MAPPING GLOBAL HEALTH RESEARCH

MAPPING PATTERNS AND IDENTIFYING CONCEPTUAL FRAMEWORKS IN GLOBAL HEALTH RESEARCH: A SYSTEMATIC REVIEW

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TITLE: Mapping Patterns and Identifying Conceptual Frameworks in Global Health Research: A Systematic Review

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Lay Abstract

While the importance of the field of global health is more prominent than ever, it is a field of uncertainty, controversy, contested merit, and often disreputable history. Conversations abound on the strengths and weaknesses of the field and what needs to change; yet, there is a lack of empirical grounding for these discussions. In this study, I reviewed global health research literature, identifying 17 key characteristics that surface in theoretical conversations on global health, and scored 1033 global health research studies according to these characteristics. Using multiple correspondence analysis, the 17 characteristics were analyzed together and visualized to elucidate the relationships between the characteristics. I found that: over half of the studies were quantitative observational; most research in global health had at least one author from a high-income country; and middle-income authors were less likely to study social and structural determinants of health than high-income authors. These findings lend important empirical evidence to conversations on the direction of the field, starting from where we are at now.

Abstract

Background: Global health is a complex, interdisciplinary, and contested field. It is rapidly growing and undergoing ideological and methodological changes. Despite many theoretical claims over what global health research *ought* to be, there are few empirical reports on what global health *is,* as a present field of research. The aim of this study is to: 1) determine patterns in global health research, based on key research characteristics; and 2) determine relationships between these characteristics to identify and define conceptual frameworks in global health research. **Methodology:** A systematic review of research in global health journals was conducted for papers published in the years 2010, 2015, and 2020. Categorical data on 17 research characteristics was extracted from all studies included in the analysis. The relationships between these characteristics was analyzed and visualized using multiple correspondence analysis, as implemented in the R's **ca** package. Significance tests of independence determined relationships between pairs of variables. **Results:** The final analysis was done on 1033 included studies from 14 journals. 56% of the studies used a quantitative observational methodology. While 82% of research had at least one author affiliated with a high-income country, 96% of research funded (at least partially) by the Bill & Melinda Gates Foundation had at least one author affiliated with a high-income country. There was a significant relationship between the use of social and structural determinants of health and the authors' affiliations (X^2=59.06, $p < 0.001$), with the use of social and structural determinants of health lower among lower-income authors than high-income authors. The first and second dimensions of multiple correspondence analysis explained 38% of the variables' deviation from independence. **Conclusion:**

Multiple correspondence analysis offers a novel way of understanding global health research, contributing empirical data to the discourse on what lies ahead for the field of global health. The relationship between the use of social and structural determinants of health, authorship, and research methodologies point to the need for important conversations on the direction of global health research, starting from where we are at now.

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Table of Contents

List of Figures and Tables

Figures:

Tables:

List of all Abbreviations and Symbols

BMGF: Bill & Melinda Gates Foundation

COVID-19: coronavirus disease of 2019

DALY: disability-adjusted life year

HIC: high-income country

LMIC: low- and middle-income country

MCA: multiple correspondence analysis

MDGs: Millennium Development Goals

SDGs: Sustainable Development Goals

SDOH: social and structural determinants of health

UDHR: Universal Declaration of Human Rights

QALY: quality-adjusted life year

WHO: World Health Organization

Declaration of Academic Achievement

The following is a declaration that the content of the research in this document has been completed by Michal Leckie and recognizes the contributions of Dr. Harry Shannon, Dr. Nancy Doubleday, and Dr. Deborah DiLiberto in both the research process and the completion of this thesis.

Introduction

The field of "global health" is a complex, interdisciplinary, and contest field (Crane, 2010; Holst, 2020; Koplan et al., 2009). Many scholars note the difficulty of defining the field, with some questioning whether it is yet a field at all (Abimbola, 2018; Adams, 2016b; Farmer, 2013; Robson et al., 2019). Paul Farmer, acclaimed global health scholar and physician, writes that "global health, while a marked improvement on its forebear 'international health', remains a collection of problems rather than a discipline" (Farmer, 2013)[1]. Yet, as the inaugural editor of the *British Medical Journal of Global Health* asserts, it is critical that global health be properly defined, particularly for global health journals (Abimbola, 2018). Despite many normative claims over what global health research *ought* to be, there are few empirical claims on what global health *is,* as a present field of research.

Global health was preceded by tropical medicine and then international health, both criticized for reflecting colonial ideology, employing paternalistic assistance approaches, and lacking a health equity focus (Adams, 2016a; Benatar, 2016). Global health emerged with aspirations to address these shortcomings, but there is debate over whether it has succeeded or whether it has merely "reproduce[d]" the failures of its predecessors

[1] It is notable, however, that Farmer wrote this in 2013, and global health has transformed a lot since then.

(Adams, 2016b; Holst, 2020; Robson et al., 2019; Yiu et al., 2020). The aim of the present review is to examine patterns in global health research according to research characteristics that are discussed in global health literature. Relationships between these characteristics are analyzed in order to "map" the field of global health research and start to understand whether global health succeeds in its aspirations.

Part of understanding a field of study is describing the conceptual frameworks that shape its methodologies and research questions, and form its theoretical groundwork (McGaghie et al., 2001). Relationships between research characteristics in global health research are assessed to examine whether 'individualistic' and 'collectivist' frameworks for health can be used to describe different ways of (or conceptual frameworks for) doing global health research. These frameworks have been used in global and public health literature, but not rigorously defined. The individualistic and collectivist frameworks for health were described by Elizabeth Fee and Nancy Krieger in the context of the AIDS epidemic in the early 1980s (Fee & Krieger, 1993). The individualistic paradigm for AIDS understood it as biomedical disease affecting individuals; under this paradigm, AIDS prevention focused on individual action, and emphasized the primacy of physician and scientist perspectives over those of patients. An individualistic approach is "profoundly ahistorical, it contains within itself a dichotomy between the biological individual and the social community, and then it ignores the latter" (Fee & Krieger, 1993). A collectivist approach, by contrast, considers the perspectives and understandings of patients themselves and examines how historical processes contribute to health and

health inequalities, and considers "patterns of risk" formed by social and historical contexts (Fee & Krieger, 1993). Many definitions of global health—both in describing what it is now, and what it aspires to be—consider these approaches to the AIDS epidemic described by Fee & Krieger.

The field of global health is gaining increased acknowledgement in the context of the COVID-19 pandemic, but it is also facing ontological challenges (Lincoln, 2021). There is currently no method for identifying different types of global health research. To make global health the field envisioned by scholars eager to differentiate it from its predecessors—one with true global partnership, an emphasis on planetary health, disruptions to North-South power asymmetries, and a shift away from biomedical approaches (Abdalla et al., 2020; Benatar, 2016; Birn et al., 2019; Koplan et al., 2009)—the field of research must be understood as practiced now. Abimbola & Pai (2020) write: "A crucial first step [to true transformation of global health] is recognizing that ours is a discipline that holds within itself a deep contradiction—global health was birthed in supremacy, but its mission is to reduce or eliminate inequities globally". It is a field of contradictions, contrasts, and controversy; and it is a field with few empirical claims illustrating what it is. The present project aims to take a first step at understanding patterns in the type of research that has been done over time in what is stated to be the field of global health.

For this thesis, I conducted a systematic review of published global health research to explore the following two questions:

1. How is recent global health research oriented in terms of characteristics of research related to the conception of health, methodology details, and author information? Is there a change in orientation over time, between 2010, 2015, and 2020?
2. Do these characteristics group together, and can they be described by the underlying conceptual frameworks for health, individualism and collectivism?

The first chapter (Literature Review) gives some background information and justification for the research project. In the first section of the Literature Review, I discuss the history of global health and its roots in tropical medicine and international health; as will be seen, many present-day criticisms of the field can be traced to this history. In the second section, building upon past iterations of the field of global health, definitions of global health will be considered; as I detail below, despite increasing interest in the field, there is still much debate about what global health *is* and how it should change, including conversations on global health decolonization. In the third section, I situate this work in the broader context of research on global health; despite several notable and important pieces of work seeking to study the field of global health, I argue that the present project fills an important gap in global health research. In the fourth section, conceptual frameworks are discussed in relation to global health; this section will provide important groundwork for considering theoretical underpinnings in the field of global health. In the fifth section, a brief description of the research project is outlined; while detailed

methodology is in the methods section, a brief outline of the project is necessary here to make sense of the following section. In the sixth section of the Literature Review, a description of each research characteristic that was extracted from the research studies included in the present systematic review will be given, with a justification for their inclusion. Following the Literature Review, the second chapter outlines the Methodology for this project, followed by the third chapter, the Results of the systematic review, and the fourth chapter, the Discussion.

1. Literature Review

1.1 The History of Global Health

Examining the history of global health can illuminate the field's present aims and challenges (Birn et al., 2017). Its lineage begins with colonial medicine that persisted into the 19th century and concerned itself with the health of imperial militaries during conquests, focusing primarily on infectious disease (Greene et al., 2013). As European invasion, colonial expansion, and mass enslavement continued, increased trade and movement of people contributed to the spread of diseases, which were far more prevalent and deadly among Indigenous than settler populations (Birn et al., 2017). The field of tropical medicine emerged at the beginning of the 20th century to protect European settlers, with newfound infectious disease strategies, and to ensure that slave workers remained productive (Adams, 2016a; Benatar, 2016; Birn et al., 2017). With its focus on infectious disease *security*, tropical medicine was a tool for colonization and worked to exert settlers' sovereignty (Benatar, 2016; Greene et al., 2013; Adams, 2016a; Birn et al., 2017).

A globalizing world economy required collaboration on infectious disease surveillance and containment (Birn et al., 2017). International health replaced tropical medicine in the mid-20th century, alongside the development of institutions such as the International

Sanitary Bureau and the League of Nations Health Organizations, as a field still concerned with tropical diseases and infectious disease security, but with a new focus on international cooperation, redistribution, and peace (Birn et al., 2017; Horner, 2020). International health was tightly linked to large philanthropic organizations such as the Rockefeller Foundation, founded in 1913, which was heavily involved in setting its agenda and tended to focus on short-term, technological solutions to public health problems (though it also supported social medicine endeavors; Birn, 2014). This structure continues today, with both the Rockefeller and the Bill & Melinda Gates foundations as powerful actors in global health agenda-setting (see Section '1.6 - Q' for further discussion on the role of philanthropy in global health; McGoey, 2016).

International health pushed against the colonial motivation of tropical medicine (Adams, 2016a) by focusing (purportedly altruistically) on health in mostly low-income countries (Holst, 2020; Koplan et al., 2009), rather than working to protect the colonizers and exert control. However, in practice, divisions between the Global North and South remained (Abimbola, 2018; Adams, 2016a; Benatar, 2016; Birn et al., 2019; Koplan et al., 2009). Moreover, international health employed a paternalistic assistance approach that was often biomedically-focused (Benatar, 2016) and lacked an understanding of social, political and economic factors—especially how a history of colonialism and oppression built social structures that threatened people's health. Thus colonial ideology persisted in the practice of international health (Horner, 2020).

Eventually, international health became as much about the health of economies and nations as about the health of people, with visions to develop, "civilize", and "moralize" other nations; indeed, the rise of industrial development and capitalist endeavors with international health was no coincidence (Birn et al., 2017). While global health today is not typically thought of as employing colonial ideology, ties with tropical medicine and international health have ongoing influences (Birn et al., 2017).

Global health began to replace the fields of international health and tropical medicine in the 1990s, but its prominence has dramatically increased since 2000 with a proliferation of academic journals, new university programs, and non-profit organizations (Abdalla et al., 2020; Holst, 2020; Robson et al., 2019). Global health emerged with the vision of a practice that is genuinely global and not tied to nation states; one that has overcome its colonial past and let go of the idea of the Global North[2] as saviors and the Global South as in need of saving (Adams, 2016a; Birn et al., 2017; Crane, 2013). The end of the Cold War arguably shaped the field's focus on partnership, cooperation, and economic and social development—a focus that continues today (Birn et al., 2017). Global health, in a way that differs from its predecessors, has adopted a *globalized* view of health, in conjunction with late 20th- and early 21st-century globalization, which means both cooperation (rather than domination) and an acknowledgement of global

[2] The Global North/Global South distinction is one commonly used in global health academic circles. Yet each region is not clearly defined, and some argue that there is a middle-ground that cannot be accounted for by this binary distinction (Müller, 2020). Despite the lack of clarity, often the Global South can be understood as encompassing low- and middle-income countries, while the Global North contains high-income countries. While this categorization is not consistent or well-defined alas, it will be used throughout this paper.

interconnectedness (in terms of infectious disease, but also with an interest in economic globalization; Birn et al., 2017; Horner, 2020). Thus while health might be understood in tropical medicine terms as a means to *security,* in global health terms, it is sometimes understood as—and increasingly tied to—(economic) *development.*

While the field of global health today is new in name, the institutions, theories, and efforts to improve global health that preceded it continue to have enduring effects. In the following section, the enduring legacy of global health's past will be considered in the context of present definitions of global health, common criticisms of the field, and the persistence of the colonial era.

1.2 Defining Global Health

Global health, while gaining academic, governmental, NGO, and philanthropic interest in its over two decades of work, lacks a strong definition (Abimbola, 2018; Beaglehole & Bonita, 2010; Cousins et al., 2021; Farmer, 2013; Horner, 2020; Lincoln, 2021; Salm et al., 2021; Taylor, 2018). The Consortium of Universities for Global Health met in 2009 and produced the "Koplan definition" of global health: "Global health is an area for study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide" (Koplan et al., 2009). This definition echoes the World Health Organization's slogan at Alma Ata in 1978: "Health for All" (Katz, 2008). Global health focuses on global cooperation and partnership and puts emphasis on

health equity (Koplan et al., 2009), distinguishing it from the colonial-era practices that preceded it. Furthermore, global health is an interdisciplinary field, borrowing ideas, methodologies, and knowledge from fields both inside and outside the health sciences (Koplan et al., 2009).

Although the Koplan definition remains widely cited today, it is not without criticism. For example, Beaglehole & Bonita (2010) consider it "wordy and uninspiring". Moreover, it is not universal: a review of research since the Koplan definition identified 34 papers with unique and new definitions of global health (Salm et al., 2021). These papers defined global heath as "a multiplex approach to worldwide health improvement" and an area of academic pursuit; an approach that holds values of equity and social justice; a form of governance; a field with unclear distinctions from international health, tropical medicine, and public health; and a "vague" field (Salm et al., 2021). Similarly, Robson et al. (2019) find that the definition of global health used in global health ethics literature often does not clarify the distinction between global health and international health. Furthermore, while some notable differences between global health and international health literature have been found, such as methodology and degree of international collaboration, the distinction is still not completely clear (Yiu et al., 2020). Efforts to define global health are tasked with the challenge of outlining the purview of this new field, as well as making a clear division between global health and its predecessors. While the definition of global health put forward in 2009 (Koplan et al., 2009) attempts to distinguish global health

from international health, it seems as though a robust "common" definition is still absent (Salm et al., 2021).

Beyond the content of any one definition is the question of *who* defines global health. The greatest power of the North is the power to define[3], including, importantly, the power to define what constitutes global health and who is involved. In the 34 papers that Salm et al. (2021) included, each with a definition of global health, a striking 30 had a first author with affiliations in North America and/or Europe. The final four had a first author with affiliations in New Zealand, Israel, Brazil, and cross-affiliations in Canada and South Africa. While global health claims to be in service of lower-income countries, it is a field almost entirely defined by the Global North[4]. Thus, while it is important to understand how global health is being defined, so too is it important to understand who has the power to define it. This is the focus of decolonization discourse.

1.2.1 Global Health Decolonization

One central criticism of global health is that, while it attempts to distinguish itself from its colonial past, it does not always succeed. Discussion on decolonization has thus become more prevalent in attempts to improve global health (and also further define it and

[3]Dr. Paul Hamel (University of Toronto) brought this phrase – "the greatest power of the North is the power to define" – to my attention, and I have not been able to find another source.

[4] It is important to note, however, that these 34 definitions that Salm et al. identify are certainly not the *only* definitions of global health; they were identified by searching published, peer-reviewed articles in common (often North American) databases. There are likely many other definitions of global health that did not get identified by Salm et al.'s search. However, it is still telling to consider who has the power to write definitions of global health in published, reputable, academic work.

distinguish it from its predecessors). Tropical medicine was profoundly colonial, created to address the spread of disease among settlers and to *protect* settlers from colonized populations (who were made sick *by* exposure to colonizers). International health then sought to focus not on security and division but rather on collaboration. In contrast to tropical medicine, it directed its gaze to low-income populations and countries. Coloniality is about both disrupting and dispossessing people and land, but also dispossessing knowledge (Atuire & Rutazibwa, 2021). While tropical medicine may have been more colonial in terms of the dispossession of land, international health and now global health can be seen as colonial in terms of dispossessing knowledge. One form of colonial persistence is *epistemicide,* a loss of ways of knowing and teaching, and a loss of agency and self-determination (Atuire & Rutazibwa, 2021). Global health is thus seen as a colonizing activity when it uses an idea of "health" that isn't universally shared (Abimbola & Pai, 2020; Atuire, 2021), and when it supresses local views and knowledge (Horton, 2013). Conversations on decolonization are important to understanding where global health has come from, and how it has been influenced by its history as tropical medicine and international health, and also about where global health stands now and where it is (or should be) going.

Despite the rhetoric of partnership, colonial ideology is expressed in present-day global health by assumptions about the transfer of knowledge and skills. The movement of knowledge in global health is seen as going from North to South: global health assumes that "theory [about global health] comes from the Global North while data comes from

the Global South" (Adams et al., 2019). This is how epistemicide can work; when global health is largely controlled by the Global North, and executed in "partner" institutions in the Global South, northern funding (a value-laden activity) might inadvertently harm health institutions in the South (Crane, 2013) and disparage (and/or undervalue) local knowledge. Global health institutions, while ostensibly aiming to rectify the ills of the past, instead can in some cases reify colonial ideology by sequestering resources and knowledge (data) in high-income countries (Khan et al., 2021). Organizations created in the Global North, with the aim of improving the health of people in the Global South, for example, are often deprived of participation from people in the Global South, and lack coordination with local populations and organizations (Khan et al., 2021). Furthermore, we see a form of ongoing colonial ideology in global health authorship, where academic literature is dominated by researchers in the Global North, while in many cases being "about" people in the Global South (Abimbola, 2019). Saha et al. (2019) argue that, while tropical medicine and international health "reflected the unequal power relations of that time, global health reflects the unequal relations of present". While global health today might not be "colonial" in terms of flag-planting land dispossession, it is colonial more covertly by dispossessing knowledge, by holding (universal) ideas of what it means to be "developed" (Atuire & Rutazibwa, 2021), and by framing the Global North as the sole producers of knowledge and disseminators of "help" (Crane, 2013). In the context of COVID-19, "the current global health ecosystem", Büyüm et al. (2020) argue, is not prepared to consider ways in which colonial ideology persists, and "the system itself upholds the supremacy of the white savior."

Decolonization is about returning land *and* agency, knowledge and knowledge-*making.* Education is one way in which colonization acts, when knowledge is assumed as universally-shared, and when "development" means reproducing the structures of knowledge and knowledge production that exists in "developed" places " (Atuire & Rutazibwa, 2021). The notion of *pluriversality* can be used here to replace this form of epistemological coloniality—a "pluriversal" approach to decolonization means recognizing the possibility of many equal worlds within worlds, rather than a domination of one (Atuire & Rutazibwa, 2021). Eugene Richardson, for example, reimagines Plato's Allegory of the Cave to express the need for understanding knowledge as pluriversal (Richardson, 2021). In Richardson's account, there are many caves (in contrast to Plato's single cave, which might here be imagined as the colonial idea of universal truth and desire) and each harbors a truth (there is no one Truth). Each truth does substantial work in how we see reality (i.e., which cave are we in?) and in the context of global health, how we see problems of health and ways of addressing (and researching) them. In one example (or, as Richardson calls it, "redescription"), Richardson considers the Ebola epidemic in west Africa; academic literature on the epidemic identified some patients as "superspreaders", in that, biologically, they infected many other people. And, as Richardson grants, this is a "truth"—we are in one cave. But this is not the only cave (Richardson, 2021). Decolonization acknowledges the multitude of caves. The corrupt mining companies that impoverished the region where the Ebola epidemic took place are also, Richardson asserts, superspreaders (Richardson, 2021). The process of decolonizing

must include an acknowledgement of not just health equity in terms of *access*, but health equity in terms of health knowledge generation (Atuire & Rutazibwa, 2021).

The decolonization discourse in global health can be used as a way to explain and contextualize ongoing problems and criticisms in the field of global health. It can also inform what work and research happens in global health; as with the many possibilities for who/what the "superspreaders" of the Ebola epidemic are, with each health problem, how the problem is conceptualized informs how it is addressed. Certainly, there is a place for asking the question, 'why do some people spread disease much more than others?', but it is important to consider whether the field of global health is equipped to answer that question, and what questions might be asked in its place. Decolonization, as Atuire & Rutazibwa argue, must acknowledge many possibilities for understanding the world, many caves, in Richardson's language. Part of that is acknowledging that the questions that are asked in global health are suffused, whether tacitly or not, with colonial legacies and unequal power relations.

1.3 Themes in conversations on defining and remodelling global health

Ideas about how to define global health, and how it should be remodelled, can be broadly understood as fitting into two categories: first, the "global" in global health is highlighted to discuss the places and actors in global health (i.e., where global health happens, and by whom). Second, the "health" in global health is considered in order to identify how health

is conceived, and thus how it is researched or achieved. Each of these parts of "global health" will be considered in turn.

1.3.1 "Global" health: places and actors

While tropical medicine and international health were fields of study practiced, in general, by those in wealthy Western countries, often in poorer countries (Beaglehole & Bonita, 2010), global health purports to extinguish that division. However, as I have noted, there is still concern that global health is an idea of the resource-rich world, controlled by the North and taking place in the South (Abimbola, 2018; Crane, 2013). Thus in many discussions on the merits of global health (and how it *is* different from its predecessors), the *place* and *actors* in global health are of central interest.

Johanna Crane, borrowing from Lisa Malkki's idea of "sedentarist metaphysics", suggests that global health as defined by the North presupposes "access" to research subjects "geographically rooted in place" while assuming the mobility of researchers (Crane, 2013). There is then the paradoxical challenge of figuring out whether students in low-resource settings can "do" global health (Crane, 2013). Abimbola pushes back against the idea that global health is done by high-income countries in low-income countries, to emphasize that "global health is about health equity everywhere, including within high-income countries" (Abimbola, 2018). Yet for many low-income countries, global health is just health (Crane, 2013). There is thus ambiguity as to what the "global" in global health

means, and how to define it without demarcating the Global North and South and writing unequal power dynamics into the very definition of the field. Global health institutions, from NGOs to larger transnational organizations, need to acknowledge the work they do that perpetuates health inequalities and "asymmetries of power" (Khan et al., 2021). Part of acknowledging power is looking at what Kabir Sheikh calls "boundary-spanning": disrupting geographic divisions, health system divisions and divisions in terms of goals and priorities, which means researchers from the North acknowledging and taking to heart that they do not always know best (Sheikh et al., 2016). If global health remains focused on low-income countries, there ought to be explicit interrogation of power dynamics such that unequal hegemonic relationships between the Global North and South are resolved (Abdalla et al., 2020).

Another point of consideration is the relationship between the researchers and the researched. Abimbola considers that the implementers or "deliverers" of global health are often far removed from the recipients—"removed not only geographically, but also socially, culturally and economically, even when geographically proximate" (Abimbola, 2018). The distance is manifest "when people with resources to address delivery problems do not have the information or motivation to either make the discoveries available or tailor them to local circumstances" and "when there are asymmetries of power, motivation and information between the helper and the helped". Global health practitioners, Abimbola argues, need to recognize that they are not always in a position to understand the needs and conditions of the communities they seek to help (Abimbola,

2018). Furthermore, Adams et al. (2014) argue that research in global health ought to be more "local" in the sense that programs and policies are made with explicit connection to and in collaboration with the communities that they serve. Global health research should not have the potential for universality and scalability (of an intervention or practice) as its goal; indeed, the failures of international health stemmed in part from their obsession over "one-size-fits-all" models (Adams et al., 2014).

Some scholars suggest that global health ought to shift from place-focused study to a study of global processes and system-level issues (Abdalla et al., 2020; Robson et al., 2019). Climate change, for example, is a phenomenon affecting (albeit to different degrees) the global community, and must be addressed through concerted effort (Robson et al., 2019). The fields of health studies and environmental studies are becoming more and more interrelated; acknowledging (and addressing) the role of the climate crisis on human health is becoming more mainstream—and urgent. The meaning of "global" in global health, in sum, recurs in conversations about the definition of global health, as well as discussions about how to change the field.

1.3.2 Global "health": Biomedical versus social medicine

While the "global" in global health has contentious definitions and remains unclear, so too does the "health" in global health. Part of the discussions and debates on the merits of global health and its flaws involves considering what "health" is and how to achieve it. The World Health Organization defines health as: "a state of complete physical, mental

and social well-being and not merely the absence of disease or infirmity" (World Health Organization, n.d.-b). While this definition is quite widely accepted, ways of conceiving of how to achieve health and address health problems are more disputed. One way of understanding the "essence" of this dispute is to consider what *causes* health and ill-health. Richard Lewontin, in *Biology as Ideology* (1992), argues that while medicine tends towards explanations of disease using the biological agent (i.e., tuberculosis as caused by the tubercle bacillus), social and economic contexts of disease lead to justification for "claiming that *the* cause of tuberculosis is unregulated industrial capitalism". While the tubercle bacillus, as Lewontin notes, is of course *necessary* for tuberculosis, to ignore all other factors leading to disease is incomplete.

What is understood as causing disease, of course, is implicated in how achieving health is approached. Two broad (and interconnected) approaches are the biomedical approach and the social medicine approach, where the *cause* of disease (and health) is placed closer to biological explanations or social explanations, respectively. Biomedical approaches to health understand health, and seek to ameliorate health, through a focus on biological systems and physiological processes. Often, this approach means placing the locus of interest on the individual (biology as an individual property). Social medicine approaches understand the relationship between biological health and the social environment, and direct efforts towards ways in which changes in the social environment can lead to changes in health. Here, the locus of interest is removed from the individual and instead located at public institutions (health systems, schools, sanitation systems) and social processes (relationships between people, political structures, economic conditions, social

and cultural beliefs and frameworks, historical contexts). These conditions and contexts are *social* or *structural determinants of health* (see Section 1.6 - C; Birn et al., 2017).

Many scholars argue that global health as practiced now, while ostensibly a field rooted in social medicine, instead puts too much attention on biomedical approaches. Global health ought to, for example, focus on building strong health systems and public health services, as well as ensuring "broader economic and social conditions conducive to good health, such as employment, housing, income support and gender equality" (Gostin et al., 2013). It ought to divert its gaze from individual risk factors to turn also towards social and political processes and social justice (Biehl & Petryna, 2013, p. 3). Adams et al. (2019) argue that global health largely sidelines social medicine approaches, with ongoing "bio-medical hegemony" in the field, promoting a focus on individual problems at the expense of considering underlying multifaceted social conditions. Yamada et al. (2020) call for a shift to "revolutionary medicine" that abandons biological reductionism in favour of a view of health that considers the social circumstances and origins of disease and calls for addressing social conditions to improve health.

One way of considering the distinction between biomedical and social approaches to global health is looking at the *methods* that global health uses. Abimbola (2018) proposes a distinction between 'problems of discovery' and 'problems of delivery', arguing that global health is (or should be) about problems of delivery. Problems of discovery lie mostly in the hands of hard scientists in health sciences; in other words, problems of discovery are *biomedical* problems. They often seek technological solutions to health

problems and inequity (Abimbola, 2018). Problems of delivery, by contrast, seek to figure out how to get these solutions to work in specific contexts, and they rely heavily on social sciences; delivery is in the purview of *social* medicine. Thus, how global health conceives of "health" is both topical (i.e., a focus on iron levels shifts towards biomedical, while a focus on access to water shifts towards social—with an understanding of the overlaps) and methodological. For example, increasing iron levels can be achieved through biomedical/'problems of discovery' means, or social/'problems of delivery' means. Health can, in sum, be considered through biomedical or social lenses, which informs how health problems or issues are addressed (by the scientific community, or otherwise).

To understand how global health is defined, and consider its enduring colonial legacies, as well as how it is rapidly changing in response to criticisms, it is helpful to consider both how "global" and how "health" is used and defined. The "global" in global health distinguishes it from other health studies, yet it is unclear what "global" entails exactly, and what the ramifications are of that definition. While tropical medicine and international health were explicitly about a transfer of knowledge and skills from higher-income countries to lower-income ones, global health attempts to extinguish this dynamic, though it is unclear on whether it succeeds. Global health is a field that both seeks to rectify global inequalities, yet also paradoxically relies on these inequalities. As Crane remarks, global health in lower-income countries is just "health". And, despite efforts at collaboration and partnership, global health is for the most part a field defined and enacted by wealthy country's institutions—how do we define a field that excludes the

very people it claims to help? Clarity on the "global" in global health is regretfully lacking. And furthermore, while global health is often defined in ways that suggest that "health" in the field of global health is addressed through a social lens, many critics argue that the field is too bio-medically focused. Part of defining a field is distinguishing it from other fields; understanding the role of place and actors in global health helps to distinguish it from its predecessors, while understanding the meaning of and approach to health helps to distinguish it from similar fields such as medicine and health sciences.

1.4 Research Gaps

As we have seen, there has been lively conversation on the merits of the field of global health, theorizing on the relationship between global health and its predecessors, and ways in which it should change. However, despite much theoretical research on global health, there are few empirical reports on what global health research is doing right now. To my knowledge, there have been only two reviews of 'global health' research itself (Abdalla et al., 2020; Yiu et al., 2020). Abdalla et al. conducted a meta-knowledge analysis of global health work, reviewing publications in global health journals for how global health was defined and the topical focus. The authors found that the definitions of global health and what was done in practice generally did not match, with published definitions focusing more on social and economic determinants of health, and published research focusing more on biomedical aspects of health. Overall, the authors found that global health research generally focused on issues of low- and middle-income countries

rather than looking to global challenges, and also did not focus much on non-communicable diseases despite being major causes of morbidity and mortality in low- and middle-income countries. Topics with "global implications" (like climate change, migration) were infrequent topics of study. To determine the topical focus of research, for each time period, text in titles and abstracts were combined into a "string", and the top terms were identified, extracted, and mapped based on frequency, proximity to other terms, and clustering around underlying topics.

Abdalla et al. found interesting trends in the field, and noted the important realization that the definitions of global health that are used do not tend to match what is actually taking place. However, a focus solely on topics studied, determined by frequency of particular terms, misses nuance in global health, and an important consideration of *how* research is done (not just *what* research is done). For example, one time period in their analysis showed that the words "patient", "age", and "corrigendum" were some of the most frequently-appearing words, which is not very elucidating (however, the occurrence of the word 'patient' might indicate an individual lens of the research; though determining any sort of theoretical underpinnings from solely the frequency of words seems difficult). Furthermore, Abdalla et al. write that definitions of global health, which focus more on social determinants of health, do not tend to match global health research in practice, with a more biomedical focus; however, this remains a vague claim, with little empirical evidence to support it. There are no clear definitions of what the authors consider a "biomedical" approach, or how they came to that conclusion, and no clarity on what "the

definitions bore *little alignment* to the topical areas published in global health journals" entails (Abdalla et al., 2020, emphasis mine).

Studying global health *topically,* while interesting, misses the important consideration of underlying ideologies, impetus for the research, and actors involved. Definitions of global health, as seen in the previous section, do not limit what topics, per se, are studied, but rather *how* they are studied. Two research projects on AIDS, for example, can take very different approaches; one project might focus on AIDS as a disease that results from certain individual behaviors, and understand physicians and scientists as the knowledge-holders, while another project might consider AIDS in the context of poor living conditions, inadequate health care, discrimination, and other comorbidities, and understand patient perspectives as critical to addressing it (Fee & Krieger, 1993). A purely topical analysis sidelines this nuance, which is critical to getting a grasp of current global health research.

Yiu et al. (2020) reviewed research published in a global health journal and compared it to research published in an international health journal. They expand the analysis from a purely topical one (as seen in the Abdalla et al. study) to instead identify the methodology of research, income status of the study location, research collaboration, and empowerment of participants, to compare research in the two journals. Given the unclear distinction between research in global health and international health, their goal was to identify differences in the literature (Yiu et al., 2020). This study is important in identifying characteristics of global health research that might differentiate it from international

health, and for identifying characteristics of research beyond solely the topic of study. Its goal, however, departs from our goals here in two ways.

First, since their goal was to compare global health research to international health research, their focus was on identifying differences rather than on establishing the theoretical underpinnings of the ways in which global health research is conducted. Second, Yiu et al. were mostly interested in methodological details, such as the research design, the country in which the study took place, where the authors were from, and whether there was collaboration between countries (the study also extracted information on the topic of research). The topic, author information, and methodology are important, which is why the Yiu et al. study makes a significant contribution. This present study, however, aimed to further differentiate empirical approaches by identifying underlying theoretical and conceptual frameworks used in global health research studies (the understanding of what it means to be *healthy* and how to improve people's health), and an examination of the relationships between methodology, author information, and this understanding of health. To do so, this present study includes information on the use of technology, focus on social determinants of health, and economic considerations, for example, and the relationship between these characteristics, to identify the authors' conception of health and how to address health problems. Finally, as Yiu et al. note, their study is limited by sample size (the study includes research published in 2017) and journal restriction (only one journal is studied for each of global health and international health). It is difficult, as a result, to identify trends in research. Thus, this present study

builds and extends Abdalla et al. and Yiu et al.'s work in order to identify the theoretical grounding of global health research over time.

There have also been a few studies examining definitions of global health, as mentioned previously. Salm et al. (2021) identify definitions of global health used in the literature, while (Robson et al., 2019) identify definitions of global health in global health ethics literature[5]. These both point to the inadequacy of current global health definitions, and the lack of clarity in the literature on what 'global health' means. Building upon this literature, the following section will discuss present approaches to global health research.

1.5 Conceptual Frameworks & Approaches to Global Health

As we have seen, global health comes from a lineage of fields with approaches that would not be celebrated today. Global health actors attempt to distinguish global health from its predecessors, to varying degrees of success. Still, many scholars consider global health, at best, ill-defined, and at worst, merely a name change of its colonial predecessors and a promulgator of ongoing inequality. As we discussed, conversations on how to define global health as well as its merits and criticisms often revolve around conversations on what is meant by "global" and what is meant by "health". While there has been rich and ongoing discussion and debate on global health—where it has come from, what it is,

[5] Robson et al. (2019) also identify methodological characteristics of global health ethics literature, such as the study design, the "level of interaction" (interpersonal, institutional, international, and structural), the ethical framework, and the location of authors.

where it is going—there are few empirical claims on what the field of global health is "doing" now and how it is doing it. As discussed in the previous section, while some authors have examined global health topically and others have examined what definitions of global health are being used in the literature, to our knowledge, there are no examinations of the *theoretical grounding* of global health work. To examine conceptual frameworks underpinning the field of global health, the 'individualistic' and 'collectivist' frameworks for health, described by Elizabeth Fee and Nancy Krieger in the context of the AIDS epidemic (see 'Introduction'), will be used as a starting point (Fee & Krieger, 1993). The 'individualistic' and 'collectivist' frameworks described here will form the molds for further evaluation and study of how these terms can be described empirically, how they might be used to distinguish different kinds of global health work, and how they can be applied to understand where the field of global health research is oriented now. Below we discuss ways in which individualism and collectivism are approached in the context of health.

Diez-Roux (1998) considers individualistic approaches to epidemiology. They raise concern with emphasis being placed on the "individualization of risk", focusing on individual behavior and how it affects health, rather than on how social contexts can modulate risk to a population (Diez-Roux, 1998). This approach would be described by Birn et al. as the "behavioral or lifestyle approach", where people *choose* healthy habits and are considered the central locus of control over their health (Birn et al., 2017). The methodological focus on individuals, by studying individual-level variables, precludes research into broader social-level processes that affect individual health (Diez-Roux,

1998; Richardson, 2021). Diez-Roux cites sociologist Steven Lukes and his criticism of 'methodological individualism', whereby group-level processes are thought to be best understood (perhaps only understood) by studying the individual-level data (Diez-Roux, 1998; Lukes, 1968). "Facts about society and social phenomenon", Lukes writes, "are to be explained solely in terms of facts about individuals" (Lukes, 1968). In global health, a methodologically individualist approach "reifies 'disease' as a salient and commonsensical phenomenon, enabling causal inference to flourish as an explanatory paradigm" (Richardson, 2021, p. 89). Action is placed on downstream risk factors, such as malnutrition, rather than on the social, political and economic conditions that led to such factors, like colonialism (Richardson, 2021).

Multi-level or contextual analysis, by contrast, considers how group-level characteristics affect individuals (Diez-Roux, 1998). Group-level variables that measure aggregate individual-level information (like mean income in a population, proportion of people with high school diplomas) "are more than summaries of individual properties"—they can shape individual-level health beyond the individual-level measure of that variable (Diez-Roux, 1998). There is also a type of group-level variable that measures something not obtained by individual information; like laws and regulations, or political systems, this kind of group-level variable is indeed influenced by individual-level properties (e.g., political orientation; Diez-Roux, 1998). This shift in gaze (or widening of gaze) is comparable to how the collectivist approach to health is described. The Latin American Social Medicine or Collective Health tradition puts emphasis on the consideration of how social processes affect the health of individuals (Abadía-Barrero & Martínez-Parra,

2017). It politicizes studies of health, looking to how historical and political/economic contexts influence health access, and move away from a narrow Western focus on disease causality and biological explanations of risk (Abadía-Barrero & Martínez-Parra, 2017).

The collective health approach criticizes an "ontological primacy of the individual and his/her actions in health outcomes" (Abadía-Barrero & Martínez-Parra, 2017), a criticism of the behavioral approach to health (Birn et al., 2017). Abadía-Barrero & Martínez-Parra build on Agnes Heller's elaboration of the problems with the "bourgeois notion of the individual as a free being who can always make rational choices that maximize benefit to the self". Heller, influenced by Marxist approaches, argues that one cannot understand individual "choice" without an understanding of the individual's environment and social order; it is a critique of the public health idea of risk as a behavior-mediated concept (Abadía-Barrero & Martínez-Parra, 2017).

The distinction between individualistic and collectivist approaches to health are understood here as the ideological grounding for the biomedical versus social understandings of "health", as discussed earlier ('Defining Global Health'). AIDS was first studied as an individual-level disease, where certain behaviours (particularly those of homosexual men) were the culprit (Fee & Krieger, 1993). This approach developed into one that became focused, when available, on biomedical evidence; the concept of the "virus" served an explanatory power where social factors failed to do so (Fee & Krieger, 1993). During the AIDS epidemic, social prejudice informed many of the approaches to explanations of disease causation and containment. In many ways, colonial medicine was

a larger-scale manifestation of individualism. Tropical medicine began as a health security method, in an effort to protect the (European) colonizers from the ills of the colonized. Similarly, the infectious disease understanding of AIDS created marked divisions in society (quarantine, in its starkest form), and a desire to "protect" those uninfected, mostly through individual mediation of behavior (i.e., sexual behavior of those infected; Fee & Krieger, 1993). Thus, the *individualistic* ideological outlook of health manifests as biomedical (and thus methodologically individualistic) health practice. Moreover, attention to the biomedical (individual) can be traced to efforts of disease containment and security, rooted in strong discrimination (in terms of sexual orientation, in the context of the AIDS epidemic, and in terms of race in the context of colonial medicine).

While collectivist approaches to health, manifested as social medicine, began to replace more individualistic approaches, the "status" of global health, i.e., its collectivist/individualist orientation, remains unclear. Definitions of individualism and collectivism, defined by Fee & Krieger, and further described by many others (see Abadía-Barrero & Martínez-Parra, 2017; Diez-Roux, 1998; Richardson, 2021) are presented dichotomously, but health projects no doubt exist on a continuum. While continuums are typically imagined as one-dimensional (in this case, with individualism on one end, and collectivism on the other), we might instead imagine a continuum that is multi-dimensional, whereby many qualities of research, conceptions of health, and researchers' backgrounds take part in pulling or pushing particular research projects in

different directions. The descriptions of individualism and collectivism in the literature are used as starting points to define our frame of reference and further build the map.

The descriptions of individualistic and collectivist approaches that we have considered are used for this current project as the foundation from which to both draw the space between (and within) individualism and collectivism, and identify where on it global health research falls. Clarifying individualism and collectivism requires understanding their relationship to other ways of describing health research, such as who does the research, what kinds of tools are used, how the research is analyzed, etc. (see Section 1.6 below). The project thus aims at contributing to understanding whether global health research has adopted a collectivist approach (as many critics hope for; see Section 1.2 above), or whether it follows the path of tropical medicine and international health by working from an individualistic conception of health.

1.6 Description of variables

A systematic review of research articles published in global health journals was conducted (see Chapter 2). Data extraction from the included studies took place according to a list of "research characteristics" informed by the literature. While a detailed description of the methodology is presented in later, the information sought from each study included in the systematic review (the research characteristics, or *variables*) is discussed here. Given that these variables were chosen based on the critical literature in global health, a justification for the inclusion of each variable is offered below, with

reference to the literature. For a description of how the information for each variable will be extracted from the studies, see Chapter 2; for the criteria for data extraction and the data extraction template, see Table B 1 in Appendix B.

A, B: Health technologies

During a keynote address to the 2005 World Health Assembly, Bill Gates proclaimed that eradicating smallpox with a vaccine happened without eradicating poverty, and that malaria can be eradicated, too, without addressing poverty. His conclusion was that work on a malaria vaccine must be the focus (Birn, 2014). He is an avid supporter of technology to address health inequalities. Similarly, Jeffrey Sachs argues that technological innovation ought to play a central role in addressing global issues, including health issues, and that the spread of technological advancement to low-income countries will allow for these countries to meet the level of development of high-income countries (Sachs, 2014).

However, many researchers have criticized the use of health technology for sidelining broader social contexts. Health technologies address tangible, isolated problems, like the malaria parasite and the mosquito, rather than the more complex work of understanding and addressing the social factors (education, health infrastructure; Cueto, 2013). Global health critics have argued that international health (and to some extent, global health) tended towards technological solutions targeted at single diseases—"magic-bullet

approaches" (Biehl & Petryna, 2013)—and that this approach is problematic when the technology is not combined with social approaches to health or lacks a consideration of social factors (Adams et al., 2019; Biehl & Petryna, 2013; Birn et al., 2017; Cueto, 2013; Holst, 2020). Often, global health is focused on technological solutions that are profitable, seen particularly in the projects funded by philanthropic foundations (Adams et al., 2019; Benatar, 2016; Holst, 2020). The technological approach to malaria that Gates promotes is an example of widespread adoption of technological solutions to health issues that demand a more holistic approach (Cueto, 2013).

While technological approaches to global health problems are criticized for disregarding social factors, it is important when examining these criticisms to consider two different questions. One question asks, how do we best tackle health inequalities? The other asks something more specific: how do we address a given health problem, such as malaria? If we ask the latter, a suitable answer might be developing a vaccine, just as a vaccine successfully eradicated smallpox. But if we ask the first question, developing a malaria vaccine no longer seems like a suitable answer. Thus when considering the use of technologies to address health problems, it is important to consider which question is being asked. Research areas like immunology or microbiology tend towards considering questions like the latter, and providing solutions to such questions. Global health, however, most would argue, asks the first—and so should answer the first. That is, how do we best tackle health inequalities? Criticism to health technologies as an answer to *that*

question consider the neglect of social contexts, such that underlying factors contributing to many diseases are not addressed.

"Health technology" is a difficult term to define; indeed, physicist and technology theorist Ursula Franklin defined technology quite broadly as "practice" (Franklin, 2004). But, for the purpose of this project, the definition of 'health technology' from the Health Technology Assessment Glossary, will be used. A health technology is defined as: "An intervention developed to prevent, diagnose or treat medical conditions; promote health; provide rehabilitation; or organize healthcare delivery […] The intervention can be a test, device, medicine, vaccine, procedure, program or system". The health technology variable will be split into 'digital health technologies' and 'non-digital health technologies', including systems, programs, devices, tests. Digital health technologies are described and classified by the WHO 'Classification of Digital Health Interventions'.

Pharmaceutical technologies (medicines, vaccines) are given their own category, and so will not be included in the 'Health technologies' variable. Research on pharmaceutical health technology is considered a subset of research on health technologies broadly. Pharmaceutical technology is given its own variable ('Variable B') due to the particular connections between pharmaceuticals and corporations ("Big Pharma"). There is concern that, through support and promulgation of pharmaceutical technologies, global health is prioritizing corporate gains over health gains (Adams et al., 2019; Birn et al., 2017, p. 606).

C: Social and structural determinants of health

I previously discussed a central point of interest in conversations on the definition of global health: how 'health' is defined and thus how health is achieved. Attention to 'social and structural determinants of health' is one concept that is used to consider how to achieve health. Social determinants of health are defined in the Birn, Pillay, & Holtz Textbook of Global Health (4th Ed., 2017) as not merely biological conditions, but also as access to resources and the political and economic structures that determine access to resources, as well as social relations, that are critical in the study of health (Birn et al., 2017).

As discussed earlier, Fee & Krieger (1993) consider approaches to the AIDS epidemic by using the concepts or paradigms, *individualism* and *collectivism.* These terms are similar to, and have overlaps with, the biomedical versus social medicine approaches to health, yet they are not used synonymously. While individualism and collectivism are, as Fee & Krieger identify, "ideolog[ies]", the biomedical model and the social medicine model are methods. "The biomedical model", Fee & Krieger (1993) write, "is also premised on the ideology of individualism"; thus individualism and collectivism are considered *ideologies,* or the theoretical groundwork (in other words, conceptual framework), while the variable to capture social determinants of health is used as an operationalization of one aspect of these conceptual frameworks. Thus, for this project, attention to social determinants of health is used as an operationalization or proxy of the social medicine

model (albeit imperfectly). The social medicine model is then understood as one part of how collectivist ideology produces concrete methods and action.

Social determinants of health are mentioned frequently in global health discourse, but seldom researched directly and acted upon, some argue; the focus of much of global health rests on biomedical approaches, influenced particularly by large philanthropic foundations (Holst, 2020). Indeed, while reduced infectious disease is largely due to improved social determinants of health, like proper sanitation and living conditions, rather than biomedical discoveries, Bill Gates continues to promulgate the idea that health can be addressed through medical discoveries and good business (Birn, 2014; Fee & Krieger, 1993). Birn et al., (2017) argue that a "dominant" approach in global health today is a focus on biomedical (individual) problems and solutions, putting the locus of the control in the individual (and their genetics and behavior) rather than society (and how political and economic conditions affect the health of people); global health currently has a "relentless biomedical and behavioral bias", Birn writes (2017, p. 606). Adams et al. (2019) also argue that global health largely sidelines social medicine approaches, with ongoing "bio-medical hegemony" in the field, promoting a focus on individual problems at the expense of considering underlying multifaceted social conditions (Adams et al., 2019). Echoing Fee & Krieger, global health often sees problems of health through the lens of individual social behavior rather than being seen as a response to the political and economic context (Adams et al., 2019). While global health is envisioned as a practice looking beyond biomedical approaches to health and instead attending to social

determinants of health, and while many scholars emphasise the necessity of this approach, there is doubt as to whether the field succeeds in its aim. Thus, information on whether published global health research acknowledges and/or studies social determinants of health will be critical in understanding the direction of the field.

D, E, F: "Economization of life" (Murphy, 2017)

Adams et al. (2019) cite Michelle Murphy's idea that international health has brought about an "economization of life", such that vulnerable populations (such as girls, the poor) are framed as sources of income or investments (Adams et al., 2019; Murphy, 2017). The relationship between health and the economy or economic development is highly contested. Research in global health might review economic considerations, and understand the connection between human health and the economy in different ways; each "economization of life" variable describes different ways in which economics might be considered in a global health study. How "health" is understood in global health research is dependent upon whether health is conceived of as a good unto itself, or as a means to an end (e.g., economic development).

First, health research or programs can be rationalized based on their potential for economic return, such that health is understood as a precursor for economic growth, rather than (solely) an end in itself (Adams et al., 2019; Birn et al., 2017; Sachs, 2014). The 'Economic Development' variable captures this possibility. The elimination of

malaria, for example, was understood as a global economic problem—and one that, if successful, would contribute to strengthening the global economy (Cueto, 2013). Sachs argues that investment in health in low- and middle-income countries is required for economic prosperity (Sachs, 2014). Yet while economic development can improve health, it does not necessarily improve health if it is not equitably distributed; instead, it can deepen inequalities and worsen health (Birn et al., 2017). The WHO Commission on Macroeconomics and Health, established in 2000, argues for an approach to improving health conditions that benefits the economy and contributes to economic development; its philosophy is based on the notion that healthy people leads to a healthy economy, which, while somewhat of a truism, ignores the much greater contribution poverty has on ill health (Birn et al., 2017). The 1993 World Bank's World Development Report, as well as the Disease Control Priorities Project (funded by the World Bank, WHO, US NIH, and BMGF), also understand health as conveniently tied to economic growth, and see health interventions as an opportunity for private economic gain (Birn et al., 2017). This idea is tied to the notion of philanthropy as a good business plan, termed philanthrocapitalism (see Section 1.6 - Q; Adams, 2016a; McGoey, 2016).

The DALY (disability adjusted life years) is a way in which gains in health are tied to economic development. The DALY, originally created by the World Bank, determines disease burden by showing the loss of years of life as well as *productive* years; it attempts to link economic return to health investment (Adams, 2016a). As defined by the WHO: DALYs are "the sum of years of potential life lost due to premature mortality and the

years of productive life lost due to disability" (World Health Organization, n.d.-a). The DALY "continues to be used to justify economic expenditures on health in most countries" (Adams, 2016a). The DALY implicitly ties individual health gains to economic gains, and thus is a way in which research in global health can be rationalized based on its use as a contributor to economic development. Health, however, should not be used as a business plan, some argue (Holst, 2020); when a health intervention is understood as a business plan, the conception of "health", and how to achieve it, is altered.

Second, research in global health might be understood as an economic investment, where economic evaluations are used to compare costs of two or more interventions and assess the benefits to determine the "value" of the intervention (Higgins & Harris, 2012). The 'Economic Investment' variable records whether this kind of approach was taken. Economic evaluations can be used in a beneficial manner but, as Birn argues, "these tools are accompanied by ideological assumptions around how decisions are or should be made, what kinds of evidence and values should be taken into account, and how success should be gauged" (Birn et al., 2017). Cost-effectiveness analyses (a type of economic evaluation) do not often consider long-term impacts or cost spread over time (such as the high upfront cost of new infrastructure); instead, they tend to focus only on direct costs, seeking interventions with high rewards for health at the lowest cost. Indeed, far more money is spent on treatment (clinical science) for the individual than on population-level preventative care that will out-live current generations (Richardson & Polyakova, 2012),

possibly in part due to the difficulty of measuring the value of the economic investment. Furthermore, while we know that equity-focused interventions on social determinants of health (that affect a wide range of pathologies) "pay for [themselves]", and have long-lasting impacts, donors often claim that they are too costly to implement in low-resource settings (Birn et al., 2017). The QALY (predecessor of the DALY; quality-adjusted life year) is one way of expressing cost-utility, another form of economic evaluation. The QALY determines the relationship between money spent on a medical intervention and the quality of life gained as a result, thus determining the value of a health intervention[6] (Adams, 2016a; Higgins & Harris, 2012).

The connection between economic evaluations and other characteristics of research is notable; when a project or intervention is assessed by a form of economic evaluations, does it relate to anything about the nature of the research? Birn, interestingly, considers that economic evaluations are often used in short-term, pathology-focused interventions ("magic-bullet" solutions), rather than efforts directed at social determinants of health or "joint efforts that may have synergistic effects" (Birn et al., 2017). There is a tendency for economic evaluations of global health programs to favour biomedical, vertical approaches to health, that can be easily measured, evaluated, compared, and replicated, rather than the more long-term, sustainable social determinants of health that have diffuse (yet enduring) effects. This pattern might be a result of the short-term nature of economic

[6] While the QALY itself only indicates the "outcome" of an intervention as an aggregate measure of morbidity *and* mortality averted as a result of the intervention, it is used in cost-utility analyses to measure the benefits gained against the cost of the intervention(s) (Higgins & Harris, 2012; Whitehead & Ali, 2010).

evaluations, and the difficulty in measuring the economic benefit of programs that work to improve social determinants of health and have long-lasting impact. This project seeks to understand these relationships. While economic evaluations might be considered at first glance value neutral, they can play a role in determining the type of research that happens in global health. Richardson, for example, observed "the pacification of a bold social justice agenda in global health by cults of cost-effectiveness" (Richardson, 2021).

Finally, global health research might consider the economic ability of individuals to access health or healthcare. This approach considers the cost of health (or conditions that lead to health) in relation to the ability of individuals to access it.

G: MDGs/SDGs

The millennium development goals (MDGs) came into effect in 2000, with the aim of meeting eight targets by 2015 (eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality, improve maternal health, combat HIV/AIDS, malaria and other diseases, ensure environmental sustainability, and global partnership for development; United Nations, 2015). MDGs played a significant role in improving the health of people worldwide, but "failed to close the health gap" (Gostin et al., 2013). The MDGs were followed by the sustainable development goals (SDGs), with 17 goals, adopted in 2015 with plans to achieve the goals by 2030 (Sustainable Development, Department of Economic and

Social Affairs, n.d.). The SDGs, in contrast to the MDGs, call not only on low-income countries to act but high-income countries as well, expressing that these goals are not solely the job of low- and middle-income countries to achieve (Holst, 2020). They are focused on collaboration and the understanding that all goals are interconnected. SDGs are interdisciplinary in nature, acknowledging the intersection of the environment, economy, politics, society, and health (Holst, 2020). The MDGs and SDGs rely on certain metrics to assess whether they are met, using quantitative indicators for each target (see Section 1.6 - K; Adams, 2016a; Sustainable Development, Department of Economic and Social Affairs, n.d.). Research that is tied to these sets of goals might tend to employ certain types of research methods or uphold certain conceptions of health, but these relationships are not yet known.

H: Human rights

Discussions in global health have often been accompanied by human rights discourses. However, human rights language can be invoked to signify many different ideas. Human rights can vary vis-à-vis ethical weight (whether rights are aspirational, i.e., with no one to blame, or normative), actors (rights are what recipients are entitled to, or what certain agents are obligated to uphold), and agency (who is responsible for upholding human rights? Individuals? States?; O'Neill, 2005). While human rights are outlined in the Universal Declaration of Human Rights (United Nations, 1948), there is "no clear course on the shared responsibility needed to realize them" (Birn et al., 2017). Gostin et al.

(2013) propose a framework convention on global health, as part of the post-2015 sustainable development goals, with a justice focus and "grounded in the right to health". Gostin et al. argue that clarifying the right to health and the duties of states is necessary to realize the goal of global health (Gostin et al., 2013). Furthermore, global health has been accompanied by a "narrow Human Rights discourse", Benatar argues, "focusing on individual perpetrators and individual victims of 'human rights abuses'", which "ignores the vastly greater contribution of flawed systems to the failure to achieve Human Rights more widely for whole populations of people" (Benatar, 2016). These descriptions get at O'Neill's question of *agency:* while human rights are clearly outlined, who is responsible for ensuring their acquisition is unclear.

Applying a human rights framework to global health would mean understanding "health as a matter of justice—a product of social relations as much as biological or behavioral factors" (Yamin, 2008). It would mean challenging biological individualism (Yamin, 2008). The UDHR version of human rights, Mann (1996) argued, expressed the need for attention to social determinants of health, a "broader, societal approach to the complex problem of human wellbeing". However, the rhetoric of health and human rights can be falsely applied, some argue, conflating the right to health and the right to *healthcare,* thus sidelining structural factors (Birn, 2008), i.e., the exclusion of factors such as sanitation systems as a component of the right to health. Indeed, human rights can be invoked in many fashions; there are more individualistic ways of applying a human rights framework, ones in which neoliberal economic development is at the forefront, and more

justice-oriented ways of applying it that attend to social factors (Yamin, 2008). One distinction often made in human rights discourses is between civil and political (CP) rights or economic, social, and cultural (ESC) rights, with ESC rights paying closer attention to structural issues like access to healthcare and the conditions necessary for health (Benatar, 2016; Birn, 2008). Moreover, human rights' deprivations are sometimes *justified* for health; in the context of the COVID-19 pandemic, for example, restrictions on individuals' freedom is explained by their contribution to population health (Chia & Oyeniran, 2020). In sum, there are many different (yet overlapping) approaches taken when considering the right to health and its role in global health discourses.

Understanding how the human rights discourse is used in global health research, and what citing human rights might mean for the kind of research being done, is critical to the understanding of ideological patterns in global health research.

I: Planetary health

Planetary health is a concept that holds that "human health and human civilization depend on flourishing natural systems and the wise stewardship of those natural systems" (Whitmee et al., 2015). Solomon Benatar calls for a global health that incorporates the ideas of planetary health, that is, a recognition of the interdependence of human health and the health of the natural environment (Benatar, 2016). *The Lancet* journal welcomed a new sub-journal, *The Lancet Planetary Health*, in 2017. *The Lancet* also has a Global Health journal, making a distinction between the two. Climate change is of widening

concern among the health fields, yet the extent of its consideration in global health research is unknown. There are important connections between an understanding that health cannot be considered in isolation from natural systems (Whitmee et al., 2015) and economic development. Rockström et al. (2009) presented the 'planetary boundaries framework' that defined a 'safe operating space' for human activity that avoids destabilizing the natural environment. In this model, economic development has to fit within the boundaries, thus attempting to improve socioeconomic conditions cannot be at the expense of safeguarding the environment (Hickel, 2019). Ideas of economic development (see Section 1.6 - D, E, F) fit tightly with the notion of planetary health. With urgent need to act on the climate crisis, and thus also to understand how environmental disruptions will affect human health, an assessment of the use of planetary health in global health literature is essential.

J: Vertical/horizontal approach

Vertical and horizontal approaches are terms that have been used for many decades to describe the scope and aim of health research. Vertical approaches are short-term, directed projects aimed at a health problem, by the use of "single-purpose machinery", with the goal of providing expedient aid; mass campaigns and eradication programs are examples of vertical approaches (Gonzalez, 1965; see also Birn et al., 2017). Vertical programs are often employed through technological means (Mills, 1983). Under a vertical approach, "technological solutions, not health systems strengthening, were deemed the most prudent investments in international health" (Basilico et al., 2013). Horizontal

approaches are often longer-term, "holistic" (Mills, 1983) approaches aimed at strengthening health systems and addressing health problems "on a wide front" to support present and future health challenges ("general health services"; Birn et al., 2017; Gonzalez, 1965). Primary health care is an example of a horizontal approach, where there are no quick fixes (Basilico et al., 2013). Vertical approaches have "categorical" objectives, while horizontal approaches have "non-categorical" objectives (Gonzalez, 1965). While vertical and horizontal approaches can be thought of in dichotomy, some argue that they are not mutually exclusive and should instead be applied in conjunction (Mills, 1983), for example through multi-level analyses. The distinction, as well as discussion and debate on the merits of each, has been longstanding and has occupied a prominent place in global health discourse, continuing to the present (Ilesanmi & Afolabi, 2020; Mills, 1983).

Vertical programs are often looked upon favorably by foreign donors, since the program can be implemented with limited integration with local health services, and can have a clear, limited timeline (Adams et al., 2019; Kenworthy, 2018; Mills, 1983). Indeed, in the early Rockefeller Foundation days (early 20th century), vertical models of disease eradication were the norm (Greene et al., 2013). Horizontal approaches, in contrast, are in favor of *integration* of health services, programs, interventions, and sectors beyond health, and fit within existing health systems (Ilesanmi & Afolabi, 2020; Mills, 1983). Vertical programs are often rationalized by limited resources in low- and middle-income countries for the sustainable strengthening of general health services (Ilesanmi & Afolabi,

2020). However, despite this rationalization, it is accepted that supporting primary health care is a more effective way to address health problems than through directed health interventions (see also Section 1.6 - D, E, F; Mills, 1983).

Birn et al. (2017) describe the vertical approach to health as "global health's dominant modus operandi that entails attacking diseases one by one" (Birn et al., 2017). Other global health scholars have expressed concern at the use of vertical programs to address health problems, given their neglect of health system strengthening and underlying sociopolitical and economic determinants (Biehl & Petryna, 2013; Birn et al., 2017; Holst, 2020). A UNICEF program to address diarrheal deaths in the 1980s and 1990s used oral rehydration therapy as its method, and despite the widespread availability of oral rehydration solutions following the program, the therapy was seldom adopted (Basilico et al., 2013). This program is an example of a "Band-Aid" solution with short-term benefits to health, but that do not address underlying structural issues, like the "lack of clean water and modern sanitation", in the case of diarrhea (Basilico et al., 2013). Narrow eradication programs can neglect primary care and preventative medicine, such as child immunization, as well as the critical determinants, like housing and sanitation, that influence holistic health rather than single disease prevention (Birn et al., 2017, p. 607)[7]. Given the ongoing debate on the merits and drawbacks of each approach, vertical and

[7] While horizontal approaches can be described similarly to social medicine (and the 'social determinants of health' concept), they are not necessarily synonymous, as a horizontal approach might look at many pathologies, but all from a biomedical (as opposed to social medicine) perspective (V. Adams, personal communication, May 11, 2021).

horizontal, as well as their relationship to other aspects of research (such as methodology and economic considerations), understanding the use of these approaches will help to understand the direction of global health research.

K: Research methodology

In a satirical article advising global health researchers, Desmond Jumbam (2020) writes:

> And yes, your study in one small community in remote Zimbabwe can be generalised to the entire country and even to the mostly homogeneous, if large, African continent. Be sure to emphasise this in the discussion section. Show how impactful your project and findings could be and recommend that your intervention be scaled up in all other low-income and middle-income countries, seeing that they all have similar needs.

This excerpt points to a key criticism of global health methodology: that it seeks projects and interventions that can be used and re-used, without major modification. High impact projects are those that can be applied to a wide range of contexts and populations. The randomized control trial (RCT), for example, has come to be considered a gold standard in global health research, somewhat displacing the use of DALYs (see Section 1.6 – D, E, F) working to justify health expenditures, secure grant money, yet also define (and thus exclude) what research is worth doing (Adams, 2016a). And a critical aspect of the RCT is its scalability; the merits of research in global health is often justified by its ability to be scaled up and applied to other populations and locations (Adams, 2016a). Quantitative

metrics, in sum, “tether neoliberal forms of profit seeking to global health by making ‘scalability’ the primary measure of efficacy” (Adams, 2016b).

Many researchers hold that RCTs are “value-neutral” and, furthermore, that this is an unequivocal advantage, by enabling a kind of “globalization” of methods, or conferring new sovereign power (Adams, 2016a). Adams (2016) believes that good global health research is more and more relying on (and necessitating) good metrics, particularly RCTs. These forms of metrics "displace other kinds of evidence" (Adams, 2016b). Case studies and stories are “[pushed out] of the epistemological frame of evidence-based medicine” (see Section 1.6 - L; Adams, 2016a).

More broadly, it has been shown that quantitative research methods are more common in international health literature (defined by the publishing journal) than global health literature, which also tends to conduct research with participation and input from stakeholders more than international health research (Yiu et al., 2020). Of interest now are the trends in research methods in global health literature, and the relationship between methodology and other characteristics of research. Indeed, the push towards quantitative methods in global health research is not as universal and apolitical as it claims to be—metrics dictate which projects are executed (and funded) in global health and which are not (Adams, 2016a). Adams suggests that privately-funded projects, for example, will lean towards quantitative designs, randomized control trails (RCT) specifically (Adams, 2016a). RCTs are, of course, considered the gold standard for a reason; they offer a

rigorous comparison of interventions and allow for confident conclusions to be made. There are certainly times in which an RCT is the best option, for example, when assessing whether a new medication for a condition is better than the old form of treatment. However, the choice of methodology becomes an issue when it's not the research question that informs the methodological design, but rather the methodological design (like the choice of RCT) that informs the research question (Adams et al., 2014). In this way, because funders and philanthropic organizations tend to think more highly of quantitative, RCT designs, what questions researchers ask, and how researchers in global health choose what interventions to study, can in part be influenced by the RCT hegemony in global health research, and health sciences more broadly.

I classified studies by methodology according to whether they were quantitative, qualitative or mixed-methods; and whether they are observational or experimental. The RCT has been given its own variable category owing to the focus in the literature, specifically by Vincanne Adams, on the increasing attention to RCTs as well as their shortcomings. Research methods are defined according to Bowers (2019).

L: Participants' construction of outcomes

We return again to Jumbam's satirical piece (2020), where he writes that community support is essential for global health work, yet it is often used pro forma without being seriously considered:

> In order to ensure that your project has the buy-in of the community, set up a 1- to 2-day workshop with community members to get their input on the project for which you already have funding and a protocol. As long as this workshop is held, and you mention it in your final write-up, it will be clear to your readers that you were able to obtain the buy-in of the community.

Global health research often involves people and how groups of people interact with services, technologies, diseases, etc. Yet global health research can perpetuate inequalities by not using local knowledge and lived experiences, and by a lack of engagement with the populations that the research aims to serve (Abimbola & Pai, 2020; Khan et al., 2021). Efforts at solidarity in global health research ought to acknowledge that there *are* power imbalances between researchers from the Global North and research participants in the Global South, and thus that these relationships will not be entirely equal (Daftary & Viens, 2020). However, a lack of integration with local communities and collaboration is one way in which epistemicide, a form of enduring coloniality in global health (Atuire & Rutazibwa, 2021), can occur, whereby it is understood that there is only one 'right' way of addressing health problems, thus disparaging the knowledge of local populations. Furthermore, even when local communities take part in the research process, their involvement ought to be seen as necessary and a benefit to the project (rather than as "altruistic"), or it "risks being tainted by an unwanted neocolonial flavor" (Daftary & Viens, 2020).

Abimbola (2021) describes this challenge in terms of *subsidiarity;* research in global health should prioritize small and proximate (local) knowledge and rely on larger centralized (distal) institutions of knowledge only when required or requested by the proximate knowledge-holders. Yet academic global health literature right now is created by, and for, academics often far-removed from the proximate site of their study—the people who are "primary producers and holders of knowledge" (Abimbola, 2021). The Rockefeller Foundation, for example, implemented a hookworm campaign in Mexico even though hookworm was scarcely present (Greene et al., 2013). Additionally, one factor in the decision to eliminate malaria at the 1955 World Health Assembly was, alongside technological, magic-bullet solutions, the assumption that there was a group of people, in high-income countries with great resources, who understood the malaria problem and how to approach it the best (Cueto, 2013). "Innovation came from the outside", Cueto argues, "and from well above the level of the local communities that it aimed to benefit" (Cueto, 2013). This approach to malaria eventually failed (Cueto, 2013). The practice of a lack of community engagement is far more widespread than solely the malaria and hookworm campaigns. Indeed, as we have seen with COVID-19, while the pandemic is perhaps the most major health problem in wealthy countries, many other countries are more concerned by ongoing environmental devastation, hunger, and other communicable diseases; thus, despite accessibility to COVID-19 vaccines, populations in South Sudan, for example, are mostly uninterested (Addario, 2021).

"Supremacy is enacted", Abimbola & Pai (2020) argue, "when a greater value is placed on research by high-income or distant experts than the knowledge of those with lived experience". Global health is made more unjust by having the holders of power be those at distal locations to their units of study, rather than local people, and by a lack of engagement with the populations the study aims to serve (Abimbola, 2021; Khan et al., 2021). "[Global health] literature reads like a conversation to which the primary participants were not invited", Abimbola (2021) writes, and this relationship perpetuates inequalities (Khan et al., 2021). Generalizable knowledge-production that reaches for "universal truths" is prioritized, a remnant of the "biomedical and colonial" origins of global health (Abimbola, 2021). To address this injustice in the way that global health research is conducted requires radical change to our methods of ethics review, publishing, and prioritization (Abimbola, 2021); it requires the use of "local knowledge" and "following the lead of the affected communities in the assessment of their problems and the appropriate application of medical and public health evidence to their situations" (Khan et al., 2021).

"Consulting" local populations alone is not sufficient—and can even further the imbalance when perfunctory attempts at collaboration do not fully acknowledge the expertise of people in the places that are researched (Daftary & Viens, 2020). However, it will be used here as a proxy measurement of a step in the direction of more just research that relies on the knowledge and experiences of the populations that the research aims to "help". Yiu et al. (2020) examine "participation of stakeholders/users" in global health

research and find that 40% of studies in the *Annals of Global Health* journal (in 2017) included stakeholders/users in the planning and execution of the study. For this present study, participant involvement in the research design or construction of outcomes will be assessed. Focus groups can be used as ways to understand the perspectives and thoughts of participants and patients themselves (Tausch & Menold, 2016). They vary in terms of how structured they are, but generally allow for open-ended conversation and knowledge gathering. Focus groups, or another form of open-ended, participatory information gathering, will be used as a requirement for being classified as having "participatory" methods.

M: International collaboration among authors

In a previous study on the differences between global health and international health literature, it was found that about half (53%) of global health literature was written by authors from more than one country (Yiu et al., 2020). This variable documents whether there is collaboration between high-income and low- and middle-income countries. While North-South collaboration is often discussed, and global health prides itself on prioritizing North-South collaboration, South-South collaboration is also seen as crucial, as a way of avoiding colonial power relations (Birn et al., 2019). One important relationship is that between the income level of the country of authors' affiliations and which authors are given first (or last) authorship (Cash-Gibson et al., 2018), and thus this variable will be considered particularly in relation to the first and last author location (Yiu et al., 2020; 'Variable L/M').

N, O: First/last author location

The location of authors is classified based on income designation as outlined by the World Bank, following Robson et al. (2019), Cash-Gibson et al. (2018), and Yiu et al. (2020). Countries are identified as high-income, upper-middle income, lower-middle income, or low-income. The first and last authors of academic papers tend to be highly coveted authorship positions, held for principal investigators or lead authors.

In a review of global health inequality research, researchers from high-income countries were authors on published research much more than researchers from low- and middle-income countries (Cash-Gibson et al., 2018). Additionally, in publications with at least one author from a LIC, more than half (57.6%) of publications were found to have a first author from a HIC (Cash-Gibson et al., 2018). It is thus of interest to study this relationship in global health work (which certainly overlaps with health inequality research; though articles were identified by Cash-Gibson et al. based on key words rather than journal). Sheikh et al., (2016) raise concern that global health is used to further concentrate power in the Global North, and exclude less powerful voices. In this context, it is critical that power balances are disrupted, involving "questioning one's own power and privileges" (Sheikh et al., 2016). "Boundary-spanning" in global health means resisting power demarcations and geographical divisions; it means acknowledging and respecting a plurality of approaches to health, and ensuring that the Global North version does not always prevail (Sheikh et al., 2016). One way in which boundary-spanning

might be seen in global health research is through authorship. With high-income countries in the Global North often at the "core" of research on global health inequalities and researchers from the Global South at the "periphery" (Cash-Gibson et al., 2018), it is of interest to understand how much of research has Global South authorship, and if there are any differences in the kind of research conducted by researchers in the Global North and South.

P: Location of study

One distinguishing feature between international health and global health is where it happens; while international health focused on low-income countries, global health purportedly does not only happen exclusively in low-income countries, but in high-income countries as well (Abimbola, 2018). The location of study, as well as the relationship between the location (high-income or low-income country) and other research characteristics is thus of interest. The relationship between the location of study and the location of authors, for example, is considered a marker of equitable research (Yiu et al., 2020).

Q: Funding source

What bodies fund global health research elucidates who/what has power to decide what projects to fund, and thus also what kind of research gets done. Funding for global health

has shifted dramatically from government bodies to private bodies (in the Global North), a shift that entangles goals in health with goals in business (Adams, 2016a). While global health purports to be in service of diminishing inequalities, global health funding "dominated by the rich part of the world reproduce precisely those processes that have led to their prosperity and thus to the extremely unequal global distribution of resources" (Holst, 2020). As well, not only does funding dictate what research gets done but also, across the sciences, topics chosen to research in the first place are often dictated by what is most likely to receive funding (Richardson & Polyakova, 2012).

The desires of funders have huge power in determining what is done with funds. The Bill & Melinda Gates Foundation (BMGF), a significant player in global health philanthropy, plays a large role in determining priority for global health projects; indeed, it funds 10% of the WHO budget (McGoey, 2016). The Rockefeller Foundation, another major philanthropist in global health, created the International Health Board, which later transferred its role and much of its staff to the WHO precursor, the League of Nations Health Organization; thus the Rockefeller Foundation had, and continues to have, a major influence in global health agenda setting (Birn, 2014). Indeed, until the establishment of the WHO, the Rockefeller Foundation was the forerunner of global health (McGoey, 2016). Private NGOs and humanitarian organizations continue to be leaders of global health, resulting as an offspring of the neoliberal conviction that charity and profit can coexist, a technique termed 'philanthrocapitalism' (Adams, 2016a; McGoey, 2016). "Aid and philanthropic organizations that purport to remedy [economic inequality]", McGoey

writes in *No Such Thing as a Free Gift* (2016), "often manage, whether inadvertently or not, to perpetuate it." Thus, interventions put forth by philanthropic organizations tend to be those that attract attention and make money, which means choosing interventions that can be rigorously measured, that resolve quickly so as to limit prolonged involvement by donors, and that have a high probability of success (Adams, 2016a; Kenworthy, 2018). These projects conflate good business and beneficence, where "self-interest is championed as the best rationale for helping others" (McGoey, 2016). The relationship between the funding source and the research methodology in published global health research is of interest.

Each of these 17 variables have a prominent position in conversations on what global health is, what it ought to be, and what research gets done in global health. This project has collected information on each of these variables in the studied group of global health literature. The research methodology for this review is described in the following section.

2. Methodology

2.1 A Systematic Review, Edited

A systematic review is a method of knowledge synthesis that aims to assess a topic of study and make unbiased conclusions through the review of all research with a particular scope (Uman, 2011). It typically focuses on a particular topic of interest and, as such, searches many databases to identify all relevant literature to form a complete repository of studies pertaining to the topic of interest (Tawfik et al., 2019). The process, from idea inception to data synthesis, is well-defined, with a series of steps each review is expected to follow, including title and abstract screening, and full-text screening (Tawfik et al., 2019). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) outlines the key steps to follow when planning a systematic review (PRISMA-P Group et al., 2015).

This systematic review, while still fitting its definition, diverges from a traditional systematic review in several ways. First, rather than studying a topic of interest (such as surgical interventions for congenital anomalies or a medication), this review studied a *field* of research. In the case of this study, the "field of global health research" is the topic of interest. Thus, rather than searching for terms, we have defined what the "field of global health research" includes by what studies are published in global health journals

(see Section 2.3 below). Second, this systematic review focused primarily on abstracts, rather than the full text article. With the aim of extracting key information on the conceptual frameworks underlying research, looking only at the abstract provides the most pertinent information while also allowing for a large group of studies to be included. This review is not interested in results (as is common in systematic reviews aiming to assess the impact of some intervention or exposure), but rather to glean information to help understand conceptual frameworks in the field of global health. And third, this review searched only one database: Ovid MEDLINE, a large database used widely by scientists and researchers in a broad range of fields. While this decision does limit the scope of the study, it also restricted the search to studies that meets high publication standards by MEDLINE and, as a part of PubMed, has many journals available through open access. Thus MEDLINE was used as a "screen" for research published in the journals of interest that are also of high scientific quality. The description of the methodology below follows the structure of typical systematic reviews, but with adjustments for the aforementioned reasons.

2.2 Eligibility Criteria

The inclusion criteria for the studies in this review were: (1) studies in the field of global health research that are indexed on MEDLINE; (2) studies published in the years 2010, 2015, or 2020 (according to the Year of Publication, as indicated by Ovid); and (3) studies which are primary empirical research. Studies published in global health journals

were used as a proxy definition of "global health research". Global health journals were defined as journals with the words 'global' and 'health' consecutively in the name. Only studies indexed on MEDLINE were included.

The sustainable development goals (SDGs) were put in place in 2015, marking 2015 as a benchmark year of interest. Five years post-SDGs, 2020, was the most recent full year at the start of this project, and gives enough time for the SDGs to have potentially influenced the direction of published research. A date five years prior to 2015 was included to be able to determine how global health research characteristics have changed over time before the SDGs were announced, as well as the relationship between the characteristics of research and time. Intermediate years were not included in this study due to the author's time constraints.

Primary research was defined as empirical research where the researchers have collected their data; but this review also includes research on previously-collected data when new questions are asked. Reviews, meta-analyses, commentaries, correspondences, and editorials, for example, were excluded. But research that uses previously collected data, such as census data, published datasets, and survey results (the Demographics and Health Surveys, or the UNICEF Multiple Indicator Cluster Surveys, for example), but addresses a new question, was included. Research on previously analyzed and published data, such as the results of a survey that has been published as a research article in a scholarly journal, were excluded. In sum, to be classified as primary research, the research must

present a new analysis on a new research question. Additionally, any research primarily studying COVID-19 was excluded. Studies had to be published in English and peer-reviewed to be included in the review.

2.3 Information Sources

The purpose of this review is to study the field of global health. What literature is included in or excluded from the field, however, is not always clear. The term "global health" itself is relatively new, emerging in the 1990s as a replacement to "international health" (Holst, 2020). Studies published in global health journals are used here as a proxy definition of global health. To identify global health journals, journals for which the title included the term "global health" were sought. This criterion was chosen for two reasons: first, it provides a clear delineation of what research is marked as global health, allowing for a narrowing in scope of the review. The field of global health is not easily defined and identified in research, and thus journals whose title included the words "global heath" were chosen. And second, the inclusion criteria allows for a clarity of focus: the aim of the review is not to examine all work that might be considered "global health" under various definitions, but rather research explicitly labelled as global health by the researchers themselves. All studies submitted to global health journals was research considered by the authors as "global health". Global health is a field in which semantics matter; the field has changed names several times, with the hopes of a name change producing a value or orientation change (Brown et al., 2006). Thus it was not only

interesting to examine all research that we might consider "global health" but to specifically examine research that has been identified as global health.

To create a list of global health journals, Ulrichsweb Global Serials Directory was used. The following search terms were used to find global health journals:

> +(+TITLE:("GLOBAL HEALTH")) STATUS:("ACTIVE") SERIAL TYPE:("JOURNAL") CONTENT TYPE:("ACADEMIC / SCHOLARLY") KEY FEATURE:(+"REFEREED / PEER-REVIEWED") LANGUAGE OF TEXT:("ENGLISH")

Journals for which the name did not include the words 'global' and 'health' consecutively were excluded (e.g., 'Globalization and Health'). Journals only published in print were excluded[8].

The MEDLINE database was used to identify studies published in the journals of interest. Ovid was used to conduct searches. The 'Ovid Medline Epud Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present' database was used to conduct searches.

2.4 Search Strategy

[8] Journals only published in print were excluded in order to simplify the review process and allow for collaborators in different locations to work on the review together, virtually. It also took into account the difficulty of finding hard copies of journals, particularly during the COVID-19 pandemic.

The included journals were each searched using the Ovid search field ‘jn’. Each year of interest was specified. The search was limited to the English language, and results with published abstracts. The search was further limited to exclude non-primary research based on Ovid classification (see *line 23* of the search), and to exclude publications with COVID-19 or related terms (defined by Ovid) in the title (see *line 18*).

See below for the complete search:

Ovid MEDLINE:

Ovid medline epub ahead of print, in-process & other non-indexed citations, ovid medline(r) daily and ovid medline(r) 1946 to present

1 "annals of global health".jn.
2 bmj global health.jn.
3 "central asian journal of global health".jn.
4 clinical epidemiology & global health.jn.
5 global health governance the scholarly journal for the new health security paradigm.jn.
6 glob health action.jn.
7 global health innovation.jn.
8 global health journal.jn.
9 global health promotion.jn.
10 "global health research and policy".jn.
11 "global health epidemiology and genomics".jn.
12 "international journal of travel medicine & global health".jn.
13 "journal of epidemiology and global health".jn.
14 "journal of global health".jn.
15 "journal of global health reports".jn.
16 "pathogens and global health".jn.
17 "lancet global health".jn.
18 (2019 novel coronavirus disease or 2019 novel coronavirus infection or 2019 ncov disease or 2019 ncov infection or 2019-ncov disease or 2019-ncov diseases or 2019-ncov infection or 2019-ncov infections or covid 19 or covid 19 pandemic or covid 19 virus disease or covid 19 virus infection or covid-19 or covid-19 pandemic or covid-19 pandemics or covid-19 virus disease or covid-19 virus diseases or covid-19 virus infection or covid-19 virus infections or covid19 or coronavirus disease 19 or coronavirus disease 2019 or coronavirus disease-19

or disease 2019, coronavirus or disease, 2019-ncov or disease, covid-19 virus or infection, 2019-ncov or infection, covid-19 virus or infection, sars-cov-2 or pandemic, covid-19 or sars cov 2 infection or sars coronavirus 2 infection or sars-cov-2 infection or sars-cov-2 infections or virus disease, covid-19 or virus infection, covid-19).ti.

19 1 or 2 or 3 or 4 or 5 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17

20 19 not 18

21 limit 20 to english language

22 limit 21 to abstracts

23 limit 22 to (address or autobiography or bibliography or biography or clinical conference or clinical trial, veterinary or clinical trials, veterinary as topic or clinical trial protocol or clinical trial protocols as topic or comment or congress or consensus development conference or consensus development conference, nih or dataset or dictionary or directory or duplicate publication or editorial or "expression of concern" or festschrift or guideline or interactive tutorial or interview or lecture or legal case or legislation or letter or meta analysis or news or newspaper article or observational study, veterinary or patient education handout or periodical index or personal narrative or portrait or practice guideline or preprint or published erratum or randomized controlled trial, veterinary or retracted publication or "retraction of publication" or "review" or "scientific integrity review" or "systematic review" or technical report or video-audio media or webcast)

24 22 not 23

25 limit 24 to yr="2010"

26 limit 24 to yr="2015"

27 limit 24 to yr="2020"

28 25 or 26 or 27

2.5 Study Records

2.5.1 Data management

Search results from Ovid were exported as .ris files and uploaded to Covidence[9], a systematic review management software. Covidence was used to screen the publications

[9] Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia. Available at www.covidence.org

for review, and for data extraction. Covidence excludes any study duplicates that have been imported.

2.5.2 Selection process

The title and abstract screening was conducted by ML (myself) and NR (Natasha Ross) for all studies selected for review. The inclusion/exclusion criteria were discussed with the secondary reviewer, NR, prior to starting the review. Any points of disagreement or uncertainties (studies labelled as 'maybe') were discussed between ML and NR, with HS resolving any persisting disagreement.

2.5.3 Data collection process

Data extraction used the built-in feature on Covidence; a data extraction form was created based on the information of interest (see Section 2.6 and Table B 1). Data was extracted from the abstracts of all included studies. Time constraints of the authors limit the ability of extracting data from the full texts of all the included studies. Furthermore, the objectives of the review outline interest not in particular methods or results but rather the theoretical groundwork, impetus for the research, and authors' background—the conceptual framework—behind the study. Authors put the most key information in the abstract, limited by space and so requiring that authors thoroughly consider the most critical information and consolidate it. Thus, we expect that the most relevant information

for the purpose of this review will be included in the abstract. A small subset of full-text studies was reviewed, to allow for a descriptive comparison between information extracted from abstracts and the full-text. To ensure that the reviewers are not biased by the abstract, data extraction from the full text was done without looking at the abstract.

ML performed data extraction on all included studies. NR performed data extraction in duplicate on a random subset of the studies (100 studies). Before data extraction began, ML and NR discussed the outcomes of interest for this study and the criteria for classifying each article according to each variable description. The data extraction form was tested on several groups of studies not included in the review, and agreement was determined; any inconsistencies were resolved through discussion and consultation with HS.

The data extraction table (Table B 1) was created iteratively, with input and suggestions from HS, ND, and DD. Outcomes of interest were selected based on global health theory literature and refined in conjunction with reading empirical global health research. The variable descriptions were written based on scholarly work in the global health field. The variable categories went through many revisions, with rounds of testing on groups of published global health studies (from years other than those chosen for the study proper) and making appropriate changes with input from global health theory literature. ML and HS conducted this pilot testing, discussed the findings, and made revisions.

2.6 Data Items

The data extraction process identified information on 17 variables (characteristics of research) in three groups, each with two to seven possible categories. Below is a list of all variables of interest. See Section 1.6 for the rationale for choosing these variables and a discussion of each. See Table B1 in Appendix B for the data extraction sheet: a complete list and description of all variables and categories to be extracted from each study included in the review.

Conception of health

A. Health technology (non-pharmaceutical)
B. Pharmaceutical health technology
C. Social and structural determinants of health
D. Economic development
E. Economic investment
F. Individuals' economic ability
G. Millennium development goals/sustainable development goals
H. Human rights
I. Planetary health
J. Vertical-horizontal approach

Research methodology

K. Research methodology

L. Participants' construction of outcomes

P. Location of study

Q. Funding source

Author information

M. International author collaboration

N. First author location

O. Last author location

2.7 Outcomes[10]

1. For each variable (see Table B1), descriptive information was sought; the proportion of articles in each variable category, in each year and in each journal, was determined. Specifically:
    a. For all 17 variables, what proportion of articles were classified under each category?
    b. What proportion of articles included were published in each year (2010, 2015, 2020) and in each journal?

[10] Ideally, a systematic review would involve a quality assessment of all studies included in the review. However, for this review, a quality assessment was not conducted. The review aimed not to consolidate results or demonstrate acceptability or functionality of a method, but rather to identify underlying characteristics of the research of these methods and results. For that reason, whether the results are to be trusted or not, while interesting, does not fit within the objectives of this review. Despite that, it would be of great interest in the future to conduct quality assessments on this body of research, and to identify any changes in research quality over time as well as the relationship of quality with the variables of interest (see Section 4.3).

2. The relationship between pairs of variables was examined. For example, for articles of a given methodology (e.g., qualitative), the likelihood of another variable category (e.g., digital technology) can be determined. Specifically:
    a. Are there relationships between variables?
3. Clustering of variable categories was determined to understand any patterns of commonly coexisting characteristics of research. Specifically:
    a. Do variable categories group together, i.e., tend to coexist?
    b. Can the characteristics that make up each group be used to further define and describe the individualistic and collectivist approaches to health (by Fee & Krieger, 1993)?
4. The reviewers (ML and NR) made notes during data extraction on variable categories that they deem important, to be included in the data analysis. Specifically:
    a. What comments do the reviewers, ML and NR, have as they review and extract data from the studies?

2.8 Data: Synthesis and Analysis

2.8.1 Quantitative analysis

Quantitative analysis was performed using the R statistical programming environment (R Core Team, 2021.09.01, Build 372).

Descriptive statistics

For each variable (Table B1), the distribution of the variable categories was determined. That is, the proportion of studies classified under each category for each variable was determined. The distribution of the variable categories per year and per journal were also determined.

Interrater Agreement

To determine agreement between data collected from each reviewer, Cohen's kappa (κ) scores, a measure of interrater reliability, was calculated, with scores above 0.6 indicating good agreement.

Bivariate analysis

To analyze pair-wise relationships between variables, separately from the analysis of many variables together using MCA, chi-squared tests were performed, with chi-square statistics calculated according to Equation 2. The alpha value indicating significance was set at 0.05. The Monte Carlo approximation was used for comparisons where there were a small number of observations; rather than relying on an assumption about the distribution of the data, the Monte Carlo approximation randomly produces possible arrangements of

the data, and then compares these possibilities to the observed frequencies. The *p*-value was calculated based on 5000 repetitions, giving the Monte Carlo approximation.

EQUATION 2 $$\chi^2 = \sum \frac{(\text{observed row profile} - \text{expected row profile})^2}{\text{expected row profile}}$$

Multivariate analysis

Multiple Correspondence Analysis (MCA) is a multivariate technique used to analyze categorical data (Greenacre, 2017). Similar to principal component analysis (PCA) used for continuous data, MCA determines the relationship between variables to elucidate underlying structures within data, and visualizes these relationships graphically (Ayele et al., 2015; Greenacre, 2017). It allows for a broader examination of the variables that might not be elucidated through pair-wise tests (Sourial et al., 2010). Correspondence analysis is particularly useful for nominal data, as it does not assume any underlying distribution in the data (Sourial et al., 2010). Correspondence analysis has been used for health survey data (Ayele et al., 2015; Lana et al., 2017) and systematic literature reviews (Langdon et al., 2020; Salamin & Hanappi, 2014). In the present study, MCA is used to determine patterns in variation in global health research.

To understand not only the relationships between pairs of characteristics (such as whether most qualitative research considers social determinants of health), but rather the

relationship between *all* research characteristics together, MCA allows for a visualization and analysis of commonly co-occurring characteristics of global health research, such that different types of global health research can be identified and described (for example, it might be determined that research with a vertical focus tends to also be quantitative, have economic considerations, and not use social determinants of health). This is important in contributing a small piece to the question, 'what is global health?', and to understand how it has changed over time. These findings will provide an empirical grounding for advances in the field of global health, helping these advances fit within an empirical understanding of global health as practiced now. The ca package in R was used for conducting MCA and the ggplot package was used for visualizing the results (Greenacre, 2017; Nenadić & Greenacre, 2007). The year of publication are included as supplementary categories in the analysis (Greenacre, 2017).

ca package

The steps and necessary code for conducting MCA in the ca package, including the preparation of data and plotting the results, is outlined in Appendix B of *Correspondence Analysis in Practice* (Greenacre, 2017). The mjca function in the ca package computes MCA. The form of input to the mjca function was a table with each variable as a column and each row as an article in the review, as per Greenacre (2017). The variables were treated as factors according to the possible variable categories (or "levels"; see Table B1). The default option for data type for the mjca function (for multiple and joint

correspondence analysis) was used, which performs the MCA analysis on a Burt matrix, which is a large table of all cross-tabulations between each of the variables. The number of cross-tabulations is equal to the number of possible combinations of variables, in this case equal to 17^2. The number of rows in the Burt matrix is equal to the number of columns, with one row and column for each variable category. The default option for computing MCA in R according to Greenacre uses adjusted inertias (a measure of variance, see below) rather than the total inertia of the Burt matrix; since the Burt matrix includes comparisons between a variable and itself (along the diagonal), it inflates the total inertia. The adjusted inertia corrects for that.

The mjca function computes the dimensions which explain the most variance in the dataset. The dimensions are composite scales of the variable categories, which maximize the variance in the dataset that can be explained. By plotting the variable categories according to the variance-explaining dimensions, relationships between variables are understood by their relative locations in the "highest-variance" space. "Relationships", in correspondence analysis, can be understood as "distance"; and distance, in inferential statistics, can be measured as "chi-squared distance" (Greenacre, 2017).

Chi-squared distances are calculated for pairs of variables, and they indicate the "distance" between the observed distribution of data across columns/rows and the average or expected distribution (Greenacre, 2017). Thus an expected "row profile" would be the frequency distribution of the first variable across variable categories, assuming that the

second variable has no "relationship" with the first. The greater the chi-squared distance, the less independent the variables are. Chi-squared distances in correspondence analysis are used to calculate *inertia,* a measure of the deviation between variables from independence, see EQUATION 1 (comparable to eigenvalues in principal component analysis; Greenacre, 2017; Sourial et al., 2010).

EQUATION 1 $$inertia, \emptyset^2 = \frac{\chi^2}{n}$$

The mjca function indicates the contribution of each variable category to the total inertia of each dimension (i.e., how much variance in the data set is explained by each dimension), as well as the contribution of each dimension to the inertia of the variable category (Greenacre, 2017). To calculate the total inertia of the Burt matrix, the inertia of each sub-table (two-way comparison between variables) are averaged (Greenacre, 2017). The highest inertia will always be along the diagonal of the Burt matrix, where a variable is compared to itself; the relationship between a variable and itself will be maximal, and thus its distance minimal. The maximal inertia, along this diagonal, is equal to the number of variable categories minus one (i.e., the dimensionality of the data; Greenacre, 2017). The *principal inertia* is the inertia of the principal dimension/axis, i.e., the dimension responsible for explaining the most variance in the data (the second dimension explains the second-most variance, and so forth). It is calculated by singular value decomposition (SVD; Greenacre, 2017). Using Greenacre's threshold of $1/Q$, which represents the

average inertia of dimensions, where Q is the total number of variables, all dimensions with an inertia value above $1/Q$ were retained for analysis (Greenacre, 2017).

Addition of Supplementary Categories

Time dependency, i.e., whether the frequency of variable categories is dependent upon the year of study publications (2010, 2015, or 2020), was analyzed. To do so, this additional variable was included in the MCA as a supplementary category. The additional of supplementary categories to an MCA map allows for an assessment of whether the variable category assignments differ between additional variables (in this case, different years of publication), without these additional variables affecting the original results (Sourial et al., 2010). Data is aggregated according to the supplementary category and mapped along the same dimensions as the variable data. The supplementary categories map is then superimposed on the MCA map(s) of the dimensions analyzed (Greenacre, 2017).

2.8.2 Qualitative analysis

Qualitative data includes additional notations made on included studies. A text section of the data extraction form allowed for authors to add any notes as they saw fit. These notes were descriptively analyzed separately from the quantitative analysis. In addition, data extraction was performed on a random group of 10 full-text studies (see Table A2 for the

references), to compare the process and results with the analysis of solely the abstract. Due to the small number of full-text studies examined, the comparison is described qualitatively (rather than by Kappa score).

3. Results

3.1 Included Studies

Covidence was used to remove duplicates, screen the studies, and perform data extraction. Following a database search on October 31, 2021 on Ovid MEDLINE, 1250 studies were imported into Covidence. 15 duplicates were removed, leaving 1235 studies to screen for inclusion. As outlined in Section 2, two reviewers screened all study abstracts for inclusion and exclusion criteria. During this abstract screening process, 185 studies were excluded, leaving 1050 studies included (Figure 1). A third reviewer (HS) resolved disagreement about eligibility on 29 studies.

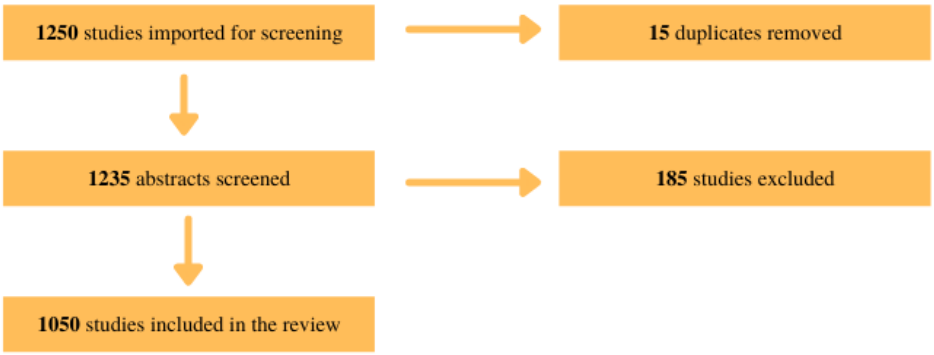

Figure 1: PRISMA DIAGRAM. From the Preferred Reporting of Systematic Reviews and Meta-Analyses, the chart outlines the process from collection of studies through a database search, to the final included studies in the review.

3.2 Data Collection

During data collection, some studies were further excluded for various reasons: 5 studies were excluded for a focus on COVID-19 that was missed during screening; 8 studies were excluded for study design that did not meet inclusion criteria (not being primary research) and that were missed during data screening; 4 studies were excluded where the full text could not be found. Notes on each study were taken where needed and marked as "essential" or "interest". The "essential" notes were reviewed before any data analysis (see Section 3.3 below).

Seventeen studies were excluded during data collection, resulting in a total of 1033 studies included in data analysis (see Appendix A for a complete list of references).

Due to the elusive nature of social determinants of health, a running list of what the reviewers included and what they excluded was kept. While there are many definitions of social determinants of health (see Birn et al., 2017), a comprehensive list of all possible social determinants of health is not feasible. For that reason, to ensure consistency in data extraction, a list was kept of the social determinants of health encountered in the studies. Similarly, notes were kept for other variables to keep track of the authors' thought processes while performing data extraction.

The complete dataset can be found in Appendix A. Table A1

3.3 Preparation of Data

Comments were made throughout data extraction; following data extraction, the comments were read, and minor changes to the data were made, as listed below.

a. During data extraction, some modelling and simulation studies did not fit into the methodology categories; thus, a new category was created ("modelling/simulation") and noted in the comments. Following data extraction, when indicated in the comments, articles were assigned to a new category for methodology, "modelling/simulation".
b. For interviews to be included as a method for participants' construction of outcomes, the interviews had to be explicitly open-ended. A few studies were adjusted following data extraction to ensure that only explicitly open-ended interviews were included.
c. Some comments questioning whether a specific technology was indeed a technology were read, and changes were made to ensure consistency. For example, "universal health coverage" was tentatively classified as a "system" (one category of health technology). Through the data extraction process, however, it was decided that studying universal health coverage ought not be classified as a study of technology, since universal health coverage more often describes a present state (i.e., whether there is universal health coverage) rather than a clear and defined system.

d. The author affiliations for *Annals of Global Health* were found on the first page in small print at the bottom, and missed early in the data extraction process. Articles published in this journal were returned to in order to collect information on the authors' affiliations.

3.4 Quantitative Data Analysis

3.4.1 Descriptive statistics

Overall distribution of variable categories

The distribution of variable categories in the 1033 included articles in shown in Table 1. Notably, 35% of the included articles studied health technologies (excluding pharmaceutical health technologies), with the study of a "procedure, program, or system" being the most common (Variable A). Social and structural determinants of health (Variable C) were used, as a variable in the study, in 64% of articles, while they were mentioned without being used in 10% of articles. A small proportion of studies considered participants to be contributors to human capital (5%), included economic considerations of the study (14%), and considered the economic ability of individuals (9%; Variables D, E, & F).

Over half (56%) of the articles used a quantitative observational methodology (Variable K). Seventy-five percent of research was observational (including both quantitative and qualitative research), while 71% of research was quantitative (including both observational and experimental research). Mixed-method research encompassed 9%, while modelling or simulation studies made up 6%. In 16% of studies, the participants had agency in the kind of information that was gathered, through open-ended questions, focus groups, and participatory research (Variable L).

Eighty-two percent of studies had at least one author from a high-income country; 23% of studies had authors exclusively from high-income countries, while 59% of studies had a mix of authors from high-income countries and low- and/or middle-income countries (Variable M). Among first and last authors, 53% and 58% were from high-income countries, respectively (Variables N & O). Thirty-five percent of first authors were from low- and middle-income countries (excluding collaboration between high-income and low- and middle-income countries; Variable N). Eighty percent of research took place exclusively in low- and/or middle-income countries, with 9% done in high-income countries (Variable P). Finally, 12% of the studies are funded at least in part by the Bill & Melinda Gates Foundation (Variable Q).

Variable	Number of Studies	Proportion (%)
A – Health Technology (non-pharmaceutical)		
Not a study of health technologies	673	65
Study of a combination of health technologies	10	1
Study of digital health technologies	29	3
Study of other health technologies: a procedure, program, or system	279	27
Study of other health technologies: a test or device	42	4
B – Pharmaceutical Health Technology		
B - Not a study of pharmaceutical health technologies	971	94
B - Study of pharmaceutical health technologies	62	6
C – Social and Structural Determinants of Health		
Determinants of health mentioned	108	10
Determinants of health not mentioned or used	198	19
Determinants of health used	665	64
Uncertain	62	6
D – Economic Development		
Research participants are not referred to as contributors to human capital	985	95
Research participants are referred to as contributors to human capital	48	5
E – Economic Investment		
Economic considerations for the study is included	141	14
Economic considerations for the study is not included	892	86
F – Individuals' Economic Ability		
Economic considerations of individuals is included	92	9
Economic considerations of individuals is not included	941	91
G – Millennium Development Goals/Sustainable Development Goals		
MDGs and/or SDGs referenced	40	4
MDGs/SDGs not referenced	993	96
H – Human Rights		
Human rights not referenced	1015	98
Human rights referenced	18	2
I – Planetary Health		
Planetary health mentioned	6	1
Planetary health not mentioned or used	1000	97

Planetary health used	27	3
J – Vertical/Horizontal Approach		
1 – very strongly horizontal	65	6
2 – strongly horizontal	209	20
3 – moderately horizontal	177	17
4 – uncertain/both vertical & horizontal aspects	165	16
5 – moderately vertical	175	17
6 – strongly vertical	128	12
7 – very strongly vertical	114	11
K – Research Methodology		
Mixed-methods - experimental	27	3
Mixed-methods - observational	63	6
Modelling/simulation	61	6
Qualitative - experimental	17	2
Qualitative - observational	131	13
Quantitative - experimental, non-RCT	105	10
Quantitative - observational	577	56
Quantitative - randomized control trial (RCT)	52	5
L – Participants' Construction of Outcomes		
Participants do not have agency in the kind of information gathered	869	84
Participants have agency in the kind of information gathered	164	16
M – International Collaboration		
Authors are all from one or more high-income countries	238	23
Authors are all from one or more low-income countries	18	2
Authors are all from one or more lower middle-income countries	81	8
Authors are all from one or more upper middle-income countries	79	8
High-income country (HIC) and low- and middle-income country (LMIC) collaboration	611	59
LMIC collaboration	6	1
N – First Author Location		
Cross-affiliation with HIC and LMIC	120	12
Cross-affiliation with LMICs	7	1
High-income country	548	53
Low-income country	59	6
Lower middle-income country	148	14

Upper middle-income country	151	15
O – Last Author Location		
Cross-affiliation with HIC and LMIC	100	10
Cross-affiliation with LMICs	2	0.2
High-income country	594	58
Low-income country	39	4
Lower middle-income country	133	13
Not applicable (single author)	20	2
Upper middle-income country	145	14
P – Location of Study		
HIC and LMIC	79	8
High-income country	93	9
Low-income country	196	19
Lower middle-income country	338	33
No particular place	31	3
Two or more LMICs	112	11
Upper middle-income country	184	18
Q – Funding Source		
Funded (at least partially) by Bill & Melinda Gates Foundation	129	12
Not funded by Bill & Melinda Gates Foundation	904	88

Table 1: The distribution of variables categories in the included studies (N = 1033). See Table B1 in Appendix B for a full description of each variable.

Distribution of studies by year and journal

While 17 journals were included in the initial search, 14 ended up being represented in the final group of articles. Articles from *Global Health Governance, Global Health Innovation*, and *Global Health Journal* did not meet the inclusion criteria, either in the database search stage, or during abstract screening. *Global Health Action, BMJ Global Health, The Lancet Global Health, Annals of Global Health*, and *Journal of Global*

Health contributed the most articles to the final sample, with each contributing at least 10% (see Table 2).

Journal	**Number of Studies**	**Proportion (%)**
Global Health Action	272	26
BMJ Global Health	170	16
The Lancet Global Health	135	13
Annals of Global Health	109	11
Journal of Global Health	104	10
Journal of Epidemiology and Global Health	82	8
Global Health Promotion	63	6
Pathogens and Global Health	58	6
Central Asian Journal of Global Health	16	2
Global Health Research and Policy	14	1
International Journal of Travel Medicine & Global Health	4	0
Global Health Epidemiology and Genomics	3	0
Clinical Epidemiology & Global Health	2	0
Journal of Global Health Reports	1	0

Table 2: The distribution of included studies (N = 1033) by journal.

The year 2020 included by far the majority of the studies, with 62% published in 2020, 33% in 2015, and a mere 6% in 2010 (Table 3).

Year	**Number of Studies**	**Proportion (%)**
2010	61	6
2015	336	33
2020	636	62

Table 3: The distribution of included studies (N = 1033) by year.

Many of the included journals did not have equal numbers of publications in each year studied (Table 4). Only two journals (*Global Health Action* and *Global Health Promotion*) began prior to 2010. While all journals have at least one publication in 2020, 2015 is missing publications from five journals.

	Number of Studies			**Total**
	2010	2015	2020	
Annals of Global Health	0	24	85	*109*
BMJ Global Health	0	0	170	*170*
Central Asian Journal of Global Health	0	13	3	*16*
Clinical Epidemiology & Global Health	0	1	1	*2*
Global Health Action	45	132	95	*272*
Global Health Epidemiology and Genomics	0	0	3	*3*

Global Health Promotion	16	13	34	*63*
Global Health Research and Policy	0	0	14	*14*
International Journal of Travel Medicine & Global Health	0	0	4	*4*
Journal of Epidemiology and Global Health	0	47	35	*82*
Journal of Global Health	0	26	78	*104*
Journal of Global Health Reports	0	0	1	*1*
Pathogens and Global Health	0	29	29	*58*
The Lancet Global Health	0	51	84	*135*
Year Sum	*61*	*336*	*636*	*1033*

Table 4: The distribution of studies (N = 1033) in each journal by year.

3.4.2 Bivariate analysis: relationship between pairs of variables

Social and Structural Determinants of Health

There was a significant relationship, X^2 (N=1033) = 133.8, $p < 0.001$, between the 'social and structural determinants of health' (SDOH) variable, and the 'research methodology' variable. While SDOH were 'used' in 64.4% of all studies included (Table 1), quantitative experimental research and RCT research 'used' SDOH 17.7% and 46.2% of the time, respectively, demonstrating a marked reduction in use among quantitative and experimental studies (Table 5). Conversely, qualitative research tended to mention or use social determinants of health, with under 6% of qualitative observational and qualitative experimental research neither mentioning nor using SDOH, while 19% of research overall

(regardless of methodology) neither mentioned nor used SDOH (Table 1). While 12.7% of research was qualitative and observational (Table 1), 3.5% of research that neither mentioned nor used social and structured determinants of health was qualitative and observational (Table 5). When SDOH were used, 60.8% of this research was quantitative and observational, and 82.4% was observational (Table 5).

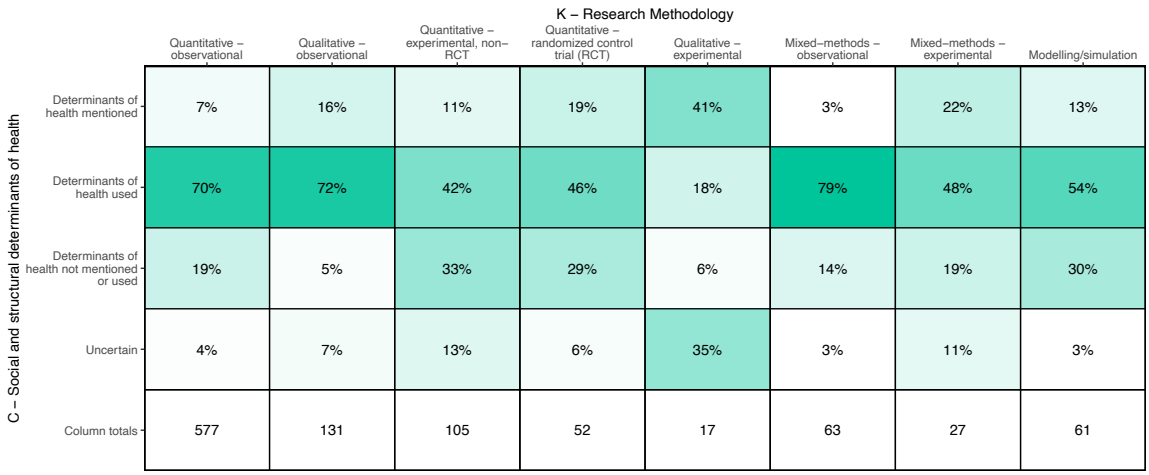

Table 5: The relationship between 'social and structural determinants of health' (Variable C) and 'research methodology' (Variable K). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 133.83, p < 0.001.

There was a significant relationship, X^2 (N=1033) = 59.06, $p < 0.001$, between the 'SDOH' variable, and the 'international collaboration' variable (Table 6). Authors from lower-middle and upper-middle income countries published under 8% of research each (Table 1); however, authors from lower-middle and upper-middle income countries published 13.1% and 16.2% of research that neither mentions nor uses SDOH, respectively (Table 6).

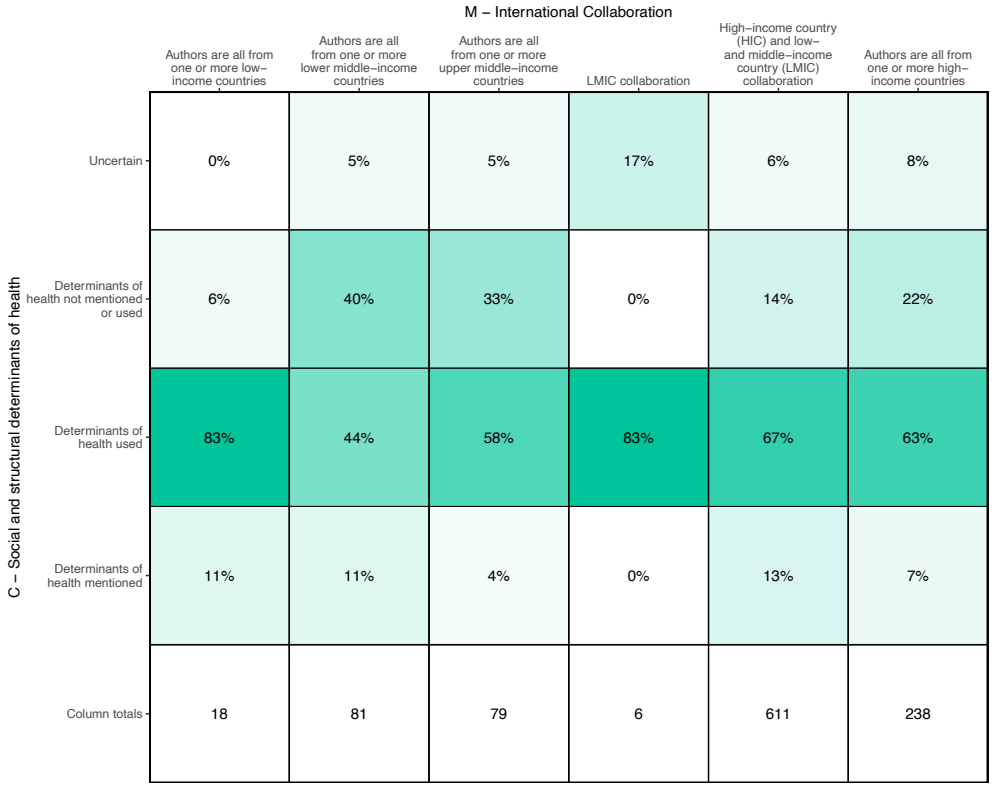

Table 6: The relationship between 'social and structural determinants of health' (Variable C) and 'authors' international collaboration' (Variable M). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, $X^2(N = 1033) = 59.06$, $p < 0.001$.

While authors' international collaboration was found to have a significant relationship with the use SDOH, the 'last author location' variable did not, X^2 (N=1033) = 28.12, p = 0.06 (Table 7). When the last author is affiliated with upper-middle and lower-middle income countries, 24-28% of studies neither mention nor use SDOH; however, when the last author is affiliated at least in part with a high-income country, 17-18% of studies neither mention nor use SDOH (Table 7). The relationship between SDOH and first author location, however, is significant, X^2 (N=1033) = 40.08, $p < 0.001$; Table 8). Similarly to the last author location, we see that a greater proportion of research that is done by upper- and lower-middle income countries neither mentions nor uses SDOH (26-

28%), than research done by high-income countries (18%), or a combination of high- and LMICs (12%). In both Table 7 and Table 8, caution is given to research with a first or last author from a low-income country, or with cross affiliations in LMICs, and research that is done by a single author, as these cases are rare (Table 1); a small change in the absolute numbers of articles falling into each category could create a large change in the distribution.

C – Social and structural determinants of health	O – Last Author Location: High–income country	Upper middle–income country	Lower middle–income country	Low–income country	Cross–affiliation with LMICs	Cross–affiliation with HIC and LMIC	Not applicable (single author)
Uncertain	6%	6%	8%	3%	0%	5%	0%
Determinants of health not mentioned or used	18%	24%	28%	10%	0%	17%	0%
Determinants of health used	66%	63%	54%	77%	100%	61%	85%
Determinants of health mentioned	10%	8%	11%	10%	0%	17%	15%
Column totals	594	145	133	39	2	100	20

Table 7: The relationship between 'social and structural determinants of health' (Variable C) and 'last author location' (Variable O). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 28.12, p = 0.06.

C – Social and structural determinants of health	N – First Author Location: High–income country	Upper middle–income country	Lower middle–income country	Low–income country	Cross–affiliation with LMICs	Cross–affiliation with HIC and LMIC
Uncertain	7%	5%	7%	5%	0%	3%
Determinants of health not mentioned or used	18%	26%	28%	10%	0%	12%
Determinants of health used	67%	62%	52%	64%	100%	69%
Determinants of health mentioned	9%	7%	12%	20%	0%	16%
Column totals	548	151	148	59	7	120

Table 8: The relationship between 'social and structural determinants of health' (Variable C) and 'first author location' (Variable N). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 40.08, $p < 0.001$.

There was a significant relationship, X^2 (N=1033) = 297.08, $p < 0.001$, between the 'SDOH' variable, and the 'vertical/horizontal approach' variable (Table 9). The proportion of studies falling into each category of the SDOH variable tends to follow closely along the spectrum from 'very strongly vertical' to 'very strongly horizontal'. 91% of research that was 'very strongly horizontal' used SDOH, while 14% that was 'very strongly vertical' used SDOH (Table 9). Similarly, 68% of research that was 'very strongly vertical' neither mentioned nor used social and structured determinants of health, while 0% that was 'very strongly horizontal' neither mentioned nor used. What we see here is that most research that is very strongly vertical neither mentions nor uses SDOH, and most research that is very strongly horizontal uses SDOH. However, a mere 9% of articles that use SDOH were classified as very strongly horizontal, and 33% were classified as either 'very strongly' or 'strongly' horizontal (Table 9). Thus, while most horizontal research uses SDOH, the reverse shows a less stark relationship. A similar relationship is seen for vertical research (Table 9).

J – Vertical/Horizontal Approach	C – Social and structural determinants of health: Determinants of health mentioned	Determinants of health used	Determinants of health not mentioned or used	Uncertain
1 – very strongly horizontal	1%	9%	0%	8%
2 – strongly horizontal	12%	24%	9%	31%
3 – moderately horizontal	16%	20%	8%	18%
4 – uncertain/ both vertical & horizontal aspects	23%	14%	19%	21%
5 – moderately vertical	14%	21%	7%	16%
6 – strongly vertical	17%	11%	18%	5%
7 – very strongly vertical	18%	2%	39%	2%
Column totals	108	665	198	62

Table 9: The relationship between 'social and structural determinants of health' (Variable C) and 'vertical-horizontal approach' (Variable J). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 297.08, p < 0.001.

Funding and Authorship

While all funders were collected from the studies included in the analysis, only studies funded by the Bill & Melinda Gates Foundation (BMGF) are shown here. Research funded at least in part by the BMGF ('BMGF-funded') is distinguished from research done either by other funders or without funders ('Not BMGF-funded'). To begin with, BMGF funding showed a significant relationship with the 'research methodology', X^2 (N=1033) = 25.84, p = 0.001. While BMGF funded a total of 12% of the studies (Table 1), it funded 21% and 26% of RCTs and modelling/simulation studies, respectively (Table 10). When qualitative and mixed-methods studies are pooled, and quantitative and modelling studies are pooled, to examine differences in funding between quantitative and qualitative research, we see that BMGF funded 5% of qualitative and mixed-methods research, while they funded 15% of quantitative and modelling studies (X^2(1, N = 1033) =

13.15, $p < 0.001$). There was also a significant relationship ($X^2(N = 1033) = 10.33$, $p = 0.003$) between participants' construction of outcomes and funding, where 6% of research funded by BMGF had participants with agency, while 17% of research not funded by BMGF had participants with agency (Table B2).

K – Research Methodology	Q – Funding Source: not BMGF	Q – Funding Source: BMGF
Mixed–methods – experimental	3%	2%
Mixed–methods – observational	7%	3%
Qualitative – observational	14%	5%
Qualitative – experimental	2%	1%
Quantitative – observational	56%	57%
Quantitative – experimental, non–RCT	10%	12%
Quantitative – randomized control trial (RCT)	5%	9%
Modelling/simulation	5%	12%
Column totals	904	129

Table 10: The relationship between 'methodology' (Variable K) and 'funder' (Variable Q). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 25.84, p = 0.001.

There was a significant relationship between BMGF funding and authorship (Table 11, Table B3, Table B4). BMGF-funded research more rarely had authors solely from LMICs; 0-2% of research in which all authors were from one or more LMICs was funded by BMGF, while research not funded by BMGF had 0.7-9% of research done by authors affiliated with LMICs. Research funded by BMGF almost always (96% of the time) had at least one author from a high-income country, while research not funded by BMGF had

at least one author from a high-income country 80% of the time (Table 11). In BMGF-funded research, 69% of last authors were affiliated with high-income countries and 18% had cross-affiliation with high-income countries and LMICs; in research that was not funded by BMGF, 56% of last authors were affiliated with high-income countries and 9% had cross-affiliation with high-income countries and LMICs (Table B3). In BMGF-funded research, the first author was affiliated with a high-income country 71% of the time, while 50% of the time in research not funded by BMGF (Table B4).

M – International Collaboration	Q – Funding Source: BMGF	Q – Funding Source: not BMGF
Authors are all from one or more high–income countries	23%	23%
High–income country (HIC) and low– and middle–income country (LMIC) collaboration	73%	57%
LMIC collaboration	0%	1%
Authors are all from one or more upper middle–income countries	2%	8%
Authors are all from one or more lower middle–income countries	2%	9%
Authors are all from one or more low–income countries	0%	2%
Column totals	129	904

Table 11: The relationship between 'authors' international collaboration' (Variable M) and 'funder' (Variable Q). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, $X^2(N = 1033) = 21.02$, $p < 0.001$.

There was a significant relationship, X^2 (N=1033) = 59.77, p = 0.02, between the 'research methodology' variable, and the 'international collaboration' variable (Table 12).

While 59% of authors are from a combination of high-income countries and LMICs (Table 1), 88% of RCT research is done by this combination of authors (Table 12).

M – International Collaboration	K – Research Methodology: Quantitative – observational	Qualitative – observational	Quantitative – experimental, non–RCT	Quantitative – randomized control trial (RCT)	Qualitative – experimental	Mixed–methods – observational	Mixed–methods – experimental	Modelling/simulation
Authors are all from one or more low–income countries	2%	2%	0%	0%	0%	2%	4%	0%
Authors are all from one or more lower middle–income countries	10%	2%	12%	4%	6%	6%	7%	2%
Authors are all from one or more upper middle–income countries	9%	8%	7%	0%	0%	6%	0%	7%
LMIC collaboration	1%	0%	0%	2%	0%	0%	0%	0%
High–income country (HIC) and low– and middle–income country (LMIC) collaboration	56%	64%	57%	88%	59%	63%	48%	59%
Authors are all from one or more high–income countries	22%	24%	24%	6%	35%	22%	41%	33%
Column totals	577	131	105	52	17	63	27	61

Table 12: The relationship between 'methodology' (Variable K) and 'authors' international collaboration' (Variable M). Percentages by column are shown, with the total counts for each variable shown as totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 59.77, p = 0.02.

There was a significant relationship $X^2\,(N = 1033) = 735.94$, $p < 0.001$, between the 'location of study' variable, and the 'last author location' variable (Table 13). When the last author is from a low-income country, 95% of the studies took place in a low-income country. Similarly, when the author was from an upper-middle income or lower-middle income country, most (69% and 93%, respectively) of the research look place in a country with an income level matched to that of the last author. Last authors affiliated with low-income and lower-middle income countries did research in a high-income country 0% of the time; upper-middle income authors did research in a high-income country 0.7% of the

time (a single study). However, last authors with affiliations in a high-income country did research in a low-income country 19% of the time, in a lower-middle income country 29% of the time, in an upper-middle income country 10% of the time, and in multiple LMICs 14% of the time (Table 13). There is a similar relationship between authors' international collaboration and the location of study, $X^2(30, N = 1033) = 833.69$, $p < 0.001$ (Table B5).

P – Location of Study \ O – Last Author Location	Low–income country	Lower middle–income country	Upper middle–income country	Cross–affiliation with LMICs	Cross–affiliation with HIC and LMIC	High–income country	Not applicable (single author)
Low–income country	95%	2%	3%	50%	34%	19%	20%
Lower middle–income country	5%	93%	6%	0%	28%	29%	25%
Upper middle–income country	0%	1%	69%	0%	19%	10%	15%
Two or more LMICs	0%	2%	10%	50%	13%	13%	5%
HIC and LMIC	0%	1%	7%	0%	6%	10%	10%
High–income country	0%	0%	1%	0%	0%	15%	20%
No particular place	0%	2%	5%	0%	0%	3%	5%
Column totals	39	133	145	2	100	594	20

Table 13: The relationship between 'last author location' (Variable O) and 'location of study' (Variable P). Percentages by column are shown, with the total counts for each variable shown as column totals. The significance test of independence was done using a Monte Carlo approximation, $X^2(N = 1033) = 735.94$, $p < 0.001$.

Additional Observations

There was a significant relationship, X^2 (N=1033) = 18.2, p = 0.008, between the 'location of study' variable, and the 'MDGs/SDGs' variable (Table B6). Research is more likely to cite the MDGs or SDGs when it is done in countries of multiple income levels;

research done in both high-income countries and LMICs, or in two or more LMICs, cited MDGs/SDGs 9% of the time in both cases, while research done in only one country or multiple countries of the same income level cited MDGs/SDGs 1-4% of the time (Table B6). There was also a significant relationship between MDGs/SDGs and economic considerations for the study, with more research citing MDGs/SDGs when the study included economic considerations, X^2 (N=1033) = 5.61, p = 0.02 (Table B7).

There was a significant relationship, X^2 (N=1033) = 18.35, p = 0.005, between the 'location of study' variable, and the 'participants' construction of outcomes' variable (Table B8). The wealth of the country studied seems to be related to whether the participants in the research have agency in the kind of information gathered, with participants in poorer countries more likely to have agency than in wealthier countries (Table B8). 37% of research in which participants have agency is done in lower-middle and 24% in low-income countries (Table B8). There was a significant relationship, X^2 (N=1033) = 98.55, $p < 0.001$, between the location of study and SDOH; generally, research done in poorer countries use SDOH more than research done in wealthier countries (Table B9). Research in low-income, lower-middle income, upper-middle income, and two or more low- or middle-income countries used SDOH 65%, 64%, 63%, and 79% of the time, while research done in high-income countries used SDOH 50% of the time (Table B9). However, research done in both HICs and LMICs used SDOH 81% of the time (Table B9).

Citing human rights is rare in global health research (Table 1), however, when human rights are referenced, the research is more likely to have participants with agency in the kind of information that is gathered, employing a form of open-ended knowledge gathering. When human rights are referenced, 39% of research has participants with agency, while when human rights are not referenced, 15% of research has participants with agency (Table B10). Similarly, among research where participants have agency, 4% cites human rights, compared to 1.2% of research citing human rights when participants do not have agency (Table B10).

Economic considerations of the study, including cost analyses and discussion of need for increased investment in some aspect of health, were more common when a health technology was studied than when it was not (Table B11). While 10% of research that does not study a health technology incudes economic considerations, 17-30% of research that does study a health technology includes economic considerations. Research studying a combination of health technologies and a study of digital health technologies is most likely to also include economic considerations (Table B11).

3.4.3 Multivariate analysis: multiple correspondence analysis (MCA)

Multiple correspondence analysis (MCA) was performed on R, according to Michael Greenacre (2017).

The result of MCA computed based on all variables is shown in Figure 3, where the first and second dimensions explain 26% and 11% of the inertia, respectively (the deviation of the variables from independence, i.e., a measure of variation; Table 14, Figure 2). The first and last author location co-vary with the authors' international collaboration since these variables depend on each other; the inflated covariation among these variables would overshadow patterns of co-occurrence that are not guaranteed by definition and so the first and last author location variables have been removed from the analysis in Figure 3. The center of the plot is the "average" location of variables, and so variables closest to the center describe a characteristic of studies that is closest to average, and so also contribute the least to the construction of the dimensions. The year of publication has been included as a supplementary variable, and so appears on the plot without affecting its construction. Figure 4 shows the same map again, but the variable categories that contribute below the average contribution to the inertia of either dimension (see Table 15) have been hidden. As can be seen, most of the variables near the center of Figure 3 have been removed in Figure 4, while other variable categories with a very small number of articles have also been removed (due to their small contribution to inertia). A plot of dimensions 3 and 4 can been seen in Figure B1, with the contribution of the variables to the inertia of each dimension shown in Table B12.

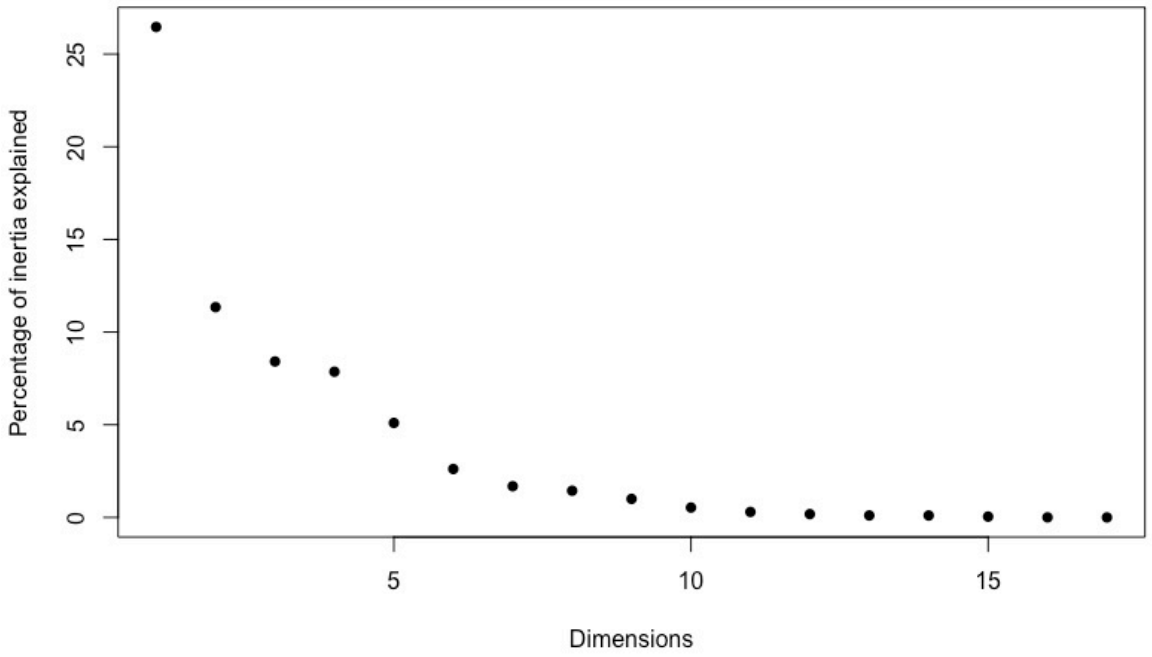

Figure 2: Scree plot for MCA in Figures 3 & 4.

Dimension number	Principal inertia	Percentage of inertia explained (%)	Cumulative percentage of inertia explained (%)
1	0.01	26.5	26.5
2	0.005	11.3	37.8
3	0.003	8.4	46.2
4	0.003	7.9	54.1
5	0.002	5.1	59.2
6	0.001	2.6	61.8
7	0.0007	1.7	63.5
8	0.0006	1.4	64.9
9	0.0004	1.0	65.9
10	0.0002	0.5	66.4
11	0.0001	0.3	66.7
12	~ 0	0.2	66.9
13	~ 0	0.1	67.0
14	~ 0	0.1	67.1
15	~ 0	0.0	67.2

16	~ 0	0.0	67.2
17	~ 0	0.0	67.2

Table 14: Principal inertias for MCA using all variables (excluding year published, first author, and last author).

The 'closeness' of variables in Figure 3 is related to their likelihood of co-occurring in studies, and the areas of the points reflects the relative number of studies in each category. Variables near the center of the plot do not contribute greatly to the inertia of the dimensions, and so are not significant in explaining variation in the dataset. The 'research methodology' variable (Variable K), for example, is spread widely across the map, indicating that it contributes highly to the inertia. The greatest contributors to the inertia of the first dimension (i.e., the variables that distinguish research along this axis the most) are variables on the use of social and structural determinants of health (SDOH), the consideration of the economic ability of individuals, the vertical-horizontal approach, participants' agency, and the investigation of pharmaceuticals (Table 15). These are the variable categories most dispersed on the map (Figure 3).

Along the first dimension, variables furthest to the right side of the map include research with a very strongly horizontal approach, research in which participants have agency in the kind of information gathered, qualitative observational research, and research that considers the economic ability of individuals. Nearest to the left side of the map is very strongly vertical research, research on pharmaceuticals, research that neither mentions nor uses SDOH, and research done solely by authors in one or more lower-middle income countries. We see an ordinal progression from very strongly horizontal research on the left of the plot, to very strongly vertical on the right (Figure 3), indicating the most

dissimilar studies are those labelled as "very strongly horizontal" and those labelled as "very strongly vertical". The (nearly) ordered progression from one to the other suggests that the vertical-horizontal variable is a good measure of different types of research, showing that 'strongly horizontal' (2) research is more similar to 'moderately horizontal' (3) research than 'strongly vertical' (6) and 'moderately vertical' (5) research. The number (4) in this variable indicates research that is deemed uncertain or has both vertical and horizontal aspects. 'Very strongly vertical' and 'very strongly horizontal' research both have high contributions to the inertia of the first dimension (Table 15), indicating that they contribute greatly in explaining how global health research differs according to the 15 variables. While methodology contributes most to the second dimension, we see a distinction along the first dimension with quantitative research on the left side, and qualitative and mixed-method research on the right. Research funded by the Bill & Melinda Gates Foundation (BMGF) tends to drift towards vertical research using experimental methods where participants do not have agency (Figure 3).

The second dimension, which explains 11% of the total inertia (Table 14), is mostly composed of the technology focus, SDOH, consideration of participants as contributors to human capital, methodology, authors' affiliations, and where the research takes place (Table 15). Looking to the location where research is done, towards the top part of the map, research is done in lower-middle and low-income countries; this research tends also to study health technologies and have an experimental design (Figure 3). Towards the bottom of the map, research tends to take place in at least one high-income country, or in

many low- and middle-income countries. Research towards the bottom also tends to be observational, use planetary health concepts, consider participants as contributors to human capital, and cite the MDGs or SDGs (Figure 3).

Research involving at least one author from a high-income country, either solely authors from high-income countries or from both high and low- and middle-income countries tends to be more horizontal, while research done by solely authors from upper-middle or lower-middle income countries tends to be more vertical. As seen above in the pairwise comparisons between the social and structural determinants of health variable and the authors' international collaboration variable (Table 6), authors from upper-middle and lower-middle income countries are more likely *not* to use social and structural determinants of health than authors from high-income countries (or with high and LMIC collaboration).

Figure 3: Multiple correspondence analysis map of all variables describing global health research (excluding first author location & last author location) along the first two dimensions. The Year Published is included as a supplementary category. The area of the circles corresponds to the relative proportions of studies falling into each category. The first and second dimensions explain 27% and 11% of the total inertia, respectively. Refer to Table 15 for the complete label key.

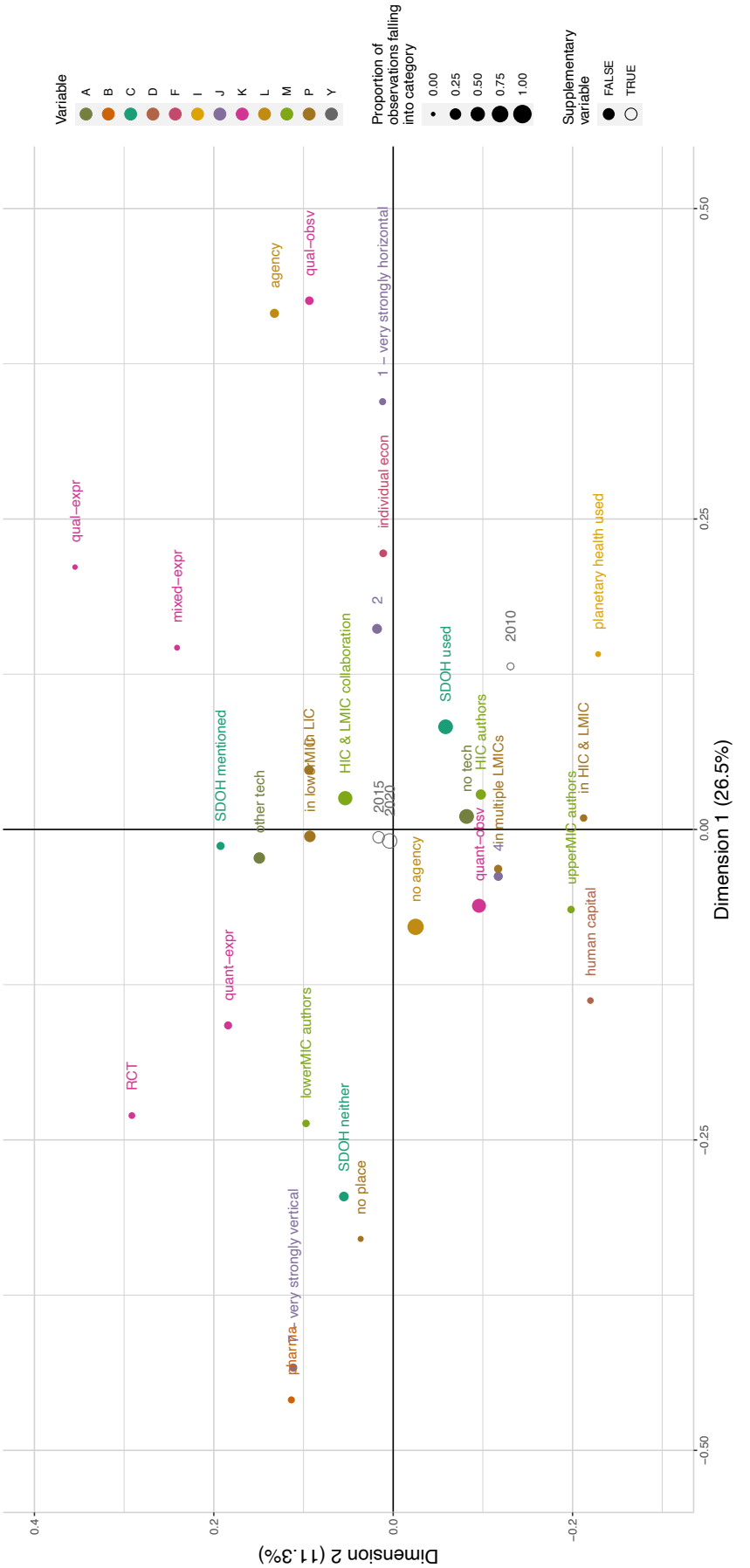

Figure 4: Multiple correspondence analysis map of all variables describing global health research (excluding first author location & last author location) with a high contribution to the inertia to the first two dimensions. The Year Published is included as a supplementary category. Only the variable categories with an above average contribution to inertia are shown in this map. The area of the circles corresponds to the relative proportions of studies falling into each category. The first and second dimensions explain 27% and 11% of the total inertia, respectively. Refer to Table 15 for the label key.

Variable category	Map key	Contribution to the inertia of each dimension (expressed in permills)	
		Dimension 1	*Dimension 2*
Study of digital technology	digital tech	0	15
Study of other health technology	other tech	1	102
Not a study of health technology	no tech	0	62
Study of pharmaceutical technology	pharma	78	11
Not a study of pharmaceutical technology	no pharma	5	1
Social and structural determinants of health not mentioned or used	SDOH neither	103	8
Social and structural determinants of health used	SDOH used	27	31
Social and structural determinants of health mentioned	SDOH mentioned	0	55
Social and structural determinants of health uncertain	SDOH uncertain	2	12
Research participants are not referred to as	human capital	5	32

contributors to human capital			
Research participants are referred to as contributors to human capital	no human capital	0	2
Economic considerations for the study is included	study econ	0	0
Economic considerations for the study is not included	no study econ	0	0
Economic considerations of individuals is not included	no individual econ	3	0
Economic considerations of individuals is included	individual econ	27	0
MDGs and/or SDGs referenced	MDG/SDG	4	16
MDGs/SDGs not referenced	no MDG/SDG	0	1
Human rights referenced	HR	8	1
Human rights not referenced	no HR	0	0
Planetary health used	planetary health used	3	19
Planetary health mentioned	planetary health mentioned	5	0

Planetary health not mentioned or used	planetary health neither	0	1
1 – very strongly horizontal	1 - very strongly horizontal	46	0
2 – strongly horizontal	2	32	1
3 – moderately horizontal	3	7	0
4 – uncertain/both vertical & horizontal aspects	4	1	31
5 – moderately vertical	5	0	1
6 – strongly vertical	6	16	5
7 – very strongly vertical	7 - very strongly vertical	127	20
Quantitative - observational	quant-obsv	13	73
Quantitative - experimental, non-RCT	quant-expr	15	49
Quantitative - randomized control trial (RCT)	RCT	16	61
Qualitative - observational	qual-obsv	141	16
Qualitative - experimental	qual-expr	4	30
Mixed-methods - observational	mixed-obsv	18	0

Mixed-methods - experimental	mixed-expr	3	22
Modelling/simulation	modelling	17	6
Participants do not have agency in the kind of information gathered	agency	168	40
Participants have agency in the kind of information gathered	no agency	32	7
Authors are all from one or more high-income countries	HIC authors	1	31
Authors are all from one or more upper middle-income countries	upperMIC authors	2	43
Authors are all from one or more lower middle-income countries	lowerMIC authors	27	11
Authors are all from one or more low-income countries	LIC authors	2	1
Low- and middle-income country collaboration	LMIC collaboration	0	1

High-income country and low- and middle-income country collaboration	HIC & LMIC collaboration	2	24
Study takes place in a high-income country	in HIC	0	9
Study takes place in an upper-middle income country	in upperMIC	0	13
Study takes place in a lower-middle income country	in lowerMIC	0	40
Study takes place in a low-income country	in LIC	3	24
Study takes place in two or more low- and middle-income countries	in multiple LMICs	1	21
Study takes place in a high-income country and a low- and middle-income country	in HIC & LMIC	0	49
Study takes place in no particular place	no place	20	1

	Q: BMGF	1	0
	Q: not BMGF	9	0

Table 15:The contribution of each variable to the inertia of each dimension for the plot in Figure 3 & 4. The contribution is represented as permills (out of 1000), and so with 54 variable categories, the average contribution is 18.5. The highlighted cells are those where contribution to the inertia of the dimension is more than we would expect (more than average).

In Figures 3 & 4, while 38% of the variance in the data set is explained, 62% is not. To fully capture the relationships between these variables, we would need a $(J - Q)$-dimensional space, where J is the total number of variable categories, and Q is the total number of variables. 15 variables are represented the Figure 3 map, with 54 possible variable categories (or levels). $J - Q = 54 - 15 = 39$ dimensions; thus, with our variables, we would need a 39-dimensional space. The beauty of MCA, like factor analysis, is that it allows for an analysis of the relationships between many variables in a lower-dimensional space. We can reduce 39-dimensional data to only two dimensions, which is sufficient to explain more than a third of the total inertia in the data, or how the data varies. However, the reduction in dimensions results in relationships in the data that the map is not able to represent, with 62% of the total inertia not explained in this map. In keeping with the approach recommended by Greenacre (2017), Table 14 displays information only for the dimensions that explain a disproportionate amount of inertia; i.e., more than $1/Q$ of the total inertia, where Q is the total number of variables. To satisfy the $1/Q$ condition, the principal inertia is calculated based on the Burt matrix (a cross-tabulation of all variable comparisons); however, following Greenacre, "adjusted inertias" are displayed in Table 14, which take into account the "problematic" (Greenacre, 2017) inertia along the diagonal of the Burt matrix (where each variable is compared to itself). The number of

dimensions shown in Table 14 is equal to the principal inertias calculated from the Burt matrix (rather than the adjusted inertias) that are > *1/Q,* or > 0.067. The 17 dimensions included explain 67% of the total inertia (Table 14); however, given that the first two dimensions explain a plurality of the inertia, I chose to only include a map of the variables plotted along these dimensions.

3.4.4 Agreement between reviewers

The agreement between the two reviewers was calculated using Cohen's Kappa score, on 91 studies. Nine studies were excluded during data extraction (see Section 3.1). Agreement for each variable varied between 0 (no agreement) and 1 (perfect agreement) (Table 16). The distribution of studies between the two reviewers is shown for Variable C (social and structural determinants of health; Table 17) and Variable K (research methodology; Table 18). There was a weak correlation between the two reviewers for the vertical-horizontal approach variable (as a scale from 1 to 7), $r(89) = 0.12$, $p = 0.26$. Similarly, a weighted Kappa test (using squared weights, where a disagreement with a greater distance from perfect agreement is "worse" than a smaller distance), showed poor agreement, $\kappa = 0.13$.

Variable	**Kappa Score [95% CI]**
A – Health Technology	0.38 [0.19-0.58]
B – Pharmaceutical Health Technology	0.71 [0.39-1.03]
C – Social and Structural Determinants of Health	0.23 [0.09-0.34]

D – Economic Development	0.74 [0.38-1.09]
E – Economic Investment	0.46 [0.11-0.82]
F – Individuals' Economic Ability	0.33 [-0.03-0.68]
G – MDGs/SDGs	0.79 [0.39-1.12]
H – Human Rights	1 [1-1]
I – Planetary Health	0
K – Research Methodology	0.48 [0.33-0.62]
L – Participants' Construction of Outcomes	0.58 [0.37-0.78]
M – International Collaboration	0.83 [0.73-0.94]
N – First Author Location	0.75 [0.63-0.86]
O – Last Author Location	0.62 [0.48-0.76]
P – Location of Study	0.80 [0.71-0.90]

Table 16: Agreement between reviewers for each variable on 91 studies.

	ML ratings			
NR ratings	Mentioned	Used	Neither	Uncertain
Mentioned	3	8	0	2
Used	2	20	2	0
Neither	10	16	18	3
Uncertain	2	4	0	0

Table 17: Agreement for 'social and structural determinants of health' (Variable C), k = 0.23 [0.09-0.34]. 'ML' ratings refer to the ratings by myself, Michal Leckie. 'NR' ratings refer to the ratings by the second reviewer, Natasha Ross.

	ML ratings							
NR ratings	Quant-obsv	Qual-obsv	Quant-expr	RCT	Qual-expr	Mixed-obsv	Mixed-expr	Modelling
Quant-obsv	35	0	7	0	1	1	1	6
Qual-obsv	4	11	0	0	2	1	1	0
Quant-expr	1	0	3	0	0	0	0	0
RCT	0	0	0	6	0	0	0	0
Qual-expr	0	0	0	0	1	0	0	0
Mixed-obsv	3	0	1	0	0	2	1	1
Mixed-expr	0	0	1	0	1	0	0	0

Modelling	0	0	0	0	0	0	0	0

Table 18: Agreement for 'research methodology' (Variable K), k = 0.48 [0.33-0.62]. ML' ratings refer to the ratings by myself, Michal Leckie. 'NR' ratings refer to the ratings by the second reviewer, Natasha Ross.

3.5 Qualitative Data Analysis: Comments

While collecting data, the following observations were made:

1. The *Global Health Action* journal has a whole series on climate change effects for working people, thus the relationship between Economic Development and Planetary Health is likely inflated. Mathee et al. (2010) is an example of research published in the series.

2. While the data extraction method collected information on whether a given research study mentioned or used social and structural determinants of health, it did not distinguish between different "degrees" of use. Some studies marked as "using social and structural determinants of health" did so as a central part of the research, while others used SDOH to a lesser degree. Thus while there are many ways a study might use SDOH, all of this research was grouped together. The following studies, for example, while marked as using SDOH, did so in a minor way: Flor et al. (2020), Benova et al. (2020), Barnabas et al. (2020), Nassaif et al. (2015), Odendaal et al. (2020), Salvi et al. (2015), Dotchin et al. (2015), Arbyn et al. (2020), Khorasan et al. (2020).

3. Additionally, data extraction did not distinguish "social" from "structural" determinants of health, with social determinants focusing more on individual characteristics (for example, access to sanitation, income level, education level, family size, etc.), and structural determinants focusing more on system-level determinants (for example, universal health coverage, availability of education for girls, capitalism, price of food, etc.). For example, one study proposed an intervention for mothers with a primary school level of education or lower, to improve child development and maternal wellbeing (Singla et al., 2015); this approach responds to a *social* determinant of health, the education level of parents. However, the underlying *structural* determinant is access to education by girls. Another study might have considered ways to ensure that girls are educated. The data extraction method did not differentiate between these two ways of approaching social and structural determinants of health.

4. The vertical/horizontal distinction was difficult at times. Data extraction for this variable was based on the distinction of vertical/horizontal approaches in the literature; vertical approaches are short-term, directed research with a "categorical" objective, while horizontal approaches are longer-term and aim to strengthen health systems, with "non-categorical" objectives (Birn et al., 2017; Gonzalez, 1965). Sometimes, research fits into aspects of each of these definitions. In this case, the research was assigned a "4", indicating uncertainty about the assignment, or that the research employed aspects of vertical and horizontal approaches. For example, Palk

et al. (2020) studied HIV elimination, which could be classified as "categorical" objective. HIV is a specific pathology, and the aim of the study was elimination of HIV. Given that, we might consider this research to lean towards a vertical approach. However, the authors studied travel distance to HIV treatment and access to transportation (such as bicycles) as factors influencing HIV treatment coverage. Travel distance and transportation access are both *structural* factors with widespread ramifications; distance from health facilities influences a multitude of health outcomes, and so in this way is "non-categorical". Given the focus on an aspect of health system strengthening (improving access) and the likelihood of long-term impact the provision of bicycles might have on people's health, this research also seems to employ horizontal approaches.

Another example of a difficult assessment of the vertical/horizontal approach is a study by Freeman et al. (2020). Freeman et al. study a WASH (water, sanitation, and hygiene) and nutrition intervention. WASH and nutrition have broad health outcomes ("non-categorical") with long-term benefits. However, the study used a cluster randomised trial to assess the benefits of the WASH and nutrition intervention, which used behavioral change techniques to improve WASH and nutrition conditions. A behavioral change intervention is both short-term and individual-focused, rather than strengthening health systems. Given this approach, the research seems more vertical. The distinction between vertical and horizontal approaches in global health research is thus not always clear, and made it difficult in some cases to determine the approach.

3.5.1 Agreement between abstracts and full-text

I read 10 full-text articles to allow for at least a minimal comparison between the data collected from abstracts and the data collected from full-text articles. Below I outline differences for each variable:

- *A – Health Technology:* There was disagreement on three studies. In two of them, the data collected from abstracts indicated a study of technology, while data collected from full-text indicated no study of technology. In the third, the abstract and full-text agreed that it was a study of technology, but the abstract identified it as a test, while the full-text identified it as a system.
- *B – Pharmaceutical Health Technology:* There was no disagreement (no studies were identified as studying a pharmaceutical health technology).
- *C – Social and Structural Determinants of Health:* There was disagreement on three studies. In two of them, the data collected from abstracts indicated that SDOH were merely mentioned, while data collected from the full-text indicated that SDOH were used. In one study, the data collected from the abstract indicated that SDOH were neither mentioned nor used, and the data collected from the full-text indicated that SDOH were mentioned.
- *E – "Economization of Life", Economic Development:* There was no disagreement (no studies were identified according to the criteria for this variable).

- *E – "Economization of Life", Economic Investment:* There was disagreement on two studies, both where data collected from the abstract indicated that economic considerations were not included, while data collected from the full-text indicated that economic considerations were included.
- *F – "Economization of Life", Individuals' Economic Ability:* There was disagreement on two studies (the same studies for Variable D), both where data collected from the abstract indicated that economic considerations of individuals were not included, while data collected from the full-text indicated that economic considerations of individuals were included.
- *G – MDGs/SDGs:* There was disagreement on three studies. In all three, data extraction from the abstract indicated that MDGs/SDGs were not referenced, while data extracted from the full-text indicated that MDGs/SDGs were referenced.
- *H – Human Rights:* There was no disagreement (no studies were identified according to the criteria for this variable).
- *I – Planetary Health:* There was disagreement on one study. Planetary health was identified as being 'used' according to the full-text data collection, but neither mentioned nor used according to the abstract data collection.
- *J – Vertical/Horizontal:* There was disagreement on five studies. However, only two studies differed by more than one "level". See below for the pairs of data extracted from the full-text and the abstract, in the five studies where disagreement occurred.

Data collected from full-text	Data collected from abstract
5 – moderately vertical	6 – strongly vertical
2 – strongly horizontal	5 – moderately vertical
2 – strongly horizontal	1 – very strongly horizontal
2 – strongly horizontal	3 – moderately horizontal
1 – very strongly horizontal	3 – moderately horizontal

- *K – Research Methodology:* There was disagreement on six studies. In four of them, the data collected from the full-text indicated a mixed-method study design, while the data collected from the abstract did not. In the remaining two, the data collection methods did not agree on whether it was a modelling/simulation study, with the full-text identifying "modelling/simulation" as the methods in one, and the abstract identifying "modelling/simulation" as the methods in the other.
- *L – Participants' Construction of Outcomes:* There was disagreement in one study, where data collected from the full-text indicated that participants had agency, while the abstract indicated that participants did not have agency.
- *M – International Collaboration:* There was no disagreement.
- *N – First Author Location:* There was no disagreement.
- *O – Last Author Location:* There was disagreement on one study, where data collected from the full-text indicated "high-income country" while data collected from the abstract (rightly) identified it as "not applicable" since there was a single author.

- *P – Location of Study:* There was disagreement on one study, where data collected from the full-text indicated “high-income country” while data collected from the abstract indicated “no particular place”.

4. Discussion

4.1 Discussion of key findings

I performed a systematic review on a group of 1033 studies published in Global Health journals in the years 2010, 2015, and 2020. I collected data on 17 variables of interest (see Table A1) and analyzed the pair-wise and group relationships among them. I aimed to elucidate how global health research is oriented in terms of these characteristics, and how these characteristics are related to each other. I outlined the overall distribution of variables across the group of studies, lending empirical data to conversations on different aspects of global health research. By examining pair-wise cross tabulations, I found important new relationships between pairs of variables, some of which are discussed below. Using multiple correspondence analysis, I visually represented the relationships among this group of 17 variables, allowing for a broad examination of the relationships between characteristics of global health research. I found that, of the 17 variables, the study of technology, study of social and structural determinants of health, vertical or horizontal approach, methodology used, participants' agency, the authors' international collaboration, and the location of study distinguish types of global health research most effectively. Two dimensions explain 38% of the variance in the data (Figure 2). Below, I discuss three findings: *(1)* that individualistic and collectivist explanations of health (outlined in the 'Literature Review') might help explain the trends seen in the characteristics of the studies; *(2)* that most research is observational; and *(3)* that middle-income authors used social and structural determinants of health less than did higher

income authors. I conclude with a discussion of the purpose of research in general and with a speculative comment on the role of research in the field of global health.

4.1.1 Individualism and collectivism

I sought to identify relationships between characteristics of global health research and apply those relationships and patterns to individualistic and collectivist conceptual frameworks for understanding health. The individualistic framework understands individuals as a locus of disease and ill-health and, as such, uses biomedical approaches focusing on downstream risk factors affecting individuals (Diez-Roux, 1998; Fee & Krieger, 1993; Lukes, 1968; Richardson, 2021). The collectivist approach, by contrast, understands health as a consequence of historical, political and social forces and looks to structural factors affecting individuals' health, considering upstream societal conditions, often referred to as social and structural determinants of health (SDOH; Abadía-Barrero & Martínez-Parra, 2017; Fee & Krieger, 1993; Richardson, 2021).

As described in the 'Literature Review', I use these definitions of individualism and collectivism as a starting point, and inquire into how they might be applied to empirical data on characteristics of research in the field of global health. The map that is constructed by an analysis of the relationships between characteristics of research was shown in Figures 3 & 4. Individualism and collectivism offer a useful lens by which to understand this map, lending "labels" to the poles. The left side of the map describes

individualistic approaches to health, including vertical research and research that does not use SDOH; an absence of attention to SDOH indicates a more biomedical approach, and vertical research tends to employ specific methods to address acute needs rather than looking to upstream causes and structural issues. The right side describes collectivist research, including horizontal research, research that gives participants agency in the kind of information gathered (rather than deferring to researchers), and research that considers the economic ability of individuals. The use of SDOH in research tended to co-occur with what we might now call collectivist approaches. Similarly, participants without agency tended to predict more individualistic approaches.

Global health as a field faces ontological challenges (e.g., Farmer, 2013; Taylor, 2018; Cousins et al., 2021; Lincoln, 2021). Its roots in tropical medicine and international health persist, despite efforts to part ways. The Koplan definition attempts to separate global health from its colonial past, with a renewed focus on health equity (Koplan et al., 2009); the definition came out of the 2009 Consortium of Universities for Global Health meeting and is still widely used today. That said, thirteen years later, at the 2022 Consortium of Universities for Global Health conference, there are still ongoing conversations on global health decolonization (Kyobutungi et al., 2022).

The questions of what global health *is* and what global health *should* be are not new, but they are not resolved, either. While there are many ways to describe global health research—by its use of SDOH, its location of study, its methodologies, its

sustainability—the analysis of research characteristics taken together offers a way to describe global health research as a whole. Individualistic and collectivist frameworks for understanding the AIDS epidemic and approaches to address it were used by Fee & Krieger in 1993 and more frequently in Latin American conceptions of health (Abadía-Barrero & Martínez-Parra, 2017). By distinguishing between two conceptual frameworks for global health research, and establishing what specific characteristics of research might describe each framework, these frameworks can be more readily used to define what global health research *should* be. Individualistic and collectivist ways of understanding health provide a useful point of departure by which to assess the relationship between characteristics of research and to work towards a clear, strong definition of global health.

4.1.2 Most research is quantitative and observational

The first finding I will discuss concerns the methodologies used in global health research. A study by Yiu et al. (2020) found that quantitative research is less common in global health than international health literature. In the present study, 71% of research is quantitative (see Table 1). This trend is important because, as I have discussed, many critics are wary of the widespread use of quantitative metrics in global health research. Vincanne Adams, for example, presents quantitative methods as tightly connected to funders; privately funded projects tend to prefer quantitative methods because they are quicker, appear more definitive, and are often perceived to be "clear". The value placed on methods thus influences what kind of research in global health gets done, and what

does not (Adams, 2016a, 2016b). Indeed, research was more likely to be quantitative or modelling/simulation-based ($X^2(1, N = 1033) = 13.15, p < 0.001$; Table 10) when it received funding from the Bill & Melinda Gates Foundation. While global health purportedly values qualitative research more than its predecessors (Yiu et al., 2020), this study found that the majority of global health research remains quantitative.

The use of quantitative methodologies might also be tied to the desire for scalability, where the best global health research is research that can be applied elsewhere (Adams, 2016b). There is a place for quantitative research, and it might sometimes be used (and so funded) because it is the most appropriate method for the purpose of the research (see the 'Literature Review'), but the primacy of quantitative research, and the possible influence of funders on this chosen methodology, raises concern about methodological choices in global health research.

While we found that quantitative metrics were most common in this group of studies, we also found that observational methodologies were the most common, with 75% of studies in this review being observational, and 56% being both quantitative and observational (Table 1). Furthermore, while 64% of the studies included in this review used SDOH, 82% of research that used SDOH was observational (Table 5). 11% of research using SDOH was experimental (Table 5). Much of research in global health is not focused on improving SDOH (directly), but instead passively measuring it. While remaining cognizant that anecdotes cannot establish evidence for a claim, I will share a few studies

that depict a trend I noticed while reading the studies included in this review. One study included in this present analysis by Van Minh et al. (2010) showed that those in Vietnam with higher economic status were healthier and had a better quality of life. Another study showed that, among people with cardiovascular disease in Lebanon, lower education level decreased quality of life (Khalifeh et al., 2015). Similarly, people with lower education levels in Sweden were more likely to get diabetes (Lindahl et al., 2010). Among infants in South Africa, malnutrition was associated with higher risk of pneumonia (le Roux et al., 2015). Children were more likely to be underweight in the Solomon Islands when they lived in households without access to clean drinking water (Hall et al., 2020). In sub-Saharan Africa, increases in GDP per capita correlated with decreases in stunting (Yaya et al., 2020). And access to surgical care is much higher among high-income countries than lower-income countries (Alkire et al., 2015).

Many[11] studies use the following format: a cross-sectional study examining the prevalence or severity of a biological state (disease, injury, mortality, etc.), comparing groups divided by a social determinant of health (wealth, urban/rural status, gender, occupation, insurance, etc.). While of course it is important to understand how SDOH affect health, I think it is also critical to ask: do we need specific numbers in every area of the world to convince us that poorer people are less healthy? Context-specific work in global health is important; "one-size-fits-all model[s]" (Adams et al., 2014), in which

[11] I regret to admit that I cannot quantify "many"; indeed, this project did not distinguish between different types of use of SDOH, instead lumping them all together. However, this structure of research is common enough that it stood out to me while I read the included studies, and I think warrants a deeper examination.

scalability and reproducibility are paramount while local specificities are side-lined, are frowned upon. Perhaps this approach has made researchers wary of assuming results from one place will hold in another. This is an important shift from international health and tropical medicine: local knowledge and experience are now given more weight in global health (Abimbola, 2018). However, I think the emphasis on context-specific research that moves away from suggestions of "universality" can go too far, to the point that very similar research is done in many places when there is no reason to believe that in one place, for example, a lack of clean drinking water is no problem. Indeed, some global health scholars suggest that global health should focus less on place-specific studies and more on global processes and system-level issues, such as climate change (Abdalla et al., 2020; Robson et al., 2019).

SDOH is a meaningful concept that has done important work in informing global health and highlighting the importance of work in healthcare outside of biology. The WHO established the Commission on Social Determinants of Health in 2005 to highlight the need to achieve global health equity, and SDOH have since become widespread in conversations on global health (World Health Organization & Commission on Social Determinants of Health, 2008). The Final Report of the Commission outlines the ways in which factors beyond our biology affect our health in inequitable ways. "The poorest of the poor have high levels of illness and premature mortality" and regardless of the country income level, "health and illness follow a social gradient: the lower the socioeconomic position, the worse the health" (World Health Organization &

Commission on Social Determinants of Health, 2008). The Commission calls on the world to act to address health inequity, emphasizing again that "social injustice is killing people on a grand scale". As this study has shown, global health has answered these calls: 75% of the studies included in this review were published with attention to SDOH (64% of research used SDOH, and an additional 10% mentioned SDOH; Table 5). At first glance, this trend follows what has been called for: global health should focus on SDOH, and it has. But results shown here—that most research on SDOH is observational—point to a potential need for an important addendum on the imperative to study SDOH; that merely *observing* SDOH alone is not *always* enough and that most attention on SDOH should now be directed towards addressing the problems rather than documenting them. The Commission wrote in 2008 that injustice is killing people, yet over a decade later, too many studies are devoted to confirming rather than ameliorating that injustice.

Indeed, acclaimed global health researcher Dr. Paul Farmer jested in an interview that "we should limit our expenditure [on documenting people dying from a poor health system] to about 12.4% of our time and we should work the majority of time actually building the healthcare system" (Ayed, 2020). Similarly, Dr. Sapna Desai articulated the need for global health to spend less time on knowledge generation and knowledge organization and more time on practice (Kyobutungi et al., 2022). In discussions on the need for a social medicine approach in global health (Adams et al., 2019; Biehl & Petryna, 2013; Birn et al., 2017; Gostin et al., 2013), it is critical that methodologies in global health research play a role. If global health ought to be more focused on "problems

of delivery" than "problems of discovery" (Abimbola, 2018), we might understand the finding that 75% of research in global health is observational as a problem. In an effort in global health to focus on social medicine approaches, rather than biomedical approaches, 82% of global health research on SDOH included in this review (an admittedly problematic proxy for social medicine) is observational. That leaves a very small piece of global health research focused on *delivering* healthcare or solutions to health problems with attention to the social forces that affect our health.

Of course, we can then make the distinction between research in global health (which can work towards building the healthcare system) and global health practice, which I did not study here. We might imagine global health research as a very small part of the *field* of global health, and perhaps the part that is, arguably, in charge of problems of discovery, of observing patterns in health so that others are inspired to *act.* However, research informs practice; academic work changes how we think, giving us frameworks that shape how we represent problems and imagine solutions. Global health research ought to reflect the values in the field of global health itself, and inform the kind of practice that the field hopes to see. I am skeptical that all observational research on SDOH, focusing on creating statistical links between SDOH and health outcomes, is really necessary or productive in contributing to global health's goal of reducing health inequalities worldwide. If global health research is in fact in charge of problems of discovery, the focus of such "discovery" informs the way problems are conceptualized and later addressed.

4.1.3 Authorship and the use of social and structural determinants of health

The next finding that I will discuss is authorship and its connection to the use of social and structural determinants of health in research. In the Literature Review, I wrote about how conversations on defining the field of global health generally revolved around two themes: one, the understanding of "health" and how to achieve it, and two, the understanding of "global", that is, where global health happens and by whom. Consideration of SDOH, and how that approach fits in with methodological choices, as discussed in the previous section, aligns with the "health" part of defining global health. This section will focus more on the "global", with a discussion of who does global health research, and how that changes the kind of research being done.

I found a significant relationship between the use of social and structural determinants of health in global health research, and the authors' international collaboration ($X^2(N = 1033) = 59.06$, $p < 0.001$; Table 6). An analysis using MCA visually illustrated the relationship between these two variables, showing that when high-income authors are involved (either only high-income authors, or a collaboration between high and LMIC authors), research tends to use social and structured determinants of health. In contrast, when research is done by only middle-income countries, it tends to use SDOH less (see Figures 3 & 4). I will consider several possible explanations for this observation below, and discuss what it might mean for how global health is defined by academics.

A common criticism of the field of global health is that it is controlled, and created, by the Global North, and lacks consultation and collaboration with the Global South (or LMICs; Abimbola & Pai, 2020; Adams et al., 2019; Cash-Gibson et al., 2018; Khan et al., 2021; Crane, 2013). If global health *should* place more importance on the views of the populations it aims to serve, and "invite" those populations into the global health conversation (Abimbola, 2021), then global health work that is done by those proximal to the populations and places it aims to help should look *more* like 'global health'. In other words, if the best global health research does not rely on researchers from the Global North who are often distal to the site of research, then we might expect research done by researchers in the Global South (or LMICs), with lived experience and a visceral understanding of the local issues, to fit most closely to what is imagined as the best global health research. A key aspect of "good global health research" as discussed in the literature is research that considers SDOH; global health is distinguished in part by its study of SDOH from both other health fields and its predecessors (tending towards biomedical approaches). Global health without a social focus on disease, I think, would hardly seem like global health[12]. What I found, though, is that research done by LMICs[13] tended to look less like "global health" than research done by high-income countries.

[12] Holst writes: "There are barely any Global Health documents that do not mention the social determinants of health; however, the adequate consideration and implementation is lagging behind the aspirations" (Holst, 2020, p. 6).

[13] An important note to consider, however, is that I have documented where researchers are affiliated, not where they were trained. Indeed, many researchers in LMICs might have been trained in institutions in HICs. Conversely, there might be many researchers trained in LMICs who then moved to HICs to pursue work, and thus have HIC affiliations. Understanding the role that a researcher's training plays on their approach to health research, rather than just their affiliations, is an important consideration, however, it is not studied here.

Decolonization is the antidote to a global health defined and controlled by the Global North; decolonization calls for the return of knowledge and autonomy to the Global South (Atuire & Rutazibwa, 2021). A key part of this process is not imposing ideas of what global health *is,* as defined by the North, onto the Global South. The relationship between SDOH and author collaboration that I have found corroborates the possibility that global health in LMICs is sometimes seen as just "health" (Crane, 2013), and suggests a need for further conversation on how global health is defined, and by whom. If global health done by authors in LMICs looks more like "health" and less like "global health", this might support the worry that global health is still an idea, or structure, defined by the Global North. As discussed in the 'Literature Review', in a paper reviewing 34 definitions of global health (Salm et al., 2021), 32 were written with a first author affiliated with a high-income country. Tropical medicine and international health, global health's predecessors, were by definition defined by the Global North. This history seeps into how global health is conceptualized today.

I found that 67% of research in global health has a last author affiliated with a high-income country (57% of last authors are affiliated with solely a high-income country, while 10% are affiliated with both a high-income country and a LMIC), and 9% of research takes place in a high-income country (Table 1). 82% of research had at least one author from a high-income country (Table 1). This finding agrees closely with a finding that 72% of research in "global health inequality" has at least one author from the United States, UK, Canada and/or Australia (Cash-Gibson et al., 2018). Similarly, in "global

health ethics" literature, 88% of articles were written by authors affiliated solely with high-income countries (Robson et al., 2019).

Additionally, the relationship between the location of study and the location of authors is considered a marker of equitable research, where the most equitable research has the authors of the study affiliated with a country of the same income status as the country in which the study takes place (Yiu et al., 2020). However, I found that, among studies whose last author (often the most senior) had affiliations in a high-income country, the research took place in LMICs 72% of the time (Table 13). Global health research is thus done mostly *by* researchers in high-income countries, *in* low- and middle-income countries. Global health research, in sum, is dominated by high-income countries, and differs in its use of SDOH depending on who is writing it, with LMIC authors using SDOH less than HIC authors. This finding provides some evidence that global health continues to be defined by the Global North; by its authorship patterns and attention to SDOH, global health continues to serve high-income countries to the detriment of its aim for equitable, decolonized approaches to health.

Many journals aim to address authorship equity issues in global health. For example, a new journal, *PLOS Global Public Health,* aims to address enduring issues in authorship equity, with the goal of creating a platform for research dissemination that takes equity and diversity into account at every level (Kyobutungi et al., 2021). Other journals acknowledge authorship issues and the need for ensuring that authors from LMICs are

able to publish. The *Journal of Global Health*, for example, which has been included in this analysis, wrote in a promotional email that the journal, based in the United Kingdom, has "been a voice for many authors from low- and middle-income countries who shared their experience on the COVID-19 pandemic". I think it might be important to ask, however, whether authorship alone will remedy the issue of power imbalance in global health scholarship. As we see here, even when LMIC scholars published in global health journals, they are sometimes required to fit their work into the Global North idea of what global health is in order to be published in global health journals; "Global health is academic, political, and economic in HICs", Naidu (2021) writes, "It is social, emotional, survival-related, and personal in LMICs" (Naidu, 2021). We might turn again to epistemicide, whereby the Global North dispossess the knowledge of the Global South (Atuire & Rutazibwa, 2021).

The discordance in use of SDOH in global health literature, depending on the author, demands bigger questions to be asked than just a matter of authorship equity. It demands more clarity on what global health research is, what it aims to do, and what conceptual frameworks it uses to ask the questions it asks and understand the data it seeks to understand. Bhakuni & Abimbola (2021) argue that epistemic injustice exists throughout academic global health: "It is now well known that structural and persistent epistemic exclusion exists in academic global health, and that knowers, and producers and recipients of knowledge, from marginalized groups in HICs and LMICs suffer distinct epistemic wrongs". Epistemic injustice occurs, in part, in authorship, where LMIC

authors, regardless of intellectual contribution, are often deprived of first or last authorship status in favour of high-income, high position authors (Bhakuni & Abimbola, 2021). Holders of knowledge distal to the places and people in and by which that knowledge was produced make interpretive mistakes that not only discredit and devalue locally-held knowledge, but also impair the global health endeavor (Bhakuni & Abimbola, 2021). But epistemic injustice also occurs when knowledge frameworks and ways of understanding are assumed to be universal and are imposed on marginalized groups proximal to the data gathered in research (Bhakuni & Abimbola, 2021).

In other words, global health continues to be dominated by the Global North not only in authorship, but also perhaps in its frames of understanding. SDOH, as one way in which global health is defined, shapes the questions that are asked in global health research. It shifts questions from "what bacteria caused tuberculosis?" to "what aspects of the social and economic context caused tuberculosis?" (Lewontin, 1992); from "what biological properties of individuals causes Ebola to spread?" to "what political properties of the country cause communities to be vulnerable to disease?" (Richardson, 2021). It also asks questions like "does education level contribute to diabetes risk?" (Lindahl et al., 2010) or "does one's socioeconomic status correlate with one's quality of life?" (Van Minh et al., 2010). Yet for the most part, these questions have been answered. As I discussed in the previous section, much of global health research on SDOH is observational and makes a conclusion to the effect of: poverty worsens health.

I wonder now whether SDOH as a frame of understanding obscures larger questions of "what can global health do to ensure more access to education?" and "what properties of a health system contribute to equitable access to healthcare?" to focus instead on a much narrower understanding of disease causes, more proximal to their effects, privileging more observation and less action. A new global health educational framework responds to those concerns, considering social determinants of health as the consequences of social structures and social forces and calls for attention to those upstream structures; rather than solely a focus on poverty, for instance, students in global health are encouraged to consider the political, economic, and social forces and structures that lead to conditions conducive for poverty (Harvey et al., 2022[14]). I wonder whether the reliance on the SDOH framework is one way in which Western academics impose a "dominance of frameworks" (Bhakuni & Abimbola, 2021) to issues facing local populations, and in doing so, commit some degree of epistemic injustice. While authorship equity in global health is certainly a critical need, it does not equate to epistemic equity. There is still ambiguity as to what it means to do global health. The connection between authorship and the use of SDOH found here contributes to important conversations about who defines global health, and what frames are used to make sense of injustices in health.

[14] I would like to thank Dr. Bram Wispelwey who brought this source to my attention during his talk at the 2022 Consortium of Universities for Global Health conference.

4.1.4 Additional findings

Funding: Bill & Melinda Gates Foundation

This study found that 12% of global health research was funded – at least in part - by the Bill & Melinda Gates Foundation (Table 1). Funding for global health in general has been overwhelmed by private organizations (Adams, 2016a), and the Bill & Melinda Gates Foundation, in particular, plays a large role in global health philanthropy (McGoey, 2016). As has been argued, funders contribute decision-making power to which global health projects occur, often inspired by what projects or research are most flashy, lucrative, and quick (Adams, 2016a; Kenworthy, 2018; McGoey, 2016). This study found that the BMGF funded 5% of qualitative and mixed-methods research, while they funded 14% of quantitative and modelling studies ($X^2(1, N = 1033) = 12.9, p < 0.001$; Table 10). We thus see a marked bias towards quantitative research in what BMGF funds. BMGF-funded research also has participants less likely to have agency in the information gathered (X^2 ($N = 1033$) = 10.33, $p < 0.01$; Table B2). Furthermore, I also found a significant relationship between author affiliations and BMGF funding, with an increase in high-income country affiliations among research that is BMGF-funded (Tables 11, P3 & P4). Ninety-six percent of research funded by the BMGF had at least one author from a high-income country (Table 11).

First, these findings confirm the literature suggesting that BMGF holds a large amount of power in global health research, and, second, illustrate the differences between the

research that is funded by BMGF and the research that is not. Philanthropy is not always altruistic, and not always in the best interest of the cause it aims to serve (McGoey, 2016). In an 1891 essay, Oscar Wilde wrote:

> The majority of people spoil their lives by an unhealthy and exaggerated altruism – are forced, indeed, so to spoil them. They find themselves surrounded by hideous poverty, by hideous ugliness, by hideous starvation. It is inevitable that they should be strongly moved by all this. […] Accordingly, with admirable, though misdirected intentions, they very seriously and very sentimentally set themselves the task of remedying the evils that they see. But their remedies do not cure the disease: they merely prolong it. Indeed, their remedies are part of the disease. (Wilde, 1891).

These were strong, some might say unappreciative words. There is no doubt that the BMGF has done some good for global health. But their work is (partially) misdirected. BMGF, created by a very wealthy man, exists in the very system of inequality it purports to attempt to demolish. "Philanthrocapitalism" is the contention that altruistic charity and profit can coexist, indeed thrive in companionship (Adams, 2016a; McGoey, 2016). As Žižek describes in relation to a basic income program, philanthropy attempts the impossible task of "(cons)training the capitalist beast to serve the cause of egalitarian justice" (Žižek, 2010). Global health as a field ought to think critically about the role of philanthropists in its work, but researchers, too, ought to assess the influence of funders on their projects, not just the end result but the very questions that are asked in the first place.

Agreement between full-text and abstract data extraction

There was some disagreement between the data collected from abstracts and the data collected from the full-texts. While the full-text of only 10 studies was examined, some observations can be made. Generally, the full-text data collection retrieved "more" information than the abstract, as expected. Disagreement on SDOH occurred for studies where the full-text collection identified the "use" or "mention" of SDOH when the abstract did not. Disagreement on the economic investment and individuals' economic ability occurred in studies where the full-text identified economic considerations where the abstract did not. The full-texts identified the referencing or use of MDGs/SDGs and planetary health where the abstracts did not. Finally, in one study, the full-texts indicated that participants had agency where the abstracts did not. These findings were to be expected; the full-text of studies provides, of course, more detailed information on methodology, background information, and a thorough discussion.

Interestingly, in two studies, the abstract data collection identified the study of a technology, while the full-text did not; this might point to the difficulty in defining "technology", and the need for a more detailed description. There was disagreement on the vertical/horizontal approach, but most of the disagreement was within a tight margin; with the exception of two studies, there is no more than one unit of disagreement between the abstract and full-text. This finding suggests that the abstract provides enough information to make an approximate allocation along the spectrum. One interesting

finding was the agreement on methodology: in four studies, the full-text data collection identified mixed-methods, while the abstract did not. In three of these four, the abstract identified "qualitative" methods. This finding suggests that quantitative data might be added to a primarily qualitative study, yet only presented in the full-text as a more minor result.

Despite the disagreement, I still believe that information in abstracts is the most salient, and thus worth the most attention, for the purposes of this review. Performing the same study on the full-text articles would provide more specific data on the state of the field of global health research; however, extracting the information from solely the abstracts serves the purpose of attaining only the information most important (according to the authors) in a study.

Agreement between reviewers

A secondary reviewer extracted data on 91 abstracts, and Kappa scores, indicating interrater reliability, were calculated for each variable. While eight variables showed good agreement ($\kappa > 0.6$), three showed moderate agreement ($\kappa = 0.4\text{-}0.6$) and four showed poor agreement ($\kappa = 0\text{-}0.4$). The social and structural determinants of health variable (Variable C) in particular showed disappointingly low agreement, at $\kappa = 0.23$ (Table 16). An analysis of the agreement shows that I identified SDOH much more than the second reviewer; in 16 studies, I indicated that SDOH were used and NR indicated

that they were neither mentioned nor used; in 10 studies, I indicated that SDOH were mentioned, while NR indicated that SDOH were neither mentioned nor used; in eight studies, I indicated that SDOH were used, while NR indicated that they were only mentioned (Table 17). From these results, it is clear that I had a broader understanding of SDOH than NR. This finding points to the need to perhaps engage in more discussion and practice between reviewers prior to data collection. In addition, a list of examples of SDOH might have helped to ensure that the reviewers were consistent. However, this kind of categorization might just be inherently difficult, especially when only considering the abstract. Perhaps I was asking a complex question and requiring a simple answer, creating difficult decisions and disagreement.

Another peculiarity was the merely moderate agreement on methodology (Variable K), with $\kappa = 0.48$. In seven studies, I identified the research as quantitative experimental, while NR identified it as quantitative observational. In six studies, I identified modelling/simulation and NR identified quantitative observational. In four studies, I identified the research as quantitative observational and NR identified it as qualitative observational (Table 18). I think the instructions for modelling/simulation studies, which was a category added later, were not clear, contributing to some of the disagreement.

As I discuss in 'Future Directions' below, a more robust way of assessing interrater reliability could be to have two unique reviewers performing data extraction on a single variable; there would then be no between-variable biasing, and perhaps the focus on only

one variable would create better agreement. However, it would be labor-intensive and required many people. Instead, more practice for reviewers and discussion among reviewers would help ensure that there is clarity in the variable descriptions and criteria for classification before beginning data collection.

Change over time

Starting this project, I hoped to not only look at how global health research aligned to the variables I identified, but also whether this alignment changed over time. However, I found that a mere 6% of articles included in this study were published in 2010, while 33% were published in 2015 and 62% were published in 2020 (Table 3). Looking at the map of all variables (Figures 3 & 4), with the year published superimposed without affecting the construction of the plot, the positioning of the points for publication years 2015 and 2020 were very close together (this is easier to see on Figure 4), suggesting that there is little difference in the type of research between these two years. The publication year of 2010 is further away, but contains very few studies (a total of 61 studies out of 1033; Table 3). The studies published in 2010 represent only two journals (Table 4) and so any trends seen might be due in large part to the journal (and its criteria and focus) rather than the year. Given the paucity of strictly "global health" journals in 2010, global health scholarship was likely spread across journals from many different disciplines. In future studies, it would be interesting to collect data on research published over many years, rather than just three, to be able to assess possible trends in global health research.

4.2 Limitations

4.2.1 Defining global health research as that which appears in global health journals

One limitation of this study is in terms of its methodology, specifically the choice of which studies to include and which to exclude. First, "global health research" was operationalized as research published in global health journals. This poses several problems. Global health (as we discussed) is difficult to define. While research on antibody properties might readily be classified as "immunology", rarely can research be easily and definitively identified as "global health". The choice, then, to define global health research by studies in particular journals no doubt excludes much research that was not defined by the authors, or the publishers of the journal, as strictly global health.

Additionally, many terms can be used to describe global health: public health, population health, global public health, community health, global health ethics, etc. Global health is a term and field defined by the Global North, and so by limiting research studied to what is defined as "global health", we preferentially select research from the Global North (and written in English). Furthermore, much research perhaps considered by the authors as global health research will be published in journals that are more broad and not specifically designated global health. Global health research might be published in *The Lancet, BMJ Open, New England Journal of Medicine, Medical Anthropology, International Health, International Affairs, PLoS Medicine, Critical Public Health, Human Rights Quarterly, Social Science & Medicine,* etc. There are *many* journals in

which "global health research" might fit, and many reasons that authors might choose these journals as opposed to explicit "global health" journals.

Furthermore, I have defined global health journals as journals with the exact term "global health" in the title. Some journals might even define themselves as global health journals, while not having the term in their title. Others define itself in a way "suggestive" of global health: *Medical Anthropology,* for example, is "An international journal publishing research on medical anthropology including the social patterns of ill-health and disease transmission"; *Critical Public Health "*is an international peer reviewed journal publishing critically engaged research in public health, health promotion, political economy of health, and related fields". Thus excluding these journals, for the lack of "global health" in the title, excludes research that we would likely classify as "global health". However, my goal was to understand what is being published in journals specifically labelled as global health, not all research that might be considered global health (without being published in "global health" journals).

4.2.2. Data extraction limitations

Information for all variables was extracted together for each study. This method opened the possibility for some variable categories to bias others. For example, since the author information was extracted at the same time as SDOH or vertical/horizontal approach, despite making every attempt to make the variable scoring as objective as possible, there was the potential for some variable outcomes to influence others. Unfortunately,

extracting information on each variable one by one would exceed the time that the authors had available for this study, and also require duplicated work.

Along this vein, another limitation with data extraction was that the journal was visible when extracting data. There were discernible patterns in the type of research published in each journal. *Pathogens and Global Health,* for example, tended to publish quantitative observational research that did not include human participants and did not use social and structural determinants of health. While this was not *always* the case, reviewers were primed for certain variable outcomes by virtue of seeing the journal. The format abstracts were reviewed in could have been changed such that all abstracts were presented in a consistent style irrespective of the journal; however, doing so would have required making changes to the process of data extraction in Covidence, and was beyond time availability of the authors.

4.2.3 Positionality

One piece of information I extracted is whether the participants in a research study contributed to the kind of data that was collected. Whether research considers the ideas and perspectives of the participants themselves was important to consider because of the problems that arise when only the knowledge of the researchers, often from the Global North, is considered at the expense of those with the most lived experience (Abimbola & Pai, 2020). If there is worry that most *theory* about global health comes from the Global North (Adams et al., 2019), then we should also worry about global health critique

coming from those in the Global North—including myself, a white woman who has lived in North America her whole life. I have underlying assumptions about what global health should be, informed by my reading, discussion, and values, most of which come from others in the Global North. While global health is increasingly acknowledged as a field in pursuit of health for *all,* not just those in the Global South, there is still a problem when what global health should be is by and large defined by those in the North. We might return to the notion of epistemicide; a form of colonization is the paving over of other forms of knowing and the upholding of one truth (Atuire & Rutazibwa, 2021). Pluriversality is an antidote to epistemicide; it is an ideal of knowledge holding and knowledge making where many perspectives and truths can coexist and are not hierarchical[15] (Atuire & Rutazibwa, 2021). While I have attempted—as much of science does—to be "objective" (whatever that means), my work and my analysis is surely informed by my experience, my assumptions, my epistemologies and my limitations, alas. I have yet to figure out how to attempt to meaninfully contribute to global health discourse without reinforcing the very power dynamics that I discuss. Perhaps part of that is acknowledgement and discussion.

[15] There are certainly situations in which perspectives or "truths" are contradictory; I understand the concept (or ideal) of pluriversality not as the idea that all perspectives are equal or valid, but that they *can* be. Rather than, for example, distrust being *the* cause of the Ebola epidemic, oil mining companies are another cause (Richardson, 2021). I understand pluriversity to look out for those other causes, to not stop at one explanation. There is a slippery slope between that and the disappearance of any truth, and that is dangerous; but pluriversality is not to be used as a way of demoting facts as "one possibility". Instead, the notion of pluriversality encourages a wider analysis of possible ways of explaining phenomena we observe.

4.3 Future Directions

Below I outline some possible future research projects based on this one. I start with some possible changes to the methodology that would strengthen this research, and then discuss potential extensions to this research. First, given the discrepancy between the abstract review and full-text review, it would be worthwhile to perform data collection on a larger group of full-text studies. Doing so would allow for a more in-depth analysis of global health research, without limiting the information gathered to only what is written in abstracts. However, given the length of full-text studies and the possibility for authors to write about concepts only "in passing", such as mentioning human rights without it being a major part of the study, it might make sense to create a more fine-grained extraction method to distinguish different "degrees" of concept or term use.

Second, we found some disagreement between the two reviewers performing data extraction. For the data extraction form to be a useful tool for researchers to use, it needs to be consistent. Further work ought to be done to clarify aspects of the data extraction that resulted in disagreement. One change that might be warranted is dividing the SDOH variable into different levels. As outlined in the Results (Section 3.5), "social" and "structural" determinants were not distinguished, and neither were different degrees of SDOH use. Given the wide range of studies falling under the "SDOH used" category, dividing this option into multiple options might clarify some ambiguity and result in greater agreement between different reviewers. Also, for the purposes of data analysis, it

would be interesting to consider whether different degrees of use of SDOH, or the difference between "social" and "structural" determinants, affects the results across other variables in this study. Perhaps a high degree of SDOH use would predict other variables more than a lower degree of use; perhaps, for example, high degree of use of SDOH might coincide with "very strongly horizontal" approaches and participants' agency more than lower degrees of use. Something similar might be seen with the distinction between social and structural determinants of health.

Third, to provide more robust agreement data, it would be interesting to have two unique reviewers for each variable, such that each reviewer is collecting data on no more than one variable. This would minimize any between-variable biases (where assigning one variable category might influence another). It might also be important to blind reviewers to the year of publication and the journal in which the study was published; as discussed in the previous section, this information was available to reviewers, and could have influenced the results. A more segregated data collection process would minimize any influence between pieces of information. Additionally, incorporating a risk of bias/quality assessment into data extraction would strengthen the quality of data collected. It would be worthwhile to, first, ascertain the overall quality of global health research, and second, to determine the relationship between the quality of research and the variables of interest.

In addition to those methodological changes, further studies could be done on different groups of research, using the same method. As discussed in the 'Limitations', restricting

the study to only journals with the term "global health" in the name excluded a lot of research. For example, the new *PLOS Global Public Health* journal would have been excluded for a lack of the term "global health". In addition, many journals not published in English would be interesting to study; the lack of consideration of these journals may have systematically excluded a more collectivist-leaning body of research. Latin American research, for example, holds a collective health tradition (Abadía-Barrero & Martínez-Parra, 2017), and journals such as *LILACS: Latin American and Caribbean Health Sciences Literature, Revista de Salud Pública* (Public Health Journal), *Salud Colectiva* (Collective Health), and *Biomédica* might be more collectivist-leaning than North American-European journals[16]. Performing data collection on a different body of research, perhaps research published in Latin America, might highlight important differences in research published in different locations.

Additionally, once the method developed here of extracting data on key characteristics in global health research is refined, it could be applied to new bodies of research. For example, it could be applied to research on COVID-19 such that different bodies of research can be systematically compared. Perhaps research on COVID-19 (or even research published during the COVID-19 pandemic) approaches health issues with a more collectivist framework, or perhaps, in the context of vaccine hesitancy and distrust, it considers participants' perspectives more than before. Furthermore, research on the

[16] I would like to thank Carolina Chaparro Buitrago and Stuart Davidson (PhD Candidates in Global Health) for bringing these journals to my attention.

COVID-19 pandemic could be compared to research on the Ebola epidemic, to understand different approaches to infectious disease crises.

Furthermore, using the data collected here as a starting point, each of the variables examined here might be analyzed further. For example, from this study, 164 studies have been identified that give participants agency in the kind of information gathered (Table 1). It would be worthwhile in future studies to examine this smaller group of studies in more depth, to consider what specific methods are used to give participants' agency. This research could then inform future studies in global health that attempt to ensure that participants have a role in the study design and outcomes. Additionally, the author information could be further analyzed to document particular countries, rather than just income levels. Among research that is done by low-income authors, for example, it would be interesting to determine what countries these authors are from, and where in the world might be underrepresented. Lastly, while it was determined whether the studies included here were funded by the BMGF, it would be important to return to the data collected on funders and classify them by private or public, to identify potential differences in research characteristics funded by different bodies.

Finally, while I plotted the variable categories in the MCA plot, I could also plot individual articles along the same axes. The variables plotted in MCA along the principal dimensions creates a map of the relationships between variables in a two-dimensional space, which can be used to understand overall patterns in global health research. It would

be interesting to also plot individual articles along these same dimensions. That way, the "position" of each article within this constructed space can be visualized. A few possible applications of this method might be: (a) to determine where a single article on the map falls, and perhaps compare that to narrative comments made by another reviewer; and (b) to plot a large group of articles on the map and code them based on some characteristics (perhaps journal of publication, topic of focus, etc.). The paper by Abdalla et al. (2020) that I discussed in the Literature Review examines global health research by topic; this same group of research could be categorized based on the variables used here, and then plotted by topic, as identified by Abdalla et al.

4.4 Contributions to the field

The use of multiple correspondence analysis offers a novel way in which to understand global health research. MCA has visually represented characteristics of global health research, depicting relationships between these characteristics that provide empirical data to ongoing conversations and suggest possible shortcomings in global health research. I have discussed two important findings in particular. First, much of global health research is observational, and second, authorship in global health research is dominated by high-income countries. When we look at the use of social and structural determinants of health in each of these categories, we see that *a)* even more research on SDOH is observational and *b)* using SDOH is less common among middle-income authors than HIC authors.

These findings contribute to current conversations about what global health is, what it should be, and what it might accomplish. I will end with a discussion of research itself, and its limits. In this systematic review, I have chosen to study global health research, but that is not all of global health. Indeed, much of global health is "practice"; it occurs outside of academic journals, "on the ground". I am not able to comment on properties of global health practice. This narrowing of scope limits my understanding of what the field of global health does as a whole, but it also allows for the understanding that research itself is ideology. While I have attempted to identify different conceptual frameworks within global health research, and different approaches to problems of health, I want to discuss here research *as* a conceptual framework *itself*.

Research *qua* research inherently looks at the "collection of problems" that is global health (Farmer, 2013) as something requiring observation and documentation. Research—knowledge production, synthesis, and interpretation—is a conceptual framework for health; it conceives of global health as a field requiring more data. A central part of research is observing, rather than doing. But it has been shown, time and time again, that the problems we suffer from are ideological not material, distributive not innovative. They demand action, not only observation. As discussed, writing a clear and compelling definition of global health and producing research that advances health equity is hard. I wonder now whether one part of the problem in efforts to define global health, to do equitable research, to move on from its colonial past, is the very fact that *we are still doing so much research.*

Global health as a body of research imposes values; there are, for example, state-of-the-art research centers better funded than primary clinical care (Richardson, 2021). There is a paradoxical need for knowledge to leave a place, find a home in an academic journal, before it can come back to result in change. Before any action occurs, well-understood phenomena have to be given the academic seal of approval: "Knowledge on issues about which people have day-to-day experience does not exist because it is not in the literature" (Bhakuni & Abimbola, 2021). The field of global health research is itself a pronouncement of ideology, the building of a system to both explain the great health injustices the world faces, and propose solutions to those injustices.

And research *qua* research has limits. Research is not always called for: "Simply undertaking global health research will not necessarily generate the knowledge needed to help improve healthcare and systems for those considered disadvantaged or marginalized" (Pratt, 2021). The "Research for Health Justice" framework was designed to inform more equitable research in global health (Pratt, 2021). The framework provides guidance for researchers to choose research populations, identify the topic and research questions, develop research capacity, provide ancillary care, and focus on knowledge translation (Pratt, 2021). The framework also provides guidance to funders such that research advancing equity is funded (Pratt, 2021). This is critical work that builds a foundation for developing equitable research in global health. Indeed, just as there are many ways in which to conduct observational research on SDOH in an unproductive, perhaps unjust,

manner, so too are there many ways in which to conduct this research in equitable, sustainable, and meaningful ways. Rather than research that examines the link between clean drinking water and child stunting[17], for example, research might examine the impact of new water infrastructure programs, compare different ways of offering accessible primary care for children, consider water-polluting oil mining policies, etc. Following a framework like Pratt's could encourage more productive and equitable research to take place, rather than research that confirms what is already known.

But at the same time as the global health community discusses ways to produce equitable research, it might also be crucial for researchers to step back and ask whether more research is indeed needed, and what might take its place. In his book, "Epidemic Illusions", Eugene Richardson discusses the Ebola epidemic in West Africa:

> The very notion of bounded "outbreak" is problematic as it obscures the transnational and translocal historical forces that coalesce over time to manifest as human pathology. When tribes left the region once West Africa reached "zero Ebola", I was left wondering: Can the traveling circus of humanitarian relief and epidemic research deliver *sustained* improvements in global health? (Richardson, 2021, p. 39)

As I "leave" this research project on characteristics of global health research I, too, wonder what the role of global health research is in delivering sustained improvements. I have presented here empirical data on what is happening in global health research now. I

[17] Or, the link between [a social determinant of health] and [health outcome].

have shown that the majority of research in global health is quantitative, observational, and written by authors from high-income countries. I have also shown that while social and structural determinants of health are readily used in global health research, middle-income countries use them less, and when they are used the research tends to be observational. I hope that this data contributes to the discussions on what makes global health research equitable, what results in sustainable improvements, and how we define such a field, starting from where we are at now. But I also hope that it contributes to conversations on the role of global health research as a whole in achieving the goal of health for all (Katz, 2008), spurring questions about what the most effective kind of research looks like and whether more research is needed at all.

4.5 Conclusion

The present study aimed to map the field of global health research according to key characteristics of research that are discussed in the literature. This project has presented the frequencies of each of the 17 variables of interest in global health research. It has also presented the relationships between pairs of characteristics to elucidate patterns in the field of research. Finally, the project uses multiple correspondence analysis to "map" the field of global health research according to the group of research characteristics, and as a result, has suggested that the individualistic and collectivist conceptual frameworks for health offer a useful lens by which to understand patterns in the field. The discussion focused on the relationships between three variables in particular: the use of social and

structural determinants of health, research methodology, and the authors' affiliations according to country income level. I have suggested that the relationships between these variables lends critical evidence to conversations on the direction of the field of global health, and that these relationships suggest that important questions regarding the use of social and structural determinants of health and global health authorship should be considered. I ended with a brief discussion of the merits of research in global health, discussing the ways in which research itself acts as a conceptual framework. I hope that these findings contribute important empirical data to ongoing conversations on the direction of global health research.

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Appendix A

Table A1, a list of all included studies (N=1033) in the review, and Table A2, a list of the 10 studies for which full-text data extraction was done, can be found on Open Science Foundation (OSF) at this link. Table A3 shows all of the data collected for this project, through Covidence, and is also accessible at the aforementioned link.

Appendix B

	Variables	Description
A	Health technology (non-pharmaceutical)	A health technology is defined as: "An intervention developed to prevent, diagnose or treat medical conditions; promote health; provide rehabilitation; or organize healthcare delivery. | The intervention can be a test, device, medicine, vaccine, procedure, program or system" (Health Technology Assessment Glossary). Health technology here will exclude "medicine" and "vaccine", as these will fall under Variable B (Pharmaceutical health technology).
1	Study of digital health technologies	Digital health technologies are described and classified by the WHO 'Classification of Digital Health Interventions' (2018). Digital health technologies are grouped by targeted user into: interventions for clients, for healthcare providers, for health system or resource managers, or for data services. Refer to this document for clarification: World Health Organization. (2018). Classification of digital health interventions v1. 0: a shared language to describe the uses of digital technology for health (No. WHO/RHR/18.06). World Health Organization. A digital health technology is the main focus of the study (the research works to create, improve, evaluate, or adapt the technology). Exclude if the technology is used solely in the study's methods.
2	Study of other health technologies: A test or device	A 'test' or 'device' health technology that is non-digital is the main focus of the study (the research works to create, improve, evaluate, or adapt the technology). Exclude if

		technology is used solely in the study's methods. Please specify the technology.
3	Study of other health technologies: A procedure, program, or system	A 'procedure', 'program', or 'system' health technology that is non-digital is the main focus of the study (the research works to create, improve, evaluate, or adapt the technology). Exclude if technology is used solely in the study's methods. Please specify the technology.
4	Study of a combination of health technologies	A digital health technology and other health technology (defined above), or two types of other health technologies (test/device and procedure/program/system) are both the main focus of the study (the research works to create, improve, evaluate, or adapt the technologies). Exclude if technology is used solely in the study's methods.
5	Not a study of health technologies	A health technology is not researched as an intervention or exposure of interest.
B	Pharmaceutical health technology	Pharmaceuticals are "chemicals that are used because of their more or less specific biological activity" for medicinal purposes (Kümmerer, 2010). Research might be on pharmaceuticals that are preventative (i.e., vaccine, PrEP, birth control) or curative (i.e., antibiotics, chemotherapy, oral rehydration solution). Pharmaceuticals might also be maintenance substances, such as supplements and vitamins.
1	Study of pharmaceutical health technologies	A pharmaceutical is the main focus of the study (the research works to create, improve, evaluate, or adapt the pharmaceutical).
2	Not a study of pharmaceutical health technologies	A pharmaceutical technology is not researched as an intervention or exposure of interest.
C	Social and structural determinants of health	Social or structural determinants of health are factors that affect health beyond biological conditions. They encompass access to resources that contribute to health, and the political and economic structures that determine access to resources, as well as social and cultural relationships (Birn et al., 2017). They include individual properties that are modulated by social forces, such as an individual's education level, access to food and housing, etc.
1	Determinants of health mentioned	Social determinants of health (either the term itself or what it describes; see definition) are mentioned (acknowledged,

		made reference to, aware of) while being outside the scope of study (i.e., not a variable in the study).
2	Determinants of health used	Social determinants of health are explicitly used in the study (i.e., they are a variable in the study, either a dependent or independent variable). They must be used by the authors in advance of the study, and not solely an incidental finding. If they are used, it is assumed that they are also mentioned.
3	Determinants of health not mentioned or used	Does not fit criteria above.
D	"Economization of life" (Murphy, 2017), economic development	Health research or programs are sometimes rationalized based on their potential for economic return, understanding health as a precursor for economic growth (Sachs, 2014; Birn et al., 2017). Yet while economic development can improve health, it does not necessarily improve health if it is not equitably distributed; instead, it can deepen inequalities and worsen health (Birn et al., 2017). Research in global health might review economic considerations in different ways; each "economization of life" variable describes different ways in which economics might be considered in the study. For the 'economic development' option, participants in the study, or the population of interest as a whole, are referred to as contributors to the economy, such that gains in health translate to economic gains.
1	Research participants are referred to as contributors to human capital	Participants or the population of interest in the study are described as contributors to the economy, such that economic development is, explicitly or implicitly, used as a justification for the research. The locus of interest is on individuals contributing to economic growth, and participants (and their health) are seen as sources of income or investments into the local economy (Adams et al., 2019; Murphy, 2017). The DALY (disability adjusted life years), originally created by the World Bank, determines disease burden by showing the loss of years of life as well as productive years (Adams, 2016a); as defined by the WHO: DALYs are "the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability" (World Health Organization, n.d.). The DALY thus implicitly ties individual health gains to economic gains, and a study considering DALYs (as a measure of cost-effectiveness; Shillcutt et al., 2009; Birn et al., 2017) would be assigned

		this variable category. Include studies that mention economic development, regardless of how large of a role it plays in the study.
2	Research participants are not referred to as contributors to human capital	Does not fit criteria above.
E	"Economization of life" (Murphy, 2017), economic investment	For the 'economic investments' option, an economic evaluation of the intervention or approach in the study is referenced as a whole, to present the cost of improved health, and sometimes seen in relation to the corporate profitability of an intervention (Birn et al., 2017; Adams, 2016). Economic evaluations compare the costs of two or more interventions and assess the benefits to determine the "value" of the intervention; cost-minimization, cost-effectiveness, cost-utility, and cost-benefit are types of economic evaluations (Higgins & Harris, 2012). The QALY (quality-adjusted life year) is one way of expressing cost-utility; the QALY determines the relationship between money spent on a medical intervention and quality of life gained as a result, thus determining the value of a health intervention (Adams, 2016a; Higgins & Harris, 2012).
1	Economic considerations for the study is included	Economic evaluations for the intervention/approach studied is referenced. The locus of interest is on the economic investment made in the intervention/approach, by the community, government, or private/public organizations, and the benefits of the investment in terms of health outcomes or costs saved. Include studies that mention economic evaluations, regardless of how large of a role they play in the study.
2	Economic considerations for the study is not included	Does not fit criteria above.
F	"Economization of life" (Murphy, 2017), individuals' economic ability	For the 'individuals' economic ability' option, the economic ability of individuals to access health or healthcare in the context of the study is considered.
1	Economic considerations of individuals is included	The economic ability of individuals (participants, patients, inhabitants) to access health (broadly understood, access to health can include access to conditions that allow of a healthy life, such as housing or food; see WHO definition of "health") or healthcare is referenced. The locus of

		interest is on the individual's economic ability to access heath resources. Include studies that mention individuals' economic ability, regardless of how large of a role it plays in the study.
2	Economic considerations of individuals is not included	Does not fit criteria above.
G	MDGs/SDGs	Millennium Development Goals and Sustainable Development Goals describe a series of global goals outlined by the United Nations in 2000 and 2015, respectively, as targets for improving the lives of people globally. The SDGs also consider the importance of environmental sustainability and the threat of climate change.
1	MDGs and/or SDGs referenced	MDGs/millennium development goals and/or SDGs/sustainable development goals are mentioned.
2	MDGs/SDGs not referenced	Does not fit criteria above.
H	Human rights	Human rights refer to the articles outlined in the Universal Declaration of Human Rights in 1948, or the International Covenant on Economic, Social and Cultural Rights (1966), or the International Covenant on Civil and Political Rights (1966), or a region-specific declaration (ex. European Convention on Human Rights). Human rights might be used specifically with reference to the right to conditions conducive to health (Article 25 of the UDHR), or it might refer to other rights which affect and shape health (i.e., right to education; Birn et al., 2017).
1	Human rights referenced	Reliance on one or more descriptions of human rights in establishing the frame of reference (justification or design) of the study (right to health, right to education, human rights violation, etc.).
2	Human rights not referenced	Does not fit criteria above.
I	Planetary health	Planetary health refers to the acknowledgement of the connection between the health of humans and the health of the environment (climate change progression, e.g., erratic weather, changing landscape of infectious disease, agricultural disruptions) and the understanding that human health cannot be considered in isolation from natural systems (Whitmee et al., 2015).

1	Planetary health mentioned	The concept of planetary health (either the term itself or what it describes; see definition) is mentioned while being outside the scope of study (i.e., not an outcome of the study).
2	Planetary health used	The concept of planetary health is used in the study (i.e., an aspect(s) of planetary health is a measured outcome of the study).
3	Planetary health not mentioned or used	Does not fit criteria above.
J	Vertical/horizontal approach	Vertical approaches are short-term, directed research projects at a health problem, by use of "single-purpose machinery", aimed to provide expedient aid; mass campaigns and eradication programs are examples of vertical approaches (Gonzalez, 1965; Birn et al. 2017). Horizontal approaches are often longer-term solutions aimed at strengthening health systems and addressing health problems "on a wide front" to support present and future health challenges (“general health services”; Birn et al., 2017; Gonzalez, 1965). Vertical approaches have a "categorical" objective, while horizontal approaches have "non-categorical" objectives (Gonzalez, 1965).
1	Very strongly horizontal	Using the definitions of vertical and horizontal approaches above, make a decision on a given study based on how closely it fits with either definition. If a study has aspects of both vertical and horizontal approaches, or if the designation is not appropriate for the study, indicate a '4'.
2	Strongly horizontal	
3	Moderately horizontal	
4	Uncertain/both vertical & horizontal aspects	
5	Moderately vertical	
6	Strongly vertical	
7	Very strongly vertical	
K	Research methodology	See Bowers, 2014
1	Quantitative – observational	Outcomes measured are quantitative, and no variables are manipulated.
2	Qualitative – observational	Outcomes measured are qualitative, and no variables are manipulated.
3	Quantitative – experimental, non-RCT	Outcomes measured are quantitative, and one or more variable(s) are manipulated.
4	Quantitative – randomized controlled trial (RCT)	The RCT is one type of a quantitative experimental study; one or more variable(s) are manipulated in a randomly-assigned experimental group and compared to a control

		group. Cluster randomized trials are a type of RCT, and included in this variable.
5	Qualitative – experimental	Outcomes measured are qualitative, and one or more variable(s) are manipulated.
6	Mixed-methods – observational	Both quantitative and qualitative outcomes are measured, and no variables are manipulated.
7	Mixed-methods – experimental	Both quantitative and qualitative outcomes are measured, and one or more variable(s) are manipulated.
L	Participants' construction of outcomes	Focus groups can be used as ways to understand the perspectives and thoughts of participants and patients themselves (Tausch & Menold, 2016). They vary in terms of how structured they are, but generally allow for open-ended conversation and knowledge gathering.
1	Participants have agency in the kind of information gathered	Focus groups, or another form of open-ended, participatory information gathering, was used in the study.
2	Participants do not have agency in the kind of information gathered	No open-ended method of study was mentioned or used.
M	International collaboration	The author affiliations listed in the publication are assessed here. Countries are designated as high-income (H), upper middle-income (UM), lower middle-income (LM), or low-income (L), according to the World Bank classifications, in the year of publication.
1	Authors are all from one or more high-income countries	The affiliations of all of the paper's authors are from high-income countries, as defined by the World Bank.
2	Authors are all from one or more upper middle-income countries	The affiliations of all of the paper's authors are from upper middle-income countries, as defined by the World Bank.
3	Authors are all from one or more lower middle-income countries	The affiliations of all of the paper's authors are from lower middle-income countries, as defined by the World Bank.
4	Authors are all from one or more low-income countries	The affiliations of all of the paper's authors are from low-income countries, as defined by the World Bank.
5	High-income country (HIC) and low- and middle-income country (LMIC) collaboration	There is at least one author with affiliations in a high-income country, and at least one author with affiliations in a low- or middle-income country (upper middle-income, lower middle-income, or low-income)

6	LMIC collaboration	The affiliations of the paper's authors are all from several categories of LMICs (UM and LM, UM and L, LM and L, etc.).
N	First author location	First author's affiliation is examined, following Robson et al. (2019) and Cash-Gibson et al. (2018), as an indication of where the leading researcher is located.
1	High-income country	The first author is affiliated with an institution(s) in a high-income country.
2	Upper middle-income country	The first author is affiliated with an institution(s) in a upper middle-income country.
3	Lower middle-income country	The first author is affiliated with an institution(s) in a lower middle-income country.
4	Low-income country	The first author is affiliated with an institution(s) in a low-income country.
5	Cross-affiliation with LMICs	The first author is affiliated with institutions in LMICs of more than one category (UM and LM, UM and L, LM and L, etc.). Or, there are more than one "first authors" with affiliations in LMICs.
6	Cross-affiliation with HIC and LMIC	The first author has cross-affiliations with an institution in a high-income country and an institution in a low- or middle-income country. Or, there are more than one "first authors" with affiliations in a HIC and a LMIC.
O	Last author location	Last authors' affiliation is examined as well, following Yiu et al. (2020).
1	High-income country	The last author is affiliated with an institution(s) in a high-income country.
2	Upper middle-income country	The last author is affiliated with an institution(s) in a upper middle-income country.
3	Lower middle-income country	The last author is affiliated with an institution(s) in a lower middle-income country.
4	Low-income country	The last author is affiliated with an institution(s) in a low-income country.
5	Cross-affiliation with LMICs	The last author is affiliated with institutions in LMICs of more than one category (UM and LM, UM and L, LM and L, etc.). Or, there are more than one "last authors" with affiliations in multiple LMICs.
6	Cross-affiliation with HIC and LMIC	The last author has cross-affiliations with an institution in a high-income country and an institution in a low- or middle-income country. Or, there are more than one "last authors" with affiliations in HICs and LMICs.

7	Not applicable	The study has only one author.
P	Location of study	The relationship between the location of study and the location of authors is considered a marker of equitable research (Yiu et al., 2020).
1	High-income country	The study takes place in a high-income country (or several high-income countries).
2	Upper middle-income country	The study takes place in an upper middle-income country (or several upper middle-income countries).
3	Lower middle-income country	The study takes place in a lower middle-income country (or several lower middle-income countries).
4	Low-income country	The study takes place in a low-income country (or several low-income countries).
5	Two or more LMICs	The study takes places in several LMICs of different categories (UM and LM, UM and L, LM and L, etc.).
6	HIC and LMIC	The study takes place in one or more high-income countries and in one or more low- or middle-income countries.
7	No particular place	There is no particular location for the study noted.
Q	Funding source	The funding source listed in the article is noted. Only funding for the project itself (and not funding for any individual researcher) is included.
1	Public	A list of funders with designation as public or private will be made. When extracting data, indicate the name of the funder, separating multiple funders with a semi-colon.
2	Private	
3	Public and private or public-private partnership	
4	No funding listed	

Table B 1: Description of all variables and their categories, as used during data collection.

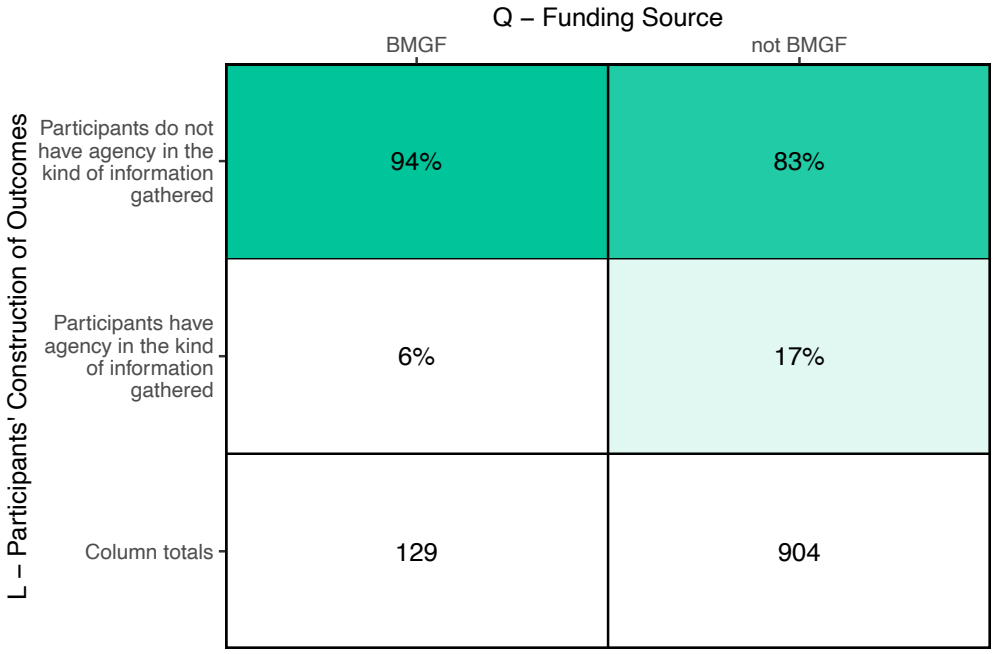

Table B 2: The relationship between 'participants' construction of outcomes' (Variable L) and 'funder' (Variable Q). Percentages by column are shown, with the total counts for each variable shown as column and row totals. The significance test of independence was done using a Monte Carlo approximation, X^2 (N = 1033) = 10.33, p = 0.003.

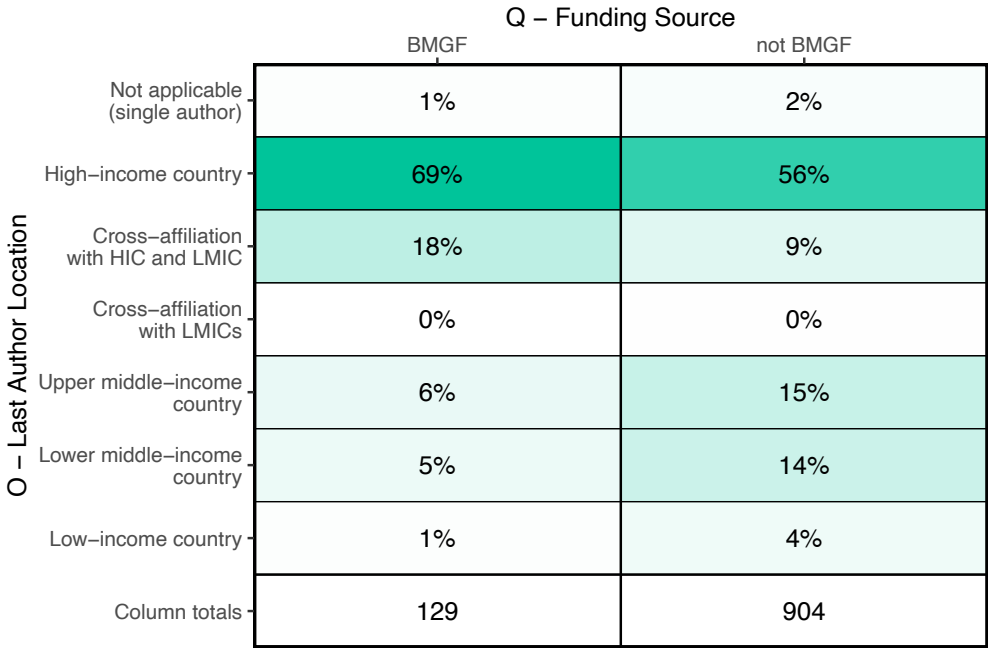

Table B 3: The relationship between 'last author location' (Variable O) and 'funder' (Variable Q). The significance test of independence was done using a Monte Carlo approximation, X^2(N=1033)= 31.12, p < 0.001. Percentages by column are shown.

N – First Author Location	Q – Funding Source: BMGF	Q – Funding Source: not BMGF
Low–income country	5%	6%
Lower middle–income country	5%	16%
Upper middle–income country	5%	16%
Cross–affiliation with LMICs	0%	1%
Cross–affiliation with HIC and LMIC	15%	11%
High–income country	71%	51%
Column totals	129	904

Table B 4: The relationship between 'first author location' (Variable N) and 'funder' (Variable Q). The significance test of independence was done using a Monte Carlo approximation, $X^2(N=1033)= 29.17$, $p < 0.001$. Percentages by column are shown.

P – Location of Study	M – International Collaboration: Authors are all from one or more low–income countries	Authors are all from one or more lower middle–income countries	Authors are all from one or more upper middle–income countries	LMIC collaboration	High–income country (HIC) and low– and middle–income country (LMIC) collaboration	Authors are all from one or more high–income countries
Low–income country	94%	0%	1%	50%	26%	8%
Lower middle–income country	6%	96%	3%	33%	37%	13%
Upper middle–income country	0%	0%	80%	17%	18%	5%
Two or more LMICs	0%	0%	4%	0%	12%	14%
HIC and LMIC	0%	0%	5%	0%	5%	18%
High–income country	0%	0%	0%	0%	1%	37%
No particular place	0%	4%	8%	0%	1%	5%
Column totals	18	81	79	6	611	238

Table B 5: The relationship between 'authors' international collaboration' (Variable M) and 'location of study' (Variable P). The significance test of independence was done using a Monte Carlo approximation, $X^2(N = 1033) = 833.69$, $p < 0.001$. Percentages by column are shown.

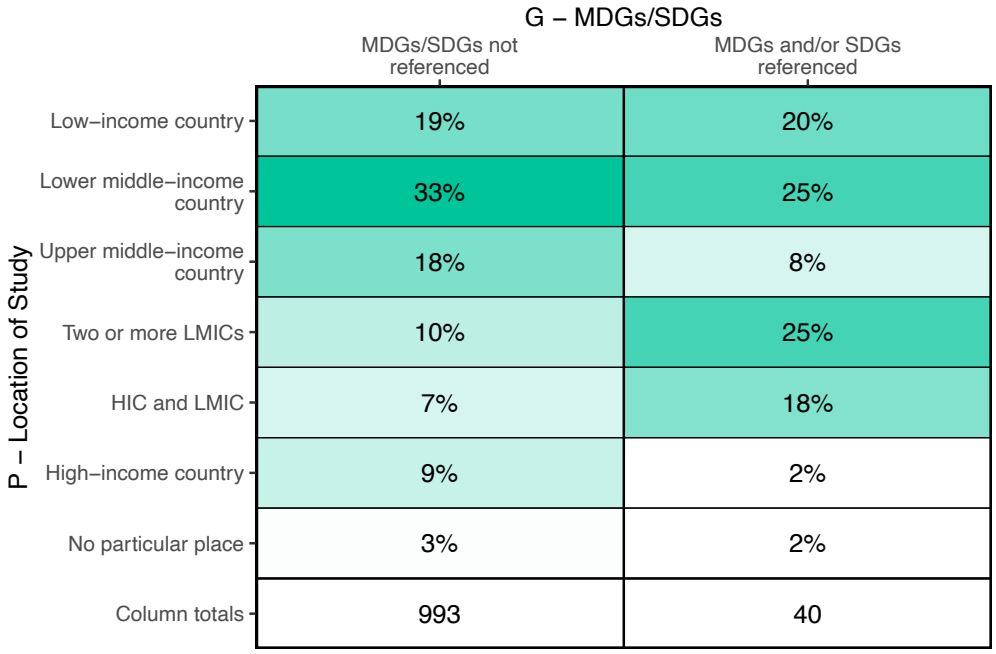

Table B 6: The relationship between 'location of study' (Variable P) and 'MDGs/SDGs' (Variable G). The significance test of independence was done using a Monte Carlo approximation, $X^2(N = 1033) = 18.23$, $p = 0.008$.

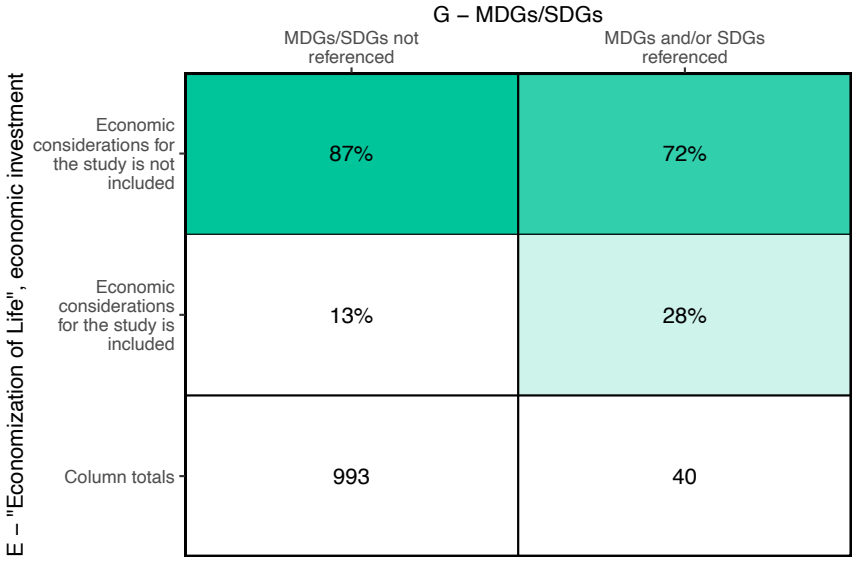

Table B 7:The relationship between 'economic investment' (Variable E) and 'MDGs/SDGs' (Variable G). The significance test of independence was done using a Monte Carlo approximation, $X^2(N=1033) = 5.61$, $p = 0.02$. Percentages by column are shown.

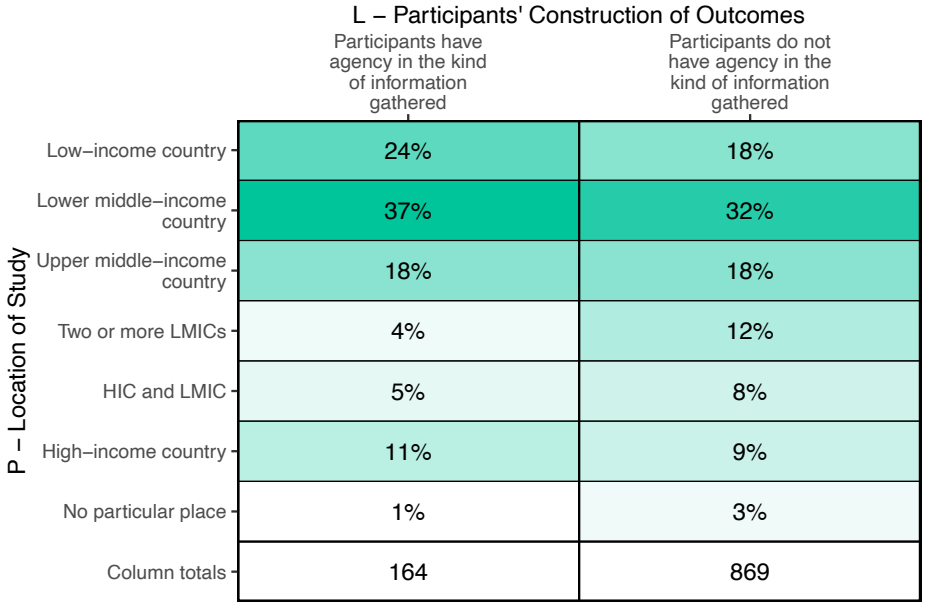

Table B 8: The relationship between 'participants' construction of outcomes' (Variable L) and 'location of study' (Variable P). The significance test of independence was done using a Monte Carlo approximation, X^2(N = 1033)= 18.35, p =0.005. Percentages by column are shown.

Table B 9: The relationship between 'social and structural determinants of health' (Variable C) and 'location of study' (Variable P). The significance test of independence was done using a Monte Carlo approximation, X^2(N = 1033) = 98.55, p < 0.001.

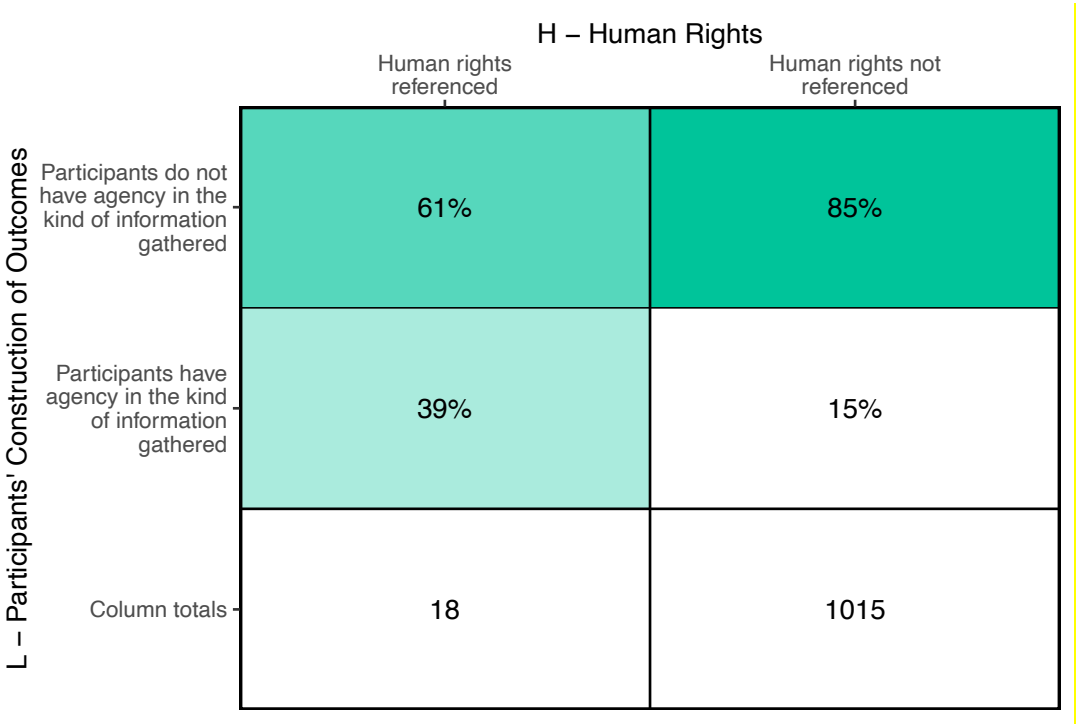

Table B 10: The relationship between 'participants' construction of outcomes' (Variable L) and 'human rights' (Variable H). The significance test of independence was done using a Monte Carlo approximation, X^2 (N=1033) = 7.26, p =0.02.

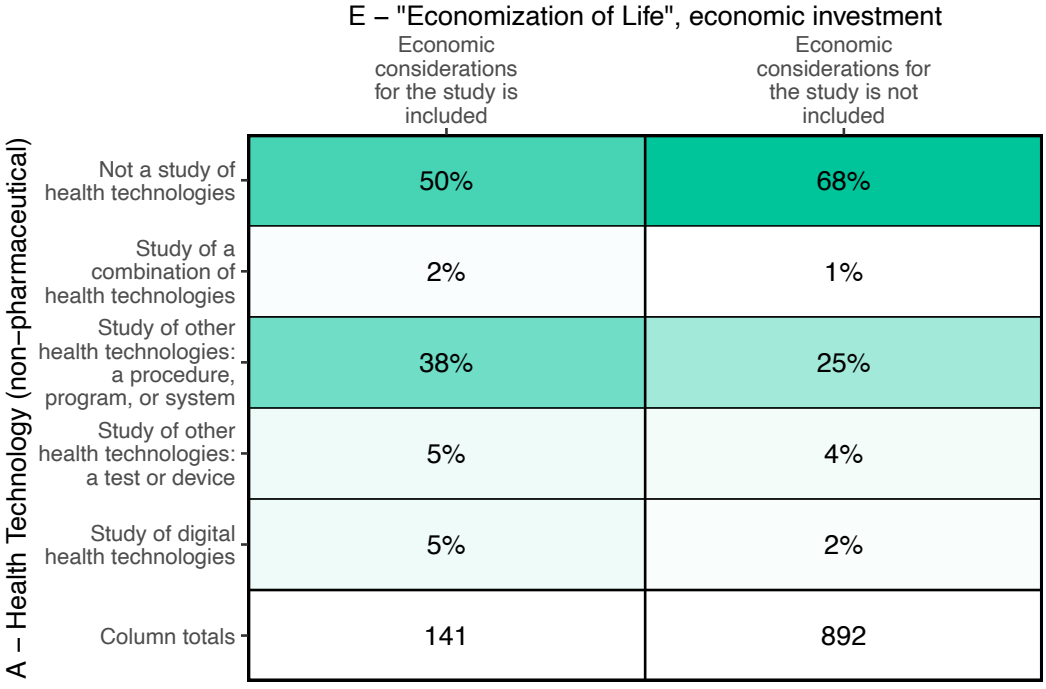

Table B 11: The relationship between 'health technology (non-pharmaceutical)' (Variable A) and 'economic investments' (Variable E). The significance test of independence was done using a Monte Carlo approximation, X^2 (4, N = 1033) = 19.03, p < 0.001.

Variable Category	**Contribution to the inertia of each dimension (expressed in permills)**	
	Dimension 3	Dimension 4
Study of digital technology	1	8
Study of other health technology	11	36
Not a study of health technology	7	23
Study of pharmaceutical technology	2	0
Not a study of pharmaceutical technology	0	0
Social and structural determinants of health not mentioned or used	44	10
Social and structural determinants of health used	19	11
Social and structural determinants of health mentioned	0	0
Social and structural determinants of health uncertain	2	36
Research participants are referred to as contributors to human capital	16	28
Research participants are not referred to as contributors to human capital	1	1
Economic considerations for the study is included	103	25
Economic considerations for the study is not included	16	4
Economic considerations of individuals is not included	3	1
Economic considerations of individuals is included	32	6
MDGs and/or SDGs referenced	26	0

MDGs/SDGs not referenced	1	0
Human rights referenced	9	2
Human rights not referenced	0	0
Planetary health used	6	0
Planetary health mentioned	1	21
Planetary health not mentioned or used	0	0
1 – very strongly horizontal	4	0
2 – strongly horizontal	2	2
3 – moderately horizontal	0	7
4 – uncertain/both vertical & horizontal aspects	38	8
5 – moderately vertical	7	2
6 – strongly vertical	16	2
7 – very strongly vertical	21	4
Quantitative - observational	0	31
Quantitative - experimental, non-RCT	2	17
Quantitative - randomized control trial (RCT)	16	1
Qualitative - observational	34	0
Qualitative - observational	0	22
Mixed-methods - observational	0	0
Mixed-methods - experimental	0	25
Modelling/simulation	77	43
Participants have agency in the kind of information gathered	29	3
Participants do not have agency in the kind of information gathered	5	1
Authors are all from one or more high-income countries	13	234
Authors are all from one or more upper middle-income countries	41	19

Authors are all from one or more lower middle-income countries	37	27
Authors are all from one or more low-income countries	5	11
Low- and middle-income country collaboration	0	3
High-income country and low- and middle-income country collaboration	41	29
Study takes place in a high-income country	71	170
Study takes place in an upper-middle income country	17	30
Study takes place in a lower-middle income country	2	31
Study takes place in a low-income country	32	10
Study takes place in a low-income country	51	6
Study takes place in a high-income country and a low- and middle-income country	17	27
Study takes place in no particular place	22	16
Not funded by BMGF	12	1
Funded at least partially by BMGF	83	7

Table B 12: The contribution of each variable to the inertia of dimensions 3 and 4. The contribution is represented as permills (out of 1000), and so with 54 variable categories, the average contribution is 18.5. The highlighted cells are those where contribution to the inertia of the dimension is more than we would expect (more than average.

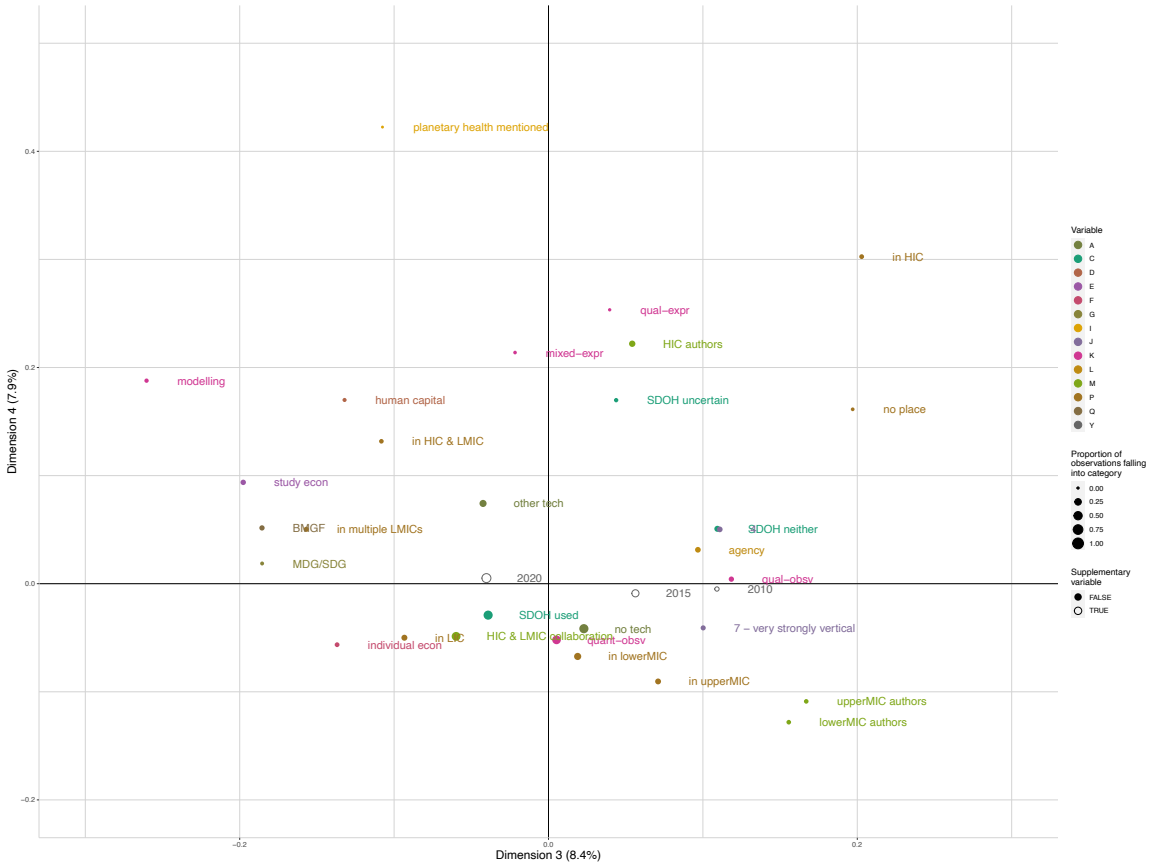

Figure B 1: Multiple correspondence analysis map of all variables describing global health research (excluding first author location & last author location) with a high contribution to the inertia to the third and fourth dimensions. The Year Published is included as a supplementary category. Only the variable categories with an above average contribution to inertia are shown in this map. The area of the circles corresponds to the relative proportions of studies falling into each category. The third and fourth dimensions each explain 8% of the total inertia. Refer to Table 15 for the label key.