.4 Low- and Middle-Income Countries

Perhaps one of the most surprising observations from this analysis was that over three-quarters of research spend by LMICs is on basic research with limited domestic research investment for applied research, as illustrated in Figure D.23. Figure 4, in the main report, shows the split between domestic and foreign research investments for LMICs, i.e., those investments made by LMICs that stayed within that country versus those that are made from HICs but occur within the LMIC. As illustrated in Figures D.17 and D.18 about one-third (US$50 million per year) of total mental health research spending comes from within the country and two thirds from outside (US$90 million per year). Of the domestic spending, 76% of funded research is classified as having RACs 1 and 2, i.e., basic research (Figure D.23), compared to 12% of applied research with RACs 6, 7 and 8. By comparison 58% of donor investments were for basic research compared to 31% for applied research (Figure D.24).

"Over three-quarters of research spending by LMICs is on basic research"

Figure D.17: Trends in domestic mental health research funding in LMICs, adjusted for inflation

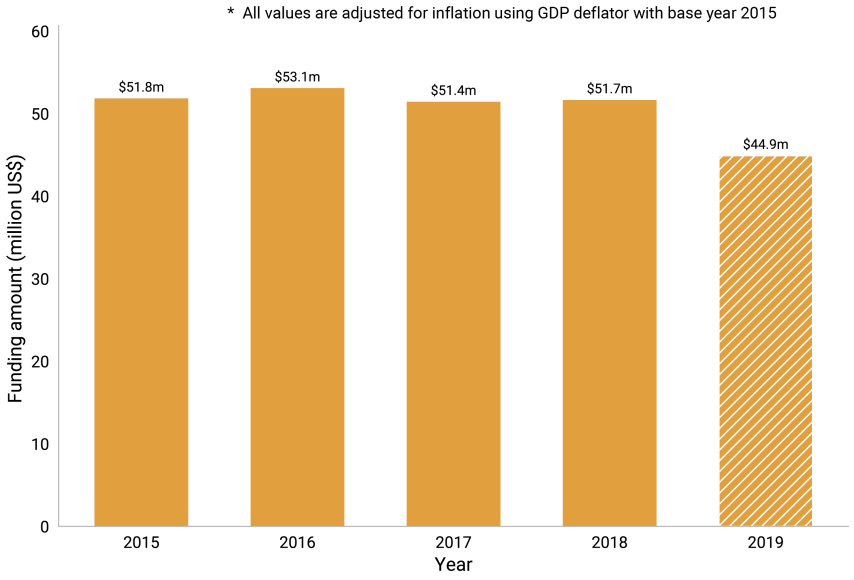


Figure D.18: Trends in foreign mental health research funding in LMICs, adjusted for inflation

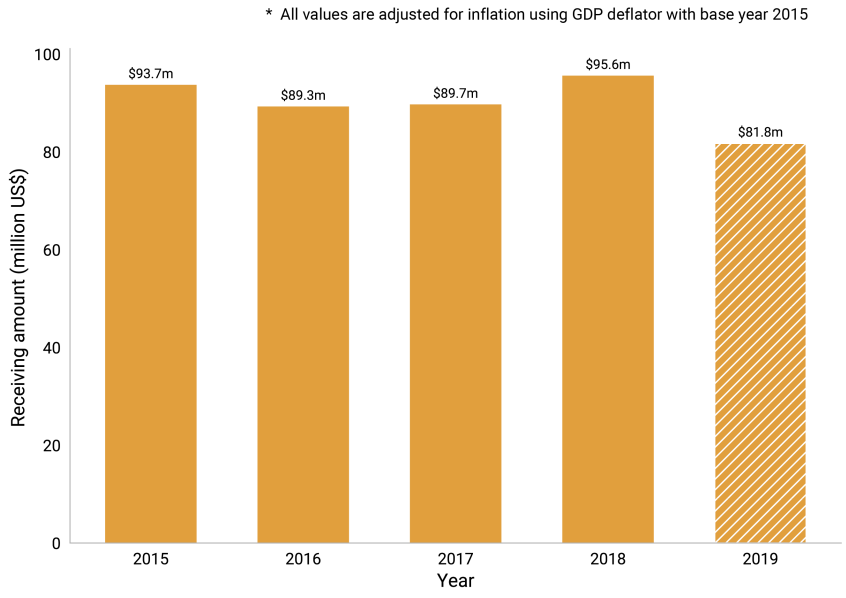


Figure D.19: Domestic mental health research funding in LMICs by source of funding

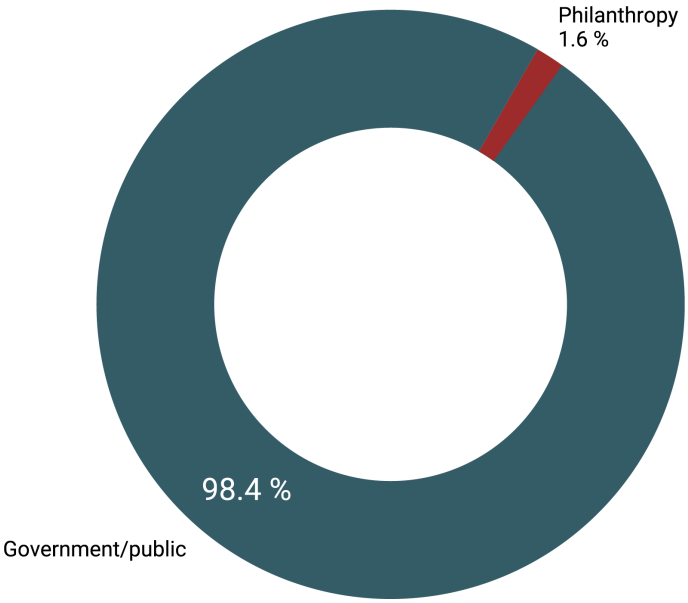


Figure D.20: Foreign mental health research funding in LMICs by source of funding

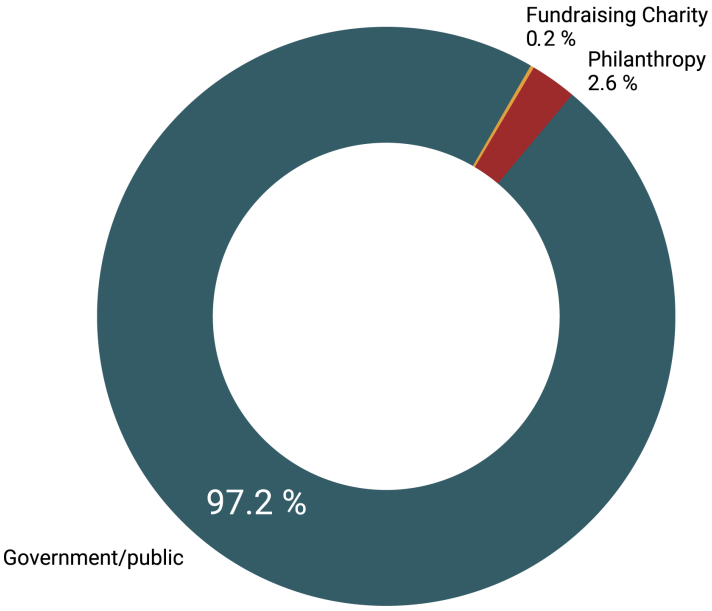


Figure D.21: Domestic mental health research funding in LMICs by specific mental health conditions

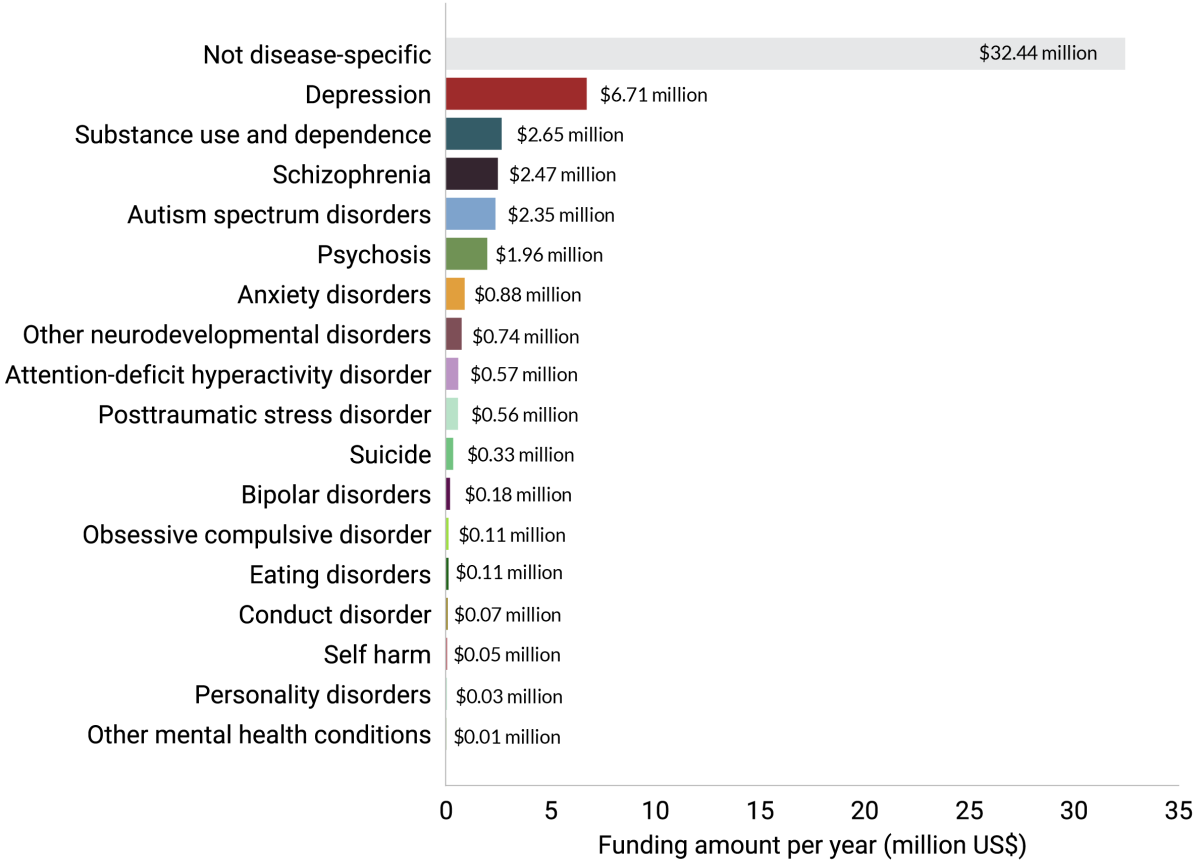


Figure D.22: Foreign mental health research funding in LMICs by specific mental health conditions

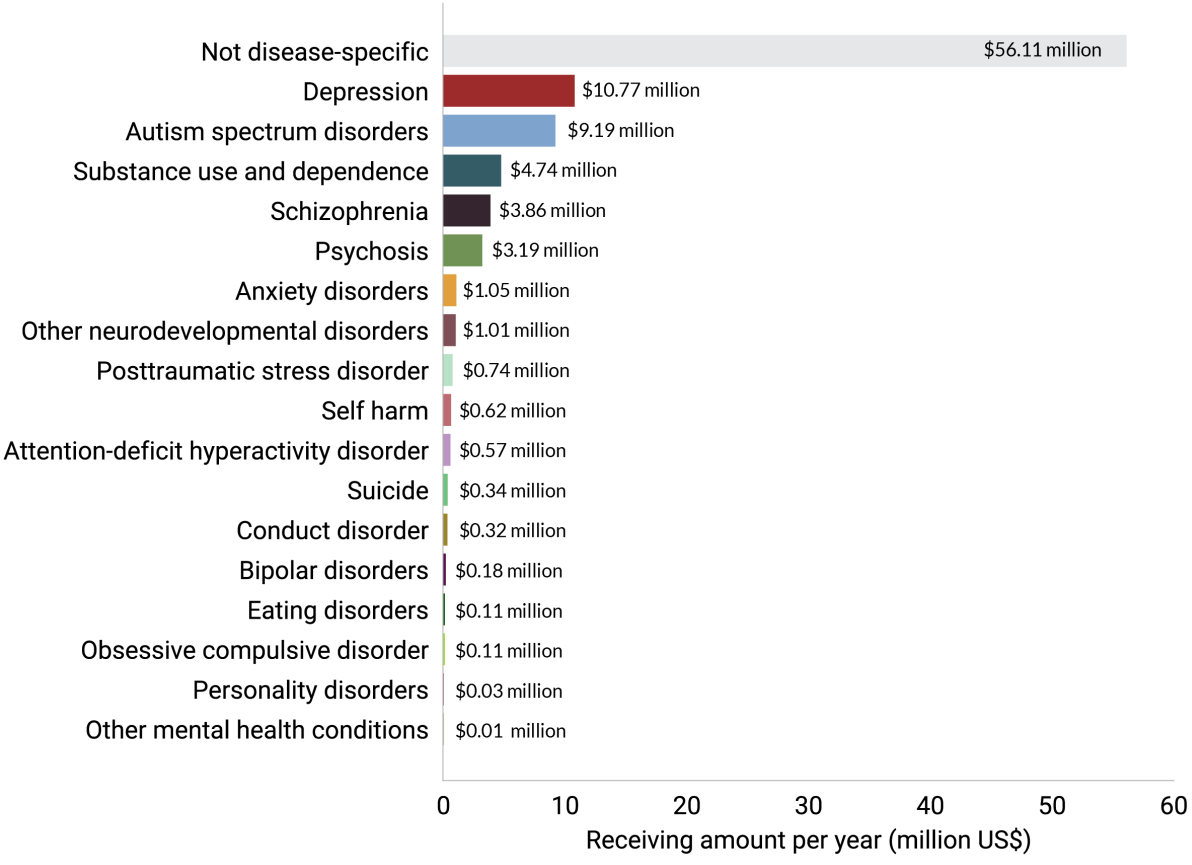


Figure D.23: Distribution of annual domestic mental health research funding in LMICs by Research Activity Code (RAC)

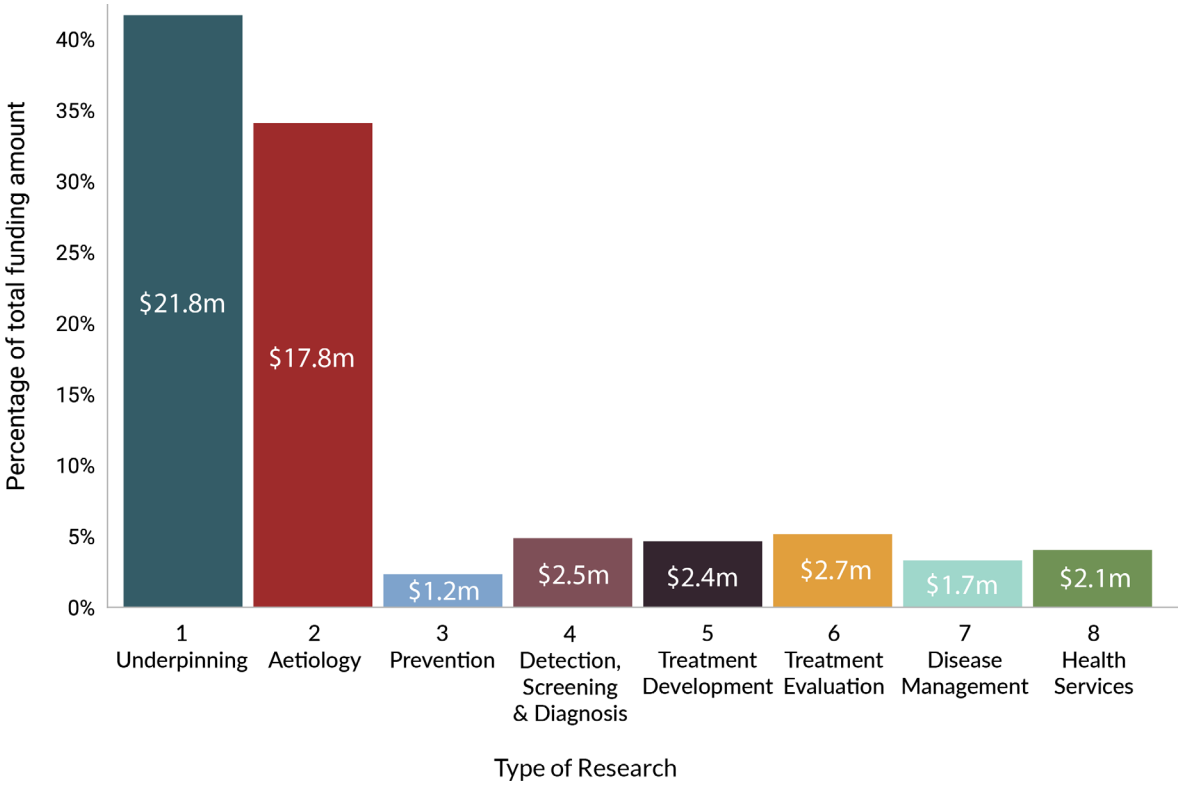


Figure D.24: Distribution of annual foreign mental health research expenditure in LMICs by Research Activity Code (RAC)

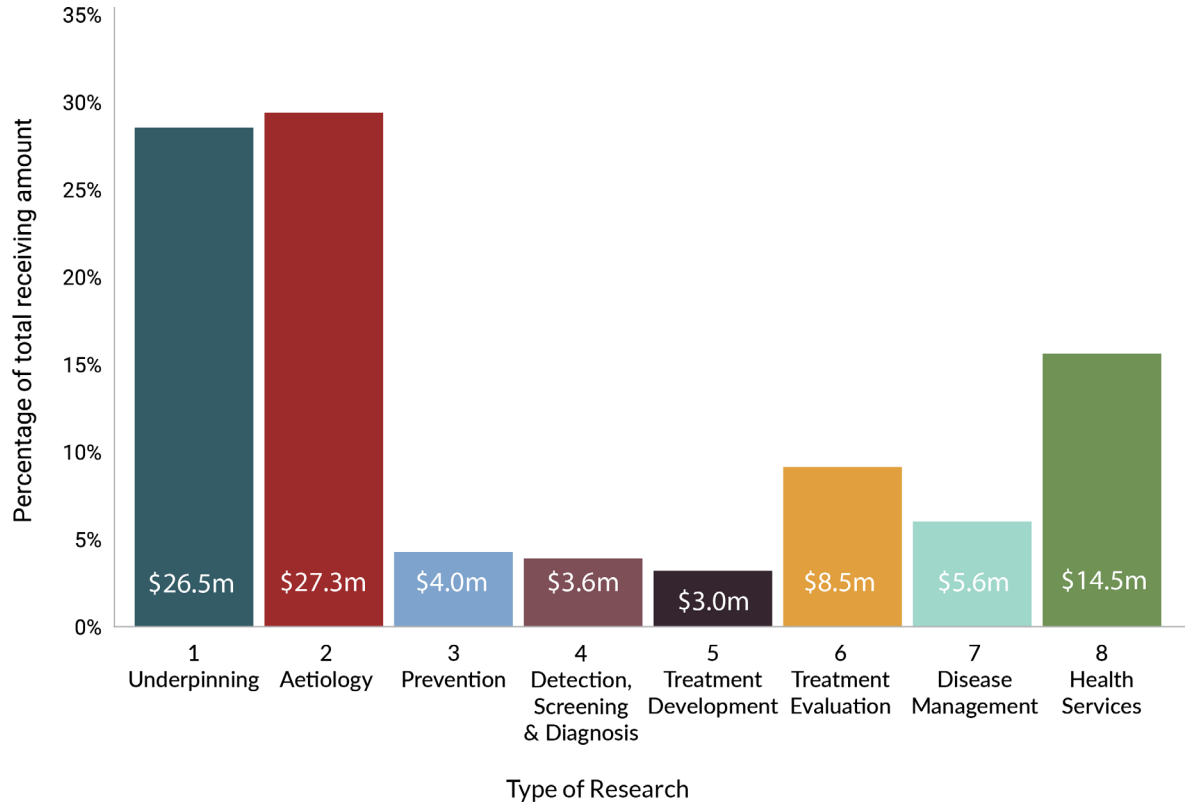
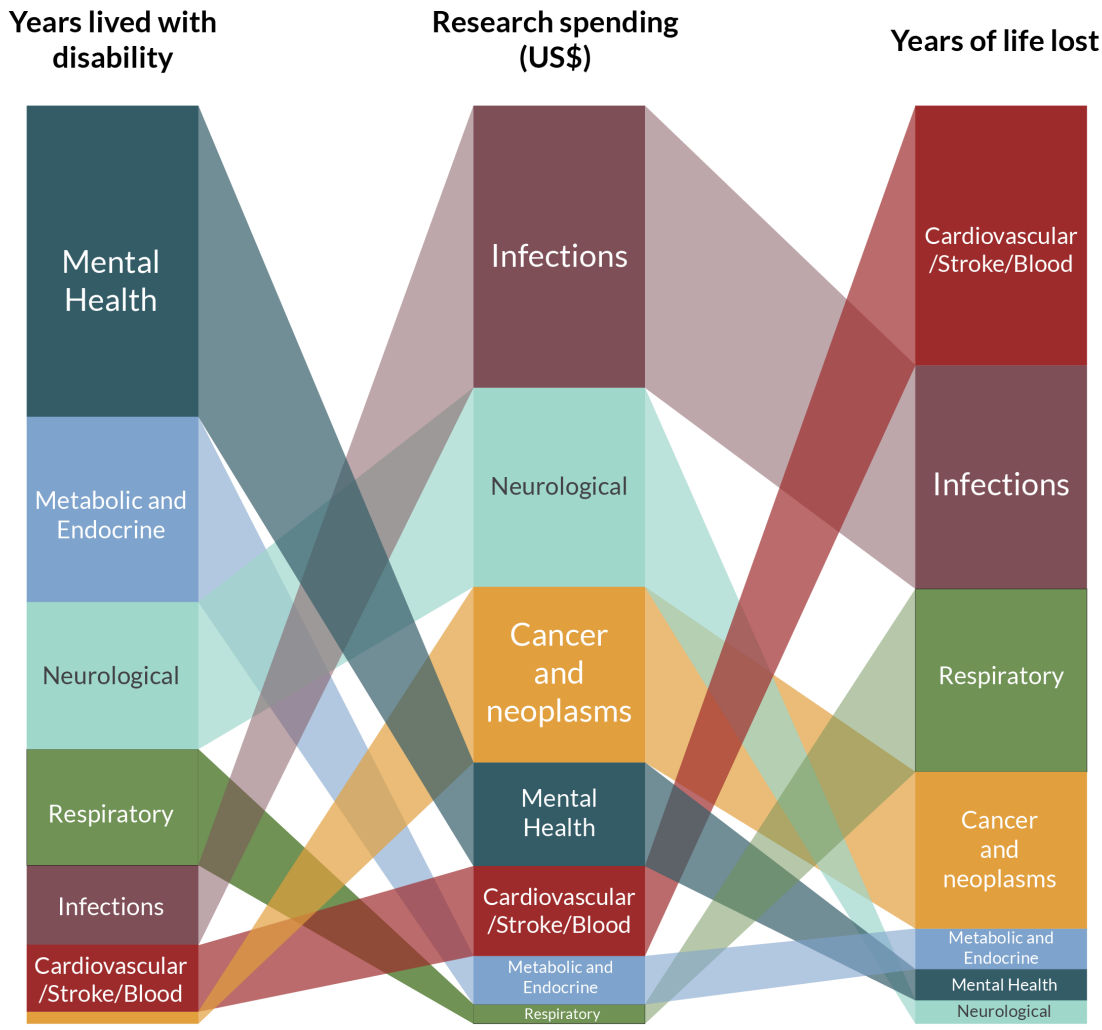


Figure D.25: Domestic research funding in LMICs for selected fields, including mental health, compared to measures of burden of disease



D.5 United Kingdom

The most salient feature of UK mental health research funding is that a quarter comes from philanthropy and charity fundraising sources, as illustrated in Figure D.27. Of the US$1.15 billion invested by UK mental health research funders between 2015 and 2019, 22% percent came from philanthropy (which would largely be the Wellcome Trust) and a further 4% from fundraising charities. In contrast, in all other regions, less than 5% of funding came from these two sources. The other feature to note is that, like in Australia & New Zealand, over one-third (36% - Figure D.29) of research investments were allocated to RACs 6, 7 and 8 (i.e., Evaluation of treatments, Management of treatments and Health services), i.e., applied research. This is in comparison to 12% in LMICs, 23% in Europe and 26% in the US.

"The most salient feature of UK mental health research funding is that a quarter comes from philanthropy and charity fundraising sources."

Figure D.26: Trends in mental health research funding in the UK, adjusted for inflation

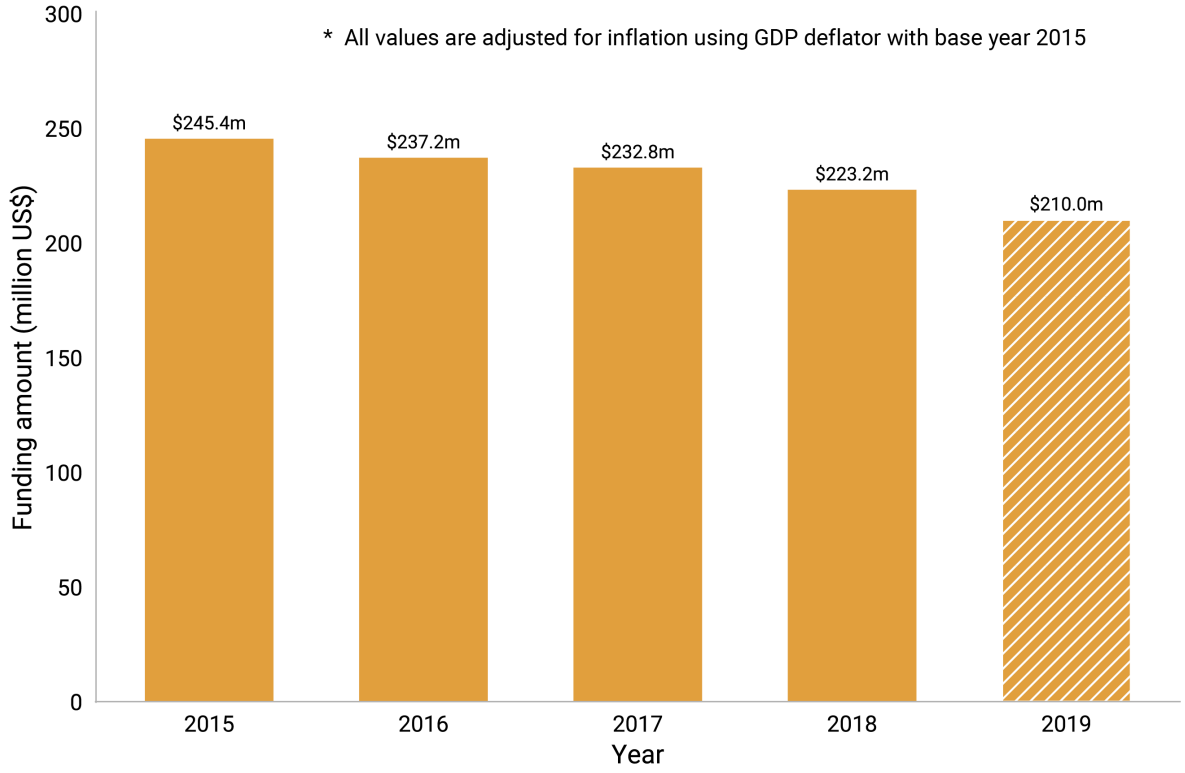


Figure D.27: Mental health research funding in the UK by source of funding

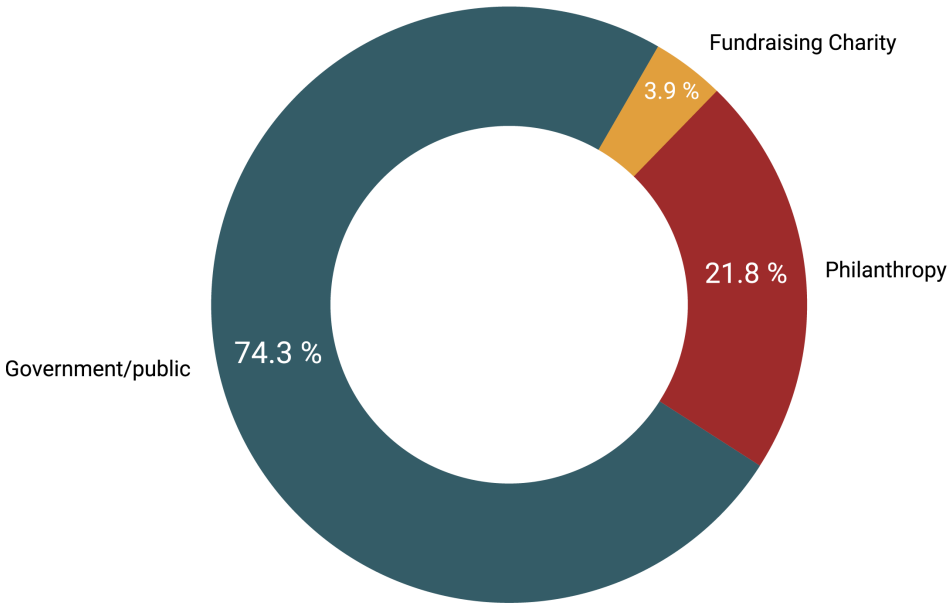


Figure D.28: Mental health research funding in the UK by specific mental health conditions

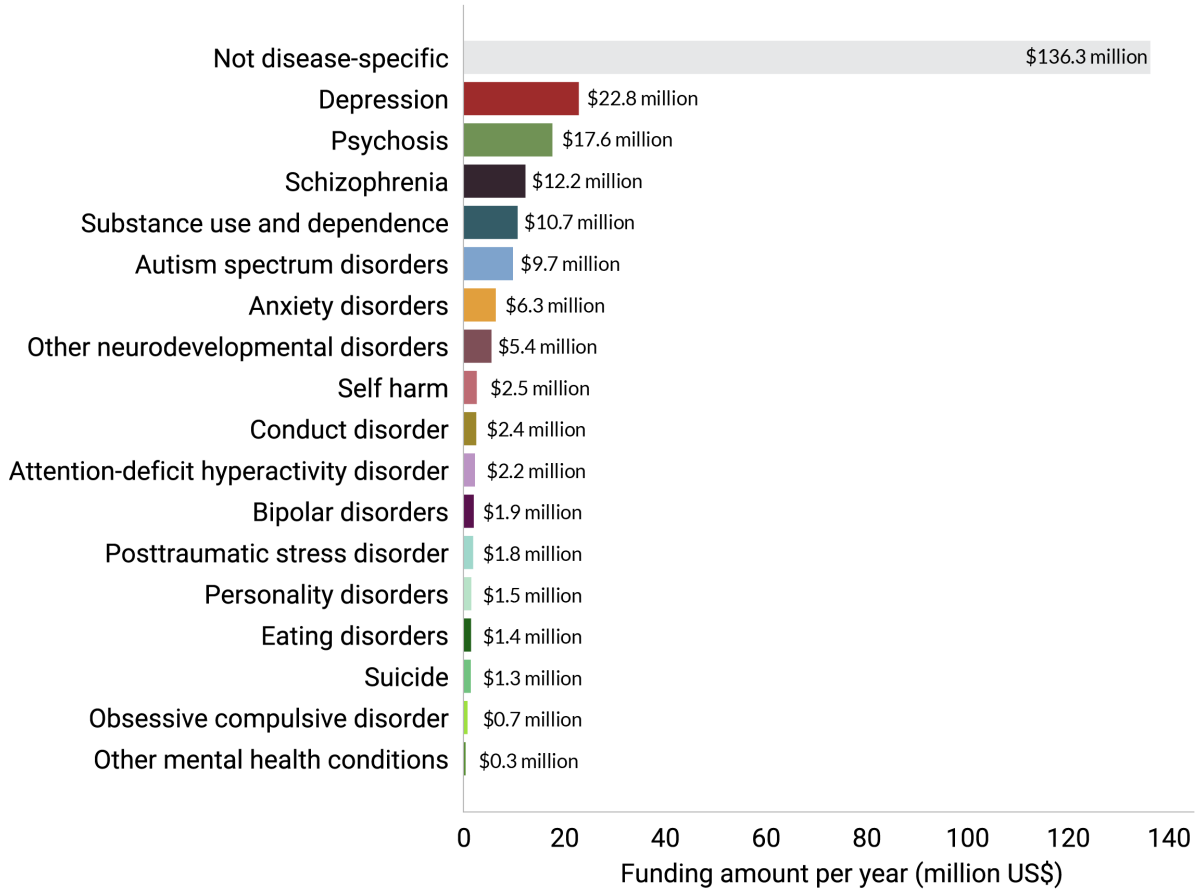


Figure D.29: Distribution of annual mental health research funding in the UK by Research Activity Code (RAC)

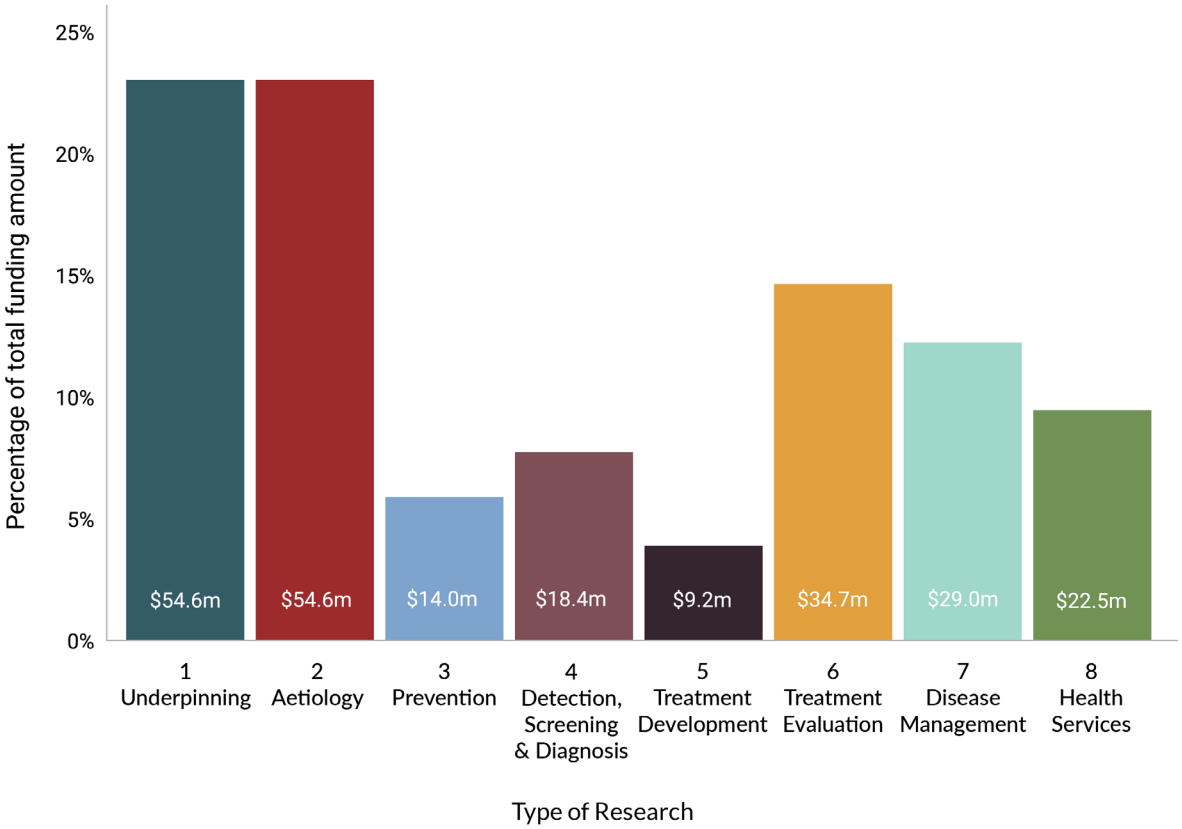
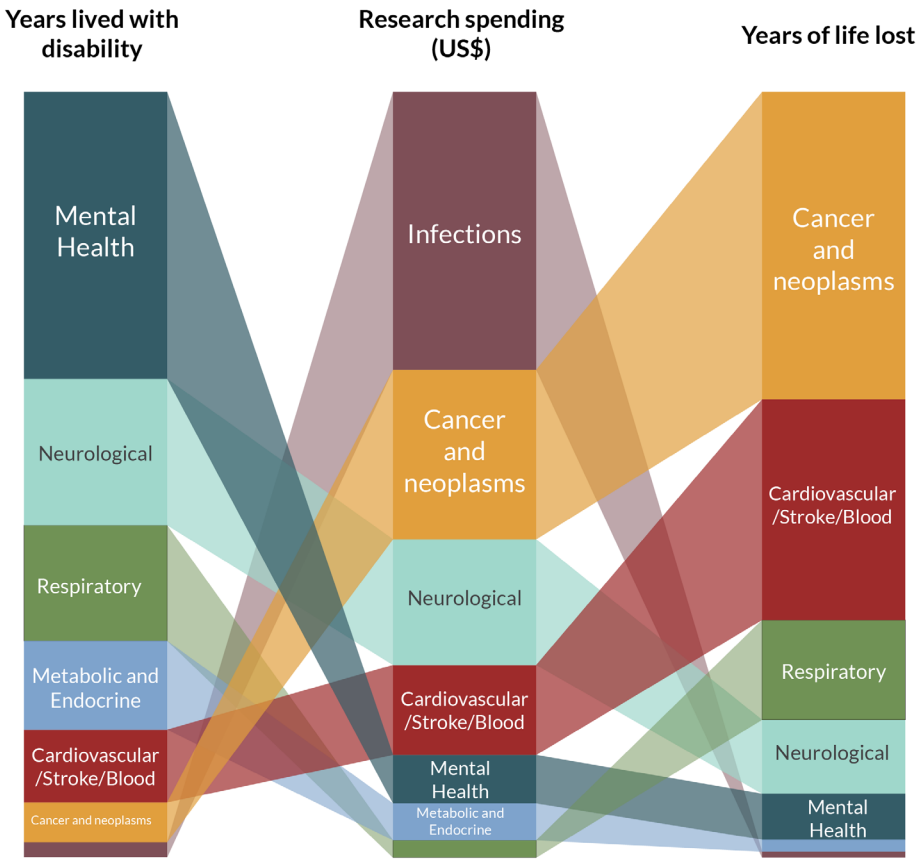


Figure D.30: Research funding in the UK for selected fields, including mental health, compared to measures of burden of disease



D.6 United States

Most sizable investments in mental health research originate from US funders. The stand-out feature for the US is that it invests proportionately more in Substance use and dependence research than any other region (Figure D.34). Overall, 24% of US mental health research funding is spent on Substance use and dependence, in comparison to 9% in Canada, 8% in Australia & New Zealand, 5% in Europe, 5% in LMICs and 4% in the UK. In other words, the US is supporting 93% of all mental health research funding on Substance use and dependence globally. This observation is further confirmed in Table D.2 (for the regional analysis on Europe), where the ratio of the top condition for investment to the 5th ranking one was 5.59 compared to 2.09 for Europe. That means the US is investing 5 times as much in Substance use and dependence research than its fifth ranking condition, Schizophrenia.

"Most sizable investments in mental health research originate from US funders"

Figure D.31: Trends in mental health research funding in the US, adjusted for inflation

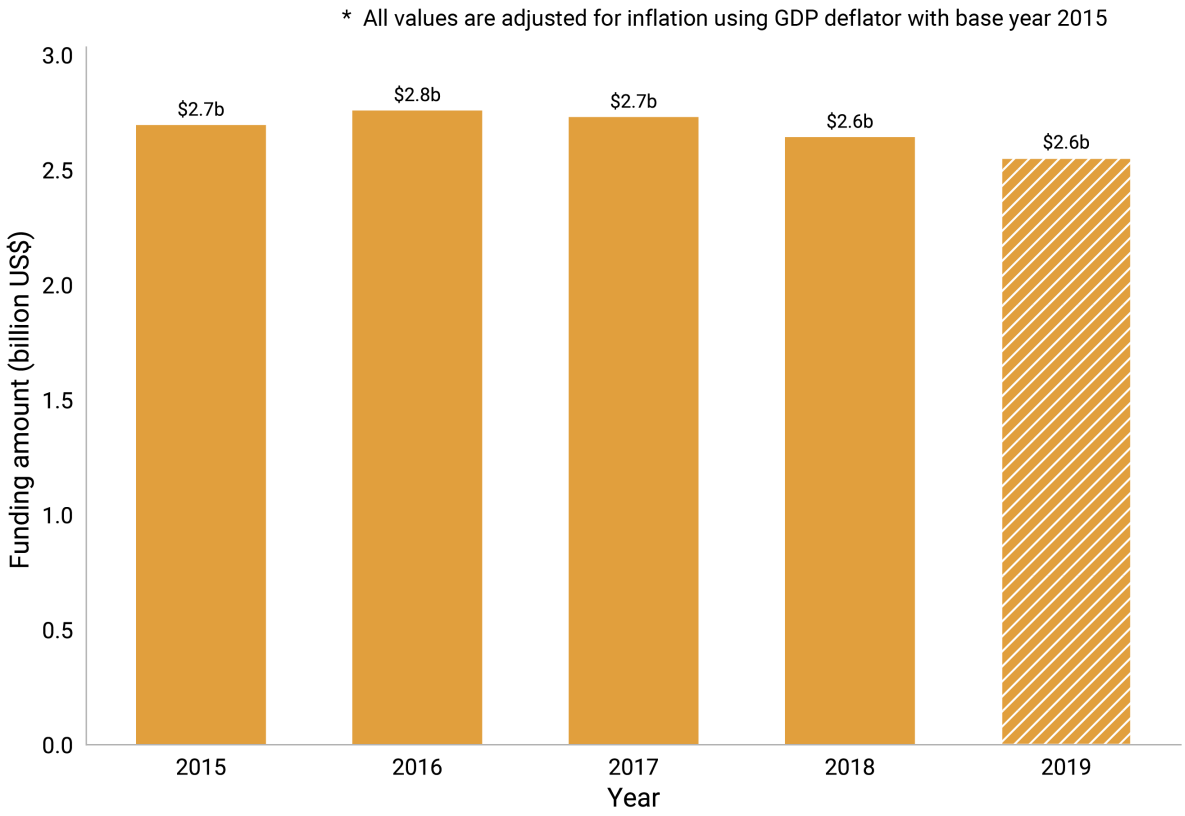


Figure D.32: Mental health research funding in the US by source of funding

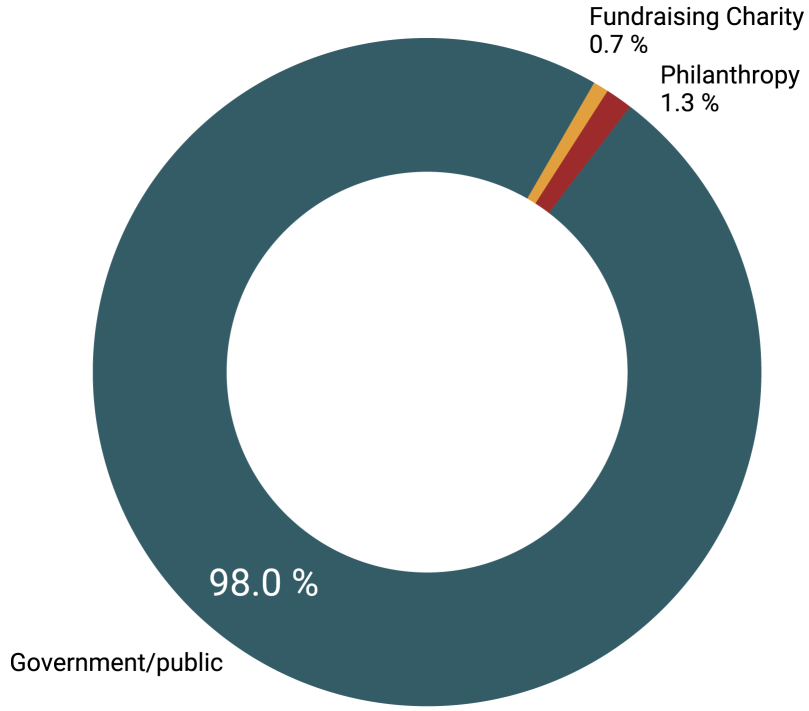


Figure D.33: Mental health research funding in the US by specific mental health conditions

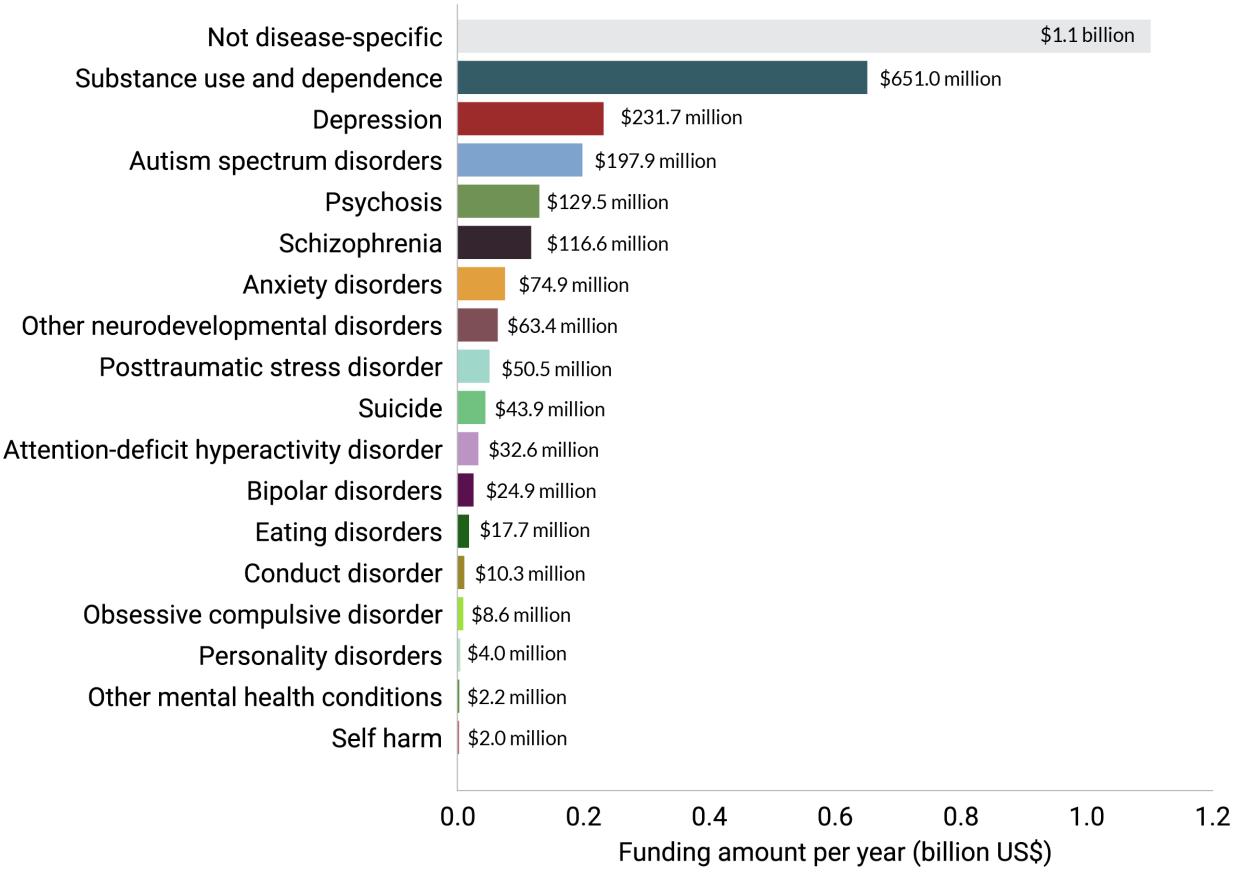


Figure D.34: Distribution of annual mental health research funding in the US by Research Activity Code (RAC)

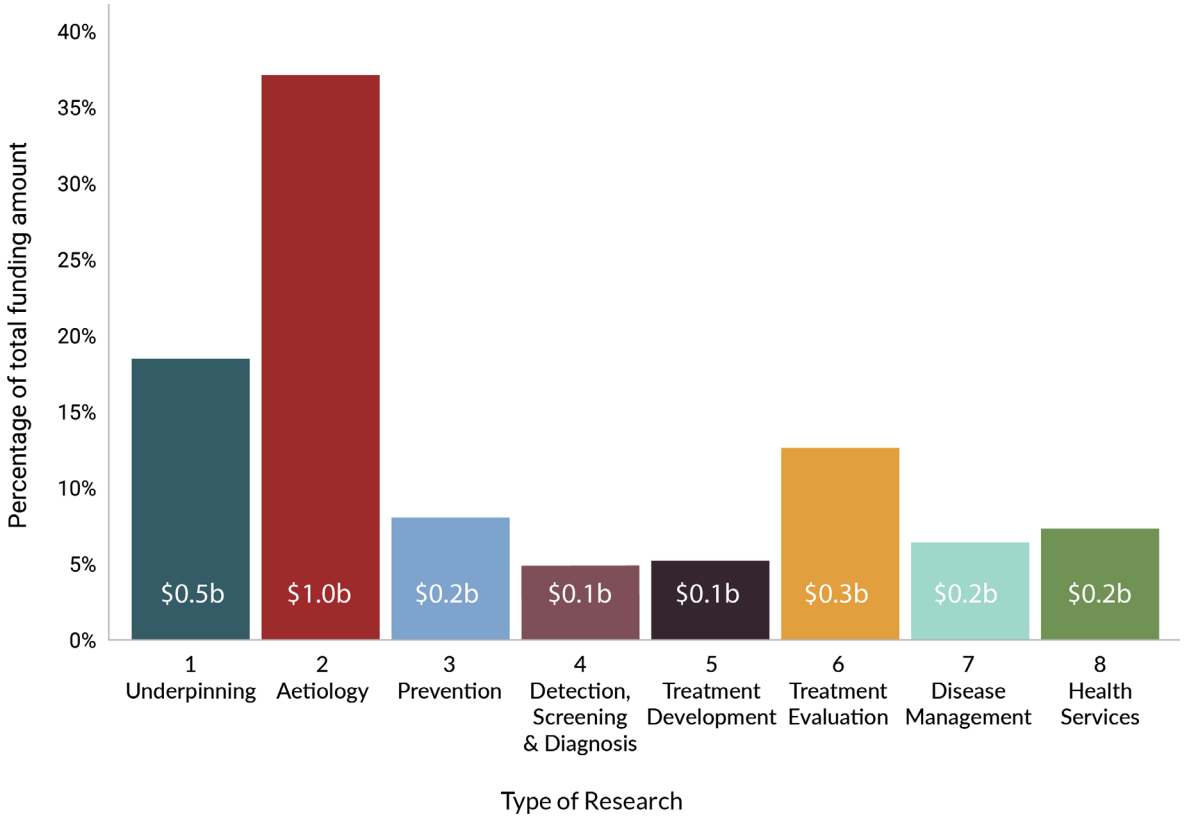
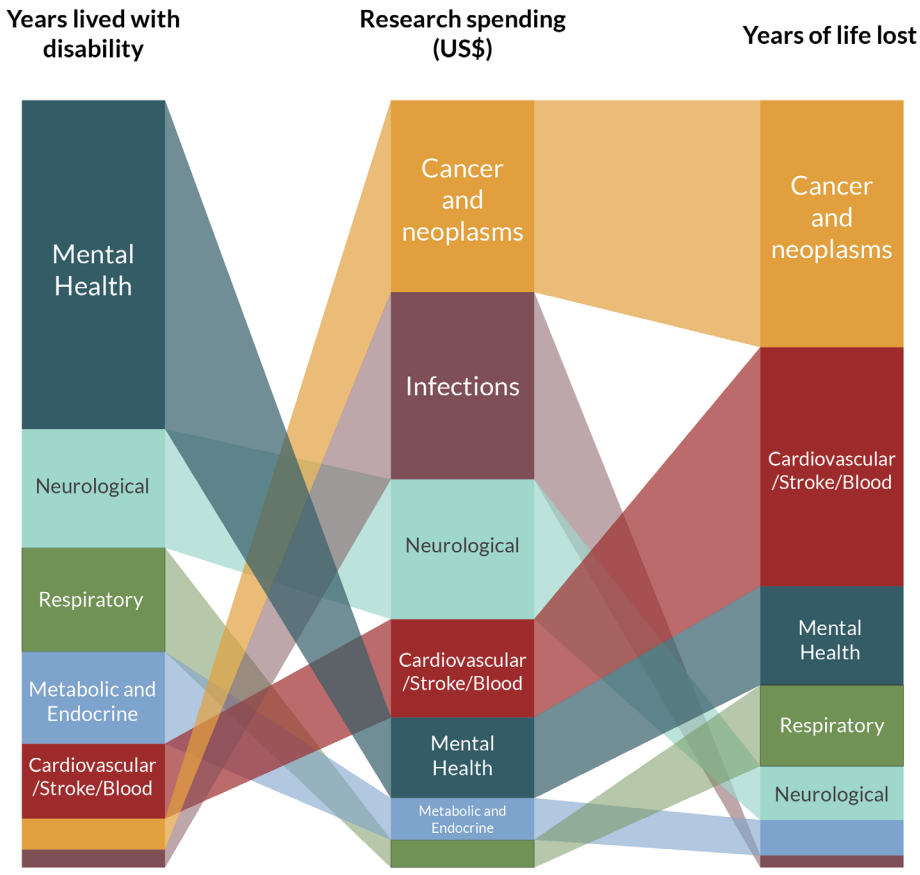


Figure D.35: Research funding in the US for selected fields, including mental health, compared to measures of burden of disease



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